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THE EXCHANGE RATE AND INTEREST RATE EXPOSURE OF UK NON-FINANCIAL FIRMS AND INDUSTRIES

By

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Abstract

Exchange rate and interest rate risk have been documented as the most managed financial risks by most UK non-financial firms and industries. This is probably because of the severe adverse effects that contrary movements in these financial risks can have on the value of the firm or industry. Nevertheless, empirical studies on these risks have been very few and predominantly limited in scope. Therefore, using a sample of 402 UK non-financial firms from 31 industries, over the period January 1990 to December 2006, this study examines the relevance of these financial risks on the stock returns of firms and industries. Following the weaknesses of the Ordinary Least Square (OLS) methodology, the AR(1)EGARCH-M model was subsequently used for the estimation.

The results indicated that the stock returns of UK firms and industries were more affected by long-term interest rate risk than exchange rate risk (Trade weighted index, US$/£ JP¥/£, ECU/£ and Euro/£) or even short-term interest rate risk. Furthermore, the introduction of the euro reduced the exchange rate exposure and interest rate exposure of only a few UK firms and industries. Additionally, by means of the Herfindahl index as a measure of industry concentration, competitive industries were found to exhibit a higher degree of exposure to movements in exchange rates and interest rates, and also higher volatility in returns than industries that were classified as concentrated. Then using firm specific accounting variables, the results indicated that the determinants of exchange rate exposure were different to that of interest rate exposure.

Finally, it was also found that for most UK firms and industries: increased risk did not necessarily lead to an increase in returns; severe adverse movements in exchange rates and interest rates can potentially make returns more volatile; volatility of returns has time varying properties; persistence of volatility is much higher in some firms and industries than others; and the volatility of returns increased in the period after the introduction of the euro.

Table of Contents

List of Tables

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Author's Declaration

I declare that this thesis has not been previously submitted, either in this university, or any other university, for a degree or any other qualification. In addition, I declare that all of the work done in this thesis is my own work.
This study was fully self-sponsored.

The following activities have been undertaken:

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- Econometrics
- Introduction to quantitative research
- Introduction to SPSS (Part 1)
- Introduction to SPSS (Part 2)

2. Publications

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CHAPTER 1 INTRODUCTION AND STUDY BACKGROUND

1.1 Introduction

Exchange rate, which is the value of one country's currency relative to another, and interest rate, which reflects the price of money are two important economic and financial factors that can affect the value of the firm (Vardar *et al.*, 2008). For instance, fluctuations in exchange rates can impact the cash flows of the multinational firm, which has operations in various locations abroad, importers, exporters, and also the purely domestic firm (Hyde, 2007). The extent to which a firm is exposed to movements in exchange rate can sometimes be determined through its net position in foreign currency. Essentially, exporting firms or firms with international activities, usually have a net long position (receivables) in foreign currency. Therefore changes in exchange rates will affect their future cash inflow since they benefit (suffer) from a depreciation (appreciation) of the pound sterling. On the contrary, importing firms or firms that are affected by foreign competition, these usually exhibit short position (payments) in foreign currency. Intuitively, movements in the exchange rate will have an impact on their future cash outflow as they benefit (suffer) from an appreciation (depreciation) of the pound sterling (El-Masry, 2004).

Similarly, movements in interest rates can also impact the firm's cash-flow by altering the firm's cost of finance, impinging on the amount of principal and loan interest payable (Hyde 2007) and also the value of its financial assets and liabilities (Bartram, 2002). Furthermore, Dhanani *et al.* (2008) provide evidence that the management of interest rate risk has gained prominence in the UK, due to interest rate volatility, a significant increase in the use of corporate debt, especially in the guise of short-term borrowing rather than equity, an increase in the number of highly leveraged transactions, such as take-overs and management buyouts, and funding arrangements with financial institutions based on interest rate covenants. Therefore, since non-financial firms are usually net borrowers, an increase in interest rates is expected to exert a negative effect on the value of the firm. Besides, even individual investors, with a portfolio comprising of securities from different countries, are not precluded from the influence of exchange rate and interest rate risk, as Vardar *et al.* (2008) points out that in the face of increasing interest rates, investors are likely to change the composition of their investment from capital markets to fixed-income securities market.

Joseph (2002) further explains that changes in exchange rates and interest rates can affect the domestic and global competitiveness of firms, by making their inputs and outputs cheaper or more costly. Kaufold and Smirlock (1986) pointed out that fluctuations in exchange and interest rates bring about variations in the domestic currency values of cash inflows and outflows from investments abroad and foreign liabilities, respectively. Consequently, if these financial risks (exchange rates and interest rates) are not managed effectively, they have the potential of causing corporate failure. Although firms have been known to mitigate the undesirable effects of exchange rates and interest rates through the use of derivative products (forwards, options, futures, swaps) and operational hedges (matching foreign denominated revenues with cost or matching financial assets and liabilities), these have been unable to provide complete immunity. This initiative is supported by Bartram *et al.* (2005), who posit that although innovative financial instruments can be used to mitigate financial risks and alleviate the probability of corporate distress, these can be quite complex with strong leverage effects. It is therefore unsurprising that the impact of fluctuations in exchange rates and interest rates on firm value has continued to attract attention from academic researchers (Jorion, 1990; Bartov and Bodnar, 1994; He and Ng, 1998; Dominguez and Tesar, 2001; Griffin and Stultz 2001), business managers and investors.

Nevertheless, it is anticipated that the introduction of the euro will reduce the exchange rate and interest rate exposures, especially for firms within the euro zone, through exchange rate certainty and convergence of interest rates, respectively. Although the UK has opted not to adopt the euro as her national currency yet, it is still generally favoured especially by organisations involved with international business, because of the potential benefits from the reductions in the fluctuations in exchange and interest rates, and subsequently a decline in the exposure to these risks.

Subsequently, in Section 1.2 we discuss the importance and relevance of exchange rate and interest rate risk, and Section 1.3 explains the nature of competition in UK industries and its influence on exchange rate and interest rate risk. In Section 1.4, we consider the impact of the introduction of the euro on the exchange rate and interest rate exposure of UK firms and industries, while Section 1.5 explains the objectives of the study. In Section 1.6, we present the scope of the study and conclude the chapter with Section 1.7, which provides a synopsis of the other chapters in this study.

1.2 The importance and relevance of exchange rate and interest rate risk

1.2.1 Foreign exchange risk and foreign exchange exposure

Neale and McElroy (2004) assert that "exchange rate risk is the risk of loss through adverse movements in exchange rates". Adler and Dumas (1984) posit that a currency is not risky because it is likely to depreciate in value. If the devaluation is certain as to the extent and moment in time, then there is no prevalent risk because the change is anticipated. However when the fluctuation is unexpected, this poses a risk of exchange exposure to firms. A firm exhibits exchange rate exposure when its share value is affected by changes in exchange rates. These changes in exchange rates, can influence various aspects of the firm's activities and operations such as income receivable from abroad, future payment for import transactions, valuation of foreign assets and liabilities, long-term viability of foreign operations and the acceptability of overseas investment projects. It suffices to say that if these unexpected fluctuating exchange rates are not properly managed, they can lead to loss of shareholder wealth (Glen, 2005). Nevertheless, it is still possible for firms to benefit from changes in the exchange rate, depending on the nature of their operations. For example, a UK exporting firm will most likely benefit from a depreciation of the pound against other currencies since their products become cheaper in foreign markets. Therefore, they should experience an increase in sales volume and/or profit margins. On the other hand, an appreciation of the pound will have the opposite effect for exporters, as UK products become more expensive and less competitive. More so, for exporting firms which also use imported inputs in their production, they are usually able to offset some of the adverse movements in exchange rates.

Then regarding importing firms, or manufacturers who use imported inputs, an appreciation of the pound against other currencies will be beneficial as fewer pounds will be required, thereby enhancing the purchasing power of the pound in terms of the foreign currency, and facilitating the increase in sales volume and/or profit margin. Nevertheless in the case of depreciation, more pounds will be required for the foreign currency; thereby opposite effects of appreciation will be applicable for the importing firm. But even for the purely domestic firm, their products are more competitive in comparison with imported goods from abroad with a depreciation of the pound, and become more expensive when the pound appreciates.

Loudon (1993b) describes translation exposure, transaction exposure and economic exposure as the three forms of foreign exchange exposure that domestic firms are susceptible to. Firstly, translation exposure, which is also known as accounting exposure, is the sensitivity of the domestic currency book values and accounting earnings to fluctuations in exchange rates, brought about by investments and financing activities using a foreign denominated currency. On the other hand, transaction exposure is the sensitivity of the domestic currency to existing contractual agreements, denominated in foreign currency, prone to fluctuations and expected to be settled in the future. Finally, economic exposure is the sensitivity of the economic value of the firm in domestic currency to fluctuations in exchange rates. Additionally, El-Masry (2004) indicates that economic exposure includes transaction exposure, while Madura (2000) posits that economic exposure has an impact on firm value, through its effect on the value of existing contractual operations and future contracts, therefore it should be more significant than accounting exposure, which only has an effect on firm value, on the basis of accounting values. Instinctively, most empirical studies on exchange rate exposure have focused on economic exposure.

1.2.2 Interest rate risk and interest rate exposure

Helliar *et al.* (2005) explained that interest rate risk may impinge on the firms' performance in several ways and could possibly be the most important of all the financial risks that an organisation may be exposed to. They pointed out that firms are sometimes financed by debt or overdraft, which is associated with the market interest rate such as the base rate or London Interbank Offer Rate (LIBOR). Incidentally, as the rate of interest varies so will the interest payable on the debt. Consequently, for firms that have a high debt ratio relative to their equity capital, the incidence of financial distress may be a likely occurrence if there is an unprecedented rise in interest rates. Additionally, if debt affects the riskiness of share returns, then this will lead to increased variability in returns. Al-Abadi and Sabbagh (2006) also support this conjecture as they infer that most non-financial firms are net borrowers, therefore they are usually susceptible to interest rate risk, through debt service. They further outlined that a firm's debt structure comprises different maturity dates, different interest rate structures (fixed versus floating rates) and at times different currencies of denominations. Lobo (2000) pointed out that an increase in floating interest rate loans, in a period of rising rates, can adversely affect the firm's profitability by escalating outflows on loan interest payments and altering the expectations of future cash flows. This perception is further corroborated by Dhanani *et al.* (2008) who indicate that firms with high levels of fixed rate debt when interest rates are declining may pay higher rate of interest than counterpart firms with floating rate debt. On the other hand, Neale and McElroy (2004) infer that the risk of interest rate exposure is high for highly geared firms, but greater for firms who have variable interest rate rather than fixed interest rate, for most of their debt, since risk might further be exacerbated with increases in interest rates.

Arnold (2005) points out that interest rate risk can also be a function of the duration of the debt. He indicates that lenders in the financial markets would require different interest rates on loans for different length of time to maturity. This situation is usually referred to as the term structure of interest rates and normally represented graphically with interest rate on the vertical axis and time to maturity on the horizontal axis. Therefore, an upward sloping curve indicates that long-term interest rates exceed short-term interest rates while a downward sloping curve implies that short-term interest rate exceed long term interest rates. But when the curve is flat, the same interest rate applies to all maturities. Arnold (2005) further suggests that in a period of steeply rising yield curve, firms may find it more beneficial to borrow short-term than long-term. But there may be a danger to this approach, particularly if the long-term debt is being offered at a higher rate because of the expected increase in short-term interest rate. Therefore when the borrower decides to refinance after the expiration of the previous debt, the previously upward sloping graph is now downward sloping, since the short-term interest rate is now higher than the long-term interest rate. But Visvanathan (1998) argues that the assumption that short-term debt generates more interest rate exposure than long-term debt can only hold when other cash flows of the firm, that are not associated with debt, are fixed with regards to changes in the interest rates. He illustrates that if firms have cash inflows that are very susceptible to movements in interest rates, then short-term debt which fluctuates with interest rates may reduce the overall exposure of interest rate risk faced by the firm. Furthermore, Al-Abadi and Sabbagh (2006) suggest that interest rates can be unpredictable both in the short term (interest rates on short term money market fluctuate by the minute) and in the long term. According to statistics from the Bank of England (BOE, 2007), base rates in the UK fell from 15% in 1989 to 3.5% in 2003, and then rose again to 5.75% in 2007.

Eiteman *et al.* (2001) explained that another well-known source of interest rate risk for non-financial firms, especially cash-rich firms, is that which affects marketable securities or term deposits. In this instance, a decrease in interest rates reduces the potential earnings or interest inflows to the firm. This conjecture is supported by Dhanani *et al.* (2008) as they posit that for firms with interest bearing investments, the yields on these investments will increase when interest rates rise and decrease when interest rates fall, thereby leading to a positive effect on stock returns.

Helliar *et al.* (2005) also explain that contrary movements in interest rates can indirectly affect the firm. For instance, an increase in interest rates may have an adverse effect on the firm if its customers are not willing to make purchases. They insinuate that this situation is particularly applicable to the UK, where a high percentage of the populace have mortgages that are connected to the current rate of interest. Subsequently, if interest rates rise, so will mortgage repayments, thereby reducing consumers' disposable income. Ultimately, consumers may be compelled to postpone the demand for some commodities. Helliar *et al.* (2005) further posit that the magnitude of exposure to interest rate risk will be different for most firms. They explained that manufacturers of luxury products, usually with high level of leverage, may feel the brunt of increased interest rates more than the supermarkets, which would normally have a low level of leverage.

1.2.3 The significance of foreign exchange rate and interest rate exposure

Pope and Marshall (1991) argue that foreign exchange rates, as well as interest rates, are the main source of financial risk faced by most UK firms. This proposition is supported by Hunter and Isachenova (2006) who also investigated the determinants of corporate failure risk or insolvency risk for UK industrial companies and found that amongst other factors, such as inflation, the two most significant responsible for business failure were fluctuations in interest rates and exchange rates. These findings were also similar to that of Liu (2004) who cited interest rates as a major indicator of corporate failure in the UK. It is therefore unsurprising that studies by Grant and Marshall (1997), Bodnar and Gebhardt, (1999), Prevost *et al.* (2000), Mallin *et al.* (2001) Bailly *et al.* (2003) and El-Masry (2006b) found that exchange rate and interest rate risk were the most managed financial risks by firms and probably the most significant.

Buckley (2004) also pointed out that there is an intricate relationship between exchange rates and interest rates. He explained that at money market equilibrium, there is a positive slope between interest rate and exchange rates, suggesting that an increase in interest rates leads to depreciation in exchange rates. This situation is also sometimes referred to as interest rate parity theorem i.e. equal return for equal risk. This conjecture is also supported by Hauser and Levy (1991) who advocate that interest rates are linked with exchange rates and have a vital role in their pricing. Furthermore, Times Online (2006) indicates that if fluctuations in exchange rates can have incidental implications for interest rate, then fluctuations in interest rates can also influence exchange rates. Therefore, the impact of movements in exchange rate and interest rate on firm value may not be autonomous.

1.3 The nature of competition in UK industries and its influence on exchange rate and interest rate exposure

Industry structure also plays a very pivotal role in the magnitude of a firm's exposure to fluctuations in exchange rates and interest rates. Marston (2001) indicated that the type of competition displayed in an industry affects the economic exposure of firms within that industry. This notion has been further supported in studies by Ceglowski (1989), Krishnamoorthy (2001) and Bodnar *et al.* (2002) as they point out that industry structure is a significant determinant of exposure, since the type of competition exhibited by firms in an industry determines the extent to which exchange rates and even interest rates impinge on their cash flows. Bodnar *et al.* (1998) and Williamson (2001) suggested that the risk exposure of monopolistic firms with the ability to pass the cost to consumers may be small and undetectable. Therefore these firms will exhibit lower exposure because they have high pass-through. Dominguez and Tesar (2001) also point out that firms in less competitive industries such as oligopolistic industries, prices are elevated above marginal cost. Consequently they may be able to absorb these fluctuations in exchange rates by adjusting their local currency prices and lowering the pass-through. As a result a firm in an oligopolistic industry would be expected to have a different exposure to a firm in a globally competitive industry. Furthermore, Campa and Goldberg (1995), Allayannis and Ihrig (2001) and Krishmanoorthy (2001) signified that the more competitive the industry, the higher the exposure. They defined competitive industries as those with low mark-ups, while Bodnar *et al.* (2002) classified competitive industries as those with high substitutability. At a fixed price, an increase in market share increases the level of profits, not only by increasing total sales but also increasing the profit margin which increases with market share. Bradley and Moles (2001) examined, through a survey, the effect of exchange rate exposure on UK non-financial firms. Their results indicated that for a large number of respondents, possibly from firms in competitive industries, the appreciation of the pound was absorbed by their companies through reductions in profit margins, so as to maintain their market share.

Bartram (2002) also indicated that interest rate risk may have an indirect influence on the competitive position of the firm. This conjecture was supported by Andrews (2005) who posits that the market-place is becoming increasingly competitive, such that profit margins are consistently under the threat of being eroded. Consequently, significant higher cost of debt could be detrimental for the long-term profitability and survival of the business. Helliar *et al.* (2005) further explained a scenario wherein a change in interest rate impacts on the firm's competitive position. They put forward that suppliers may be forced to increase their prices so as to cover the higher cost of funding. However, this increase may prove to have a negative impact on the financial performance of the firm, especially if competition is fierce in the industry. Besides, Allayannis and Ihrig (2001) and Krishmanoorthy (2001) found that US industries with low mark-up, or competitive industries, exhibited higher exchange rate exposure than industries with high mark-up, or oligopolistic industries, respectively. In contrast, Bartram and Karolyi (2006) and Dominguez and Tesar (2006) found that industries with higher Herfindahl indices (less competitive) had higher exchange rate exposure than industries with low Herfindahl indices (less competitive).

1.4 The introduction of the euro: How will exchange rate and interest rate risk of UK firms and industry be affected?

The Bretton Woods agreement collapsed in the early 1970's, shifting the International Monetary System from fixed exchange rates to a system of floating exchange rates. This spurred global economic instability, giving rise to increased volatility of exchange rates (Bartram *et al.*, 2005) and even interest rates. In a bid to counteract this instability within Europe, a number of monetary stabilisation mechanisms were initiated to alleviate the fluctuation of European currencies. These include the "snake in the tunnel" mechanism of 1972 which failed and was replaced by the European Monetary System (EMS) in 1979 (Hu *et al.*, 2004).

The EMS was initiated by the foremost members of the European and Economic Community (EEC). The monetary system had the pivotal role of fostering stability in the exchange rate through the Exchange Rate Mechanism (ERM). The ERM was a systematic process whereby the currency exchange rates among the member countries were fixed and adjustable within acceptable margins. The exchange rates were based on the European Currency Unit (ECU), whose value was determined as a weighted average of the participating currencies. However during this regime, national central banks had to raise their interest rates to protect the position of their currency. These systematic alignments led to interest rate spikes which sometimes proved detrimental for firms seeking capital in the market and also those with considerable volumes of floating rate debts (Barrett and Turongpun, 1999).

The UK, like most European countries, joined the ERM initiative in 1990 but opted out in 1992 as a result of heavy speculative pressure culminating into the events of the infamous black Wednesday (Hu *et al.,* 2004). Considering the short term period that the UK was in the ERM and the rationale behind abandoning the system, it will be logical to presume that the ERM was not beneficial to the UK. Surprisingly, studies by Artis and Taylor (1994) and El-Masry (2005) suggest that the proportion of UK industries with significant exchange rate exposure declined when the pound was in ERM and increased again when the UK left it.

In another attempt to strengthen economic convergence especially with regards to exchange rate stability and long-term interest rates, the European Union (EU) decided to formally establish the Economic and Monetary Union (EMU) in 1992. The EMU was to be carried out over 3 stages, with the last stage culminating with the replacement of national currencies by a single European currency and the transfer of monetary policy to the European Central Bank (ECB). Eventually, the 1st of January 1999 marked the effective start of the EMU for the European Union. Invariably the ECU ceased to exist and was replaced by a single European currency (legal tender) known as the euro. In addition, the ECB set a single official short term interest rate for member states adopting the euro while for nominal long-term interest rate, member countries were not to exceed the interest rates (measured in terms of price stability) of the three best performing member states by more than 2 percentage points (ECB, 2007).

Consequently for twelve of the initial EU 15 member states, namely, Austria, Belgium, Finland, France, Ireland, Germany, Greece, Italy, Luxembourg, Portugal, Spain and the Netherlands, their interest rates have been converged, and the euro has become their official legal tender. On the other hand, Denmark, Sweden and UK (part of EU15) have chosen to abstain from the adoption. Other countries that have since joined the EMU include Cyprus, Malta, Slovakia and Slovenia (ECB, 2009).

Furthermore, it has been suggested that the introduction of the euro was poised to increase trade within euro zone countries, eliminate business costs and reduce financial risks such as currency exchange and interest rates. For instance, McKinnon (1963) pointed out that the main motivation behind the adoption of the euro was to enhance stability of the exchange rate system amongst European countries. Studies by Artis (1989), Frenkel and Goldstein (1997), Pilbeam (1998), and Welsh (1999) have also indicated that the introduction of the euro will eradicate the operational risks associated with fluctuating foreign exchange rates and interest rates. In addition, Barrett and Turongpun (1999) indicated that the initiation of the EMU and consequently the euro is poised to reduce the level of interest rates by stabilising interest rates and eliminating intra European exchange rate risk. According to Galati and Tsatsaronis (2003), there has been a threefold increase in the volume of debt denominated in euro. They identified the reduced cost of capital market financing as one of the most significant factors responsible for this occurrence.

Frisch (2003) posits that the introduction of the euro can be considered as an economic landmark achievement in Euro-land and ultimately one of the greatest events in economic history after World War II. Even the former Chancellor of the Exchequer, Mr Gordon Brown acknowledged that some of the potential benefits of the monetary union for the UK would be reduced volatility of exchange rates and probably the reduction of long-term interest rates. In 1997, the Chancellor highlighted five economic tests that had to be satisfied before the UK could consider joining the EMU (Meen, 2003). These tests were:

(a) Convergence: are business cycles and economic structures compatible such that euro interest rates can be maintained on a permanent basis?

(b) Flexibility: if there are problems, is there adequate flexibility to deal with them?

(c) Investment: would it make conditions better for firms that want to make long-term investment decisions in the UK?

(d) Financial Services: how would the entry to EMU impact on the competitive position of UK's financial services, especially the city's wholesale markets?

(e) Growth, Stability and Employment: will membership of the EMU facilitate higher growth, stability and a long-term rise in employment?

In June 2003, the Government had an assessment of these tests to determine if they had been met. They surmised that progress on the first two tests, convergence and flexibility had been inadequate but the conditions on the other three tests: investment, financial services, and growth, stability and employment had been satisfied. Consequently, it was decided that the UK would not adopt the euro yet (Meen, 2003). Nevertheless, Barrett and Turongpun (1999) explain that another possible rationale for the UK not joining the EMU is the fear that its business cycles seem to be at odds with the rest of Europe, whereas Bris *et al.* (2006) posit that a major reason why the UK may not want to join the euro is because UK firms are more exposed to the dollar than to the euro. But even if and when the UK does decide to join the EMU, the capacity of a UK company benefiting from this economic convergence would depend on the degree of trade (internationalisation) with countries in the euro zone (Bartram and Karolyi, 2006; and Muller and Verschoor, 2006b) and the industry sector to which the firm belongs (Eilidh and Marshall, 2001).

1.5 Key issues of the study

Despite the evident concerns of the impact of fluctuating exchange rates and interest rates on a firm's profitability and value, empirical studies have continued to produce mixed results. For instance Solnik (1984) examined the relationship between equity returns and changes in interest rates and exchanges rates for Belgium, Canada, France, Germany, Japan, The Netherlands, Switzerland, UK and the US. He found that changes in interest rates had the foremost monetary influence in all the stock markets, while for the changes in exchange rates, a weak relationship was observed for all the countries. Likewise, Prasad and Rajan (1995) studied the impact of exchange rate and interest rate risk exposure on the equity valuations of industry portfolios in Germany, Japan, the UK and US. They found that the German and U.S markets had the highest number of industries with significant exposure to exchange rates while all industries in the 4 countries exhibited significant exposure to interest rates. Furthermore, Joseph (2002) evaluated the impact of fluctuations in foreign exchange and interest rates on some UK firms and industries. He also found that the industry returns were more negatively affected by changes in interest rate than by changes in foreign exchange rates. In addition, Guay and Kothari (2003) indicated that for their sample of large non-financial US corporations, exchange rate exposure was smaller than interest rate exposure. However Jorion (1990) explained that since exchange rates are typically four times more volatile than interest rates, then the impact of exchange rates should be more significant than that of interest rates. Similarly, Wetmore and Brick (1994), Choi and Elyasiani (1997) and Joseph and Vezos (2006) found support for this conjecture as their results indicated that exposure to exchange rate was stronger than the exposure to interest rate.

In the literature review, regarding studies that have examined foreign exchange rate or interest rate exposure of non-financial and financial firms, it is found that most of these have primarily been on non-financial firms when exchange rate exposure was investigated. But when interest rate exposure was examined instead, the majority of these studies have focused on financial firms. Then, when the effects of exchange rate and interest rate had been simultaneously examined on stock returns, these have mainly been on financials in most cases. [For example, Choi *et al.* (1992), Wetmore and Brick (1994), Joseph (2003b) and Joseph and Vezos (2006) investigated firms in the US banking industry while Hahm (2004) examined the Korean banking industry].

Although Prasad and Rajan (1995), Joseph (2002), Rees and Unni (2005) and Hyde (2007) have examined the effects of exchange rate and interest rate exposure simultaneously, on non-financials, these have been limited in scope and in some instances have primarily been based on industry portfolios. But then, Joseph (2003a) explained that the changes in foreign exchange and interest rates sometimes showed evidence of significant financial and economic implication, which that can only be explained by a statistical analysis that is centred on the industry level. Koch and Saporoschenko (2001), who investigated the effect of market risk, interest rates and exchange rates on the Japanese financial portfolio, proposed that estimations carried out with portfolio returns had the potential of identifying patterns of risks which may not be noticeable if the returns of individual firms had being used instead. Other proponents of industry level analysis include Harrington (1983) and Carson *et al.* (2008) who suggested that the use of portfolio level data as against individual firm level data produced more reliable results because it washes out the noise in the data, while Bartram (2002) posits that the analysis of portfolio level data as against firm level is more powerful, providing that their constituencies have similar exposures. However, Dominguez and Tesar (2001) indicated that firms within the same industry might be heterogeneous in their operations and even in their choice of strategies. Therefore, their exposure coefficients might be of opposite sign and magnitude. Muller and Verschoor (2006a, 2007) also found support for this supposition as they surmise that the aggregation of firms with positive and negative exposure coefficients, might lead to finding an insignificant exposure coefficient, otherwise known as cancelling out effects, for the industry group. Similarly, Choi and Prasad (1995) found evidence that compressing firm level data into portfolios may result to loss of information, which might explain why previous studies have found little or no indication of exposure to exchange rates and maybe interest rates at the industry level.

Another observation was that almost all the empirical studies on the UK, that have investigated exchange rate exposure (Donnelly and Sheehy, 1996; Doidge *et al.* 2006;

El-Masry, 2006a), interest rate exposure (Madura and Zarruk, 1995; Dinenis and Staikouras, 1998; Oertmann *et al.* 2000) and both exchange rate and interest rate exposure (Prasad and Rajan, 1995 and Rees and Unni, 2005) have utilised a linear OLS (ordinary least square) methodology. However, due to the volatility clustering, non-normal distribution and ARCH effects inherent with most financial time series data, the OLS method generally generates inefficient estimates and consequently unreliable deductions. Incidentally, Joseph (2002) apparently undertook the only known UK study that has adopted the GARCH methodology, but his sample does not provide an adequate representation of UK non-financial firms and industries.

Moreover, various studies, Ceglowski (1989), Krishnamoorthy (2001), Marston, (2001), Bodnar *et al.* (2002) and Bartram and Karolyi (2006) have found evidence to indicate that industry structure has a significant influence on the extent of exchange rate exposure. But Dominguez and Tesar (2001) indicated that if competitive industries understand their susceptibility and hedge away these risks; their inherent exposure to exchange rate risk might be comparable to that experienced by the concentrated industries.

Another area of importance is the impact of the introduction of the euro on exchange rate and interest rate risk exposure. Joseph (2002), in his investigation of foreign exchange and interest rate exposure of some UK and industries for the period 1988 to 2000, included a dummy variable of zero/one to account for the introduction of the euro in 1999. But he found that the dummy variable coefficients were insignificant suggesting that the introduction of the euro had no impact on the returns of the 4 UK portfolios. He indicated that the short duration of the post-euro data of his sample might have influenced this result. Although the impact of the euro on firm or industry exchange rate exposure has also been investigated empirically (Bartram and Karolyi, 2006 and Muller and Verschoor, 2006b) and by questionnaires (Eilidh and Marshall, 2001), yet again, these have all been faced with the same restrictions reported by Joseph (2002). Furthermore, studies that have investigated the impact of the euro on financial risks have mainly focused on exchange rate exposure (Eilidh and Marshall, 2001; Bartram and Karolyi, 2006; and Capstaff *et al.*, 2007). The only known study that has examined the impact of the euro on interest rate risk by Korkeamäki (2007) has only focused on stock market indices. All in all, none of these studies has primarily been on the UK.

It is believed that the results of this study will be of particular importance and benefit to investors and financial managers as it should highlight portfolios that are more susceptible to exchange rate and interest rate risk. The results will also provide an indication of volatility and persistence of volatility on firms and portfolio returns, in light of fluctuating exchange rates and interest rates. Additionally, it should also shed more light on the indirect benefits of the introduction of the euro, and the extent to which industry competition can influence exposure to exchange rate and interest rate risk. Then, most importantly, for investors, the study finds evidence that the paradigm of higher returns for higher risk might not hold for most UK non-financial portfolios and firms.

1.6 Scope and objectives of the study

This study focuses on all UK non-financial quoted firms on the proviso that they have adequate data for the period of analysis. The rationale for examining only non-financial firms is based on the premise that financial firms use complex risk management strategies for their foreign exchange and interest rate exposure. Furthermore, the prescription of the economic exposure theory distinguishes financial firms as producers and consumers, and finally this study is made comparable with earlier ones. The period of this study is January 1990 to December 2006. Furthermore, all the data required for this study have been obtained from DataStream International and Worldscope Database, while the empirical investigation entailed the use of time series and cross-sectional analyses of the data.

Therefore, we use a methodology that encapsulates conditional heteroscedasticity, that may be appropriate to the financial data to:

1. Provide a more comprehensive and detailed analysis of exchange rate and interest rate exposure of selected UK non-financial firms and industries.

2. Assess the impact of the introduction of the euro on the exchange rate and interest rate exposure of UK non-financial firms and industries.

3. Examine the degree to which industry concentration may affect the extent to which industries can diversify away the exposure to exchange rate and interest rate risk.

4. Provide a methodical exposé into the factors that determine the exchange rate and interest rate exposure of UK non-financial firms.

1.7 Synopsis of other chapters in this study

This thesis comprises of 7 chapters including the current chapter, which provides the preamble for the study.

Chapter 2 is the literature review. This part focuses on the review of existing literature, relating to exchange rate exposure, interest rate exposure and the management of exchange rate and interest rate exposure, so as to provide an insight as to what has been examined on the subject. Furthermore, it provides the rationale behind exploring the apparent gaps in literature which form the basis of this thesis.

Chapter 3 presents and discusses the hypotheses, sources of data and research methodology. Here we provide an explanation of the hypotheses and research questions that will be examined in the study. We also explain the sources of the data that have been used, the criteria for data selection into the final sample and the choice of the period of study. Furthermore, we explain the relevance of the variables that have been chosen and provide an overview of the models which will be used to test the hypotheses.

Chapter 4 presents an industry level analysis based on an AR(1) EGARCH-M model. Firstly, the analysis is segregated into 3 periods. These are the total period, the period before the Euro and the period after the euro. Then, with the use of interactive dummies, the impact of the introduction of the euro on exchange rate and interest rate exposure of UK non-financial industries is examined. Next, we investigate the impact of industry competition on exchange rate and interest rate exposure, with a focus on concentrated and competitive industries. Finally, the efficacy of the mispricing hypothesis is tested by replacing the contemporaneous changes in the exchange rate and interest rate factors with lagged changes. But this analysis is performed for the total period and sub-period only.

Chapter 5 presents the results of the firm level analysis instead which has also been estimated with the AR(1) EGARCH-M model.

Chapter 6 reports the results for the determinants of exchange rate and interest rate exposure at the firm level. It also provides the description of all the firm-specific variables that are used as the explanatory variables, including the motives for their preference to understudy exchange rate and interest rate exposure.

Chapter 7 provides a summary of the results obtained from this study. It also points out some of the limitations encountered in achieving the study objectives. Furthermore, it outlines some useful recommendations for future research.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

This study comprises three major themes, which are foreign exchange rate exposure at the firm and industry level, interest rate exposure at the firm and industry level, and the determinants of foreign exchange rate and interest rate exposure at the firm level. In order to grasp the main issues pertaining to this study, and appropriately resolve the research objectives, it will be instructive to segregate existing literature on each research theme. Therefore in Section 2.2, previous studies on foreign exchange rate exposure at the firm and industry level are discussed. Then in Section 2.3, interest rate exposure at the firm and industry level is examined. Section 2.4 presents the determinants of exchange rate and interest rate exposure, while the chapter ends with Section 2.5 where we provide a précis of the literature discussed in the chapter.

2.2 Foreign exchange rate exposure at firm and industry level

According to the extant literature of Adler and Dumas (1984), firm value is the present value of the future cash flows of the firm. Flood and Lessard (1986) and Jorion (1990) posit that exchange rate risk at the firm level can be depicted as the impact of fluctuating exchange rates on the firm's value or cash flow. Allayanis and Ihrig (2001) point out that the sensitiveness of the firm's cash flow to exchange exposure is dependent on the nature of its operations, such as the extent of international trade and composition of its input and output markets. Also at the industry level, Jorion (1990) and Loudon (1993a) indicate that the degree to which fluctuations in exchange rates impinge on the performance of the industry depends on its level of international business, the competitive nature of its input markets and its foreign investments.

Aggarwal (1981) investigated the impact of changes in exchange rates on U.S stock prices, during the floating rate period 1974 to 1978. Using different measures of U.S stock prices which included the NYSE and S&P500, he correlates these against the trade weighted value of the dollar in addition to a lag by one month. He finds a positive correlation between stock prices and the dollar signifying that when the dollar depreciates, the value of stocks also declined. However the significance was stronger when the value of the dollar was not lagged. AlDiab *et al.* (1994) examined the effect of contemporaneous changes in the dollar exchange rate on daily stock returns of US MNC's from January 1, 1978 to December 31, 1987. Their findings imply that the stock returns of MNC's are not significantly affected by changes in exchange rates.

Doidge *et al.* (2006) also examined the lagged exchange exposure of non-financial firms in 18 countries including the UK and the USA during the period 1975 to 1999. They found that for most of the countries, apart from the USA, the lagged exchange rate effect was insignificant. They surmised that the mispricing theory was most likely not the major rationale behind the low magnitude of exposure found in earlier studies. Nevertheless, Krishnamoorthy (2001) could find no evidence that lagged changes in exchange rates influenced the returns of US industries.

Doukas *et al.* (2003) examined the exchange rate exposure of 1,079 Japanese firms and 25 Japanese industries to the JP¥/US$ bilateral exchange rate for the period 1975 to 1995. Their results indicated that Japanese firms were significantly exposed to the contemporaneous changes in the exchange rate, whereas the lagged change was found to have no predictive power on stock returns. They indicated that the finding of insignificant lagged exchange rate exposure coefficients suggested that Japanese investors utilised all accessible information inherent in current exchange rate changes to envisage changes in the value of the firms. On the other hand, Hsin *et al.* (2007) examined the exchange rate exposure of US firms listed on the NYSE, AMEX and NASDAQ, and with total assets in excess of US$500 million in the period 1992 to 2002. On the basis of market capitalisation, they divided their sample into large firms. They found that small firms were significantly more exposed to the lagged changes in the exchange rate than larger firms. They pointed out that this finding could have resulted from the paradigm that information inefficiency was more prominent with small firms since they have less transparent information in the market.

Bartov and Bodnar (1994) investigated the effects of contemporaneous and lagged exchange rates on the stock returns of a sample of 208 US firms from 1978 to 1990. The exposure result was insignificant for the contemporaneous exchange rate. However when the contemporaneous stock returns were regressed against a lagged change in the dollar, a significant exposure to exchange risk was found. They suggested that the success of earlier studies detecting a significant correlation between exchange rate changes and firms stock returns could have been compounded through a number of factors. Firstly, they argued that it was vital to investigate firms that showed evidence of intense exposure to currency rate changes. In addition, firms should exhibit the same sign of exposure i.e. either all the firms benefit from an appreciation or benefit from a depreciation. Another limitation that was identified was the presence of mispricing, wherein investors wrongly estimate the relationship between firm value and unanticipated movements in exchange rates. They recommended that to circumvent these problems, lagged changes of exchange rates and not just contemporaneous effects should be included in the regression equation. Similarly Tai (2005) found that in the period 1978 to 2001, the returns of 10 major US commercial banks were significantly exposed to the contemporaneous and lagged changes in the bilateral US$/JP¥ exchange rate. However their results indicate that where 100% of the firms had significant exposure for the contemporaneous exchange rate, only 40% of the firms exhibited significant exposure coefficients for the lagged changes.

Another streak of argument on evidence of low exposure coefficients was by Allayannis and Ofek (1996, 2001) who declared that if corporations extensively utilised foreign currency derivatives and other hedging instruments such as foreign debts, to reduce the impact of these currency fluctuations and preserve firm value, then it was only logical that these protectionist measures would suppress the potential impact of exchange rate movements on firm value.

El-Masry (2006a) explored the foreign exchange rate exposure of UK industries to actual and unexpected changes in the trade weighted nominal and real exchange rates for the periods 1981 to 2001. His findings suggested that a higher percentage of UK industries stock returns, mainly displayed significant positive exposure especially towards the trade weighted nominal exchange rate. This implied that more industries benefit as the pound appreciates. He introduced a lag into the model and also found a statistically significant lagged relationship between industry returns, and the trade weighted nominal and real exchange rates respectively.

Fang and Loo (1994) also conducted an industry level study to examine the effects of unexpected changes in the US trade weighted exchange rate on the stock returns of 20 US industries for the period January 1981 to December 1990. They found significant negative betas for the chemical, food and beverage, mining, petroleum and utilities industries. However positive exchange rate betas were detected for banking, finance and real estate, department stores, machinery, other retail trade, textile and apparel, transportation equipment and miscellaneous industries as well.

Jorion (1990) investigated the effect of fluctuations in exchange rates on stock returns of 287 US multinationals between 1971 and 1987. The results indicated that only 15 firms (5.2%) from the total sample had statistically significant exchange rate exposure coefficients. Furthermore, firms in industries such as chemical and machinery, that exported a considerable level of their production, gain from a fall in the dollar and lose when the dollar appreciates. In contrast, firms in the textiles, apparel and retail industry, which import a considerable proportion of their production, lose when the dollar falls and gain when the dollar appreciates. Jorion (1991) and Loudon (1993a) lend support to these findings by pointing out that an industry's susceptibility to exchange exposure is dependent on the level of its export and import activities. This supposition is further upheld by Chow and Chen (1998) and Shin and Soenen (1999), as they found positive exposure coefficients for high importing firms in their study, while Bodnar and Gentry (1993) found negative exchange exposure for exporting firms in his sample.

Griffin and Stulz (2001) study the exchange rate exposure of 58 US and 58 Japanese industries in the period 1975 to 1997. They segregated their sample of industries into 2 groups: those industries that produce goods which are traded internationally are referred to as traded goods, while those that are not engaged in internationally traded commodity are depicted as non-traded goods. They find that for the Japanese traded goods industries, all of these except the integrated oil and steel have a significant negative coefficient, indicative of exporting industries losing when the domestic currency appreciates. While the importing industry (oil and steel) benefits from an appreciation of the domestic currency. However, the results for the Japanese non-traded industries were mixed as significant negative and positive coefficients were found. But regarding the results for the US, when significant coefficients were found, this had been positive for traded goods and non-traded goods industries.

He and Ng (1998) examined the foreign exchange exposure of 171 Japanese multinationals over a period from 1978 to 1993. They found that only 25% (42 MNCs) exhibited a significant positive exposure. They established that a quarter of the firms with a foreign sales ratio of at least 10% were significantly affected by exchange rate exposure. Another comparable study by Nydahl (1999) examined the foreign exchange rate exposure of 47 Swedish firms. He finds that the firm's level of exposure increased with the fraction of foreign sales. Likewise, Priestley and Ødegaard (2007) investigated the exchange rate exposure of 28 manufacturing US industries to the Japanese Yen and ECU in the period 1979 to 1998. They divided the industries into 2 groups: industries with extensive international trade and industries with low international trade. But they found that only 3 industries with extensive international trade exhibited significant exchange rate exposure coefficients while for the industries with low international trade, all the exchange rate exposure coefficients were statistically insignificant.

Donnelly and Sheehy (1996) investigated the correlation between changes in the trade weighted nominal exchange rate and the monthly abnormal returns portfolio of the 39 largest exporting UK firms that had foreign sales of at least 40% for the period 1980 to 1992. They observe a negative contemporaneous relationship between exchange rate fluctuations and the abnormal returns of large UK exporters. They split up the period into two; 1980 to 1990 to represent Pre- ERM membership and 1990 to 1992 to represent ERM membership. They found a statistically significant relationship between the sterling and the firms' stock returns for the pre-membership period. However they find no significant relationship between the sterling and firms' stock returns during the ERM membership period, suggesting that exchange risk of ERM countries reduced during the membership period. El-Masry (2004) conducted a similar study and investigated the sensitivities of firms' stock returns to fluctuations in exchange rates. He found that exposure was more pronounced during the pre-ERM period (1981 to 1990) and decreased in the ERM period (1990 to 1992). Nevertheless, Donnelly and Sheehy (1996) argue that the reason for finding no significant relationship for UK firms during the ERM was because the UK was only in the ERM for a short period, expectedly the degrees of freedom for the statistical tests was reduced. This view is supported by Chow *et al.* (1997b) who suggested that the failure of earlier studies in establishing significant exposure coefficients was partly as a result of the short time horizon employed in the study. They pointed out that using long horizon returns with long-horizon exchange rates should shed more light on the relationship between changes in exchange rates and stock returns over time. Even so, Choi and Prasad (1995) examined the sensitivity of 409 US multinational firms over a long time horizon covering the period 1978 to 1989. They found that at the 10% level, only 15% of firms exhibited significant exposure to the trade weighted nominal exchange rate. The results also indicated that 64% of the firms which had significant exchange risk exposure benefit when the dollar depreciates in value. This may imply that the majority of firms in their study, that exhibited significant exposure coefficients, were exporting firms. Also Glaum *et al.* (2000) examined the impact of the USD on German firms over a long time horizon from 1974 to 1997. They found that only 22 firms (31%) of the 71 firms investigated were significantly exposed to variations in exchange rates.

Another ERM period study by Rees and Unni (2005), examined the exchange rate exposure of European firms from 1987 to 1988. Their sample comprised of 90 firms (30 each from France, Germany and the UK). They estimated the exposure of each firm to three exchange rates; the domestic currency with regards to the ECU, the yen and the USD. They pointed out that exchange rates were closely related to the currency market, so there was a possibility for firms to reflect a causal exposure to interest rates, despite the fact that the statistical analysis was intended to measure firm returns and fluctuations in exchange rates. To evade this problem, they controlled for the firms' interest rate exposure by including in their regression the percentage change for the short term interest rate. Their results indicated that all the firms in their sample (France, Germany and UK) showed evidence of a positive coefficient exposure to fluctuations in the USD which meant that a depreciation of the home currency against the dollar increases the returns of these firms. Then regarding the exchange rate exposure of UK firms to the ECU, their results indicated that 87% of UK firms in the sample lose value when the sterling depreciates against the ECU. However for German and French firms, the exposure was generally weaker at 23% and 27% respectively. Noticeably, the percentage of UK firms with significant exposure to the ECU was significantly higher in comparison to Germany and France. A reasonable explanation might be that during the period investigated (1987 to 1988), the UK was not in the ERM, while Germany and France, which were in the ERM, benefited by having reduced and lower susceptibility to exchange rate exposure. Additionally, Rees and Unni (2005) also found that concerning the Japanese yen, evidence of exposure was limited to less than a quarter of firms in each country. But generally, UK and French firms had positive exposure coefficients, while German companies exhibited negative exposure coefficients.

Loudon (1993b) investigated the sensitivity of monthly Australian stock returns to foreign exchange exposure between 1984 and 1989. They used a sample of 141 firms taken from all 23 industries in the ASX indices and a trade weighted index for the AUD. A negative exposure was found for resource stocks, which implied that higher stock returns correlated with depreciation in the AUD. Conversely, industrials exhibited a positive exposure suggesting an appreciation in the AUD was beneficial. On the whole, 9 out of the 141 companies (6.4%) had significant exposure while 15 out of the 23 industries (65%) had no significant exposure.

Seiyeol and Hyonsok (2004) also explored the sensitivity of 260 non-financial Korean firms to both weekly and monthly trade weighted Won/Dollar and Won/ Yen exchange rates for the period 1987 to 2001. They found that for the weekly rates, 81 firms (31.2%) in their sample were exposed to the US dollar while 47 firms (18.1%) were exposed to the Japanese yen both at the 10% level of significance. On the other hand, using monthly data, they found that 52 (20%) firms were exposed to the US dollar and 35 (13.5%) firms to the Japanese yen. They concluded from their findings that weekly data was more appropriate for determining foreign currency exposures than monthly data.

Muller and Verschoor (2006a) examined the exchange rate exposure of 935 US firms in the period 1990 to 2001. They found that approximately 7% of firms in their sample exhibited significant exposure to the trade weighted index and these were mainly positive. Their results implied that US firms benefit from the appreciation of the US dollar. However, when bilateral exchange rates were used instead, they found that of 683 firms, 8.9% were significantly exposed to the ECU. Then out of 712 firms, 9.3% exhibited significant exposure coefficients for the British pound. In addition, out of 639 firms, 17% were significantly exposed to the Asian currency, while 9.1% of 396 firms were significantly exposed to the Australian dollar. Furthermore, of 461 and 164 firms, 9.6% and 9.1% were significantly exposed to the Latin American currencies and South African rand respectively. They surmise that on the whole, 29.1% of the firms were significantly exposed to the region specific exchange rate indices. Similarly, Nguyen and Faff (2003) examined the exchange rate exposure of 144 Australian non-financial firms during the period 1997 to 1999. They found that 14.58% of the firms were significantly exposed to the trade weighted index value of the Australian dollar. They further investigated the exchange exposure sensitivity of the firms to 2 additional currencies, which were considered as relevant for Australian trade, namely the Japanese Yen and US$. They found that 10.42% of the firms exhibited significant exchange rate exposure coefficients for the Japanese Yen and then regarding the US$, 11.11% of the firms had significant exposure coefficients.

Fraser and Pantzalis (2004) study the exchange rate exposure of 310 US multinational firms during the period 1995 to 1999. They also specifically tested the conjecture that firms were more exposed to firm specific exchange rates than to the common index exchange rate. Their results indicated that 8.7% of the firms were exposed to the contemporaneous changes in the firm specific index while just 5.5% exhibited significant coefficients for the contemporaneous changes in the common index. They further introduced a lag of one period to the exchange rate. But the inferences were similar to the results from the contemporaneous exchange rate exposure. However, they observed that more firms were significantly exposed to the contemporaneous changes in the exchange rate than the lagged changes. Nevertheless, firms that were exposed to the lagged changes were not necessarily those exposed to the contemporaneous changes.

They explained that for some firms, there may be a time lag before the impact of movements in the exchange rate impacts on the stock price.

El-Masry *et al.* (2007) examined the exchange rate exposure of 364 UK non-financial firms for the period 1981 to 2001. They find that, for the actual (unexpected) changes in the nominal Trade weighted exchange rate, 61% (72%) firms had significant exposure coefficients. Then for the actual (unexpected) real exchange rate, 48% (45%) had significant exposure coefficients. Furthermore, significant exchange rate exposure coefficients for the other actual (unexpected) exchange rates were: equally weighted 36% (53%), ECU/£ 68% (64%), US$/£ 66% (57%) and JP¥/£ 43% (56%) respectively. Additionally, most of the significant exchange rate exposure coefficients were positive, but at the 10% level of significance. They infer that the finding of more significant coefficients for the ECU/£, US$/£ and JP¥/£ exchange rates rather than the trade weighted exchange rate was based on the premise that UK firms trade with Europe, the US and Japan account for 70% of UK international trade. Moreover since the trade weighted exchange rate comprised of a basket of currencies, which were unlikely to be correlated, the exposure to the trade weighted currency is likely to be lower.

Hagelin and Pramborg (2004) investigated the exchange exposure of 462 Swedish firms for the period 1997 to 2001. They found that at the 5% level of significance, only 13% of the firms had significant foreign exchange rate betas while at the 10% level of significance, only 24% of the firms had significant betas. They pointed out that the use of a trade weighted currency basket (TWC) might be the major reason why only a few firms in their study exhibited exchange rate exposure. They further explained that since the TWC index only captured the average exposure of all the firms, it followed that for many of the individual firms, the index might not be representative of their foreign exchange exposure. They also highlighted that since a lot of firms hedged their exposure, or even had low exchange exposure in the first instance, then the relatively low exposure found in their study could be accounted for by these reasons.

Nyadhl (1999) investigated the sensitivity of 47 firms in Sweden to fluctuations in exchange rates for the time period 1990 to 1997. The selection criterion was that all the firms in the study should have a foreign sale ratio of at least 10%. Taking into consideration the most commonly used currencies in exports, share of foreign direct investment and the invoicing currency, five bilateral exchange rates were utilised for the analysis. He found that 19 (40%) of firms in the sample displayed significant exposure to exchange rate exposure at the 10% level. He explained that a substantial number of firms in his study displayed significant exposure to exchange rates when compared to results using data from the US and Japan. He suggested that this might probably be due to the reason that Sweden is a small open economy. Additionally, he found that 47% of the firms without a significant exposure to the trade weighted index displayed a significant exposure to one of the three individual exchange rates. Then 25% of the firms with a significant exposure to the trade weighted index had no significant exposure to the firm specific exchange rate. But generally, the results suggested that on average, Swedish firms lose value when the domestic currency depreciates.

Jong *et al.* (2006) investigated the exposure of 117 Dutch firms to exchange exposure between 1994 and 1998. They used questionnaires to identify three currencies that firms in their sample were most susceptible to and the percentage of exchange rate exposure that is hedged with derivatives. Information was obtained from the annual reports and used to substantiate the results from the questionnaires that they received. Their results revealed that 65 firms (56%) had significant exposure to the trade weighted guilder at the 10% level and 55 firms (47%) at the 5% level. However, in the case of the firm specific nominal exchange rate, only 8 firms (24%) of the 33 firms that indicated the USD was one of the currencies they were exposed to, had a significant positive exposure, signifying that they were probably exporters. In addition, 5 firms (22%) were significantly exposed, mostly negatively to the British pound, while for the other currencies, 8 firms out of 31 (26%) had significant exposure. Overall, 18 firms out of 35 (51%) exhibited a significant level of exposure to at least one currency. Even so, the percentage of firms exhibiting significant exposure to exchange rates was higher for the trade weighted guilder than for the individual currencies. They suggested that since it was customary for some firms to use derivatives, it logically followed that low exposure coefficients would be found. This inference is also supported by Allayannis and Ofek (2001) and Doidge *et al.* (2006). But Jong *et al.* (2006) also seemed to the support the open economy hypothesis, as they explained that given that the number of Dutch firms, the average significant exposure coefficients was considerably much higher than those obtained from US studies. They concluded that firms in small open economies, such as the Netherlands or even the UK, were more exposed to exchange risk than those in the US, which is considered as one of the least open economies in the world.

Bodnar and Gentry (1993) examined the exchange exposure of Canadian, Japanese and US industries. Their results indicated that for Canada and the U.S, four out of 19 industries (21%) and 11 out of 39 industries (28%) respectively, had significant levels of exposure. Then the results for Japan indicated that 7 out of 20 industries (35%) exhibited significant exchange exposure at the 10% level. They argued that the impact of exchange rate fluctuations on an industry was dependent on the industry's connection with the global economy. Therefore, using inter-industry variance of the exposure coefficients, they tested the concept that firms in small and open economies were more sensitive to changes in exchange rates, than firms in large and less open economies. Their results revealed that the exposure variance was less significant for the US than for Canada and Japan. Since the US is the largest and least open economy of the three countries, the findings advocated that industries in smaller and more open economies were probably more exposed to fluctuations in exchange rates. Other studies that have also supported the open economy hypothesis include He and Ng (1998) and Friberg and Nydahl (1999).

Miller and Reuer (1998) study the effect of industry structure on a sample of US firms' economic exposure to foreign exchange rates between 1988 and 1992. Their results revealed that 13% to 17% of US firms showed significant exposure to fluctuations in exchange rates. Williamson (2001) investigated the effect of competition and exchange rate exposure on the automotive industry in the US ((¥/$ and DM/$) and Japan ($/¥ and DM/Y) between 1973 and 1995. One of the reasons for selecting the industry was because of its global competitiveness. The results from the empirical analysis revealed that regarding the US automobile industry, there was a significant negative exposure to the yen (the industry loses value when the yen depreciates against the dollar) and positive exposures sign for the DM (the industry gains in value when the DM depreciates against the dollar). However for the Japanese automobile industry, the results indicated a negative exposure to both the dollar and the DM.

Marston (2001) and Bodnar *et al.* (2002) explained that the structure of competition between firms may significantly affect their profitability and coherently firm value. Bartram *et al.* (2005) also indicated that since suppliers, customers and competitors were all affected by foreign exchange risk, there is the prospect that they might attempt to pass the effect to other participants in the market (pass through). Krishnamoorthy (2001) investigated the significance of industrial structure in the exchange rate exposure of US firms over a 3 year period (1995-1997). His findings suggested that industries which are globally competitive, and those that mainly served the consumer sector of the economy, displayed a higher significant level of exposure. On the other hand, industries classified as oligopolies, and institutionally oriented, had insignificant exposure. Dominguez and Tesar (2006) utilised the Herfindahl index to determine the influence of industry competition on exchange rate exposure. They infer that firms in less competitive industries, would probably pass on the movements in exchange rate on to prices, therefore unfavourable changes in exchange rates might not affect profitability. Nevertheless, they found a significant positive Herfindahl index for the UK implying that firms in less competitive industries (higher Herfindahl index) have higher exposure. Likewise, Bartram and Karolyi (2006) also utilised the sales and total assets based Herfindahl index to determine the impact of industry structure on exchange rate exposure. Their results suggested that firms in industries with low values of sale based Herfindahl indices had significantly smaller negative and positive exchange rate exposure coefficients than firms in industries with high sales Herfindahl indices.

Bartov *et al.* (1996) investigated the exchange rate exposure of 109 US firms in the period before the breakdown of the Bretton Woods system (1966-1970) and in the period following the arrival of fluctuating exchange rates (1973-1977). Their results suggested that US multinational firms witnessed an increase in exchange rate risk following the introduction of the floating exchange rates. Similarly, Verschoor and Muller (2007) study the impact of the Asian crisis of 1997 (which led to a regime change of fixed to floating exchange rates) on the exchange rate risk of 372 US multinationals. Using 4 Asian currencies, which included the Thai baht, Malaysian ringgit, Indonesian rupiah and South Korean wong, against the US$, they found that multinationals with activities in Asian countries witnessed an increase in their exposure to exchange rate risk during the floating rate regime. Their findings were also supported by Ihrig and Prior (2005) who examined the exchange rate exposure of 901 US firms during the period 1995 to 1999. They surmised that the effect of movements of exchange rates on stock returns was more prominent during a crisis period.

An industry analysis of UK MNCs via questionnaires was conducted by Eilidh and Marshall (2001). They found that firms in the engineering industry were in favour of the euro, while those in the chemical industry were indifferent. Other firms in the engineering, construction, building and service industries declared that the euro had reduced their exposure to exchange rate fluctuations. But firms in the oil and gas and paper and printing felt the euro did not alter their exposure. Generally, although a majority of MNC's were in support of the euro with regards to its impact on their management of foreign exchange risk, this varied between the different industry sectors.

Bartram and Karolyi (2006) also examined the impact of the introduction of the Euro on exchange risk exposure of 3,220 non-financial firms from 18 European countries, the United States and Japan from 1990 to 2001. They observed that in the period before the euro, there were more firms with significant negative coefficients than positive coefficients. The predominance of significant negative coefficients implied that firms experienced a decline (increase) in firm value when the local currency depreciated (appreciated). Nevertheless, the median of the negative and positive exposure coefficients were generally of similar magnitude. For instance, it was large for firms in the euro area than non-euro Europe and outside Europe. They also observed that regarding the change in the exposure after the euro, the incidence of significant exposure coefficients was quite low, but these had an opposite signed coefficient to the one previously found before the euro, suggesting a reduction in the absolute exchange rate exposure. Even then, the change in the foreign exchange rate exposure was highest for firms in the euro area, followed by firms in non-euro Europe and then firms outside Europe.

Muller and Verschoor (2006b) investigated the exposure of European MNC's to foreign exchange risk exposure. They measured the euro against the currencies of the three most important trading partners of the European Monetary Union; Japan, UK and the US for the period 1988 to 2002. They observed that 13% of the firms exhibited a significant level of exposure to the Japanese yen (in which 10% had negative exposure coefficients and 3% exhibited positive coefficients), 14% showed evidence of exposure to the US dollar (about 7.5% had a negative exposure coefficients whereas 6.5% had positive coefficients) and 22% of the firms demonstrated significant level of exposure to the UK pound (out of which 19% had negative exposure coefficients and only 3% exhibited positive coefficients). Their results suggested that an appreciation of the Japanese yen, UK pound and US dollar against the euro had a negative impact on the stock returns of European firms, hence the negative coefficient. In contrast, a positive coefficient indicated that the returns of European firms benefit when the euro appreciates against the Japanese yen, UK pound and US dollar. Their result indicates that EMU is highly dependent on imported inputs for domestic consumption and exports to the global market.

Jayasinghe and Tsui (2008) investigated the exchange rate exposure of 14 Japanese industrial sectors to exchange rate risk in the period 1992 to 2000. They found that 4 sectors namely automobile and parts, electrical and electronic equipment, household goods and textiles and information technology and hardware exhibited significant positive exchange rate coefficients implying that the returns of these sectors increased (decreased) with the depreciation (appreciation) of the yen. Conversely, 2 sectors, the construction and building materials and oil and gas sector had significant negative coefficients, indicating that their returns increased (decreased) with the appreciation (depreciation) of the yen. But for 8 sectors: chemicals, diversified industries, engineering and machinery, personal care and household products, pharmaceuticals and biotechnology, software and computer services, steel and other metals and telecom, the exchange rate exposure coefficients were statistically insignificant. From their GARCH model, they also found evidence of asymmetric effects as the volatility of sectoral returns, induced by the depreciation of the yen was higher than that caused by the appreciation of the yen.

2.3 Interest rate exposure at firm and industry level

2.3.1 Introduction

Bartram (2004) explains that the impact of interest rate risk on the value of non-financial organisations has rarely been an area of study despite the fact that interest rates are not less volatile than exchange rates, and also embody an important source of risk for non-financial firms. Faulkender (2005) pointed out that most firms are exposed to interest rate risks from two sources which are the interest rate sensitivity of their assets and the sensitivity of their debt. Hakkarainen *et al.* (1997) also suggested that the interest rate exposure of firm value is partially correlated to corporate debt and equity ratio. Theoretically, interest rate risk impinges on the value of non-financial firms, due to variations in their cash flows, and the value of their financial assets and liabilities. In addition, variations in interest rate may also have an indirect effect on the firm's competitive position by impacting the size of their future cash flows and consequently firm value. Lobo (2000) pointed out that most studies on interest rate exposure have usually ascertained an inverse or negative relationship between stock returns and changes in interest rates. However, Flannery and James (1984) indicate that an unexpected change in interest rates can either affect the firm positively or negatively depending on the relative durations of its assets and liabilities. Belongia and Santoni (1987) also hypothesise that the portfolio of financial institutions comprised of assets and liabilities, with a range of durations, such that nearly any change in the interest rate will affect the expected flow of net revenue generated by the firm's portfolio. Besides, Flannery (1983) explained that financial institutions usually owned adequate resources which allowed them to continuously hedge against their exposure to fluctuations in interest rates, by matching the duration of their assets to their liabilities. If this is the case, then the long-run profits and consequently firm value should not be affected.

Interest rate exposure studies such as Lynge and Zumwalt (1980), Flannery and James (1984), Kane and Unal (1988), Chen and Chan (1989), Bae (1990), have mainly focused on financial institutions. Then Choi *et al.* (1992) which is also on US Banks examined the significance of both interest rate and exchange rate risks. However, only very few studies have examined the relationship between interest rate exposure and the non-financial firm. But interestingly, similar to studies on exchange risks and stock returns, empirical studies on interest rates and stock returns have also mostly yielded contrasting results. For example, Stevenson (2002) pointed out that although empirical evidence has generally found that equities tend to react significantly to changes in interest rates, especially unanticipated changes, studies on typical bank stocks have been less conclusive. Booth and Officer (1985) compared the interest rate risk exposure of 66 US commercial banks and 66 US non-financial firms. Using the contemporaneous changes in the 3 month Treasury bill, they found that the returns of the commercial banks were negatively affected by the changes in the interest rate; while for the non-financial firms, a statistically insignificant coefficient for the interest rate was found. They explained that if contemporaneous changes in the interest rate affected stock returns, then this implied that the change was not fully anticipated by the market, since in an efficient market, current changes (contemporaneous changes) in interest rates should have little influence on security returns. Sweeney and Warga (1986) investigated the sensitivity of regulated industries stock returns particularly those of electric utilities, to unanticipated changes in interest rates for the period 1960 to 1979. Using the three month US Treasury bill and the twenty year US Government bond, they found negative interest rate coefficients for utility firms in their sample. Ceglowski (1989) examined the effect of industry structure on interest rate risk of some U.S firms. She found that the impact of changes in interest rate on firm's stock returns was dependent on the nature of the industrial structure in which the firm operated. Nevertheless, Haugen *et al.* (1978) and Sweeney and Warga (1986) suggested otherwise. Their results implied that a substantial number of U.S corporations did not display significant exposure to interest rates at the industry level. But when the regressors were not orthogonalized, they found that the stone, clay, glass, utilities, banking, finance and real estate industries showed a significant negative relationship for interest rate. Bae (1990) examined the sensitivity of common stock returns of US financial firms to current, anticipated and unanticipated changes in interest rates for the period 1974 to 1985. He argued that changes in current interest rates comprised of both anticipated and unanticipated changes. In an efficient market, stock prices already take into consideration the anticipated changes, therefore only the unanticipated changes should affect stock prices. However since most of the changes in current interest rates were basically not totally anticipated by the market, then many of these changes might correspond to unanticipated changes. He includes three different interest rate indices (the three month Treasury bill, three year Treasury note and twenty year Treasury bond) denoting short, intermediate and long term interest rates respectively. A sample of non-financial firms is also included to act as a control sample. He found that all the current interest rate betas for the financial firms had negative coefficients, implying that changes in current interest rates adversely affected the stock returns of financial firms generally. Their finding was also comparable to that of Al-Abadi and Sabbagh (2006) who investigated the sensitivity of 13 Jordanian commercial and investment banks to interest rate risks for the period 1990 to 2003. They used the 3 month Treasury bill as a proxy for interest rates and found that interest rate exposure was significant and negative. However, these result contradicted that of Chance and Lane (1980) who found no evidence that current changes in interest rates influenced the stock returns of financial firms in their study. Although insignificant, they found that the negative sensitivities of financial firms' stock returns to unanticipated changes were more pronounced than for actual changes in the interest rates, and sensitivity was higher for the long term interest rates than short term interest rates. Again, this finding differed from that of Lloyd and Shick (1977) as they posit that banks' stock returns was more sensitive to short term interest rates than long term interest rates. Additionally, Bae (1990) found that the stock returns of non-financial firms in their study were not sensitive to the unanticipated changes in interest rates. He explained that a lot of non-financial firms' assets comprised of real assets. whose values tend to be invariant to changes in interest rates. Notwithstanding, Lynge and Zumwalt (1980) using current changes in the interest rates, found a significant negative effect on the stock returns of non-financial firms in their study. Joehnk and Petty (1980) also investigated the impact of fluctuating interest rates on equity share prices. Their results suggested that share prices were inversely related to interest rates, in particular those with longer maturities. Dinenis and Staikouras (1998) investigated the impact of fluctuating interest rates on the stock returns of 95 industrial and commercial firms and 153 financial firms in the UK between the period 1989 and 1995. They found that the coefficients on the interest rate term were significant for all financial firms for both the one month and three month rate. For the industrial and commercial industries, their sensitivity to both the actual changes in the interest rates though significant, was half the magnitude of that observed for the financial firms. They explained that a significant exposure to the actual changes in the interest rates contradicted the supposition that current information was not incorporated in the current value of the equity. Furthermore, they posit that stocks of non-financial industries are claims on real assets which should be insensitive or at worst less sensitive to interest rates when compared to stocks of financial firms which are claims on monetary assets. But the combination of high levels of leverage, high customer credit and sometimes inept hedging of assets and liabilities may have brought about the finding of the significant negative interest rate exposure coefficient for the non-financial industry. Nevertheless, the outcome of this result conflicted that of Bae (1990) who did not find significant interest rate coefficients for non-financial firms in his study.

Bartram (2002) also investigated the interest rate exposure of German non-financial firms for the period 1987 to 1995. He used the middle rate of the 3 month Eurocurrency as a proxy for the short term interest rate index while the 10 year government bond was used as a benchmark for the long term. He found similar results with Oertmann *et al.* (2000), as the exposure to changes in the long term interest rates were mostly positive. In addition, he discovered that all the non-financial firms exhibited higher exposure towards the long term interest rate than the short term interest rate. Similarly, Ferrer *et al.* (2010) examined the interest rate exposure of Spanish industry portfolios. They found that more industries were significantly exposed to the long-term interest rate than the short-term interest rate. Nevertheless, negative exposure coefficients were found for both interest rate measures. Bartram (2002) also investigated the impact of interest rate risk on the different industries. He determined the percentage of firms per industry which exhibited significant exposure to interest rates. He pointed out that this method was more favourable than that of industry portfolios or pooled regressions, because interest rate exposures are usually different with respect to size and direction, even for firms in the same industry. He found that sectors such as agriculture/forestry, industrial machinery and construction, whose activities were somewhat diversified, are particularly sensitive to changes in the long term interest rate.

Furthermore, Madura and Zarruk (1995) examined the interest rate exposure of a sample of Banks from Canada, Germany, Japan, US and the UK. Using orthogonalized country specific actual changes in the long-term interest rates, they found an inverse relationship between all the bank's returns except the US. But the magnitude of the coefficient was highest for British banks and lowest for German banks. However, when the short-term interest rate was used instead, significant positive coefficients were found. The analysis was subsequently repeated using the unexpected changes in the short-term and long-term interest rate. The results were similar to that reported from the actual changes. Likewise, Joseph (2002) also found that the short-term maturity index, represented by the 1 month Treasury bill, had a significant positive relationship with the returns of the UK pharmaceutical industry. Loudon (2004) measured the interest rate exposure of Qantas and Air New Zealand. The firms are from the Australian and New Zealand airline industry respectively. Using a sample period spanning 1995 to 2003, he utilises the Australian 90 day bank accepted bills and New Zealand 3 month treasure bill as proxies for the short term interest rates. For the long term interest rate, he uses the 10 year government bond as a proxy. He found that Air New Zealand had significant negative exposure both for short-term and long term interest rate, while Qantas exhibited significant positive interest rate exposure coefficients.

González *et al.* (2006) examined the interest rate exposure of the returns of some Spanish sectors. These included banking, construction, chemicals, communications, electrical, food, investment trust, primary metal, utilities and others in the period 1993 to 2001. They used the 10 year Spanish government bond and the 3 month interbank rate as proxies for the long-term and short-term interest rate respectively. Regarding the long-term interest rate, their results showed that construction, electrical and utilities sector had significant negative coefficients, indicating that these sectors benefitted from a decrease in the long-term interest rate. On the other hand, they found that the banking sector had a significant positive coefficient regarding the short-term interest rate, implying that they gain from a rise in interest rate whereas for the construction sector, a significant negative coefficient was found. The latter suggested that the returns of the sector decline when interest rate rises. Wetmore and Brick (1994) study the sensitivity of the 79 largest banks in the US to actual changes in interest rates for the period 1986 to 1991. They point out that the rationale for using actual rates is that there is no difference in the results whether anticipated or unanticipated changes are used. Looking at three different maturities, namely, one-year treasury bills, seven year treasury notes and long-term bonds, they introduced a weighted average exchange value as a proxy for foreign exchange risk. Although there was a substantial degree of correlation amongst the interest rate indices, they were not orthogonalized, as they alleged that orthogonalizing the indices leads to biased estimators. They found that the sensitivity to interest rates was significant regardless of the index used.

Prasad and Rajan (1995) examined the interest rate risk of 765 firms from the U.S (20 industries), 60 firms from Germany (12 industries), 147 firms from Japan (25 industries) and 89 firms from the United Kingdom (17 industries) for the period 1981 to 1989. They used the monthly change in the Treasury bill rates as a proxy for interest rates in Germany, US and the UK, and for Japan the money market rate. Their results for the US revealed a significant positive exposure at the 10% level for the other transport industry and a significant negative exposure for the utilities industry. Regarding Germany, they found that the stock returns of the automobile industry are negatively exposed to interest rates while for the construction and housing industry, there was a significant positive exposure. They attributed the finding of a positive exposure to the presumption that the construction and housing industry may have a lagged reaction to changes in interest rates. With regards to the Japanese equity market, they found that with the exception of the banking industry, the interest exposure for all other industries were negative. They posit that the exposure coefficient for the banking industry can either be positive or negative depending on whether the bank was a net lender or borrower in the short term. Their findings suggested that banks in the Japanese market were net short term lenders as they benefit when interest rates increase. Finally for the UK, they found that only the multi industry group had a significant negative exposure to interest rate risk. The engineering industry, which had a significant negative interest rate exposure in Joseph (2002), had an insignificant coefficient at all levels of significance in Prasad and Rajan (1995). However Oertmann *et al.* (2000) found significant interest rate exposures for most non- financial corporations in France, Germany, Switzerland and U.K, but these were attributable to variations in the long-term interest rates and global interest rate index. Thorbecke (1997) adopted various empirical techniques to investigate the impact of interest rates on stock returns. His findings demonstrate that interest rates significantly influenced stock returns. Jensen *et al.* (1997) examined the short-term and long-term stock market returns of 16 industries during the period 1968 to 1991. Their results implied that declining interest rates were subsequently followed by considerably higher short-term and long-term stock returns.

Furthermore, Dinenis and Staikouras (1998) used ARIMA models to extract the unexpected changes in interest rates. Subsequently, they investigated the impact of unanticipated changes in interest rates on stock returns. The interest rate coefficients were significant for all firms but yet again, higher average sensitivity was reported for firms in the financial institutions. Studies by Flannery and James (1984), Booth and Officer (1985), and Scott and Peterson (1986), which have also used unexpected changes, have also come up with similar results. Elyasiani and Mansur (1998) investigated the sensitivity of 56 US Banks, compressed into 3 portfolios, to interest rate changes from 1970 to 1992. Using the 10 year Treasury composite yield as the interest rate measure, they found significant negative interest rate coefficients for 2 of the 3 portfolios. Their results also showed that volatility had an adverse effect on the risk-return premium and shocks to the banking sector were highly persistence and decayed at a very slow pace. Similarly, Brewer *et al.* (2007) examined the interest rate exposure of 60 US insurance companies compounded into portfolios, during the period 1975 to 2000. Utilising the 20 year US Government bond and a GARCH-M methodology, they found a significant positive coefficient between the long-term interest and the portfolio returns. Their results also indicated that increased volatility was compensated for by a higher average return, stock return volatility was time varying and evolved over time, as a function of its own lagged value, in addition to the intensity of the shock in the previous period. Lobo (2000) investigated the asymmetric effects of changes in interest rates on the returns of the S&P index for the period 1990 to 1998 using the AR-EGARCH model. He found that the 3 month Treasury bill had a significant negative effect on the returns of the index. Furthermore, he found evidence of high persistence of volatility and leverage effects, implying that past negative innovations had a grater impact on current volatility in the stock market than past positive innovations.

2.3.2 Simultaneous investigation of exchange rate and interest rate exposure

In some instances, a few studies have also investigated jointly the effects of exchange rate and interest rate exposure on stock returns. For example, Murtagh and Bessler (2003) investigated the exchange rate and interest rate exposure of some industries including those for the UK in the period 1985 through to 2002. They utilised the Bank of England trade weighted exchange rate, 1-3 years bond for the short-term interest rate and 10 year government bond for the long-term interest rate. The results for the financial indices, which comprised of banks, total financial and insurance, indicated that none of these were exposed to exchange rate or interest rate risk. But of the 8 non-financial indices, retail and utilities had significant positive coefficients for the short-term as well as the long-term interest rate, basic and engineering exhibited significant negative coefficients, but for only the long-term interest rate while regarding the exposure to exchange rate, only the basic and retail indices exhibited significant coefficients which were negative and positive respectively. In contrast, diversified, general industrial, pharmaceuticals and transport were not significantly exposed to the exchange rate and interest rate measures. Overall, their finding indicated a higher susceptibility to interest rate risk than exchange rate risk. Rees and Unni (2005) also examined the exchange rate and interest rate exposure of 90 large European firms from UK, France and Germany i.e. 30 from each country for the period 1987 to 1998. The exchange rate measures constituted of the domestic currencies against the ECU, Yen and US dollar, while the short-term interest rate were represented by the 1 month Treasury bill for the UK, then for France and Germany, this was represented by the 1 month money market rate. They found that all the directly quoted exchange rate exposure coefficients for the US dollar were positive; suggesting that a depreciation of the domestic currency vis-à-vis the US dollar increases the returns of the firms. They explained that firms in their sample were probably exposed to the US dollar largely through their revenue rather than by their cost. Furthermore, they found exposure to the ECU to be more prevalent with UK as 87% of UK firms exhibited significant exposure coefficients, which were negative, inferring that UK firms lose value when the pound depreciates against the ECU. They further pointed out that the production processes of major UK firms were intensely integrated to that of European economies, such that their costs of production and capital are more susceptible to the European currency than their revenue. Conversely, Germany and France, with only 23% and 27% of their firms exhibiting significant exposure coefficients, were less exposed to the ECU. Nevertheless, exposure to the yen was generally weak since less than 25% of the firms in all 3 countries had significant coefficients. But for those firms which had significant coefficients, UK and French firms had positive exchange rate exposure coefficients, indicating a gain in value when their domestic currency depreciates against the Yen. Then regarding German companies, these had negative exchange rate exposure coefficients, suggesting that they lose value when the Deutschmark depreciates against the Yen. In addition, Rees and Unni (2005) also found that 63% of UK firms and 90% of French firms had significant negative interest rate coefficients, indicating a drop in value when interest rate increased. However, the evidence of interest rate exposure for German firms was very weak.

Hyde (2007) studied the real exchange rate and real interest rate exposure of 31-33 industry sectors in France, Germany, Italy and the UK, in the period 1973 to 2004. Their results showed that for Germany, 56% of the industries had significant exchange rate coefficients, 26% for Italy, 21% for France and only 12.5% in the UK. The results also suggested that an appreciation of the domestic currency had a negative impact on industry returns in France and Germany, but increased returns in Italy and the UK. Furthermore, he found that regarding interest rate exposure, Germany with 34% of its industries exhibiting significant negative coefficients had the highest incidence of exposure. Then for France, 21% of the industries had significant coefficients which were also mainly negative. But for Italy and the UK, only 2 industries had significant coefficients. Joseph (2002) examined the interest rate and exchange rate exposure of four UK industrial sectors namely the chemical, electrical, engineering and pharmaceutical sectors during the period 1988 to 2000. A total of 106 firms were found in these sectors. He used the UK 1 month Treasury bill as a proxy for interest rates and the trade weighted sterling for exchange rates. The results indicated that firms in the electrical sector were mostly affected by contemporaneous changes in the interest rates, but the lagged coefficient captured more of the interest rate effects. Then regarding exchange rate exposure, firms in the engineering and chemical sector had more significant coefficients, but most of these were captured by the contemporaneous coefficient. Nevertheless, the results indicated that UK stock returns were more negatively influenced by changes in interest rates, since 34% of the firms had significant interest rate coefficients whereas just 28.3% of the firms exhibited significant exchange rate exposure coefficients. The result for the portfolio analysis was quite similar as interest rates also had a stronger influence on portfolio returns than exchange rates, which was found to be only significant for the electrical sector. But following the detection of autocorrelation and ARCH effects in the residuals of the estimated OLS model, Joseph (2002) further extended the portfolio analysis using the EGARCH and EGARCH-M models. The results and inferences were somewhat similar to that reported from the OLS model. But he found that at the portfolio level, positive and negative news seemed to have similar effects on the volatility of stock prices.

Joseph (2003b) examined the impact of movements in interest rate and exchange rate on the value of US Financial Institutions' stock. The US dollar trade weighted index was used as the exchange rate measure while the 3 month Treasury bill was used as the interest rate measure. Additionally, the analysis was based on the OLS, GARCH and GARCH-M models. The result from the OLS suggested that the impact of foreign exchange exposure was weak, whereas most of the interest rate coefficients were negative and significant. The results from the GARCH and GARCH-M models were also similar; however there was a slight increase in the incidence of significant exchange rate exposure coefficients. Besides, the risk return parameter of the GARCH-M model was statistically insignificant and consequently reverted back to a standard GARCH model.

Ryan and Worthington (2004) examined the interest rate risk and exchange rate risk of Australian Commercial Banks with the AR-GARCH-M model during the period 1996 to 2001. They found that banks' returns were only affected by the short-term and medium-term interest rate but not influenced by the long-term interest rate and the trade weighted exchange rate. Their findings also indicated that the volatility returns parameter was negative and significant, indicative of higher risk, lower expected returns. More so, the persistence of volatility was found to be very high and also decayed at a very slow pace. Joseph and Vezos (2006) investigated the exchange rate and interest rate exposure (3 month Treasury bill) of 50 US Banks and their constituent portfolios, in the period 1990 to 2001, using the OLS and EGARCH estimation methods. The results showed that 30% of the individual banks and 2 out of the 3 portfolios exhibited significant exchange rate exposure coefficients for the OLS model, which were mainly positive. However, the result for interest rate exposure was much weaker since only 8% of the banks had significant exposure coefficients, which were comprised of positive and negative signs. They highlight that the weak result from the OLS may be due to its inability to capture the time varying properties of the series. Subsequently, from the EGARCH model, 40% of the firms had significant exchange rate exposure coefficients but the result for interest rate exposure was similar to that of the OLS. Additionally, they found evidence that an increase in interest rate and exchange rate risk increased the riskiness of the firms' returns and consequentially, induced leverage effects. Leverage effect entailed that lower stock price reduced the value of equity in relation to corporate debt. Therefore a sharp decline in the price of the stock tends to increase corporate leverage, and the risk of holding the stock. They also found that persistence of volatility was very high, which could have been exacerbated by the use of the daily data.

Vardar *et al.* (2008) examined exchange rate and interest rate risk of the Financial, Industrial, Service and Technology sector indices of the Istanbul stock exchange, during the period 2001 to 2008, using a AR(1)-GARCH (1,1) framework. Their results indicated that all the sectors were significantly negatively affected by the interest rate (2-year Turkish Government bond), while for the exposure to exchange rate risk (US$ per local currency), only the services sector had a significant coefficient which was positive. Their results also indicated that movements in exchange rate and interest rate increased the persistence of volatility of sector indices.

2.4 Determinants of exchange rate and interest rate exposure

Optimal hedging theories postulate that the extent to which a firm or industry is exposed to financial risks such as exchange rate risks, interests rate risks and commodity prices risks, sometimes influences the intensity of hedging instruments it adopts. But data on firms' hedging activities are not easily accessible and neither are they divulged in much detail.

Allayannis and Ofek (1996, 2001) examined the correlation between exposure and the use of foreign currency derivatives. They identified that exposures were negatively correlated with the use of currency derivatives. Therefore, they posit that exchange rate exposure was reduced when firms used hedging instruments. This finding was supported in studies by Choi and Elyasiani (1997), Nydahl (1999), and Choi and Kim (2003) but conflicted with that of Jong *et al.* (2006) who found that off-balance sheet hedging to be positive, but then insignificant. They justified the results from their study on the premise that firms faced with economic exposure rarely opted to eliminate the risk completely. Again this view was supported by Bodnar *et al.* (2003), who suggested from their study that Dutch and US firms generally utilized derivatives to circumvent exchange risk associated with contractual commitments and transactions which were expected in the short term. However, regarding transactions anticipated to occur in the long term and competitive exposure, these were rarely hedged with derivatives.

Block and Gallagher (1986) used a questionnaire survey in 1985 to investigate the use of interest rate futures and options of Fortune 500 largest US firms. One hundred and ninety three firms (38.6%) responded from which they found that for large firms (over one billion dollars in assets), 23.7% used interest rate futures while for smaller firms only 5.36% did. In order to test the correlation between high debt exposure and use of interest rate futures, they segregated the firms into two: those that had debt ratios less than 50% and those that had debt ratios greater than 50%. But they found no relationship between debt exposure and use of interest rate futures. Then they tested the hypothesis of industry classification, on the precept that firms engaged in traditional commodities operations had more incentive to hedge than those that were not. They found that the t statistic, relating industry classification to use of interest rate futures or options, was statistically insignificant. Additionally, they found from the questionnaires that 25% of the firms engaged in traditional commodities, employed interest rate futures or options, whereas regarding non-traditional commodity users, only 18.6% of these utilised interest rate derivatives. Froot *et al.* (1993) revealed that firms which had higher investment opportunities were more likely to hedge because of the need to reduce the volatility of their cash flows, and consequently reduce the cost of debt issuance, since the level of cash available for investment opportunities is inversely related to the need for external financing. By implication, firms with higher growth opportunities should have lower exposure to changes in exchange rates. Choi and Kim (2003) found that US firms with higher leverage positions, lower liquidity and higher growth opportunities were usually more inclined to hedge and therefore reduce their exposure to exchange rate exposure. El-Masry (2005a) also found that all the variables for foreign operations had a significant negative exposure on the exchange rate indices apart from JP¥/£. Additionally, firms in his study that had a higher percentage of foreign sales and foreign assets were less exposed to fluctuations in exchange rates. Then regarding proxies for growth opportunity, which were market to book value ratio and R&D to total sales, these had a significant positive correlation to the firms' exchange rate exposure. This finding was consistent with that of Nance *et al.* (1993) and Froot *et al.* (1993) who point out that firms with high growth opportunities, are more likely to require funds, especially when they need to take advantage of good investment opportunities. More so, since cost of external financing might be high because of inadequate collateral or other credit risk factors, hedging strategies may be utilised to reduce exchange rate volatility on firm value and consequently improve access to external finance. Furthermore in El-Masry (2006a), a significant negative correlation for the trade weighted real exchange rate and long term debt was found, while the US$/£ exchange rate exhibited a significant positive association. Although weak, the result of a significant negative coefficient, presupposes that firms which have a higher debt ratio are more prone to expected costs of bankruptcy, more inclined to hedge and therefore have less exposure to changes in exchange rate. Then for dividend payout ratio, a negative relationship with exchange rate exposure was found while a positive relationship was determined for quick ratio. This signified that firms with lower dividend ratio and higher quick ratio were less likely to hedge and may be more susceptible to exchange exposure. However, Chow and Chen's (1998) findings differed since they found that dividend payout had a positive impact on exchange rate exposure. Shu and Chen (2003) examined credit rating as a possible determinant of derivative use for 300 Taiwanese firms between the period 1997 and 1999. They found that firms with better credit rating (obtained from the Taiwan Credit rating Index) and lower debt ratio are more likely to use derivatives. Further analysis also revealed that derivative users had a higher level of leverage than the non-users, which substantiated the financial distress hypothesis. They further explored the determinants of derivative use according to industry type. They found that although most firms in the electronic industry used derivatives, firms in the automobile industry had a higher percentage of usage. Additionally, they pointed out that use of derivatives was related to foreign trade. Then using the equity market to book ratio as a proxy for growth, their findings supported the growth hypothesis as they found that derivative users had a higher market to book value than non-users.

Smith and Stulz (1985) and Mayers and Smith (1987) demonstrated that if financial distress is costly, hedging lowers the probability of incurring financial distress costs, by reducing cash flow variability and thereby increasing the firm's value. He and Ng (1998) examined a sample of 171 Japanese firms. They found that highly leveraged firms, smaller firms and those with weak liquidity were more likely to exhibit lower exposure to fluctuating exchange rates. Howton and Perfect (1998) explored the determinants for the use of currency and interest rate derivatives by US firms listed on the Fortune 500 and S&P 500 hereafter FSP for the year 1994. They use currency derivatives as the dependent variable to test for the determinants of exchange risk exposure and the use interest rate derivatives to test for the determinants of interest rate exposure. Their results revealed that liquidity was inversely related to total derivative use. Also, firms' use of currency derivatives had a direct relationship with cash flows but not for leverage. Furthermore, they found that more liquid firms were less motivated to use derivatives. Additionally, it was observed that firms in the sample used derivatives to reduce expected taxes (tax dummy variable), avoid the cost of financial distress (interest cover and leverage), eliminate the direct cost of financial distress (ratio of tangible assets to total assets) and eradicate the external cost of financing (ratio of cash flows to total assets and ratio of R&D to sales). They infer that if the operations of a firm are capital intensive, and often financed by debt, a continued increase in interest rates, may lead to a higher cost of new debt, which will negatively affect the earnings of the firm and its ability to service its debts. This assertion is supported by Joehnk and Nielsen (1976) as they suggest that firms with high leverage exhibited a higher cost of financial distress and were therefore more susceptible to interest rate risk. Furthermore, Loudon (2004) posit that the cost of distress could be considerably higher for highly leveraged industries, especially since higher interest rates increase the expected costs of distress. Therefore if debt affects the riskiness of the share returns, then there would be increased variability in returns. It should therefore follow that if a firm is profitable, or has a high interest cover, then the pecking order theory might be better applicable.

Muller and Verschoor (2006b) examined the determinants of exchange exposure to the Japanese yen, UK pound and the US dollar for 817 European multinational firms. The results revealed significant effects consistent with optimal hedging theories for financial distress, dividend policy and size on the US dollar exposure coefficient as they found that the lower the dividend payout ratio or the bigger the European multinational firm, the lower the relative cost of financial distress, then the less the motivation to hedge and the higher the exchange rate exposure. However the size effect on exposure to the Japanese yen and UK pound was weak and only positively significant at the 52 week horizon. The result for dividend payout was similar to that of the US dollar as a significant negative coefficient for dividend payout was also found. Regarding the quick ratio, leverage and book value per share, they found weaker significance. Although all the leverage coefficients were negative, they were insignificant. Besides, using leverage to proxy for the possibility of encountering financial distress, Dolde (1995), Berkman and Bradbury (1996), Gay and Nam (1998), Haushalter, (2000) and Graham and Rogers (2002) found a positive relationship between hedging and leverage. However, Nance *et al.* (1993), Geczy *et al.* (1997), and Allayannis and Ofek (2001) could not find any support for this hypothesis.

Judge (2006a) explored why and how UK firms hedged. His sample comprised of the largest 441 non-financial firms, based on market capitalisation, that were susceptible to exchange rate and interest rate risk. The results indicated that firms with higher gearing and lower interest cover, these have a greater probability of financial distress. Consequently, they have more incentives to hedge. However Clark and Judge (2008) also examined the determinants of foreign currency hedging of 366 UK non-financial firms, but explained that leverage may not be an indication of the firm's financial health. He pointed out that for firms with foreign debt, leverage may not be indicative of financial distress. Furthermore, he posits that if firms which use foreign currency debts, but not foreign currency derivatives to hedge, were classified as non-hedgers, the distinction between the 2 groups as regards financial distress might be distorted. Then if foreign currency debt users dominated the sample of foreign currency derivative users, or if foreign currency debt users dominated a sample of non users, then the results might be biased also. Subsequently, he divides the sample of firms which utilised foreign hedging into 2 groups namely: firms that use foreign currency derivatives and those that used foreign currency debt alone or in conjunction with foreign currency derivatives. He found that leverage was only statistically significant and positive for the sample in which foreign currency debt had been included. He surmised that the inclusion of foreign currency debt in a sample of foreign currency hedgers had the probability of influencing the results regarding leverage.

Adedeji and Baker (2002) argued that the plausible reason why most studies found a significant relationship between foreign exchange risk, proxied by the ratio of overseas sales to total sales and use of currency derivatives and not for interest rate cover and financial leverage, was because currency derivatives had always been used to measure the dependent variable. Their study, which used a mixed methodology of survey questionnaire and accounting data from the DataStream database, examined the influence of interest cover and financial leverage on 140 UK firms. Their dependent variable was a dummy variable which measured the use or non-usage of interest rate derivatives. Using the interest cover and financial leverage ratios, they found that both interest cover and financial leverage had a positive influence on derivative use. The result for interest cover was somewhat similar to that of Schiozer and Saito (2009) for Latin American non-financial firms as they found that firms with high interest cover were more likely to use derivatives, but in this instance, currency derivatives.

Bartram *et al.* (2004) investigated the motivation behind the use of financial derivatives for 7,263 firms from 48 countries including the UK between 2000 and 2001. The results for the UK showed a significant negative relationship between use of foreign exchange rate derivatives and interest cover, quick ratio and market to book value. On the other hand, significant positive coefficients were found between foreign exchange rate derivatives usage and size, dividend payout and foreign exchange exposure (foreign assets, foreign income and foreign sales). Although leverage also had a positive coefficient, this was statistically insignificant. Furthermore, they also examined the motivation for interest rate derivative use. They found that leverage, size, dividend payout were significantly negatively related to the usage of interest rate derivatives. Conversely for interest coverage and market to book value, significant negative coefficients were found. Although quick ratio had a negative coefficient, this was insignificant.

Adedeji and Baker (2002) also investigated other determinants that influenced the use of interest rate derivatives, such as economies of scale represented by size (log of firm value in £ millions) and the existence of other derivatives. They found that size had a positive influence on the use of interest rate derivative. Then another factor, managerial risk aversion, measured as the proportion of ordinary shares owned by its directors, was found to have a negative influence on derivative use. Nevertheless, studies by Smith and Stulz (1985) and Tufano (1996) found evidence that the proportion of shares held by managers or directors may have a positive effect on the use of derivatives. They argued that share acquisition may motivate managers to take risks and subsequently hedge those risks with derivatives. However, Berkman and Bradbury (1996) and Geczy *et al.* (1997) disagree with the share acquisition motive and they could not find a significant effect for managerial risk. Adedeji and Baker (2002) further compared their findings to that of Geczy et al. (1997). Their objective to conduct a comparative analysis was based on the premise that factors which motivated the use of currency derivatives were different from the factors which prompted the use of interest rate derivatives. The results indicated that the use of currency derivatives was influenced by foreign exchange risk, tax rate, institutional shareholding and economies of scale, while factors that motivated the use of interest rate derivatives included risk of financial distress (high interest cover or high leverage), economies of scale and director's share holding. Jesswein *et al.* (1995) examined the exchange risk management of 173 Fortune 500 firms through the use of questionnaires. They segregated their sample according to industry type and found that after the finance, insurance and real estate industries, the manufacturing industry had the next highest percentage of derivative use. This was followed by the mining and construction industry, then the wholesale and retail trade industry. However the transportation and utilities industry and the other services industry, had the lowest average usage. Using total amount of corporate assets as a proxy for size, they found an insignificant relationship. For degree of internationalisation, they used foreign assets, foreign sales and foreign income as proxies and found a significant positive relationship with derivative use. Finally a cross examination of all the determinants showed that the degree of internationalisation was the most significant. Likewise, Judge (2006b) found that foreign sales had a significant and positive relationship with the decision to hedge while Faseruk and Mishra (2009) indicated that Canadian non-financial firms, with higher levels of US sales, were more likely to use derivatives, since they showed evidence of a higher level of exposure to the US$. Nguyen and Faff (2003) investigated the factors that influenced exchange rate exposure to the Australian trade weighted index. They found that the degree of international operations had no significant impact on exchange rate exposure for 144 non-financial Australian firms. Similarly, Kim *et al.* (2006) examined the determinants of exchange rate exposure of 424 US firms. Using the ratio of foreign sales and log of total assets as proxies for foreign activity and size respectively, they found no support for the conjecture that these variables affected exposure to exchange rate risk. Al-Shboul and Alison (2009) studied the determinants of exchange rate exposure of 62 Australian firms. They also found no support for the supposition that foreign operations had any influence on exchange rate exposure. However, they did find that firm size was positively associated with exposure, suggesting that the larger the firm, the higher the probability that it would be exposed to foreign exchange rate risk. This finding was also congruent with that of Chow and Chen (1998) and Nguyen and Faff (2003). In contrast, Hagelin and Pramborg (2004) found for a sample of Swedish firms, a significant negative coefficient for size, suggesting that larger firms had lower foreign exchange rate exposures than smaller firms. They further explained that larger firms were likely to be multinational corporations (MNCs) with production and sales in a variety of currencies, which could reduce foreign exchange rate exposure and also facilitate the use of sophisticated operational hedges, which are likely to be unavailable or too expensive for the smaller firms.

Nguyen and Faff (2006) investigated the determinants of exchange rate exposure for the Australian industrial sector in the period 1992 to 2000. They found no evidence that foreign sales and liquidity influenced exchange rate exposure. However they found a significant negative coefficient for size. But when the industry was disaggregated into firms, they found a significant negative coefficient for foreign sales while size became statistically insignificant. Additionally, utilising foreign sales to total sales as a proxy for internationalisation, Jorion (1990), Harris *et al.* (1991), Choi and Prasad (1995), Miller and Reuer (1998), Allayannis and Ofek (2001) and Williamson (2001) posit that the degree of a firm's foreign exchange exposure should be influenced by the firm's level of foreign operations. Then, Dominguez and Tesar (2001) pointed out that a firm's level of exposure was highly correlated to its size and the degree of its foreign operations such as foreign assets, foreign sales and any other international activity.

Malllin *et al.* (2001) conducted a postal survey to examine derivative usage for 231 (response rate of 28.9%) non-financial firms in the UK. They found a significant positive relationship for company size, measured by turnover and derivative usage. However, for industry type, they found that the general manufacturing sector had the highest percentage of derivatives use followed by consumer goods, services and utilities, which all had the same proportion of use. Nevertheless, there was no significant relationship between industry type and derivative usage. Bailly *et al.* (2003) also investigated through questionnaires in 1998, the derivative use of 234 (37.2% response rate) UK corporate firms listed on the London Stock Exchange. These comprised of the FTSE actuaries (FTSE100, FTSE250, FTSE350 and FTSE Small Cap). Their findings supported that of Block and Gallagher (1986) as they found a significant positive relationship between size (firm's market value) and the use of interest rate derivatives. However they did not find any correlation between firm size and use of foreign exchange derivative. For their industry analysis, Bailly *et al.* (2003) found that 90% of firms in the manufacturing or primary product industry, utilized currency derivatives, while for the Service industry, the percentage was obviously rather smaller at 75%. On the other hand for interest rates, usage across the industries was quite similar. Generally, their survey indicated that foreign exchange exposure was the most managed followed by interest rate exposure. This particular result on "most managed exposure" although concurs with survey studies by Mallin *et al.* (2001) and El-Masry (2006b), but is contradictory to that of Grant and Marshall (1997) whose survey study of the top 250 large UK companies (FTSE250) in 1994 found that the proportion of respondents (finance directors/treasurers) who used interest rate derivatives was more than those who used currency derivatives.

Davies *et al.* (2006) examined the determinants of exchange risk exposure of Norwegian exporters in 2001. Their sample comprised of 81 Norwegian firms classified as exporters on the Kompass Norge AS and listed on the Oslo stock exchange. They found that larger firms listed on the main Oslo stock exchange hedged more extensively than the smaller companies listed on the small cap index. However, using gearing and interest cover as proxies for financial distress, they found no support for the hypothesis that hedging reduced the cost of financial distress. In addition, using book value of total current assets as a proxy for costs of external funding, they did not find any significant evidence to support the hypothesis that hedging avoided the need of costly external financing, but their findings substantiated the firm value maximisation hypothesis for under investment and risk aversion.

Bodnar and Gebhardt (1999) conduct a comparative study on US and German non-financial firms. For the US, the questionnaire is based on the 1995 Wharton survey of non-financial firms. A total of 2000 questionnaires were sent out but only 350 responses were received. Then again for Germany, 368 large and quoted firms were sent the questionnaire, but only 126 responses were received. They found that the determinants for industries use of derivatives were very similar for both countries. Also the percentage of firms using derivatives in both countries increased with firm size. But on the whole, the proportion of German companies using derivatives was significantly more than that of US companies. They pointed out that a probable reason for this is that international operations make up for a larger proportion of the activities of German firms in comparison to US firms, which have the benefit of a much larger single currency domestic market. Secondly, regarding the principle that Germany is a smaller and a more open economy than the US, therefore it follows that German firms, may be more prone to financial price risks, especially those relating to exchange rates.

Chiang and Lin (2006) investigated the determinants of exchange rate exposure for Taiwanese non-financial firms during the period 1998 to 2002. They found a significant negative coefficient for size indicating that the greater the size, the lower the exposure and a positive significant coefficient for the foreign sale to total sales ratio. Booth and Rotenberg (1990) used foreign assets and foreign debt ratios in addition to the foreign sales to determine the sensitivity of Canadian stocks to changes in the US dollar. They found that firms with a higher proportion of foreign debt had more negative foreign exchange rate exposure while firms with higher foreign sales had more positive exchange rate exposure.

Shu and Chen (2003) argue that firm size might be positively or negatively related to the firm's hedging activities. Smaller firms with higher cost of financial distress may be more inclined to use derivatives than larger firms while larger firms with economies of scale and expertise on hedging techniques may hedge more than smaller firms. Jong *et al.* (2006) explained that firm size was not a direct cause of exchange rate exposure but a factor could determine the extent of exposure. They pointed out that larger firms, which were usually multinationals, are more involved with the global economy and would usually face more exposure than smaller firms, which are normally domesticated with regards to their operations. Similarly, Choi and Prasad (1995) and Allayanis and Ofek (2001) also found that firm size had a positive effect on exchange rate exposure.

Furthermore, Pramborg (2005) investigated the determinants of exchange rate exposure for Swedish and Korean non-financial firms. He found a significant positive coefficient for size in the study. El-Masry (2005b) investigated the determinants of exchange rate exposure of UK non-financial firms to the ECU/£, US$/£ and JP¥/£. He found that firm size was negative for all the currencies, except the JP¥/£. This implied that larger firms managed their currency risk more efficiently than smaller firms. This result was supported by Nance *et al.* (1993) and Chow *et al.* (1997a,b) who also pointed out that larger firms were more likely to be more proficient with their hedging activities. But Muller and Verschoor (2006b) explained that if smaller firms are more susceptible to financial distress, because they have higher bankruptcy costs, then they should have more incentives to hedge than large firms.

Nance *et al.* (1993) used a dummy variable to represent progressive tax. They argue that firms whose expected incomes will fall within the progressive tax range are possibly more motivated to use derivatives. Therefore progressive tax has a positive correlation with derivative use. Berkman and Bradbury (1996) also used a dummy for tax loss. Their reasoning was that firms faced with tax losses are motivated to use derivatives so as to protect the amount of the tax loss carried forward and reduce their expected taxes. In which case, the tax loss dummy should also have a positive relationship with derivative use.

Shu and Chen (2003) investigated the tax and derivative use hypothesis proposed by Smith and Stulz (1985) which advocated that a firm with an inclination for higher tax preference items such as tax loss carry forwards and investment will use less hedging instruments. Also, they examined the supposition of Froot *et al.* (1993) which implied that firms with higher tax preferences would reduce their use of hedging instruments. They found a negative relationship between derivative use and tax loss, and a positive relationship for tax investment credits and derivative use. Allayannis and Weston (2001) investigate a sample of 720 large US non-financial firms between 1990 and 1995 to test the hypothesis that firms which use foreign currency derivative to mitigate their exchange exposure, have a higher market value. They find that the use of foreign currency derivatives is positively correlated to firms' market value which is represented by Tobin's Q. Also on the average, firms that use currency derivatives to hedge against their exchange risk have a higher value than firms which do not hedge their exchange risks. Eilidh and Marshall (2001) indicated that for a majority of UK firms, the introduction of the euro would bring about a reduction in their currency exposure. They argued that better still, for member firms of the euro-zone, and also their major trading partners, they would only need to monitor and manage the euro. Invariably for these euro-zone firms, there will be little or no exposure to exchange risks, therefore culminating to reduced use of hedging instruments. To support these arguments, they conduct a questionnaire survey on 100 large firms and MNC's from different industries in the UK, of which just 49 responded. Their results show that although a large number of MNC's favoured the euro, one in four were neither for nor against the euro. In the industry sector, the engineering industry and three quarters of the chemical industry were indifferent to the implications of the introduction of the euro. Furthermore, the engineering, construction, building and service industries (55% in all) indicated that the euro had decreased their exposure whereas industries in the oil and gas, paper and printing industries indicated that the euro exerted no difference on their exchange risk, while a few MNC's believed that the euro increased their currency exposure. Despite these results, only 39% of the 55% who indicated that the euro would reduce their exposure believed that the currency would reduce their use of hedging strategies. However, a majority of the other MNC's acknowledged that they would not review their risk management policies. Capstaff *et al.* (2007) also supported the argument that the introduction of the euro was expected to change the exchange exposure of firms in the euro zone. They investigated the impact of the introduction of the euro on the derivative use of French firms for the period 1996 and 2000. Their results indicated that after the introduction of the euro, 81% of the firms in their sample decreased their use of foreign exchange derivatives. However, they also found that although the euro generally reduced exchange exposure, some firms still made significant use derivatives. They compared the pre-euro and post euro level of derivative usage and found that more resources per unit of exposure were allocated to hedging in the post euro period. Impliedly, French firms hedged more when the euro was introduced. They argued that the outcome of this result might be the likelihood that French firms hedged their exposure outside the euro zone (non-euro trade). Secondly, they proposed that the uncertainty of the euro against other major currencies might motivate financial managers to be more cautious. Other factors highlighted were management's attitude towards risk and the probability that foreign exchange derivatives were being used for speculative purposes rather than for hedging. Also, Nguyen *et al.* (2007) examined the hedging motives of a sample of 99 French firms using the exchange rate exposure coefficients to the French Trade weighted index as the dependent variable. In the period before the euro, and the period after the euro, they found that the ratio of foreign sales was not a determinant of exchange rate exposure. Furthermore, they found no support for growth options proxied by market value to book value, influenced exchange rate exposure.

2.5 Summary of review

The literature explored the relationship between fluctuating foreign exchange and interest rates on firm and industry returns. In addition a review on the determinants of both exchange rate and interest rate was also examined. Firstly, it was observed that the US, which is one of the least open economies, constitutes a large proportion of empirical studies investigating these relationships (Bodnar and Gentry, 1993; Friberg and Nydahl, 1999; He and Ng, 1998; Hagelin and Pramborg, 2004; and Jong *et al.* 2006). Even then, a lot of contentious issues were discovered from the empirical studies, making their test results somewhat inconclusive. Take for instance the measurement for the exchange rate variable; trade weighted exchange rate versus bilateral exchange rate, lagged versus contemporaneous. Aggarwal (1981) finds that the exchange rate exposure coefficient is stronger for contemporaneous than lagged exchange rates, Bartov and Bodnar (1994) finds significant exposure only for the lagged exchange rates. Al-Diab *et al.* (1994) reports no significant exposure towards contemporaneous exchange rates. Doidge *et al.* (2006) indicates in his study that the lagged exchange exposure was insignificant but El-Masry (2006a) detects significant exposure for both the contemporaneous and lagged exchange rates. Although the trade weighted index eradicates the problem of multicollinearity, studies by Hagelin and Pramborg (2004) and Jong *et al.* (2006) have pointed out that it was not ideal for measuring exchange exposure because it might not capture the exposure of the firm. However even when individual currencies had been are used, studies by Friberg and Nydahl (1999), Seiyeol and Hyonsok (2004) and Jong *et al.* 2006, have shown that the trade weighted currency outperformed the individual currencies.

For the interest rate index, most studies have used treasury bills as a proxy for the short term interest rate and government bonds for the long term interest rates (Lloyd and Shick, 1977; Chance and Lane, 1980; Joehnk and Petty, 1980; Sweeney and Warga, 1986; Bae, 1990; Prasad and Rajan, 1995; Dinenis and Staikouras, 1998; Bartram, 2002; Joseph, 2002; Loudon, 2004; and Al-Abadi and Sabbagh, 2006). However most of these studies have concentrated on financial firms. Then in the very few instances that short-term and long-term interest rate exposure had been examined jointly, the long-term interest rate index had been shown to be more significant than the short-term interest rate index. Besides, even for the few studies such as Sweeney and Warga (1986), Ceglowski (1989), Prasad and Rajan (1995), Joseph (2002) and Loudon (2004), that have examined interest rate risk of non-financial firms and industries, either to the short-term or long-term interest rate index, they have reported different exposure coefficients for the interest rate measures.

On the determinants of exposure, factors contributing to the degree of internationalisation, namely foreign sales (exports), foreign assets, foreign debt and diversification were considered among the most important sources of exchange rate exposure. Although some studies have found significant positive coefficients for firms, regarding measures of internationalisation, others have also found evidence of negative coefficients [see Booth and Rotenberg (1990), Jorion (1990), Harris *et al.* (1991), Choi and Prasad (1995), Jesswein *et al.* (1995), Miller and Reuer (1998), Allayannis and

Ofek (2001), Dominguez and Tesar, (2001), Williamson (2001), Bartram (2002), Chiang and Lin (2005) and El-Masry (2005)].

Furthermore, some studies (Jesswein *et al.*, 1995; Bailly *et al.*, 2003; and Shu and Chen, 2003) have suggested that industry sector is an important factor in the use of derivatives, but Mallin *et al.* (2001) indicated that business sector was not a significant factor for derivative usage, while Haugen *et al.* (1978), Block and Gallagher (1986) and Sweeney and Warga (1986) also found that industry sector was not significant for interest rate exposure either. However for industry competition, the results were somewhat more conclusive, as studies by Miller and Reuer (1998), Ceglowski (1989), Williamson (2001), Krishmanoorthy (2001), Marston (2001), Bodnar *et al.* (2003) and Bartram *et al.* (2005) all pointed out that industry structure was a vital determinant for exchange exposure. However, 6 of these 7 studies have mainly focused on the US. Regarding firm size, Bailly *et al.* (2003), Shu and Chen (2003), and Jong *et al.* (2006) posit that larger firms are more exposed than smaller firms (positive exposure). However since larger firms have more resources than smaller firms, they are better able to manage the exposure and therefore should exhibit lower (negative) exchange rate or interest rate exposure as indicated by El-Masry (2005) and Chiang and Lin (2006) respectively, to mention a few. Other determining factors, such as leverage, managerial risk aversion, growth opportunities, dividend payout, liquidity and the introduction of the euro, were investigated for both exchange rates and interest rates, and as expected different results have been reported. In all, the exposures to exchange rates and interest rates have been different at both the firm and industry level, in most cases.

A number of studies have examined empirically the exchange rate exposure of UK non-financial firms and industries. These include Donnelly and Sheehy (1996), Doidge *et al.*

(2006), Dominguez and Tesar (2006) and El-Masry (2006a). Then for interest rate exposure, this has been investigated by Madura and Zarruk (1995), Dinenis and Staikouras (1998) and Oertmann *et al.* (2000). Then in some instances, exchange rate and interest rate exposure of UK non-financial firms and industries has been simultaneously examined in Prasad and Rajan (1995), Rees and Unni (2005) and Hyde (2006). However, these UK studies on interest rate risk have only been on the exposure to the short-term interest rate (1 month and 3 month Treasury bill) while exposure to the long-term interest rate (10 year Government bond) has not been explored. Additionally, exchange rate risk has mainly been on those arising from fluctuations in the trade weighted index, US$/£, JP¥/£ and ECU/£ while exposure to the Euro/£ has been ignored and subsequently received no consideration in literature. Nevertheless, all these studies have used the traditional OLS model or other functional linear methodology which is incapable of capturing the time varying properties characteristic of financial time series data. Apparently Joseph (2002) is the only known UK study that has utilised a GARCH framework to overcome the limitations inherent with linear models. But this study is found to be limited in scope. Firstly, he uses the OLS model to examine the exchange rate and interest rate exposure of 4 UK non-financial industries namely Chemical, Electrical, Engineering and Pharmaceutical, and their constituent firms. But the analysis using the GARCH models [EGARCH (1,1) and EGARCH (1,1)-M] has only been applied to the portfolio level analysis. Evidently, this investigation by Joseph (2002) is not a complete representation of UK industries and has not been extended to include firm level data, which can potentially mitigate the problem of cancelling effects that is associated with analysis at the industry level.

The introduction of the euro has been considered as an important economic landmark achievement in Europe. Even the UK which has not adopted the euro, is expected to benefit from the monetary union through reduced volatility of exchange rates and reduction of long-term interest rates. Joseph (2002) found that the introduction of the euro, represented by a dummy variable, had no impact on the returns of the 4 UK non-financial portfolios in his study. However, this result might have been unfavourably influenced by the very short duration of the post-euro data in his sample. Besides, Bartram and Karolyi (2006) explored the impact of the introduction of the euro on the exchange rate exposure of non-financial firms from 18 European countries (including the UK), United States and Japan. Their investigation, which entailed the geographical compartmentalisation of the data into euro-area, non-euro area and outside Europe, is seen to be too broad. More so, since the economic climate in these countries varies, the results and inferences made may differ if the investigation were centred on a country by country basis. Furthermore, Korkeamäki (2007) examined the effects of the euro on interest rate sensitivity of 12 EU countries which included the UK. Again the analysis suffered from the problem highlighted previously for Bartram and Karolyi (2006) since this study also used country level stock returns. Besides, this compression of data could lead to loss of information.

Industry concentration has been identified to have an important influence on exchange rate exposure. Bartram and Karolyi (2006) and Dominguez and Tesar (2006) have both used the Herfindahl index to examine this conjecture for UK industries. Bartram and Karolyi (2006) focus on the exposure to the trade weighted index. But the problem associated with data compression still holds for this analysis as well. Dominguez and Tesar (2006) examined the influence of industry concentration on UK industry level exposure to the US$/£. Although the UK does have a significant level of trade with the US, trade with Japan and the euro area is equally very important. Therefore an analysis using bilateral exchange rates ECU/£, Euro/£, JP¥/£ and even the trade weighted index which could provide additional evidence on the relationship between industry concentration and exchange rate exposure has been ignored. Conversely, the influence of industry concentration on interest rate exposure of UK non-financial firms and industries, and even non-financial firms and industries in other countries, is yet to be examined. The determinants of exchange rate exposure of UK non-financial firms has been investigated by regressing the estimated exchange rate exposure coefficient on firm specific factors such as size, degree of internationalisation, liquidity e.tc in studies by El-Masry (2004 and 2005a). Even so, this methodology has not been applied to the interest rate exposure of UK non-financial firms and industries.

Therefore, evidence from existing literature indicates that:

1. This is the first study to investigate jointly the impact of exchange and interest rate exposure on UK firms and industries since the introduction of the Euro. Furthermore, this is the first comprehensive research to examine exchange rate and interest rate exposure using a GARCH methodology, and also providing a comparative analysis of the results with results obtained from the OLS model.

2. The importance of industry competition has been identified, but yet needs to be more extensively explored using the trade weighted index, and the currencies of the major trading partners. Firms in less competitive industries are expected to have lower exchange rate exposure coefficients because of pass-through. Again, the analysis needs to be extended to include the influence of interest rate exposure on industry competition.

3. Furthermore, the risk/return relationship between stock returns and volatility needs to be re-examined. Also, the presence of asymmetric effects of volatility, volatility clustering and persistence of volatility on the returns of UK firms and industries should be explored further.

4. Finally, a more comprehensive list of factors that influence exchange rate and interest rate exposure is needed. Besides, the determinants of exchange rate exposure should be contrasted against the determinants of interest rate exposure, to identify the inherent similarities and differences. Furthermore, there is a need to investigate whether the factors, that determine exposure to exchange rate and interest rate risk, are the same in the period before and after the introduction of the euro.

CHAPTER 3 HYPOTHESES, SOURCES OF DATA AND RESEARCH METHODOLOGY

3.1 Introduction

This chapter begins by pointing out the research questions that are to be explored in the study. It also provides an explanation of the hypotheses that are to be examined. The sources of the data used and the sampling processes undertaken to obtain the final data set are described. Furthermore, the chapter provides an overview of all the dependent and independent variables, with an emphasis on the justification for their use. The methodology that has been adopted to test the series of study hypotheses is also described. In addition, the preference for the specified models used for the empirical analysis is methodically substantiated with relevant literature. Subsequently in Section 3.2, the research questions are explained. Then in Section 3.3, the research hypotheses are presented. Next in Section 3.4, sources of data and methods used in the sample selection process are described. In Section 3.5, all the dependent and independent variables are explained and also the basis of their measurement is described. Furthermore, Section 3.6 explains industry competitive structure and the method applied in computing the Herfindahl Index for UK industries. Then Section 3.7 describes the empirical methodology adopted to resolve the issues pertaining to the hypotheses while Section 3.8 ends the chapter with the conclusion.

3.2 Research Questions

The evidence from the review of literature indicated that studies on exchange rate exposure, though few, have been mainly on non-financial firms or industries. Studies that have examined the exposure to interest rates have generally being centred on financial firms and industries. Then, even for studies that have examined interest rate risk, the matter of relative importance, i.e. choice of short-term or long-term interest rate factor, is still unresolved. Nevertheless, little attention has been accorded to empirical research on exchange rate and interest rate risk of the non-financial firm, even though literature expressly suggests that exposure to these risks are the mostly managed by non-financial firms. Furthermore, it has been anticipated that the introduction of the euro will have led to a reduction in exchange rate exposure and interest rate exposure, especially for euro area firms and firms outside the euro area, but with significant trade within the euro area. Since the composition of euro area trade is a little over half of total UK trade, it suffices to imply that most UK firms and industries will experience a significant reduction in their exposure, especially that pertaining to exchange rate, and probably interest rate exposure. More so, since trade with Japan and US is also substantial, resources that would have otherwise being used to manage several European currencies can be channelled towards managing these non-euro currencies, more efficiently. Therefore the introduction of the euro may also indirectly lead to a reduction in exposure to changes in the US$/£ and JP¥/£ exchange rates. It was also observed from literature that the degree of foreign activity is usually associated with exchange rate exposure, whereas for interest rate exposure, liquidity and leverage seem to be more significant. However, evidence to support these assumptions has remained inconclusive. Therefore, in light of the above themes, the key questions of this thesis are:

1. Are the returns of UK non-financial firms and industries susceptible to movements in exchange rates and interest rates? Is exposure to the short-term interest rate similar to exposure to the long-term interest rate?

2. Has the introduction of the Euro influenced the susceptibility of stock returns to exchange rate and interest rate exposure?

3. What firm-specific factors are responsible for exchange rate and interest rate exposure? And are these factors comparable?

3.3 Research Hypotheses

The main hypothesis of this study revolves around the influence of movements in exchange rates and interest rates on the returns of UK non-financial firms and industries.

Hypothesis 1: **Exchange rate exposure is more highly managed and therefore less for UK firms and industries than exposure arising from interest rate.**

Exchange rate exposure and interest rate exposure have been identified to be of particular importance for UK firms as various studies (Grant and Marshall, 1997; Mallin *et al.*, 2001; Bailly *et al.*, 2003; and El-Masry, 2006b) have all found that foreign exchange risks and interest rate risks are the most managed financial risks. However, on average, foreign exchange risk was more managed than interest rate risk. Impliedly, UK non-financial firms and industries may be more concerned about the impact of fluctuating exchange rates on firm value than the impact of movements in interest rates. Consequently, the incidence of exposure to exchange rate may be lower than that of exposure to interest rate. Nevertheless, empirical studies on the exchange rate and interest rate exposure of UK non-financial firms and industries have been limited. This hypothesis is tested in Chapter 4 (Industry level) and Chapter 5 (Firm level) using the actual and unexpected contemporaneous changes in the foreign exchange rates and interest rates. Then subsequently, lagged changes in the foreign exchange rates and interest rates are also used to test the importance of the mispricing hypothesis.

Hypothesis 2: **The introduction of the euro has led to a reduction in exchange rate and interest rate exposure of UK firms and industries**

Although the UK has not adopted the euro, it is expected that it will be of benefit to UK firms, especially those which have significant operations with euro countries, since it is expected to eradicate the complexities involved in managing several European currencies. For instance, Bartram and Karolyi (2003) point out that a common currency for businesses will reduce transaction costs and also reduce the exposure to foreign exchange rate risk. They examine the impact of the introduction of the euro on the foreign exchange rate exposure of non-financial firms from 18 European countries (including the UK), US and Japan. They surmise that the euro led to a decline in the absolute exchange rate exposure of non-financial firms after the introduction of the euro. However, the change in the exposure was highest for firms in the euro area, followed by firms in non-euro Europe and then lowest for firms outside Europe. Furthermore, Eilidh and Marshall (2001) pointed out from their survey study that a minority of UK MNCs indicated that the euro would increase their exchange rate exposure via the supply chain because products that were usually sold in sterling were now being sold in euros. Nevertheless, the euro is still generally favoured by most UK MNCs because it reduces the uncertainty of exchange rate exposure and the cost of managing exchange rate risk. Bartov *et al.* (1996) also examined the change in exchange rate exposure for US multinationals following the change from fixed to floating exchange rates following the breakdown of the Bretton Woods system. The results indicated that the change in exposure was the opposite sign to that in the period before the changeover; however exchange rate risk increased after the breakdown of the Bretton Woods system.

Then regarding interest rates, Bris *et al.* (2006) suggested that before the introduction of the euro, some of the largest European companies were reliant on bank finance. Galati and Tsatsaronis (2003) pointed out that one of the most important effects of the introduction of the Euro has been the boom in the issuance of bonds denominated in the single currency, from borrowers both from and outside the euro area, and this increase in bond issuance corresponded to the introduction of the euro in January 1999. They further asserted that factors such as low inflation and low interest rates may have motivated borrowers to tap into the capital markets. Subsequently, if inflation and interest rates are low, it becomes cheaper for firms to borrow. In addition, Bris *et al.* (2004) and Pagano and Thadden (2004) highlighted that the European corporate bond market was relatively small in the late 1990s, because the dominant source of corporate finance was through debt. But the introduction of the euro has influenced this trait since companies are aware of the prospect that larger pools of investors can be accessed, firms can more readily diversify their liabilities, and banks may face more competition and reduce their susceptibility to credit crunches. Barrett and Turongpun (1999) also explained that the initiated European Monetary Union (EMU), which functions to eradicate intra-European exchange rate risk, also manages euro area interest rates to ensure that they are stable. Besides, Pagano and Thadden (2004) posit that since the introduction of the euro, most European non-financial firms, that would normally raise a considerable proportion of their debt in the capital markets, are drawn to the more liquid European bond market. Moreover, Korkeamäki (2007) finds evidence that EMU countries and EU countries returns, including the UK, commonly showed evidence of a significant negative interest rate exposure, proxied by the 3 month inter-bank interest rate, in the period before the Euro. But after the Euro, none of the countries exhibited significant interest rate exposure coefficients. He explained that the reduction in interest rate risk corresponds to the significant growth in the fixed income markets, also synonymous with the timing of the introduction of the euro. This supposition is also supported by Rajan and Zingales (2003).

Hypothesis 3: **The introduction of the euro has reduced the stock return volatility of UK firms and industries** Bartram and Karolyi (2006) explained that if the fundamental argument for the euro is the reduction of foreign exchange rate risk, then euro area firms and non-euro area firms with considerable sales or assets in the euro area, should experience a significant reduction or significantly lower comparative increase in stock return volatility (See also Bartov *et al.*, 1996). But their results indicated that the volatility of many stock market indices, including the UK increased after the Euro. Furthermore, their results indicated that the pre-euro stock return variance of the firms were similar across the regions (euro area, non-euro Europe and outside Europe). But after the euro, stock return variances were higher. Nevertheless, volatility (statistical variance) was highest outside Europe, followed by non- euro Europe and lowest for the euro area. Morana and Beltratti (2002) also test UK stock returns for the presence of volatility shift after the introduction of the euro. However they results suggested that volatility in the stock market had not declined. Nevertheless, since the UK has substantial trade with the euro area, there is a possibility that some UK firms and industries would experience a reduction in the volatility of their stock returns.

Hypothesis 4: **The portfolio returns of competitive industries are affected more by fluctuations in exchange rates and interest rates than those of concentrated industries** Dominguez and Tesar (2001) assert that industry structure is a significant factor for exchange rate exposure. Faulkender (2005) also suggests that variations in interest rates can have indirect effects on the firm's competitive position by impacting the size of its future cash flows and therefore firm value. This is because for firms in less competitive industries, such as oligopolistic industries, prices can be elevated above the marginal cost. As a result, they are able to absorb fluctuations in exchange rates and interest rates. Bartram *et al.* (2005) also indicated that since suppliers and competitors are influenced by exchange rate and interest rate risk; there is a possibility that they might pass the effect to other participants in the market. This is otherwise known as pass-through. Williamson (2001) further explains that if monopolistic firms can pass on increase in costs to customers, then their exposure to exchange rate may be small to the point of being undetectable. Dominguez and Tesar (2006) posit that if firms in less competitive industries pass on unfavourable exchange rate movements through to prices, then profitability will not be affected. On the other hand, for firms in more competitive industries, it may not be possible to raise prices. Therefore, hypothetically, industries with high pass through should have low exposure, while industries with lower pass-through would be expected to have higher exposures (Bodnar *et al.,* 1998). This notion has been further supported in studies by Ceglowski (1989), Marston (2001) and Bodnar *et al.* (2002). Furthermore, Krishnamoorthy (2001) finds that US firms in oligopolistic industries are less exposed to exchange rate risk than firms in globally competitive industries. But on the contrary, Dominguez and Tesar (2006) and Bartram and Karolyi (2006) found evidence to suggest that firms in less competitive industries were more exposed to exchange rate risks than firms in less competitive industries.

Hypothesis 5: **The factors that determine a firm's exposure to exchange rates are different from the factors that determine its exposure to interest rates.** The extent to which a firm is exposed to exchange rate or interest rate risk can be influenced by its hedging strategy. Some studies, namely, by Booth and Rotenberg (1990), Nydahl (1999), El-Masry (2005), Capstaff *et al.* (2007), Nguyen *et al.* (2007), Clark and Judge (2008) and Al-Shboul and Alison (2009) have identified the extent of foreign activities, such as foreign sales, foreign debt, foreign assets and foreign income as the main determinants of exchange rate exposure. By contrast, regarding interest rate exposure, studies by Howton and Perfect (1998), Haushalter (2000), Adedeji and Baker (2002), Bartram (2002), Muller and Verschoor (2006) and Schiozer and Saito (2009) indicate that interest cover, liquidity and leverage are the more important for interest rate exposure.

3.4 Sources of data and sample selection

The data for this study were obtained from the Thomson Reuters DataStream International Database, hereafter DataStream and the Worldscope Database, hereafter Worldscope. The databases, which are accessible online, contain detailed financial and accounting information for all listed securities on the London Stock Exchange (LSE) as well as for other major global markets. Furthermore, DataStream also has available data on global equity indices, interest rates and exchange rates, which were also required for this study.

Regarding the firm level and industry level data, DataStream uses the Industry Classification Benchmark (ICB), which is an in-depth and comprehensive structure for sector and industry analysis. In addition, ICB facilitates the comparison of companies across 4 levels of classification and national boundaries. The benchmark system assigns firms to a subsector that depicts the nature of the firm's business, as determined by its major source of revenue. In DataStream, these industry classifications are coded INDM2 (12 industries), INDM3 (20 industries), INDM4 (41 industries) and INDM6 (102 industries). In all the INDM categories, 2 industries, designated Unclassified and Unquoted, are considered unusable, and are therefore not considered for inclusion in the final sample. Nevertheless, the numbers of firms in each of the classifications are the same.

Besides, Griffin and Karolyi (1998) and Griffin and Stulz (2001) point out that using broad industrial classifications may result in putting together heterogeneous industries, therefore disaggregated industries should be utilised for industry level studies. Furthermore, Muller and Verschoor (2006b) pointed out that the use of a finer INDM classification will help reveal, in more detail and accuracy, industry specific exchange rate and interest rate exposure. Intuitively, INDM2 and INDM3 are too coarse, and thereby there is a possibility that significant exposures might be masked out in the industry level analysis. Conversely, INDM6 is too disaggregated and may not be within a manageable range (Jayasinghe and Tsui, 2008). Therefore INDM4 was the most ideal for this study. Using the INDM4, 2,837 firms, grouped under 41 industry classifications are found. But 35 firms are listed under unclassified industries while 109 firms are grouped under the unquoted equities. These are then removed from the initial sample set, leaving 2,693 firms grouped into 39 industries. Moreover, only non-financial firms quoted on the LSE are relevant for this study, since financial firms are excluded because they utilise complex risk management strategies for their foreign exchange exposure and interest rate exposure (Bradley and Moles, 2001 and El-Masry, 2006a). Subsequently, 8 financial industries, comprising of 565 firms are identified and taken out of the dataset. This leaves 31 non-financial industries consisting of 2,128 firms.

In addition, a long time span is required to capture accurately the exposure coefficients. Chow *et al.* (1997b) identified time horizon as one of reasons why previous studies have failed to find significant exposure coefficients. They point out that exchange exposure for stock returns mirror the effects of both interest rates and cash flow effects, which counterbalance over short time horizons and are complementary over long time horizons. This inference is supported by Bodnar and Wong (2003) who suggest that regressing stock return models over short time horizons can result to weak conclusions. Additionally, Jong *et al.* (2006) point out that time variation of exposure might be distorted, while Bartram and Karolyi (2006) identify short time horizon as a key limitation that might have influenced the inferences made about exchange risk and the introduction of the euro in their study. More so, since one of the objectives of this study is to determine the impact of the euro on exchange rate and interest rate exposure, it was particularly important to selectively choose a time frame that would adequately represent the period before the euro and the period after the Euro. So, following on Morana and Beltratti (2002), Sfakianakis (2002), Bris *et al.* (2006), Simpson and Dania (2006), Korkeamäki (2007) and Nguyen *et al.* (2007), the period after the euro is chosen to start from January 1, 1999. Then regarding the frequency of the data, the impact of foreign exchange rate and interest rate on stock returns is usually more pronounced with high frequency data (Joseph and Vezos, 2006). But since daily data are noisy (Nydahl,

1999) and usually suffer from the problem of non-synchronous trading (Jong *et al.* 2006), therefore, the preference for weekly data is justified. Moreover, since accounting data are on a yearly basis, annual data will also be required. Subsequently, the weekly (Thursday prices) and annual data sets span the period January 1990 to December 2006, covering the period before and after the introduction of the euro. In order to limit the possibility of survivorship bias, the selection criteria entailed allowing the use and making the most of all the available data. Therefore, we only exclude firms that do not have at least 2 years of consecutive weekly (Thursday prices) and firm specific data before the euro.

From the selection process, 402 firms, from the 31 non-financial industries were chosen for the final sample. Although it is possible that the sample may be subject to survivorship bias, since only about 18.9% of the non-financial firms were finally selected, a trade-off had to be made to avoid a situation whereby the inferences could be distorted due to the inclusion of firms with insufficient data. At the firm level, the value of the firm was measured as the weekly return on the shares. But at the industry level, the weekly return index of firms included in the final sample was used to construct equally weighted stock portfolio returns for each industrial sector. Furthermore, a brief description of other variables, which were obtained from DataStream, is provided in the next section.

3.5 Description of dependent and independent variables used in estimations

3.5.1 Stock return

Solnik (1984) pointed out that the returns on shares are a good indicator of the firm's economic activity and moreover, they are also potentially influenced by the volatility in macro-economic factors, such as interest rates and exchange rates. Akatsuka and Leggate (2001) suggest that the underlying effect of fluctuations in these macroeconomic factors has a significant impact on the firm's performance. They identify return on shares as an ideal measure of firm performance because it encompasses all business activities. Most empirical studies on exchange rate exposure and even interest rate exposure tend to use stock returns as a proxy for the firm performance (Nydahl 1999 and Allayannis and Ofek 2001).

A return index (RI) is available for individual equities and unit trusts. This shows a theoretical growth in the value of a share holding over a specified period. The return index is determined by the DataStream database using:

$$RI_t = RI_{t-1} * \frac{PI_t}{PI_{t-1}} * \left(1 + \frac{DY_t}{100} * \frac{1}{N}\right) \qquad 3.1$$

Where: RI_t = return index on day t, RI_{t-1} = return index on previous day, PI_t = price index on day t, PI_{t-1} = price index on previous day, DY_t = dividend yield % on day t and N = number of working days in the year which is taken to be 260 days.

Subsequently RI_t is estimated using

$$RI_t = RI_{t-1} * \frac{P_t}{P_{t-1}} \qquad 3.2$$

The weekly stock returns are then computed using:

$R_{it} = \ln (RI_t / RI_{t-1})$ 3.3

The use of compounded returns is usually preferred to discrete returns in empirical studies. Ryan and Worthington (2004) explain that continuously compounded returns result to a lower value, with the exception of zero returns. In addition, compounding the returns reduces the effect of outliers and errors inherent with the data. More so, compounded returns are more likely to follow a normal distribution in comparison to discrete returns. This supposition is supported in Strong (1992) and El-Masry (2004) as they posit that logarithmic returns are expected to be normally distributed, and therefore in compliance with standard statistical procedures. Also, Joseph and Vezos (2006) posit that the use of log transformation is intended to induce stationarity into the series.

3.5.2 Industry return

The compounded weekly returns of the 402 firms in our final sample are used to construct equally weighted returns for each industry. This is achieved by averaging the compounded weekly returns of the entire firms in the industry. This process is repeated for all the weeks to cover the total sample period.

3.5.3 Market return

The overall stock market index is measured by the Financial Times All-share Index (FTSE All Share-Index) since it is the main index for stocks quoted on the London Stock Exchange (LSE) in the UK. The weekly value-weighted market index is obtained from DataStream and also covers the period 1990 to 2006. The return on the market is estimated using:

$RM_t = \ln(M_t / M_{t-1})$ 3.4

where M_t is the market index or portfolio at time t.

Additionally, the inclusion of the return of the market portfolio in the analysis has the benefit of reducing the problem of omitted variable bias, significantly reducing the residual variances of the model and possibly enhancing the accuracy of the estimated exposure coefficients (Iorio and Faff, 2000). Furthermore, Bodnar and Wong (2003) indicate that the inclusion of the market index sheds more light on the explanations accorded to the finding of zero exposure coefficients.

3.5.4 Exchange rate variables

The weakness of the trade weighted exchange has often been pointed out in studies such as those by Loudon (1993b) and Jong *et al.* (2006). It has also been suggested that the trade weighted exchange assumes that all companies have equivalent exposures to all currencies, which is not always the case. Dominguez and Tesar (2001) and Ihrig (2001) explain that firms are usually exposed to one or more firm specific bilateral exchange rates and not to a trade weighted index. But Joseph (2002) points out that the trade weighted exchange is usually favoured by researchers because it eliminates multicollinearity, if several exchange rates were used, and since a researcher might not know the specific currencies that a firm is exposed to, the currency index captures the impact of fluctuating foreign exchange on any firm. El-Masry (2006a) finds in his study of UK non-financial industries that a higher percentage of significant foreign exchange rate exposure and significant correlations between industries' stock returns is documented for the trade weighted nominal exchange rate. In addition, Bartram (2004), Fraser and Pantzalis (2004) and Muller and Verschoor (2006a) also found empirical evidence to suggest that the use of a trade weighted index rather than bilateral exchange rates has no impediment on the detection of significant exposure coefficients.

Furthermore, many of the earlier empirical studies investigating the correlation between stock returns and the changes in the exchange rates have used the nominal exchange rates, while a few have used real exchange rates. The real exchange rate is the nominal exchange rate adjusted to incorporate inflationary effects and consequently measures the country's relative competitiveness. Khoo (1994) points out that if the changes in the exchange rate are determined in real terms, then for the sake of consistency, all the variables in the regression model should be adjusted to incorporate inflation. Additionally, Choi and Prasad (1995) investigate the impact of fluctuating exchange rates using both the nominal and real exchange rates. A justification for using fluctuations in the real exchange rate is the premise that changes in competitiveness of firms in different countries are influenced by both changes in the nominal exchange rate and inflationary movements. However, they find that the firms that were significantly exposed to the nominal rate were also the firms that are exposed to the real exchange rate. Mark (1990) investigated contemporaneous fluctuations in the nominal and real foreign exchange rates for seven countries. He finds that the fluctuations are almost perfectly correlated indicating that the deviation between fluctuations in the real exchange rate and nominal exchange rates are comparable both in the short and long term. Atindehou and Gueyie (2001) assert that if the nominal and real exchange rates are highly correlated, it makes very little difference if either of them is used in the equation, since the impact on stock returns will be very comparable. Similarly, Griffin and Stulz (2001) and Jong *et al.* (2006) also reiterate that there is a high correlation between nominal and real exchange rate, therefore the choice of either exchange rate is inconsequential. These assertions are further supported by Glaum *et al.* (2000) and Muller and Verschoor (2006a).

The trade weighted exchange rate for the British pound is compiled by the Bank of England, and is based on the IMF's multilateral exchange rate model taking into account the relative currencies of the UK's major trading partners. Therefore, it is the value of the British pound against a basket of currencies. Additionally, the index has a base period of January 2005 = 100, and countries with the highest weightings include the euro area (55.2%), USA (18.8%) and Japan (4.9%). These countries make up approximately 79% of UK trade flows (Bank of England, 2005). Intuitively, we also include the bilateral exchange rates, namely, US\$/£, JP¥/£, ECU/£ and Euro/£ in this study. The ECU/£ is used in the sub-period before the euro, whereas the Euro/£ is used for the sub-period after the euro. Furthermore, all the exchange rates are in nominal terms. To calculate the change in the exchange rate series, this is transformed using:

$$XR_t = \ln[(ERINDEX/£)_t / (ERINDEX/£)_{t-1}]. \qquad 3.5$$

Where $ERINDEX/£_t$ is the nominal exchange rate expressed in terms of foreign currency to 1 pound sterling.

3.5.5 Interest rate variables

Prasad and Rajan (1995) in their study on Germany, Japan, UK and US non-financial firms and Joseph (2002) in his study of UK non-financial firms have used the one month Treasury bill rate as the short term interest rate factor. However, Dinenis and Staikouras (1998) in their examination of UK financial firms have used the one month and three month Treasury bill rates. They find that the variables are correlated and the empirical results were not significantly affected using either of the interest rate variables. However, sensitivity increased with the 3 month Treasury bill rate. This result coincides with that of Bae (1990) as he discovered interest rates with longer maturities have more significant impact on stock returns.

Staikouras (2006) point out that treasury bills constitute a major part of the UK government's stock of marketable debt. Additionally, he reports that the UK 3 month treasury bill and London Interbank Offered Rate (LIBOR) are extremely correlated, such that changes in the two rates virtually always move in tandem. Furthermore, the 3 month rate is a good representation of the short-term money market rate, and also often a reference rate for floating rate borrowing. Consequently, it is a possible source of interest rate risk (Korkeamäki, 2007). In this study, the UK 3 month Treasury bill is employed as a proxy for the short term interest rates.

Then, regarding the effect of the long term interest rate, Sweeney and Warga (1986) and Bae (1990) used the 20 year government bond while Bartram (2002) and Loudon (2004) used the 10 year government bond. Furthermore, Bartram (2002) explains that long-term interest rates are particularly relevant for investment activity of industrial corporations and even that of the private and public sector. Additionally, Gonzalez *et al.* (2006) explain that long-term interest rates determine the cost of corporate borrowing. Besides, most economists, macroeconomic UK surveyed firms (Consensus Economics, 2006) and the ECB (Gros, 2000) usually favour the 10 year government bond as the benchmark for the long-term interest rate. It is also used in this study as a proxy for the long term interest rate. Furthermore, nominal interest rates are used to circumvent any problems that may arise in the process of attempting to define real interest rates (Staikouras, 2006).

To induce stationarity into the interest rate series, and calculate the change in the interest rate, we follow on from Booth and Officer (1985), Wetmore and Brick (1994), Prasad and Rajan (1995), Elyasiani and Mansur (1998), Atindéhou, and Gueyie (2001), Liow and Huang (2006), Joseph and Vezos (2006) and Ferrer *et al.* (2010) and use the first difference. This is stated as:

$$SR_t \text{ or } LR_t = I_t - I_{t-1} \qquad 3.6$$

In all the models, the changes in the short-term interest rate and long-term interest rate are represented by SR_t and LR_t respectively.

In addition, the Augmented Dickey-Fuller test (ADF) was used to test the stationarity of all the transformed series (results not shown) using EViews. The result indicated that the ADF test statistic lies to the left of all the 3 critical values, and the null hypothesis of a unit root was rejected at the 5% level for all the series, thereby confirming that all the series were stationary.

3.5.5.1 Actual and unexpected changes in exchange rates and interest rates

The underlying assumption that financial markets are efficient leads to the insinuation that expected changes would have been reflected in asset prices and, therefore only the unexpected changes should affect stock returns (Choi *et al.* 1992). The Autoregressive Integrated Moving Average (ARIMA) p,d,q model is particularly well favoured as a vital tool for extracting unexpected changes in exchange rates or interest rates, as evidenced in studies by Fang and Loo (1994), Atindehou and Guyehie (2001), El-Masry (2006a) and El-Masry *et al.* (2007) for exchange rates, and Bae (1990), Madura and Zarruk (1995), Dinenis and Staikouras (1998) and Korkeamäki (2007) for interest rates.

This study also utilised the ARIMA model to extract unexpected changes in the exchange rate and interest rate series. Subsequently, using the EViews software, the first step involved first differencing the data (non-transformed or original) which is represented by the d. Then, appropriate numbers are used for the AR(p) and MA(q) terms. The model is adequately specified when the Q-statistics for all the auto-correlation and partial auto-correlation structures, up to 36 lags, are statistically insignificant, indicating no residual serial correlation. In addition, a Breusch-Godfrey serial correlation test is used to substantiate the results from the Q-statistics. Again, the residuals obtained were white noise indicating that the model was adequate. Although the Q-statistics for the auto-correlation and partial auto-correlation structures as well as the results from the Breusch-Godfrey serial correlation test are not shown here for presentational purposes, they are available on request. Then, on the basis of the specified selection criteria, ARIMA(3,1,2) is chosen for the Bank of England trade weighted index, ARIMA(3,1,3) for the US$/£, ARIMA (2,1,2) for the JP¥/£, ARIMA(1,1,1) for the ECU/£ and ARIMA (3,1,1) for the euro. Then, for the interest rate measures, the ARMA(7,4) was more appropriate for the 3 month Treasury bill, while for the 10 year government bond, the ARIMA(1,1,1) was found to be suitable. Subsequently, the fitted values of the ARIMA model now correspond to the expected changes while the residuals are used as a proxy for the unexpected changes in exchange rates and interest rates. These unexpected changes are then used in the model instead of the actual or contemporaneous changes. Nevertheless, Flannery and James (1984), Wetmore and Brick (1994) and Madura and Zarruk (1995) assert that there is no difference between the results when actual and unexpected changes in the short-term and long-term interest rates were used. Also, Atindehou and Guyehie (2001) indicated that using the actual or unexpected change in the exchange rate or interest rate factor seemed to produce similar results. Notwithstanding, Bae (1990) found that US non-financial firms were not significantly exposed to the unexpected changes in the 3 month treasury bill, 3 year Treasury note and the 20 year treasury bond. But Fang and Loo

(1994) and Dinenis and Staikouras (1998) find evidence that stock returns are negatively affected by the unexpected depreciation in the dollar and unexpected changes in the interest rate, respectively. Furthermore, Korkeamäki (2007) indicated that UK stock returns showed evidence of a significant negative association with the actual changes in the 3 month interest rate, but regarding the unexpected changes in the interest rate, a statistically insignificant relationship was found. This finding contradicted that of Dineneis and Staikouras (1998) who also found that the portfolio returns of UK commercial and industrial firms were negatively influenced by the unexpected changes in the 3 month Treasury bill.

3.5.5.2 Contemporaneous and lagged changes in exchange rates and interest rates

Bartov and Bodnar (1994) explain that investors may not immediately unearth the complex relationship between changes in exchange rates and firm value. Incidentally, they are likely to make systematic pricing errors for some time, when valuing stocks that have been influenced by movements in exchange rates. But as new information on past performance becomes available, investors gradually discover the full extent of the impact of the risk on firm value. Consequently, only lagged changes in exchange rates and even interest rates should influence stock prices. Bartov and Bodnar (1994) found a significant relationship between lagged changes in exchange rates and stock returns of US firms. Furthermore, El-Masry (2006a) found lagged changes in exchange rates to be more significant than contemporaneous for UK non-financial industries. Similarly, Martin and Mauer (2005) indicate that, for US banks, the incidence of exchange rate exposure to the lagged Canadian dollar is more than that reported for the contemporaneous Canadian dollar, while Fraser and Pantzalis (2004) found that US MNCs were significantly more exposed to the lagged firm-specific and major currency indices than the trade weighted index. But their results also indicated that firms which exhibited contemporaneous exchange rate exposure were not necessarily the same with significant lagged exposure. They surmise that, for some firms, there may be a lag before the effects of movements in exchange rates influences the firm's stock price. However Jong *et al.* (2006) found contemporaneous changes in exchange rates to be more significant for Dutch firms. This result is harmonious with earlier studies by Nydahl (1999), who could not find any support for the mispricing hypothesis on Swedish firms and Krishnamoorthy (2001), who found no support for the lagged response hypothesis on US industries. Additionally, He and Ng (1998) found the lagged effects of exchange rate exposure to be inconsequential since only 6 out of the 171 Japanese firms in their study exhibited significant exposure to the lagged exchange rate coefficient. Then, Tai (2005) also showed that stock returns were significantly more exposed to contemporaneous movements in the exchange rate than lagged movements. But Hsin *et al.* (2007) found that for US non-financial firms, lagged exchange rate exposure was just as important in terms of magnitude as contemporaneous exchange rate exposure. Similarly, Joseph (2002) found that for UK firms in the electrical industry, the lagged interest rate was more significant, whereas for firms in the chemical and pharmaceutical industries, contemporaneous changes in the interest rate were more relevant. But regarding firms in the engineering industrial sector, the influence of contemporaneous and lagged interest rates seemed to be the same. Nevertheless, when only the portfolios were considered instead, there seemed to be more evidence of exposure to contemporaneous interest rates than lagged interest rates. In this study, the impact of exchange rate and interest rate on stock returns is explored using contemporaneous and lagged changes, and actual and unexpected changes.

3.5.6 Correlation of the actual explanatory variables and unexpected explanatory variables used in the study

In Appendix 2, the correlation coefficients of the actual and unexpected changes in the explanatory or independent variables are presented. Since the independent variables are not all the same in the 3 periods, it was necessary to segregate the correlation tables into the total sample period, and the 2 sub-sample periods representing the period before and after the Euro. It is evident, from Tables A2.1-A2.3 and A2.4-A2.6, that there is a high level of correlation between the weekly returns of the exchange rate variables. So, the exchange rates variables are examined individually in the estimated models. Since the market index and interest rate variables exhibit low correlation coefficients with other variables, there should be no problem of multicollinearity if they are estimated jointly in the same model with an exchange rate variable. Notwithstanding, we checked for multicollinearity using the traditional OLS model, which was subsequently adjusted for heteroskedasticity and autocorrelation using the Newey-West procedure. On the basis of empirical evidence, Belsley *et al.* (1980) suggest that the minimum value of the condition index indicating the presence of collinearity is between 10 and 30, while according to Bartram (2002), a VIF close to 1 indicates no collinearity, whereas VIF values exceeding 10 are an indication of harmful collinearity. In all the estimations (actual and unexpected), the condition index and the VIF had values in the range of 1.000-1.653 and 1.005-1.248, respectively, substantiating that multicollinearity would not be a problem if a measure of the exchange rate, the interest rate and the market index variables were simultaneously estimated in a model.

3.6 Competitive structure of UK industries using the Herfindahl Index

Bodnar *et al.* (1998) and Williamson (2001) posit that industries with high pass through have lower exposures. Krishnamoorthy (2001) found that US industries which are globally competitive display a higher significant level of exposure while industries classified as oligopolies had insignificant exposure. Similarly, Fraser and Pantzalis (2004) found that US multi-national firms with higher Herfindahl indices had lower exposure to currency risk. Furthermore, Ceglowski (1989), Bodnar and Gentry (1993) and Campa and Goldberg (1995) assert that firms in globally competitive industries, have low mark-ups, lower Herfindahl indices, and are expected to display higher exposure. But Bartram and Karolyi (2006) found that firms in industries with low values Herfindahl indices exhibited significantly smaller exposures, both negative and positive, to the trade weighted index, than firms with high Herfindahl indices. We presume that the lumping together of industries from the euro area, the non-euro area and outside Europe could have distorted their results. Also, Domiguez and Tesar (2006) found a significant positive coefficient for the Herfindahl index implying that firms in concentrated industries were more exposed to exchange rate exposure from the US$ than firms in competitive industries.

In this study, the Herfindahl-Hirschman Index (H.H.I) which measures concentration by summing the squared market shares of all the firms in the industry is used to provide an insight into the degree of competition in UK industries. Nellis and Parker (2002) point out that the H.H.I is commonly used by government competition authorities, such as those in the USA and UK as a measure of competition. Generally they perceive industries with H.H.I greater than 1800 as being highly concentrated. Using the group four DataStream ICB, a total of 2,128 non-financial firms were found from 31 industries. We subsequently measure industry concentration using the Herfindahl index (H) based on total sales by industry group.

This is defined as:

$$H = \sum_{i=1}^{N} s_i^2 \qquad 3.7$$

Where s_i is the market share of firm i in the market and N is the number of firms. The procedure involves averaging the annual domestic sales of all firms within each industry during the period 1990 to 2006. The average sale for all the firms is then added together to determine the total sales for the industry. Subsequently, the market share, for each firm, is then calculated and squared to obtain the Herfindahl index. The addition of the Herfindahl indices for all firms in the industry corresponds to the Herfindahl index and therefore concentration of that industry. For firms in industries with low Herfindahl values i.e. less than 1800, these were classified as competitive industries while those with high Herfindahl values, that is over 1800, were referred to as being concentrated industries. The result shown in Table A3.1 in appendix 3 indicates that there are 19 concentrated industries and 12 competitive industries.

However, since the Herfindahl index only gives an insight into how the degree of competition in an industry is affected by the size and number of firms at the national level, it might not present a precise picture of competition (Mulhearn *et al.*, 2001). Consequently, the absolute value of the Herfindahl index is not included in the model, but only used as an indication to determine the type of concentration present in the industry. Therefore, to determine the impact of exchange rate and interest rate exposure, the returns of concentrated industries are pooled and regressed on the exchange rate and interest rate factors. The process is also repeated for competitive industries.

3.7 Empirical methodology

The capital market approach, also known as the Capital Asset Pricing Model (CAPM) was used to estimate the sensitivity of stock returns to movements in exchange rates and interest rates. Adler and Dumas (1984) defined the exposure elasticity as the change in the market value of the firm resulting from a unit change in the exchange exposure. However, to control for other macroeconomic influences, most empirical studies include a return of the market portfolio, thereby making the CAPM a 2 factor model. Martin and Mauer (2005) point out that the CAPM method is particularly very pragmatic since it estimates the exposure of the capital market as the sensitivity of stock returns to fluctuations in a trade weighted exchange rate index whilst controlling for macroeconomic influences.

Furthermore, Bodnar and Wong (2003) also posit that the CAPM model reduces the residual variance of the regression. Besides, studies by Jorion (1990), Bodnar and Gentry (1993), Choi and Prasad (1995), Allayanis and Ofek (2001), Dominguez and Tesar (2001), Williamson (2001), Bodnar, and Wong (2003) and El-Masry (2006a) have incorporated the 2 factor model to measure exchange rate exposure while Lynge and Zumwalt (1980), Sweeney and Warga (1986), Dinenis and Staikouras (1998) and Al-Albadi and Sabbagh (2006) have used the 2 factor model to measure interest rate exposure. But Wetmore and Brick (1994), Prasad and Rajan (1995), Joseph (2002), Guay and Kothari (2003) and Joseph and Vezos (2006), have employed the 3 factor model to estimate the impact of exchange rates and interest rates simultaneously on stock returns. But following on from Murtagh and Bessler (2003), Yong *et al.* (2009) and El-Masry *et al.* (forthcoming), we extend the 3 factor model to include an additional measure of interest rate. Therefore, we are able to examine concurrently the effects of exchange rate, short-term interest rate and long-term interest rate on the returns of UK non-financial firms and industries.

3.7.1 Foreign exchange rate and interest rate exposure

Some studies on exchange rate exposure, and even interest rate exposure, at the firm level or industry level have utilised the OLS methodology, adjusted for autocorrelation and heteroscedasticity using the Newey-West procedure. Therefore, so as to make this study comparable with previous ones, the analysis was initially performed using the traditional OLS model represented as:

$$R_{it} = \alpha_i + \beta_{m,i}RM_t + \beta_{r,i}XR_t + \beta_{s,i}SR_t + \beta_{l,i}LR_t + \varepsilon_{it} \qquad t=1,\ldots,T \qquad 3.8a$$

where α_i is the intercept term for industry i, R_{it} is the return of industry i, RM_t is the rate of return of the market portfolio, XR_t is the percentage change in the exchange rate index over time t, SR_t is the change in the short term interest rate over time t, LR_t is the change in the long-term interest over time t and ε_{it} is the error term which has a mean of zero, a constant variance and assumed to be normally and independently distributed. In addition:

$\beta_{m,i}$ = the beta of the industry with respect to the market portfolio,

$\beta_{r,i}$= coefficient measuring foreign exchange rate exposure of industry i,

$\beta_{s,i}$ = coefficient measuring short term interest rate exposure of industry i,

$\beta_{l,i}$ = coefficient measuring long term interest rate exposure of industry i.

The same model is also used for the firm level analysis. All the regression residuals are to be tested for autocorrelation using the Q-statistics. The choice of the number of lags is determined using lag length, $k=\ln(T)$. This method was also used in Fang and Thompson (2004) and Fang *et al.* (2007), where T is the number of observations. Therefore $k=\ln(886)=6.78$. As a result, autocorrelation is tested for up to 7 lags and a further 21 lags. Then to test for the presence of residual ARCH, the Q^2 statistics are also checked at the 7th and 21st lags. The ARCH test is further substantiated using the Lagrange multiplier (LM) test. Then, finally, the Jarque-Bera statistic is used to test the normality of the residuals. [See Appendix 4 for further discussions].

Equation 3.8a was also extended to estimate the change in exchange rate and interest rate exposure of UK industries returns following the introduction of the euro.

$$R_{it} = \alpha_i + \beta_{a,i}R_{it-1} + \beta_{m,i}RM_t + \beta_{Eurom,i}RM_tD_{Eurot} + \beta_{r,i}XR_t + \beta_{Euror,i}XR_tD_{Eurot} + \beta_{s,i}SR_t + \beta_{Euros,i}SR_tD_{Eurot} + \beta_{l,i}LR_t + \beta_{Eurol,i}LR_tD_{Eurot} + \varepsilon_{i,t} \quad 3.8b$$

In equation 3.8b, α_i is the intercept term for industry i, R_{it} is the return of industry i, RM_t is the rate of return of the market portfolio, XR_t is the percentage change in the exchange rate index at time t, SR_t is the change in the short term interest rate at time t and LR_t is the change in the long-term interest at time t, D_{Eurot} is a dummy variable that takes the value of 1 from 1st January 1999, and 0 before that date, and $\varepsilon_{i,t}$ is the error term for industry i. Even in the presence of ARCH effects, the standard OLS method still assumes that the variances are constant. Kuotmos and Martin (2003), Tai (2005) and Joseph and Vezos (2006) pointed out that this assumption may result in higher standard errors and erroneous insinuations. Kuotmos and Martin (2003) further explain that this might have been the reason why previous studies have found it difficult detecting significant exposure. Although the Newey West procedure circumvents the impact of ARCH effects and autocorrelation by adjusting the standard errors, it could not account for, nor provide, an explanation for the presence of substantial conditional heteroscedasticity in the regression residuals. Furthermore, Diebold and Nerlove (1989), Lamoureux and Lastrapes (1990), Bollerslev *et al.* (1992) and Daly (2008) explain that the presence of ARCH effects in financial time series is as a result of the time dependence in the news that flows into the market. In other words, the market's news arrival process is serially correlated. This problem may have being further exacerbated by the use of high frequency data in this study i.e. financial weekly time series, since the frequency of the data determines the type of volatility clusters that can be seen and even measured. Bollerslev *et al.* (1992) and Daly (2008) also pointed out that if the arrival of news in the market is of rapid successions, and if the data are of sufficiently high frequency to detect the arrival of news, then the returns will display evidence of a long memory or volatility cluster.

Volatility clustering is a situation where in large (small) returns are expected to be followed by large (small) returns but of either sign. Furthermore volatility clustering can be thought of as the clustering of the variance of the error term over time. Hill *et al.* (2008) suggest that the ARCH model is quite popular since its variance specification is able to capture the features that are synonymous in financial time series; it is also especially useful for modelling volatility and in particular volatility that changes over time. Besides, the family of ARCH models is instinctively appealing since it explains volatility as a function of the errors ε_t. These errors are commonly referred to as news or shocks by financial analysts and they correspond to the unexpected. Joseph (2003b) indicates that the measure of volatility is particularly important in empirical studies since it measures the degree of riskiness relative to the returns of an asset. He also suggests that GARCH models are concerned with the estimation of volatility, and they are also extremely useful since they have the ability to exploit the time varying properties of the series and at the same time also provide coefficient estimates for the time varying parameters.

Therefore, since all the financial data used in this study are weekly, an analysis based on the GARCH methodology might be more appropriate. Similarly, GARCH specification have also been added to the basic Ordinary Least Square (OLS) regression model at the firm level in Elyasiani and Mansur (1998), Koch and Saporoschenko (2001), Joseph and Vezos (2006), Muller and Verschoor (2006 a and b), and Brewer *et al.* (2007) and at the portfolio level by Joseph (2002) and Jayasinghe and Tsui (2008).

The model specifications are:

$$R_{it} = \alpha_i + \beta_{m,i}RM_t + \beta_{r,i}XR_t + \beta_{s,i}SR_t + \beta_{l,i}LR_t + \varepsilon_{i,t} \qquad 3.9a$$

$$\varepsilon_{it} \sim N(0, \sigma^2_t) \qquad 3.9b$$

$$\sigma^2_t = \alpha_o \qquad 3.9c$$

Equation 3.9a is the mean equation where, α_i is the intercept term for industry i, R_{it} is the return of industry i, RM_t is the rate of return of the market portfolio, XR_t is the percentage change in the exchange rate index over time t, SR_t is the change in the short term interest rate over time t and LR_t is the change in the long-term interest over time t and the error term ε_{it}. In 3.9b, the error term, $\varepsilon_{i,t}$ is normally distributed with mean 0 and variance σ^2_t. Then in 3.9c, the variance is a constant α_o. But since the variance of the errors from 3.9a heteroscedastic, this is normally referred to as h_t. Therefore since $\sigma^2_t = h_t$, the distribution of the error is conditionally normal and represented as:

$$\varepsilon_t \mid I_{t-1} \sim N(0, h_t) \qquad 3.10a$$

where I_{t-1} corresponds to information available at time t-1.

Next, the error variance, which is time varying (h_t), is estimated to be a function of a constant term and the lagged error squared or the error in the previous period squared (e^2_{t-1}). Therefore, the variance or volatility for a given period will be dependent on the magnitude of the squared errors in the past period.

$$h_t = \alpha_0 + \alpha_1 e^2_{t-1}, \ \alpha_0 > 0, 0 \lesseqgtr \alpha_1 < 1 \qquad 3.10b$$

The coefficients α_0 and α_1 must be positive to guarantee a positive variance. In addition, α_1 must be less than 1 or else h_t will continue to increase over time eventually exploding. Formally equation 3.10a and equation 3.10b represent the ARCH (1) model developed by Engle (1982a and b). However a major limitation with the ARCH(q) model (q is the number of lagged terms) is that it has a short memory since only the most recent squared residuals are used to estimate the change in the variance. Consequently the model is unable to capture long lagged effects, thereby resulting to loss of accuracy in the estimation. This issue is particularly important since volatility in the stock market is persistent or in other words has a long memory (Theodossiou and Lee, 1995; Choudhry, 1996; and Li *et al*, 2005). To evade this problem, Bollerslev (1986) extended the ARCH (p) model to a GARCH (p,q) which allows for long memory processes so as to incorporate past conditional variances into the equation (all the past squared residuals are used to estimate the current variance), thereby taking into consideration influences that are long-term in nature. This is now represented as:

$$h_t = \alpha_0 + \alpha_1 e^2_{t-1} + \beta_1 h_{t-1} \qquad 3.10c$$

Where h_{t-1} is the lagged value of the variance which captures long lags in the shocks. In addition, $\alpha_1 + \beta_1 < 1$ and $\alpha_1 > 0$, $\beta_1 > 0$ (that is ARCH and GARCH parameters must be non-negative). Therefore, variation in the stock return is depicted by the conditional variance of h_t, where a larger h_t is indicative of higher risk. However Nelson and Cao (1992) point out that the non-negativity constraint imposed on the linear GARCH (p,q) model is too restrictive since it may unjustifiably restrict the dynamics of the conditional variance process. Furthermore Koulakiotis *et al.* (2006) explain that the non-negativity constitutes a serious limitation to the generality of the time paths of the (e_t) and (h_t) processes. Specifically, a shock in the past (ε_{t-k}), irrespective of its sign, will always have a positive influence on the current volatility. These impacts increase with the magnitude of the shock thereby making the model incapable of detecting any non-linearity that might be inherent in the volatility. Engle *et al.* (1987) introduced the GARCH-in-Mean (GARCH-M) specification based on the financial theory which suggests that increase in volatility or variance should lead to higher expected returns. As Daly (2008) points out, the ARCH model has been applied to asset pricing models, such as Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Model (APT), to capture the time-varying systematic risk process of these models. In the CAPM model, there is a fundamental trade off between risk and return. Therefore, the incorporation of h^2_t in the mean equation is intuitively appealing since the expected return of an asset is proportional to its expected risk and furthermore, investors are not blasé to the volatility of the stocks they hold. This notion is also supported by Taing and Worthington (2005) and Léon (2008) as they pointed out that if investors are rewarded for their exposure to risk, then it is expected that the risk parameter should be significant and positive for an investor who is especially averse to risk. But this is based on the assumption that the markets are fully segmented such that investors do not need to globally diversify their portfolio, since they should be rewarded for country specific risk exposure. Therefore, the coefficient of the risk parameter is also usually interpreted as the price of the domestic market risk.

The fundamental trade off between risk and return (h^2_t) is measured in logarithmic form. Engle *et al.* (1987), Elysiani and Mansur (1998) and Brewer *et al.* (2007) point out that log (h^2_t) provides a better depiction of risk than the variance or standard deviation. Therefore as the volatility of the stock returns increases, the risk premia required by investors will also change (Elyasiani and Mansur 1998). But Koulakiotis *et al.* (2006) examined the relationship between stock prices returns and volatility of 9 industrialised countries including the UK (FTSE100) using a GARCH-M model. Overall, they find weak results but the UK exhibited a significant negative volatility coefficient implying that an increase in the stock price volatility will reduce in magnitude the return of the stock price. Taing and Worthington (2005) explained that the risk return parameter embodies systematic and unsystematic risk. Therefore if fluctuations in volatility are mainly due to unsystematic risk, then an increase in volatility might not necessarily be accompanied by a significant increase in the risk premium. However, Joseph (2003b) found insignificant trade-off coefficients in his study, which examined the impact of foreign exchange rate and interest rate changes, on the value of US financial industries' stocks, using the GARCH-M model. But he explained that the result might have been influenced by the use of aggregate estimates, which could have masked those instances when the trade-off coefficient might have been statistically different from zero. In addition, Ryan and Worthington (2004), adopt the GARCH-M approach to examine the sensitivity of Australian banks stock returns to interest rate and exchange rate risk. They posit that the results for portfolio returns might not accurately describe the return generating process inherent to individual bank returns. Elyasiani and Mansur (1998), using a GARCH-M model in investigating the interest rate risk exposure of US banks' stock returns, also reiterate that the use of portfolios masks out the dissimilarities among firms within the portfolio. To circumvent this potential problem, we extend our analysis to include firm level data.

Nevertheless, Al-Zoubi and Kh.Al-Zu'bi (2007) indicate that if a GARCH-M model is used in the presence of asymmetric effects, this may lead to a misleading estimation of the risk-return relationship since the influence of past variance on current volatility is modelled as a function of their magnitude of the error term only. The working of the GARCH-M model is characteristically linear (symmetric), and therefore unable to capture the asymmetric effect that might be inherent with financial time series, thereby potentially under-predicting volatility. Furthermore, the estimation of the GARCH-M model obviously negates the financial framework which presupposes that volatility is typically higher after a decrease than an equal increase. Intuitively, in terms of investor psychology, the response of stock returns to bad news should generally be much bigger than its response to good news. Although in some instances, good news may also have a higher impact on volatility than bad news.

The Exponential GARCH (EGARCH) and Exponential GARCH-in-Mean (EGARCH-M) initiated by Nelson (1991) overcomes the problems synonymous with these linear GARCH models since positive and negative values of ε_t have different influences on volatility. Additionally, Koutmos and Saidi (1995) pointed out that the EGARCH model allows the conditional variance to depend on the magnitude and sign of the innovation (error term). This suggests that the variance of the stock returns is an asymmetric function of the past error terms i.e. negative and positive innovations can have different impacts on volatility. But then the hybrid EGARCH-M model seems to be a superior method of estimation since it accommodates the asymmetric relationship that persists between equity returns and volatility and also embodies the relationship between volatility and expected returns. Nonetheless, it is pertinent to note that under the EGARCH or EGARCH-M framework, asymmetric effects are separated into leverage effects, indicating that negative surprises (news) increases the volatility of returns more than positive surprises (news) whereas for asymmetric effects, positive surprises increase return volatility more then negative surprises. Another explanation for the leverage effect is given in Bollerslev *et al.* (1992) whereby a reduction in the value of the equity could increase the debt-to-equity ratio, consequently raising the riskiness of the equity as evident by an increase in volatility.

Besides, we recall that the the distribution of the error is assumed to be conditional normal. But Bollerslev *et al.* (1992) and Koutmos and Martin (2007) point out that in a lot of financial time series data, especially high-frequency financial data, models which are estimated with a normal distribution are incapable of fully accounting for the leptokurtosis in the residuals. Furthermore, Bollerslev (1987) and Baillie and DeGennaro (1990) recommend that using a distribution that has fatter tails, such as a standardised student-t distribution, would be more suitable. This supposition is further supported by Elyasiani and Mansur, (1998), Chang (2002), Joseph (2002), Joseph (2003b), Brewer *et al.* (2007), Fang *et al.* (2007) and Léon (2008). Joseph and Vezos (2006) examine the sensitivity of US bank's stock returns to interest rates and exchange rates using the EGARCH model. The model is estimated under the assumption that the standardised residuals follow a conditional normal distribution and a t-distribution. The histograms associated with the normal distribution exhibited more skewness and peakedness than those estimated with the t-distribution. Additionally, an autoregressive term AR(k) process is included in the mean equation as this captures serial dependence (Koutmos and Saidi, 1995; and Fang and Thompson, 2004), improves the data generating process for the stock returns (Li *et al.*, 2005) and also improved the fit of the model for a majority of the estimates. Estimates will be made of different specifications of AR(k) up to 7 lags. Additionally, it was found that the AR(1) was more appropriate for the data. All things considered, the AR(1)EGARCH-M model with a t-distribution is used for all the estimations in this study.

$$R_{it} = \alpha_i + \beta_{ai}R_{it-1} + \beta_{m,i}RM_t + \beta_{r,i}XR_t + \beta_{s,i}SR_t + \beta_{l,i}LR_t + \lambda\log(h^2_{i,t}) + \varepsilon_{i,t} \qquad 3.11a$$

$$\varepsilon_{i,t}|I_{t-1} \sim t(0, h^2_{i,t}, \upsilon_{i,t}) \qquad 3.11b$$

$$\log h^2_{i,t} = \alpha_o + \alpha_1\frac{\varepsilon_{i,t-1}}{h_{i,t-1}} + \alpha_2\left(\left|\frac{\varepsilon_{i,t-1}}{h_{i,t-1}}\right|\right) + \varphi_1\log h^2_{i,t-1} \qquad 3.11c$$

Equation 3.11a is the mean equation wherein α_i is the intercept term for industry i, R_{it} is the return of industry i at time t, R_{it-1} (autoregressive lag parameter) is the return for industry i at time t-1 accounting for autocorrelation, RM_t is the rate of return of the market portfolio at time t, XR_t is the percentage change in the exchange rate index at time t, SR_t is the change in the short term interest rate at time t and LR_t is the change in the long-term interest at time t, $\log(h^2_{i,t})$ is the log of conditional industry volatility, while the coefficient λ reflects the fundamental trade-off relationship between expected returns and the measure of previous conditional volatility, capturing the risk pattern over time, and $\varepsilon_{i,t}$ is the error term. In 3.11b, the error term, $\varepsilon_{i,t}$ has a mean 0, variance $h^2_{i,t}$ (time varying) and a t-density distribution with $\upsilon_{i,t}$ degrees of freedom, while I_{t-1} is information available at time t-1. Then, Equation 3.11c is the variance equation where $\log(h^2_{i,t})$, the log of the conditional variance, is the current volatility forecast, conditional upon the previous period's conditional variance and error. α_o is the constant term which constitutes the time-independent component of volatility, and indicates volatility when the ARCH and GARCH parameters are statistically insignificant. Furthermore, α_1 measures the asymmetric impact of past innovations on current volatility; therefore, there are leverage effects when $\alpha_1<0$ and asymmetric effects when $\alpha_1\neq0$. α_2 is the ARCH term which links current volatility (conditional variance) to the asymmetric function of past innovations. The log $h^2_{i,t-1}$ is the past period variance and φ_1 is the GARCH term which denotes the persistence parameter that associates current volatility with past volatility. Equation 3.11(a, b and c) form the pedestal for this study's estimations and is utilised to estimate the contemporaneous changes of exchange rates and interest rates on firms' returns using actual changes and then the unexpected changes of the exchange rate and interest rate factors, in the total period and sub-period. Similar to the OLS, the adequacy of the AR(1)EGARCH-M model is also checked using the Q-Statistics for any residual autocorrelation, while the presence of residual ARCH is tested using the Q^2 statistics and the Lagrange multiplier (LM) test. Then the Jarque-Bera statistics are used to test the normality of the residuals.

To test the impact of the euro on stock return volatility, a dummy variable is included in the variance equation (3.12c). See Morana and Beltratti (2000). The model is estimated as:

$$R_{i,t} = \alpha_i + \beta_{a,i}R_{it-1} + \beta_{m,i}RM_t + \beta_{Eurom,i}RM_tD_{Eurot} + \beta_{r,i}XR_t + \beta_{Euror,i}XR_tD_{Eurot} + \beta_{s,i}SR_t + \beta_{Euros,i}SR_tD_{Eurot} + \beta_{l,i}LR_t + \beta_{Eurol,i}LR_tD_{Eurot} + \lambda\log(h^2_{i,t}) + \varepsilon_{i,t} \qquad 3.12a$$

$$\varepsilon_{i,t}|I_{t-1} \sim t(0, h^2_{i,t}, \upsilon_{i,t}) \qquad 3.12b$$

$$\log h^2_{i,t} = \alpha_o + \alpha_1\frac{\varepsilon_{i,t-1}}{h_{i,t-1}} + \alpha_2\left(\left|\frac{\varepsilon_{i,t-1}}{h_{i,t-1}}\right|\right) + \varphi_1\log h^2_{i,t-1} + \beta_{e,i}EURDUM \qquad 3.12c$$

In equation 3.12a, α_i is the intercept term for industry i, R_{it} is the return of industry i, RM_t is the rate of return of the market portfolio, XR_t is the percentage change in the exchange rate index at time t, SR_t is the change in the short term interest rate at time t and LR_t is the change in the long-term interest at time t, D_{Eurot} is a dummy variable that takes the value of 1 from 1st January 1999, and 0 before that date, and $\varepsilon_{i,t}$ is the error term for industry i. In addition, other coefficients are:

$\beta_{a,i}$ = autoregressive coefficient for industry i

$\beta_{m,i}$ = market risk exposure coefficient for industry i before the euro

$\beta_{r,i}$ = foreign exchange rate exposure coefficient of industry i before the euro

$\beta_{s,i}$ = short term interest rate exposure coefficient of industry i before the euro

$\beta_{l,i}$ = long term interest rate exposure coefficient of industry i before the euro

$\beta_{Eurom,i}$ = change in the market risk for industry i after the euro

$\beta_{Euror,i}$ = change in exchange rate exposure for industry i after the euro

$\beta_{Euros,i}$ = change in the short term interest rate exposure for industry i after the euro

$\beta_{Eurol,i}$ = change in the long term interest rate exposure for industry i after the euro

All the components of the variance equation are as explained previously in Equation 3.11c. The only difference is EURDUM, which is the euro dummy which examines the impact of the introduction of the euro on the volatility of firm's or industry's returns. This binary variable also has a value of 1 from 1st January 1999, and 0 before that date. All the stated models that are to be used for the industry level analysis will also be employed for the firm level analysis.

The returns of all industries classified as concentrated are pooled and the same procedure is repeated for the competitive industries. A pooled regression analysis is then carried out using the model stated below for the total sample and sub-period analysis.

$$R_t = \alpha + \beta_{a1}R_{t-1} + \beta_m RM_t + \beta_r XR_t + \beta_s SR_t + \beta_l LR_t + \lambda \log(h^2_t) + \varepsilon_t \qquad 3.13a$$

$$\varepsilon_t | I_{t-1} \sim t(0, h^2_t, \upsilon_t) \qquad 3.13b$$

$$\log h^2_t = \alpha_o + \alpha_1 \frac{\varepsilon_{t-1}}{h_{t-1}} + \alpha_2\left(\left|\frac{\varepsilon_{t-1}}{h_{t-1}}\right|\right) + \varphi_1 \log h^2_{t-1} \qquad 3.13c$$

Then to examine the impact of the introduction of the euro on exchange rate and interest rate exposure of UK competitive and concentrated industries, this is estimated using:

$$R_t = \alpha + \beta_{a1}R_{t-1} + \beta_m RM_t + \beta_{Eurom} RM_t D_{Eurot} + \beta_r XR_t + \beta_{Euror} XR_t D_{Eurot} + \beta_s SR_t +$$

$$\beta_{Euros} SR_t D_{Eurot} + \beta_l LR_t + \beta_{Eurol} LR_t D_{Eurot} + \lambda \log(h^2_t) + \varepsilon_t \qquad 3.14a$$

$$\varepsilon_t | I_{t-1} \sim t(0, h^2_t, \upsilon_t) \qquad 3.14b$$

$$\log h^2_t = \alpha_o + \alpha_1 \frac{\varepsilon_{t-1}}{h_{t-1}} + \alpha_2\left(\left|\frac{\varepsilon_{t-1}}{h_{t-1}}\right|\right) + \varphi_1 \log h^2_{t-1} + EURDUM \qquad 3.14c$$

In the mean equation of 3.13a (total period and sub-period) and 3.14a (change in exchange rate and interest exposure following the introduction of the euro), R_t is the pooled return of the concentrated or competitive industries. All other variables are the same and have previously been explained.

Furthermore, in models 3.15 (a,b,c) and 3.16 (a,b,c), we further test for any significant difference between concentrated and competitive industries. Therefore, R_t is the pooled return of both concentrated and competitive industries, while INDUM is the industry dummy which takes the value of 1 for concentrated industries and 0 for competitive industries. The models are represented as:

$$R_t = \alpha + \beta_{ai}R_{t-1} + \beta_{mi}RM_t + \beta_{ri}XR_t + \beta_{si}SR_t + \beta_{li}LR_t + \beta_{in}INDUM + \lambda \log(h^2_t) + \varepsilon_t \qquad 3.15a$$

$$\varepsilon_t \mid I_{t-1} \sim t(0, h^2_t, \upsilon_t) \qquad 3.15b$$

$$\log h^2_t = \alpha_o + \alpha_1 \frac{\varepsilon_{t-1}}{h_{t-1}} + \alpha_2\left(\left|\frac{\varepsilon_{t-1}}{h_{t-1}}\right|\right) + \varphi_1 \log h^2_{t-1} \qquad 3.15c$$

$$R_t = \alpha + \beta_{ai}R_{t-1} + \beta_m RM_t + \beta_{Eurom}RM_tD_{Eurot} + \beta_r XR_t + \beta_{Euror}XR_tD_{Eurot} + \beta_s SR_t + \beta_{Euros}SR_tD_{Eurot} + \beta_l LR_t + \beta_{Eurol}LR_tD_{Eurot} + \beta_{in}INDUM + \lambda \log(h^2_t) + \varepsilon_t \qquad 3.16a$$

$$\varepsilon_t \mid I_{t-1} \sim t(0, h^2_t, \upsilon_t) \qquad 3.16b$$

$$\log h^2_t = \alpha_o + \alpha_1 \frac{\varepsilon_{t-1}}{h_{t-1}} + \alpha_2\left(\left|\frac{\varepsilon_{t-1}}{h_{t-1}}\right|\right) + \varphi_1 \log h^2_{t-1} + EURDUM \qquad 3.16c$$

Furthermore, models 3.16 (a,b,c) is used to examine the impact of the introduction of the euro on exchange rate and interest rate risk of concentrated and competitive industries returns.

Then using Equation 3.17 (a,b,c), the significance of the mispricing hypothesis is tested using lagged changes of the exchange rate and interest rate variables in the mean equation instead of the contemporaneous changes. Studies such as by Bartov and Bodnar (1995), Nydahl (1999), Joseph (2002), Fraser and Pantzalis (2004), Jong *et al.* (2006), and Hsin *et al.* (2007) have incorporated both the contemporaneous and lagged changes as independent variables in the same model. Conversely, Iorio and Faff (2000), Martin and Mauer (2005) and Jayasinghe and Tsui (2008) have used separate models to estimate contemporaneous and/or lagged effects of exposure. Furthermore, Krishnamoorthy (2001) explained that the use of contemporaneous and lagged changes in the model may bias the regression coefficients, since changes in exchange rates may not be independent of one another over time. This phenomenon may also be applicable to changes in interest rates. Subsequently, the effects of lagged changes in exchange rates and interest rates on stock returns are estimated independently. But the mis-pricing hypothesis is only estimated for the total period, the sub-periods and the concentrated versus competitive models only. In order to prevent unnecessary duplication, only the model utilised for the total period and sub-periods are shown here since the model for the concentrated versus competitive industries is the same as stated previously, but using lagged changes in the exchange rate and interest rate variables instead. Moreover, the model is also available in Chapter 4. Therefore in Equation 3.17a, α_i is the intercept term for industry i, $R_{i,t}$ is the return of industry i at time t, R_{it-1} is the autoregressive lag parameter for industry i at time t-1, RM_t is the rate of return of the market portfolio at time t, XR_{t-1}, SR_{t-1} and LR_{t-1} are the lagged changes in the exchange rate, short-term interest rate and long-term interest rate, respectively. Each lag is one week.

$$R_t = \alpha_i + \beta_{ai} R_{t-1} + \beta_{mi} RM_t + \beta_{xi} XR_{t-1} + \beta_{si} SR_{t-1} + \beta_{li} LR_{t-1} + \lambda \log(h^2_{i,t}) + \varepsilon_{it} \qquad 3.17a$$

$$\varepsilon_{i,t}|I_{t-1} \sim t(0, h^2_{i,t}, \upsilon_{i,t}) \qquad 3.17b$$

$$\log h^2_{i,t} = \alpha_0 + \alpha_1 \frac{\varepsilon_{i,t-1}}{h_{i,t-1}} + \alpha_2\left(\left|\frac{\varepsilon_{i,t-1}}{h_{i,t-1}}\right|\right) + \varphi_1 \log h^2_{i,t-1} \qquad 3.17c$$

Since all the analysis carried out using the AR(1)EGACRM-M model had previously being estimated using the OLS methodology (with Newey West adjusted standard errors), it would be insightful to compare the results from the 2 models. Consequently, in Chapters 4 and Chapters 5, the results from the AR(1)EGARCM-M are evaluated against the summary results from the OLS.

3.7.2 The determinants of exchange rate and interest rate exposure

Furthermore, this study would be incomplete without exploring hypothesis 5, which relate to differences between the determinants of a firm's exposure to exchange rate and that of interest rate exposure. It is well known that firms employ operational and financial hedging strategies to mitigate their exposure to exchange rate and interest rate risks, and according to optimal hedging theories, these firms should be less exposed to fluctuations in foreign exchange rates and interest rates than non-hedging firms. However data on hedging activities are usually incomplete and difficult to obtain since firms do not disclose in great detail their use of derivative instruments. Therefore to circumvent this limitation and make this study comparable with earlier studies by Smith and Stulz (1985), Froot *et al.* (1993), Nance *et al.* (1993), Berkman and Bradbury (1996), Geczy *et al.* (1997), Haushalter (2000), El-Masry (2005b), Nguyen *et al.* (2007) and Clark and Judge (2008), proxies were used to simulate the firms' hedging motives and ascertain the determinants of exchange rate and interest rate risks. The cross-sectional regression process, which has also been used in studies by Allayanis and Ofek (2001), Nguyen and Faff (2003), Hagelin and Pramborg (2004), Faff and Marshall (2005), Jong *et al.* (2006), and Muller and Verschoor, (2006) involved regressing the estimated exchange rate exposure coefficient of the firm against its firm specific financial data. This methodology was also applied to ascertain the determinants of interest rate exposure. A detailed explanation of all the firm level data and the justification for their use is provided in Chapter 6.

Therefore using a cross sectional regression model, the determinants of exchange rate exposure are:

$$\beta_{ri} = \delta_0 + \delta_1 CFTA_i + \delta_2 PAYOUT_i + \delta_3 FATA_i + \delta_4 FITI_i + \delta_5 FSTS_i + \delta_6 ICBT_i + \delta_7 LOGASS_i + \delta_8 MVBV_i + \delta_9 PREFASS_i + \delta_{10} QUICK_i + \delta_{11} RDSA_i + \delta_{12} TANG_i + \delta_{13} TOTDEBT_i + \varepsilon_{it}, \quad i=1,\ldots\ldots,N \qquad 3.18$$

$$\beta_{ri} = \delta_0 + \delta_1 CFTA_i + \delta_2 PAYOUT_i + \delta_3 FATA_i + \delta_4 FITI_i + \delta_5 FSTS_i + \delta_6 ICBT_i + \delta_7 LOGASS_i + \delta_8 MVBV_i + \delta_9 PREFASS_i + \delta_{10} QUICK_i + \delta_{11} RDSA_i + \delta_{12} TANG_i + \varepsilon_{it}, \quad i=1,\ldots\ldots,N \qquad 3.19$$

An explanation for having two similar equations is given shortly.

The determinants of short-term interest rate exposure are:

$$\beta_{si} = \delta_0 + \delta_1 CFTA_i + \delta_2 PAYOUT_i + \delta_3 FATA_i + \delta_4 FITI_i + \delta_5 FSTS_i + \delta_6 ICBT_i + \delta_7 LOGASS_i + \delta_8 MVBV_i + \delta_9 PREFASS_i + \delta_{10} QUICK_i + \delta_{11} RDSA_i + \delta_{12} TANG_i + \delta_{13} TOTDEBT_i + \varepsilon_{it}, \quad i=1,.....,N \qquad 3.20$$

$$\beta_{si} = \delta_0 + \delta_1 CFTA_i + \delta_2 PAYOUT_i + \delta_3 FATA_i + \delta_4 FITI_i + \delta_5 FSTS_i + \delta_6 ICBT_i + \delta_7 LOGASS_i + \delta_8 MVBV_i + \delta_9 PREFASS_i + \delta_{10} QUICK_i + \delta_{11} RDSA_i + \delta_{12} TANG_i + \varepsilon_{it}, \quad i=1,.....,N \qquad 3.21$$

The determinants of long-term interest rate exposure are:

$$\beta_{li} = \delta_0 + \delta_1 CFTA_i + \delta_2 PAYOUT_i + \delta_3 FATA_i + \delta_4 FITI_i + \delta_5 FSTS_i + \delta_6 ICBT_i + \delta_7 LOGASS_i + \delta_8 MVBV_i + \delta_9 PREFASS_i + \delta_{10} QUICK_i + \delta_{11} RDSA_i + \delta_{12} TANG_i + \delta_{13} TOTDEBT_i + \varepsilon_{it}, \quad i=1,.....,N \qquad 3.22$$

$$\beta_{li} = \delta_0 + \delta_1 CFTA_i + \delta_2 PAYOUT_i + \delta_3 FATA_i + \delta_4 FITI_i + \delta_5 FSTS_i + \delta_6 ICBT_i + \delta_7 LOGASS_i + \delta_8 MVBV_i + \delta_9 PREFASS_i + \delta_{10} QUICK_i + \delta_{11} RDSA_i + \delta_{12} TANG_i + \varepsilon_{it}, \quad i=1,.....,N \qquad 3.23$$

where β_{ri} is the exchange rate exposure coefficient of a firm i, β_{si} is the short-term interest rate exposure coefficient of a firm i and β_{li} is the long-term interest rate exposure coefficient of a firm. Again, for comparative purposes, the estimated OLS exposure coefficients were used initially in the model, then these were later replaced by the exposure coefficients estimated with the AR(1)EGACRM-M model and re-estimated.

The firm specific explanatory variables are defined as follows: $CFTA_i$ is the ratio of cash flow to total assets, $PAYOUT_i$ is the dividend payout ratio, $FATA_i$ is the ratio of foreign assets to total assets, $FITI_i$ is the ratio of foreign income to total income, $FSTS_i$ is the ratio of foreign sales to total sales, $ICBT_i$ is the interest cover ratio, $LOGASS_i$ is the log of total assets, $MVBV_i$ is the ratio of market value to book value of equity, $PREFASS_i$ is the ratio of preference capital to total assets, $QUICK_i$ is the quick ratio, $RDSA_i$ is the ratio of research and development expenditure to total sales and $TANG_i$ is the ratio of tangible assets to total assets, while ε_{it} is the error term.

But an initial check on the correlation of the variables indicated a high correlation between MVBV and TOTDEBT. Therefore to eradicate any potential problem of multicollinearity, which may arise as a result of jointly using MVBV and TOTDEBT in the same equation, two models are created whereby in models 3.18, 3.20 and 3.22, TOTDEBT is included in the model while in models 3.19, 3.21 and 3.23, TOTDEBT is excluded from the model.

The analysis in this section entailed the total period, the period before and after the euro. In the total period, the determinants for exchange rate exposure were compared to that of interest rate exposure (short-term and long-term interest rate). Then in the sub-periods, the determinants for exchange rate and interest rate exposure before the euro were compared to the determinants in the period after the euro.

3.8 Conclusion

This chapter explained the rationale of the hypotheses that are to be examined in this study. It also provided a detailed account of the sources of data, the selection of the data and their relevance in the study. Furthermore, the methodology used for the empirical analysis "the exposure of UK non-financial firms and industries returns to exchange rate and interest rate risk", was unequivocally described and justified. The modelling procedure is also extended to include 2 sub-periods, the change in exchange rate and interest rate exposure following the introduction of the euro, and the extent to which competitive and concentrated industries are influenced by movements in exchange rate and interest rate. Additionally, the mis-pricing hypothesis, as it relates to exchange rate and interest rate risk, on the returns of UK firms and industries is accommodated in the proposed models. Besides, the exchange rate and interest rate coefficients are specified as being hypothetically related to firm specific accounting variables, in proposed cross-sectional regressions, to understudy the firms' factors influencing the implicit motives for hedging and elucidate the determinants of exchange rate and interest exposure. A comparative analysis of the factors that influence exchange rate exposure will then be compared to that of interest rate exposure (short-term and long-term) in the total period, while in the sub-periods, the determinants of exchange rate and interest rate exposure in the period before the euro were compared with the determinants in the period after the euro. Then since all the estimations will be carried out using the OLS model, the full results from the AR(1) EGARCH-M will be evaluated against the OLS results for comparative purposes. Subsequently, Chapter 4 examines the exchange rate and interest rate exposure at the industry level, Chapter 5 investigates exchange rate and interest rate exposure at the firm level while Chapter 6 explores the determinants of exchange rate and interest rate exposure at the firm level.

CHAPTER 4 FOREIGN EXCHANGE AND INTEREST RATE EXPOSURE OF UK INDUSTRIES: AR (1)-EGARCH-M ESTIMATES

4.1 Introduction

Most of the empirical studies on the UK that have investigated exchange rate exposure (Donnelly and Sheehy, 1996; Doidge *et al.* 2006; El-Masry, 2006a), interest rate exposure (Madura and Zarruk, 1995; Dinenis and Staikouras, 1998; Oertmann *et al.* 2000) and both exchange rate and interest rate exposure (Prasad and Rajan, 1995 and Rees and Unni, 2005) have utilized linear OLS methods. However, due to the volatility clustering, non-normal distribution and ARCH effects inherent with most financial time series data, the OLS method generally generates inefficient estimates and consequently unreliable deductions. Joseph (2002) is apparently the only known UK study that has adopted the GARCH methodology. In his empirical work, the exchange rate and interest rate exposure of 4 UK industries were investigated initially by OLS, and subsequently with the EGARCH(1,1) and EGARCH(1,1)-M models. Additionally, Joseph and Vezos (2006) pointed out that a major shortcoming of the OLS is its inability to capture the time varying properties of financial time series data. Other empirical studies have also sought to use standard GARCH type models, such as GARCH and the GARCH-M, to investigate exchange rate exposure (Chang, 2002; Fang and Thompson, 2004; Muller and Verschoor, 2006; Verschoor and Muller, 2007; Fang *et al.* 2007), interest rate exposure (Elyasiani and Mansur, 1998 and Brewer *et al.* 2007) and then both exchange rate and interest rate exposure (Koch and Saporoschenko, 2001; Joseph, 2002; Joseph, 2003a and b; Vardar *et al.* 2008). However, the limitations of these linear GARCH-type models have been documented in Nelson and Cao (1992), Koulakiotis *et al.* (2006) and

Al-Zoubi and Kh.Al-Zu'bi (2007). Therefore, utilising the asymmetric EGARCH(1,1)-M model, with an autoregressive term AR(1) term (Koutmos and Saidi, 1995; Pierre, 1998; Magnus and Fosu, 2006; and Vardar *et al.* 2008), the exchange rate and interest rate exposure of UK non-financial industries is estimated. The results for the total sample period are presented in Section 4.2. Then in Section 4.3, the sub-period analysis is segregated into the periods before and after the Euro (ECU/£ and Euro/£). Also reported in this section are the results for the change in exposure after the introduction of the Euro for the other exchange rate indices (Bank of England Trade Weighted Nominal Exchange Rate, US$/£ and JP¥/£) as well as the interest rate measures (short-term and long-term interest rate). In Section 4.4, results for the lagged changes in the independent variables are shown. Then in Section 4.5, level of exposure to exchange rates and interest rates is examined for competitive and concentrated industries. In Section 4.6, issues regarding the goodness-of-fit of the model are discussed and the chapter ends with Section 4.7 where the summary of findings is reported. Besides, a the summary of the exchange rate and interest rate exposure coefficients of UK non-financial industries, estimated using the OLS model, is presented in Appendix 12.

4.2 Descriptive Statistics

The descriptive statistics for the changes in the stock returns of non-financial industries and all the independent variables are presented in Appendix 5. All issues regarding the normality of the data are discussed at the end of the section. In addition, all the independent variables used in the study are for the total sample period except the ECU/£ which is only from 01/01/90-31/12/98 and the Euro/£ which is from 01/01/99-31/12/06. Because of this apparent difference in number of observations (in particular the ECU/£

and the Euro/£), it is essential that a full period as well as sub-period description be presented even for the dependent variable (industry returns). This has the additional benefit of revealing any changes that might have occurred between the periods. For each of the variables (including industry returns) the number of observations is 886 for the total period, 469 observations before the euro and 417 observations after the euro.

In Table A5.1, the descriptive statistics (mean and standard deviation) of the log changes in the non-financial industries weekly returns are presented for the total period and the two important sub-periods before and after the introduction of the euro. We find that 19 (61%) industries show evidence of increased weekly returns after the euro. Then the most noticeable increases occurred in Forestry and Paper with mean weekly returns before (after) the euro of -0.0008 (0.0009), then for the Mining industry, the returns were -0.0012 (0.0059) while for Pharmaceuticals and Biotechnology they were -0.0015 (0.0006).

However, industry return volatility (as reported by the standard deviation) was also higher for 23 (74%) industries after the Euro. The largest increases were for Leisure goods with a before (after) Euro standard deviation of 0.0457 (0.0872), Media with a standard deviation of 0.0449 (0.0865) and Technical Hardware and Equipment 0.0275 (0.0871). At the same time, the largest reductions in volatility were detected in Electronic and Electrical Equipment from 0.0453 to 0.0322, Pharmaceuticals and Biotechnology from 0.0469 (0.0377) and Industrial Engineering from 0.0240 to 0.0169 respectively. Overall, the volatility of non-financial industries returns which was formerly 0.0301, increased to 0.0422 after the euro, while weekly returns increased from 0.0013 to 0.0021 after the euro.

So as to evaluate the significance of the change in the industries' return variance for the sub-periods, a variance equality test or F-test is employed. The null hypothesis is that the variances in the sub-periods are equal. The test statistic is significant (at the 1%, 5% and 10% levels) for 24 (77%) non-financial industries, implying that the variance in these industry returns are different for the 2 sub-periods. The industry returns are then pooled and the variance test is repeated. The F-statistic is 1.9675 and significant at the 1% level.

Additionally, Tables A5.2 and A5.3 present the descriptive statistics for the actual and unexpected weekly changes in the independent variables. FTALLSH which is the return on the market index, BOEGBPR is the trade weighted nominal exchange rate index, US$/£ is the change in the US$ to the UK£ nominal exchange rate, JP¥/£ is the change in the JP¥ to UK£ nominal exchange rate, ECU/£ is the change in the ECU to UK£ nominal exchange rate, while Euro/£ is the change in the euro to UK£ nominal exchange rate. The short-term interest rate is measured by the UK 3-month Treasury bill while UKMBRYD is the long-term interest rate, which is measured by the UK 10-year government bond.

In Table A5.2, the results for the actual changes in the independent variables indicated that the volatility of the stock market increased after the euro, since the standard deviation increased from 0.0186 to 0.0207. This finding is synonymous to that of Bartram and Karolyi (2006), who also find that volatility increased for stock market indices in several countries, including the UK after the introduction of the Euro, but when the significance of the change in variance is assessed, the F-statistic is insignificant. However, for all the exchange rate measures and the short-term interest rate measure, the F-test indicates that the variances for the 2 sub-periods are significantly different at the 5% level (BOEGBPR), and at the 1% level (US$, JP¥/£ and UKTBTND). Consequently, there is a difference in volatility between the 2 periods.

There were also noticeable reductions in volatility for the trade weighted index, JPY/£ and US$/£ after the euro. The JP¥/£ with a standard deviation of 0.0160 was the most volatile for the total period and for both sub-periods while the trade weighted index was the least volatile in the total period and after the euro. The ECU/£ with a standard deviation of 0.0082 was the least volatile currency in the period before the euro, and also less volatile than the Euro/£, which had a standard deviation of 0.0097. For the interest rate measures, the long-term interest rate with pre (post) Euro deviations of 0.0186 (0.0200) had increased volatility after the euro, while the short-term measure had reduced volatility 0.0190 (0.0123). For the period before the euro, the short-term interest rate was more volatile while for the period after the euro, the long-term interest rate is more volatile.

However for the total period, volatility is higher for the long-term interest rate. This finding is typically different from that of Madura and Zarruk (1995), who find that volatility in the monthly changes of short-term interest rate was higher than long-term interest rate for Canada, Japan, Germany, U.S and the UK during the period 1988-1993. To further substantiate this result, a test of variance (not shown) is carried out for the total period only, to detect if there is any variance between the interest rates. The F-statistic (1.4171) is statistically significant at the 1% level, which is similar to the results reported in Madura and Zarruk (1995). The mean weekly changes for both interest rate measures were negative for all periods, apart from the period after the euro where the long-term interest rate had a positive mean.

More so, for the trade weighted nominal exchange rate index, the mean weekly log changes are positive for all the periods (total period and sub-periods) indicating that the UK pound appreciated against the trade weighted index. This finding is also the same for the US/£ total period and the period after the euro. However for the period before the euro, the mean change for the US/£ is virtually zero. Furthermore for the JP¥/£, the mean change is zero for the total period, whereas before the euro, the weekly change is negative indicating a depreciation of the UK pound against the Yen. Then for the period before the euro, the change is positive suggesting that the UK pound appreciated against the Yen.

In Table A5.3, the F-statistics are significant for all the tested exchange rate measures except the trade weighted index (BOEGBPR). In addition, both interest rate measures had significant F-statistics. There were also noticeable reductions in volatility for all the variables (with the exception of ECU/£ and Euro/£) after the Euro. The Bank of England nominal trade weighted index, with a standard deviation of 0.7859, is now the most volatile for the total period and even for both sub-periods. This finding is a sharp contrast to that of the actual changes, since the trade weighted index was the least volatile in the total period and after the euro. The ECU/£, with a standard deviation of 0.0110, maintains its position as the least volatile currency in the period before the euro, and still less volatile than the Euro/£, which now has a standard deviation of 0.0147.

The short-term interest rate measure is now less volatile than the long-term interest rate for all the periods investigated (instead of only the total period and after the euro). The variance test on the two measures has an F-statistic of 68.6188, and is also statistically significant at the 1% level of confidence.

The mean weekly log changes for the Bank of England nominal trade weighted exchange rate index and the US/£ is now negative for the total period and before the euro, while a positive mean is still reported after the euro. Notable changes have also manifested for the JP¥/£, since the mean change for the total period is negative (as against zero for the actual changes), but for the period before and after the euro, the sign of the mean changes is unaffected.

4.3 Total sample period

4.3.1 Actual and unexpected changes in exchange rates and interest rates

The AR(1)-EGARCH(1,1)-M is used to examine the responsiveness of UK non-financial industries stock returns to contemporaneous changes in exchange rates and interest rates in the total period and sub-periods. The model is specified as:

$$R_{it} = \alpha_i + \beta_{ai}R_{it-1} + \beta_{m,i}RM_t + \beta_{r,i}XR_t + \beta_{s,i}SR_t + \beta_{l,i}LR_t + \lambda\log(h^2_{i,t}) + \varepsilon_{i,t} \qquad 4.1a$$

$$\varepsilon_{i,t}|I_{t-1} \sim t(0, h^2_{i,t}, \upsilon_{i,t}) \qquad 4.1b$$

$$\log h^2_{i,t} = \alpha_o + \alpha_1\frac{\varepsilon_{i,t-1}}{h_{i,t-1}} + \alpha_2\left(\left|\frac{\varepsilon_{i,t-1}}{h_{i,t-1}}\right|\right) + \varphi_1\log h^2_{i,t-1} \qquad 4.1c$$

Equation 4.1a is the mean equation wherein, α_i is the intercept term for industry i, R_{it} is the return of industry i at time t, R_{it-1} (autoregressive lag parameter) is the returns for industry i at time t-1 accounting for autocorrelation, RM_t is the rate of return of the market portfolio at time t, XR_t is the percentage change in the exchange rate index at time t, SR_t is the change in the short term interest rate at time t and LR_t is the change in the long-term interest at time t, $\log(h^2_{i,t})$ is the log of conditional volatility and reflects the fundamental trade-off relationship between expected returns and the measure of previous conditional volatility, the coefficient λ captures the risk pattern over time and $\varepsilon_{i,t}$ is the error term.

In 4.1b, the error term, $\varepsilon_{i,t}$ has a mean 0, variance $h^2_{i,t}$ (time varying) and a t-density distribution with $\upsilon_{i,t}$ degrees of freedom, while I_{t-1} is information available at time t-1.

Equation 4.1c is the variance equation where log ($h^2_{i,t}$), the log of the conditional variance is the current volatility forecast, conditional upon the previous period's conditional variance and error. α_o is the constant term. It is the time independent component of volatility and also reflects the volatility measure when the ARCH, GARCH or other conditioning variables are not statistically significant. α_1 measures the asymmetric impact of past innovations on current volatility, therefore there are leverage effects when $\alpha_1<0$ and asymmetric effects when $\alpha_1\neq0$. α_2 is the ARCH term which links current volatility (conditional variance) to the asymmetric function of past innovations. A significant positive coefficient i.e. $\alpha_2>0$ validates the presence of volatility clustering (tendency of shocks to persist). Therefore volatility tends to rise (fall) when the absolute value of the standardised error is larger (smaller). The log $h^2_{i,t-1}$ is the past period variance and φ_1 is the GARCH term which denotes the persistence parameter that associates current volatility with past volatility. i.e. it measures the persistence of innovations on volatility (impact of old news on volatility). The system is only stable when $\varphi_1 < 1$. Generally 4.1c stipulates that the log of the conditional variance (current volatility) is an asymmetric function of last period's error (past innovations) and the log of last period's conditional variance (past volatility). Since the results for the interest rates are comparable regardless of the exchange rate index used in the model, the results regarding interest rate exposure will only be presented in the model where the TWI has been used. Additionally, only the coefficients from the mean equation are presented here, while the coefficients from the variance equation and other associated results are shown in the appendices.

Generally, all the industry stock returns are positively exposed to the market risk at the 1% level.[1] The autoregressive term is also significant for 27 (87%) industries at the 1%, 5% and 10% level indicating that for these industries, the previous period's return is a determinant of the current period's return. These results are very similar irrespective of the exchange rate index used with the interest rate factors in the model. Subsequently, the coefficients for the autoregressive parameters are only shown in Table 4.1. Also, the summary of exposure coefficients of actual and unexpected changes in the Bank of England trade weighted nominal exchange rate index, hereafter TWI, the short-term interest rate and the long-term interest rate are reported in Table 4.1. Then, for the actual and unexpected changes in the US$/£ and the JPY/£, these are presented in Table 4.2 and Table 4.3 respectively. Overall, we find that for the actual changes in the TWI, US$/£ and the JPY/£, there were 11 (35%), 13 (42%) and 3 (10%) industries with significant coefficients respectively. The results for the unexpected changes were rather similar since for the TWI, 11 (35%) industries had significant exposure coefficients although these were not all the same industries exposed to the actual changes. The results also indicated that for the US$/£, 13 (42%) industries (the same industries when actual changes were used) exhibited significant exposure coefficients. The results were slightly different for the JPY/£ as 5 (16%) industries had significant coefficients. However, these results are somewhat stronger than the results previously estimated with the OLS model (Tables A12.1 and A12.2), especially for the TWI and the US$/£ since only 9 (10) and 7 (7) industries had significant exposure coefficients for the actual

[1] For presentational purposes, the coefficients for the market risk are shown in the full results table, which is available on request.

(unexpected) changes respectively while 4 (5) industries exhibited significant exposure coefficients for the JP¥/£. Nonetheless, the incidence of significant coefficients was also predominantly positive indicating that most industries benefit from an appreciation of the pound.

Furthermore, evidence of interest rate exposure is stronger for the long-term interest rate where we find 14 (45%) industries with significant coefficients towards the actual changes and 15 (48%) industries for the unexpected changes. Then for the short-term interest exposure, 7 (23%) industries exhibited significant exposure coefficients with respect to the actual changes whereas only 5 (16%) industries were significantly exposed when unexpected changes were used instead. The result here is just marginally stronger than that found from the OLS estimates (Table A12.1) where significant exposure coefficients for the actual (unexpected) changes were 13 (13) for the long-term interest rate and 5 (3) for the short-term interest rate. Nevertheless, the significant coefficients to the long-term interest rate were mainly positive whereas the significant coefficients to the short-term interest rate were mostly negative. Usually, the finding of significant negative coefficients implies that industry returns increase (decrease) when interest rates fall (rise), whereas a significant positive coefficient suggests that industry returns increase (decrease) when interest rates rise (fall). The result from the OLS estimates also substantiates this finding.

Also included in the mean equation is the risk-return trade off parameter explained by the coefficient λ, which measures the relationship between industry returns and volatility. If the parameter is positive and statistically significant, this implies that increase in volatility is compensated for by a higher average return (increased risk leads to an increase in the conditional variance which invariably leads to a rise in the mean return).

Consequently industry returns will fluctuate in response to changes in the volatility of the returns. Retrospectively, all the models are estimated with the same interest rate factors but different exchange rate factors. Therefore, it will be more insightful if the explanations on the risk-return parameter, and even other estimated parameters in the variance equation, are also explained on the basis of the exchange rate factor used in the model. In the model using actual and unexpected TWI, actual US$/£, 5 industries (Construction and Materials, Industrial Engineering, Industrial Transport, Mobile Telecommunications and Personal Goods) have significant trade-off parameters. Although the industries are the same, the magnitude and level of significance sometimes varied. Then for the unexpected US$/£ and actual JPY/£, only 4 industries (Construction and Materials, Industrial Engineering, Mobile Telecommunications and Personal Goods) had significant trade-off parameters. Furthermore, all the industries (mentioned above) except Industrial Engineering had an expected significant positive coefficient indicating that increased volatility is compensated for by a higher average return. The finding of a significant negative coefficient for the Industrial Engineering industry is similar to that reported in Joseph (2002). The results for the unexpected JPY/£ also indicate that 5 industries had significant risk trade-off parameters. These included the 4 industries when the actual JPY/£ was used (sign of coefficients for the industries are the same but magnitude varied) and the Electricity industry which also had a significant negative coefficient. Besides, Koulakiotis *et al.* (2006) also found a significant negative volatility coefficient relationship between FTSE100 stock prices returns and volatility.

On average, the significant risk parameter, when positive, has a higher magnitude in models where actual changes have been used, but when unexpected changes are used instead, the magnitude of the significant negative coefficient is marginally higher.

Furthermore, we find that the volatility of industry returns using the TWI was highest for Industrial Transport with actual (unexpected) volatility coefficients of 0.3360 (0.1395). This result was similar for the actual US$/£, since the volatility for Industrial Transport was highest with 0.1606. In contrast, the volatility parameter was insignificant for Industrial Transport for both actual and unexpected changes in the JP¥/£. But the Construction and Materials Industry, with risk premium coefficients of 0.0025 (0.0023) for actual (unexpected) changes, was the most volatile instead. On the whole, the number of industries with significant risk premium coefficients is considerably low. But, the industries with statistically insignificant positive coefficients are predominantly higher. We therefore posit that for most UK industries, increased risk will not necessarily lead to an increase in the returns

Engle *et al.* (1987) explain that the sign and magnitude of the trade-off coefficient λ is dependent on investors' utility function for risk preference and the net supply condition of the asset. Elyasiani and Mansur (1998) and Taing and Worthington (2005) point out that λ is a measure of total risk (systematic and unsystematic risk), therefore an increase in volatility is not always followed by an increase in the risk premium. Invariably if fluctuations in volatility are as a result of shocks to the unsystematic risk, then the trade-off parameter can be of any sign. Elyasiani and Mansur (1998) and Ryan and Worthington (2004) find negative risk parameters for banks in their study. They posit that if banks are not strongly affected by random shocks like other sectors then investors might switch over to bank stocks so as to steer clear of sectors that are highly affected. This changeover will result to lower bank stock premia. Furthermore, Glosten *et al.*(1993) provide further support for a negative relationship between the trade-off risk parameter and return. In the first instance, periods of higher risk may coincide with period when investors are able to bear the risk more, and then if investors decide to save more during period of higher volatility and assets are predominantly risky, competition may increase prices thereby leading to a reduction in the risk premium. Overall, findings for the trade-off between volatility and returns have been mixed, since Glosten *et al.* (1993), Campbell (1987) and Bree *et al.* (1989) found negative risk parameter coefficients, French *et al.*, (1987) and Campbell and Hentschel (1992) find significant positive coefficients, whereas Baillie and DeGennaro (1990), Chan *et al.* (1992), Joseph (2003b) and Léon (2008) find no statistical significance for the risk parameter.

Tables A6.1, A6.2 and A6.3 in Appendix 6 reports the estimated parameters from the variance equations in all the models estimated with the TWI, US$/£ and JP¥/£, respectively. In brief, the constant term (α_o) represents the time independent component of volatility. In all the models using either the actual or unexpected changes in the TWI, US$/£ and JP¥/£ (in conjunction with the interest rate parameters), α_0 is negative and significant for all the industries except the Forestry and Paper and Pharmaceuticals and Biotechnology industries. The result of significant α_0 coefficients implies that the volatility of these industries returns is made up of time-independent components. Even then, for almost all of the industries with significant time-independent components (significant constant term), the ARCH (α_1) and GARCH (φ_1) parameters are significant, thereby indicating that the volatility of these industries' returns also comprises of significant time dependent components. Then, more importantly, we discuss the results for α_1 which measures the asymmetric impact of past innovations on current volatility. This measure is further segregated (depending on the sign) into leverage effects when $\alpha_1<0$ and asymmetric effects when $\alpha_1\neq0$. But when $\alpha_1= 0$, then the effects of negative or positive surprises on volatility of returns are of the same magnitude.

The results indicate that for the actual and unexpected TWI models, 12 (39%) industries have significant coefficients. These industries were: Automobiles and Auto Parts, Chemicals, Electronic and Electrical Equipment, General Industrial, Household Goods, Industrial Transport, Oil Equipment and Services, Software and Computer Services, Support Services, Technical Hardware and Equipment, Tobacco and Travel and Leisure. Out of all these, only the Software and Computer Services industry had a significant positive coefficient. The finding of significant negative coefficients follows the usual interpretation that lower stock prices reduce the value of equity relative to corporate debt and a sharp decrease in stock prices increases the level of corporate leverage and consequently the risk of holding stocks (Bollerslev *et al.*, 1992 and Joseph, 2006). Another explanation inherent for leverage effects in Joseph (2002) and Magnus and Fosu (2006) is that unexpected bad news increases predictable volatility of industry returns more than unexpected good news. Therefore, from the perspective of exchange rate and interest rate effects, a sharp contrary movement or negative increase in these measures makes industry returns more volatile or risky. Interestingly only 2 industries (Electronic and Electrical Equipment and Tobacco) out of the 12 industries with significant leverage/asymmetric effect coefficients had significant exposure coefficients for the TWI. The other 10 industries had significant coefficients for actual (unexpected) changes in either the short-term or long-term interest rate but most especially the long-term interest rate measure. This suggests that volatility might be influenced more by changes in long-term interest rates. For the Software and Computer Services industry, the significant positive α_1 indicates that good news has a higher impact on volatility of returns than that of bad news i.e. volatility is higher during a market boom than when the market declines. Apparently, this is the only industry with significant exposure coefficients with regards to both the short-term and long-term interest rate measures. The result of a significant positive asymmetric coefficient is similar to that of Koutmos *et al.* (1993) who also found for the Athens Stock Exchange that good news or positive innovations had a more pronounced effect on volatility than negative innovations.

Additionally, Koutmos and Knif (2002) also found evidence of asymmetric effects from their study on Finnish industry portfolios. Léon (2008) explains that this might be attributable to the fact that investors believe that market booms are not supported by economic fundamentals and that market returns behave as speculative bubbles. Additionally, Glen (2005) points out that financial assets sometimes go through periods of boom where explosive upward movements engender unsustainable prices, which may persist for a while and then are followed by a market crash (bust). Theoretically, bubbles appear to be at odds with efficient markets since prices are not supposed to distinctly deviate from fundamental value. Nevertheless, for other industries where the α_1 coefficient was insignificant, the effects of positive or negative surprises on the industry volatility is of the same magnitude. Inherently, a contrary movement in exchange rates or interest rates does not appear to make the returns of these industries more risky.

The results for the leverage parameter in the actual US$/£ model (Table A6.2) was similar to that of the TWI in terms of industries with significant parameters but with regards to magnitude, the parameter was higher for 8 industries (Chemicals, Electronic and Electrical Equipment, Household Goods, Industrial Transport, Support Services, Technical Hardware and Equipment, Tobacco and Travel and Leisure) in the actual US$/£ models. This result is also comparable with the unexpected US$/£ except that the leverage coefficient for Industrial Transport was statistically insignificant. But for both the actual and unexpected US$/£ model, all significant leverage parameter coefficients are negative except that of the Software and Computer Services Industry which is positive. In Table A6.3, the results for the actual and unexpected JP¥/£ models are similar to that of the unexpected US$/£ since the same industries have significant coefficients. But a minor difference for the unexpected JP¥/£ model is that the Food and Drug Retailers industry has a significant negative coefficient. Furthermore, the magnitude of the leverage parameter is mostly higher than that of the TWI model but mainly lower than that of US$/£ model. On the whole, the magnitude of the leverage coefficient was higher for most industries in the actual and unexpected US$/£ models.

The ARCH term denoted by α_2 links current volatility (conditional variance) to the asymmetric function of past innovations. A significant positive coefficient i.e. $\alpha_2>0$ validates the presence of volatility clustering (tendency of shocks to persist) signifying that conditional volatility has a propensity to rise (fall) when the absolute value of the standardised error is larger (smaller).

In Tables A6.1, A6.2 and A6.3, almost all the industries with the exception of Forestry and Paper, Industrial Transport and Pharmaceuticals and Biotechnology have significant positive coefficients therefore indicating the presence of volatility clustering. The tables also disclose the GARCH term (φ_1), which represents the persistence parameter and associates current volatility with past volatility. In all the actual and unexpected models (TWI, US$ and JP¥), mainly all the industries have significant positive coefficients except 3 industries (Forestry and Paper, Industrial Transport and Pharmaceuticals and Biotechnology) which also had insignificant ARCH parameters.

Besides, for the actual and unexpected TWI, US$/£ and JP¥/£, the estimate for the Leisure Goods industry does not satisfy the condition that $\varphi_1 < 1$ implying that the system might not be too stable since shocks to persistence over time are indefinite. Then for the Media industry, $\varphi_1 < 1$ is violated but only in the models for unexpected US$/£, actual and unexpected JP¥/£. Nonetheless, in all the models, the persistence of volatility is very high and close to one as it ranges from 0.9260 - 0.9999, suggesting that volatility has a long memory (once volatility increases, it may probably remain high over several periods). The finding of predominantly significant α_2 and φ_1 coefficients indicates that current volatility of industry returns (conditional variance) is time varying, is a function of past innovations and past volatility.

Furthermore, the magnitude of significant persistence parameters (GARCH parameter) was higher than that of the significant ARCH parameter in all the models (TWI, US$/£ and JP¥/£) implying that the market has a memory longer than one period, volatility is more sensitive to old news (its own lagged value) than it is to news about volatility from the previous period (recent surprises in the market). Although it was observed that for most industries, the magnitude of the conditional variance tends to vary with the exchange rate index in the model.

A more intuitive measure of persistence is the half-life of an innovation calculated by $\ln(0.5)/\ln(\varphi_1)$ and represents the duration of time in weeks it takes for half the magnitude of a unit of shock to the returns to dissipate (Koutmos and Saidi, 1995 and Saatcioglu *et al.*, 2007). Therefore, using the coefficients from Tables A6.1, A6.2 and A6.3, the effects of positive and negative innovations (news) on volatility can be determined by α_2 $(1- \alpha_1)$ and α_2 $(1+ \alpha_1)$ respectively. Then utilising $\alpha_2 (1+ \alpha_1) / \alpha_2 (1- \alpha_1)$, will generate the ratio by which negative innovations increase volatility more than positive innovations.

As shown in Table A6.4 in Appendix 6, on average, negative innovations have about 1.1 times as large an effect on volatility as positive innovations. The ratio found in this section is relatively smaller than that of Koutmos and Saidi (1995) which found an average of 2.1 for the daily stock returns of 30 companies from the Dow Jones Industrial Index and Schwert (1990) which reported an average of 2.5 for the US stock market. We posit that this difference might have been influenced by their use of daily data. Using the measure of half-life, we find that the highest persistence is for the Software and Computer Services Industry with average half-life of 419 weeks whereas the lowest persistence was for the Beverages industry with average half-life of approximately 10 weeks.

Incidentally, volatility persistence in the returns of UK industries is relatively high, but some industries are better able to absorb the volatility more than others. We attribute the finding of high persistence of volatility to the use of weekly data and which may have also been exacerbated by an increase in exchange rate and interest rate risk.

4.4 Sub-period analysis

4.4.1 Exchange rate exposure to the ECU vs. Euro

The sensitivity of industries' returns to exchange rate exposure (ECU/£ and Euro/£) is also examined using equation 4.1a-4.1c. For the period before the euro (01/01/90-31/12/98), the ECU/£ is employed as the exchange rate measure while for the period after the Euro (01/01/99-31/12/06), the Euro/£ is used instead.

The impact of the introduction of the euro on other exchange rate indices (TWI, US$/£ and JP¥/£) and interest rate indices (short-term and long-term interest rate) is examined in the next section.

Table 4.1 A summary of non-financial industries' exposure to actual changes in the Trade weighted nominal exchange rate, short-term interest rate and long-term interest rate of the total sample period from January 1990 to December 2006 - Estimated coefficients from the mean equation

	ACTUAL BOEGBPR					UNEXPECTED BOEGBPR				
INDUSTRY	λ	INDt-1	BOEGBPR	UKTBTND	UKMBRYD	λ	INDt-1	BOEGBPR	UKTBTND	UKMBRYD
Aerospace and Defence	0.0008	0.1251***	0.0230	0.0106	0.0530	0.0007	0.1231***	0.0003	0.0127	0.0094*
Automobiles and Auto Parts	0.0002	0.1436***	-0.0377	0.0035	0.1470***	0.0002	0.1433***	-0.0004	0.0030	0.0174***
Beverages	0.0008	0.1178***	0.0889*	-0.0131	-0.0134	0.0009	0.117***	0.0010*	-0.0083	-0.0011
Chemicals	0.0007	0.2001***	0.0776	-0.0197	0.0550*	0.0007	0.2023***	0.0007	-0.0016	0.0045
Construction And Materials	0.0025***	0.1023***	0.0758	-0.0478	0.0588***	0.0022**	0.1057***	0.0010*	-0.0448	0.0070**
Electricity	-0.0038	-0.0017	0.2093**	-0.0110	-0.1448***	-0.0036	-0.0038	0.0023**	-0.0183	-0.0182***
Electronic And Electrical Equipment	0.0004	0.1897***	0.10898*	-0.0381	0.0689**	0.0001	0.1917***	0.0013**	-0.0387	0.0073**
Fixed-line Telecommunications	-0.0009	-0.1079***	-0.0982	0.0809	0.0098	-0.0010	-0.1076***	-0.0011	0.1004*	0.0007
Food and Drug Retailers	-0.0004	-0.0248	0.1950**	0.0460	-0.0738*	-0.0004	-0.0240	0.0019**	0.0481	-0.0127**
Food Producers	-0.0005	0.0450*	-0.0596	0.0212	-0.0824***	-0.0005	0.0479**	-0.0007	0.0274	-0.0115***
Forestry And Paper	-0.0014	0.0545**	0.0704	-0.0368	0.0019	-0.0013	0.0543**	0.0008	-0.0263	0.0002
Gas, Water and Multi-Utilities	-0.0025	-0.023633	0.1523*	-0.0328	-0.2434***	-0.0019	-0.0257	0.0013	-0.0583	-0.0387***
General Industrial	0.0013	0.05202**	-0.0888	-0.0643*	0.0215	0.0013	0.0535**	-0.0011	-0.0425	0.0005
General Retailers	0.0007	0.1479***	0.1547**	0.0305	0.0197	0.0004	0.1465***	0.0017**	0.0455	0.0011
Healthcare Equipment and Services	0.0010	0.0728***	0.0139	0.0288	0.0089	0.0009	0.0713***	0.0002	0.0312	0.0052
Household Goods	0.0023	0.0739***	-0.0030	-0.1069**	0.0296	0.0026	0.0766***	0.0001	-0.0900*	0.0037
Industrial Engineering	-0.0018*	0.3429***	0.0390	0.0043	0.0268	-0.0018*	0.3427***	0.0004	0.0087	0.0043
Industrial Transport	0.3360***	0.4989***	0.0088	-0.0083	0.0775***	0.1395***	0.4945***	0.0001	-0.0096	0.0104**
Leisure Goods	-0.0011	0.0629***	0.0818	-0.0873*	0.1854***	-0.0012	0.0646***	0.0011	-0.0980*	0.0255***

Table 4.1 continued A summary of non-financial industries' exposure to actual changes in the Trade weighted nominal exchange rate , short -term interest rate and long-term interest rate of the total sample period from January 1990 to December 2006 - Estimated coefficients from the mean equation

	ACTUAL BOEGBPR					UNEXPECTED BOEGBPR				
INDUSTRY	λ	INDt-1	BOEGBPR	UKTBTND	UKMBRYD	λ	INDt-1	BOEGBPR	UKTBTND	UKMBRYD
Media	-0.0011	0.0641***	0.0803	-0.0858*	0.1870***	-0.0012	0.0655***	0.0011	-0.0970*	0.0255***
Mining	0.0027	0.0148	-0.2743**	0.0051	0.1629***	0.0025	0.0147	-0.0029**	0.0209	0.0219***
Mobile Telecommunications	0.0015**	0.1172***	0.1543***	0.0029	0.0212	0.0015**	0.1168***	0.0015***	0.0039	0.0012
Oil and Gas Producers	-0.0011	-0.0731***	-0.3444***	-0.0361	0.0541	-0.0010	-0.0716***	-0.0036***	-0.0334	0.0094*
Oil Equipment And Services	0.0007	0.1198***	0.1210	0.0856*	0.0543	0.0004	0.1181***	0.0017	0.0672	0.0068
Personal Goods	0.0012**	0.1683***	0.0415	-0.0208	0.0224	0.0012**	0.1691***	0.0005	-0.0133	0.0028
Pharmaceuticals and Biotechnology	0.4007	0.2839**	0.1637*	-0.1077**	0.0289	1.0335	0.376***	0.0017*	-0.1397***	0.0011
Software and Computer Services	0.0013	0.0988***	0.0517	-0.0863*	0.1651***	0.0015	0.099***	0.0007	-0.0790	0.0222***
Support Services	0.0009	0.1870***	0.0442	0.0022	-0.0224	0.0009	0.1892***	0.0005	0.0080	-0.0046
Technical Hardware and Equipment	-0.0010	0.1306***	0.1076	0.0398	0.0505	-0.0010	0.1301***	0.0013	0.0390	0.0058
Tobacco	0.0012	-0.1370***	-0.2660***	-0.0003	-0.2177***	0.0020	-0.1369***	-0.0031***	-0.0139	-0.0249***
Travel and Leisure	-0.0005	0.0659**	0.1014	-0.0421	-0.0137	-0.0004	0.0666**	0.0011	-0.0476	-0.0016

Note: λ is the risk-return trade-off parameter coefficient, INDt-1 is the autoregressive lag parameter. BOEGBPR represents the trade weighted nominal exchange rate exposure coefficient while UKTBTND and UKMBRYD are the exposure coefficients for the 3 Month TB and 10 Year GB respectively. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

Table 4.2 A summary of non-financial industries' exposure to actual changes and unexpected changes in the foreign exchange rate US$/£ for total sample period from January 1990 to December 2006 - Estimated coefficients from the mean equation

	ACTUAL US$/£		UNEXPECTED US$/£	
INDUSTRY	λ	US$/£	λ	US$/£
Aerospace and Defence	0.0008	0.0371	0.0007	0.0216
Automobiles and Auto Parts	0.0001	0.0007	0.0001	-0.0045
Beverages	0.0009	0.0641*	0.0009	0.0352*
Chemicals	0.0007	0.0875**	0.0007	0.0432*
Construction And Materials	0.0024**	-0.0049	0.0021**	0.0013
Electricity	-0.0036	0.1282**	-0.0038	0.0838**
Electronic And Electrical Equipment	0.0004	0.1064***	0.0003	0.0655***
Fixed-line Telecommunications	-0.0009	-0.0370	-0.0009	-0.0182
Food and Drug Retailers	-0.0001	0.1728***	-0.0001	0.1080***
Food Producers	-0.0005	-0.0129	-0.0004	-0.0081
Forestry And Paper	-0.0013	0.0075	-0.0013	-0.0020
Gas, Water and Multi-Utilities	-0.0024	0.1003*	-0.0018	0.0611*
General Industrial	0.0012	0.0122	0.0013	-0.0065
General Retailers	0.0007	0.0611	0.0007	0.0259
Healthcare Equipment and Services	0.0009	0.0218	0.0010	0.0090
Household Goods	0.0023	0.0033	0.0026	-0.0050
Industrial Engineering	-0.0019*	0.0227	-0.0018*	0.0120
Industrial Transport	0.1606***	0.0745*	0.2408	0.0481*
Leisure Goods	-0.0011	0.1769**	-0.0012	0.1195***
Media	-0.0011	0.1801***	-0.0012	0.1192***
Mining	0.0028	-0.0881	0.0027	-0.0480
Mobile Telecommunications	0.0016**	0.0574	0.0016**	0.0249
Oil and Gas Producers	-0.0012	-0.2607***	-0.0011	-0.1493***
Oil Equipment And Services	0.0007	0.0324	0.0005	0.0349
Personal Goods	0.0012**	-0.0199	0.0012**	-0.0128
Pharmaceuticals and Biotechnology	0.8717	0.1221*	0.4265	0.0699*
Software and Computer Services	0.0012	0.0079	0.0015	0.0084
Support Services	0.0009	0.0393	0.0009	0.0211
Technical Hardware and Equipment	-0.0010	0.0244	-0.0009	0.0095
Tobacco	0.0011	-0.2172***	0.0021	-0.1242***
Travel and Leisure	-0.0004	0.0980*	-0.0003	0.0609*

Note: λ is the trade-off parameter coefficient, US$/£ refers to the US$ exchange rate exposure coefficient. ***,** and * signifies statistical significance at the 1%, 5% and 10% level respectively.

Table 4.3: A summary of non-financial industries' exposure to actual changes and unexpected changes in the foreign exchange rate JP¥/£for total sample period from January 1990 to December 2006 - Estimated coefficients from the mean equation

	ACTUAL JP¥/£		UNEXPECTED JP¥/£	
INDUSTRY	λ	JP¥/£	λ	JP¥/£
Aerospace and Defence	0.0008	0.0100	0.0007	0.0001
Automobiles and Auto Parts	0.0001	0.0310	0.0001	0.0002
Beverages	0.0008	0.0183	0.0008	0.0000
Chemicals	0.0007	0.0105	0.0006	0.0001
Construction And Materials	0.0025***	0.0319	0.0023**	0.0002*
Electricity	-0.0037	0.0537	-0.0041*	0.0003
Electronic And Electrical Equipment	0.0003	0.0284	0.0001	0.0002
Fixed-line Telecommunications	-0.0008	-0.0846	-0.0009	-0.0004*
Food and Drug Retailers	-0.0004	0.0290	-0.0003	0.0001
Food Producers	-0.0005	-0.0175	-0.0005	-0.0001
Forestry And Paper	-0.0011	0.0128	-0.0013	0.0000
Gas. Water And Multi-Utilities	-0.0023	0.0964**	-0.0018	0.0005**
General Industrial	0.0013	-0.0279	0.0013	-0.0001
General Retailers	0.0007	0.0238	0.0007	0.0001
Healthcare Equipment and Services	0.0010	-0.0193	0.0010	-0.0001
Household Goods	0.0023	-0.0018	0.0026	0.0000
Industrial Engineering	-0.0019*	0.0286	-0.0018*	0.0002
Industrial Transport	0.3405	0.0205	0.2457	0.0001
Leisure Goods	-0.0011	0.0721	-0.0012	0.0005
Media	-0.0011	0.0742	-0.0012	0.0005
Mining	0.0030	-0.0090	0.0027	-0.0001
Mobile Telecommunications	0.0016**	0.0061	0.0015**	0.0000
Oil and Gas Producers	-0.0013	-0.1026**	-0.0012	-0.0005**
Oil Equipment And Services	0.0007	0.0387	0.0006	0.0002
Personal Goods	0.0012**	0.0426	0.0012**	0.0002
Pharmaceuticals and Biotechnology	0.4820	0.0024	0.9659	0.0001
Software and Computer Services	0.0012	-0.0044	0.0015	0.0001
Support Services	0.0009	0.0083	0.0010	0.0000
Technical Hardware and Equipment	-0.0010	0.0278	-0.0009	0.0000
Tobacco	0.0009	-0.1432***	0.0016	-0.0007***
Travel and Leisure	-0.0004	0.0442	-0.0004	0.0002

Note: λ is the trade-off parameter coefficient, JP¥/£ is the JP¥ exchange rate exposure coefficient. ***,** and * signifies statistical significance at the 1%, 5% and 10% level respectively.

The results from the mean equation for the actual changes in ECU/£ presented in Table 4.4 shows that 5 (16%) industries have significant exchange rate exposure coefficients while for the unexpected changes, we find 6 (19%) industries with significant coefficients. Then in Table 4.5, we find that with regards to the actual changes in the Euro/£, 4 (13%) industries have significant exchange rate exposure coefficients whereas when unexpected changes were used, only 3(10%) industries had significant exposure coefficients. But some of the industries that exhibited significant exposure coefficients when the actual changes were incorporated into the model were not the same industries with significant coefficients when the unexpected changes were used and vice versa. These results are fairly comparable to that of the OLS (Table A12.3) since 6 (7) industries had significant coefficients for the actual (unexpected) ECU/£ whilst 4 (2) industries had significant exposure coefficients for the Euro/£. Although the difference in the incidence of significant exposure coefficients between the ECU/£ and Euro/£ is not relatively high, but it still provides some evidence that exchange rate stabilisation was more evident in the period after the introduction of the euro. Next, the autoregressive term is significant for 25 (81%) industries for the actual and unexpected ECU/£ but this was dramatically reduced to 13 (42%) industries for the Euro/£. This outcome suggests that in the period after the euro, the returns of most industries were generally less predictable. Also from the actual changes in the ECU/£ mean equation, we find that 8 industries (Automobiles and Auto Parts, Beverages, Construction and Materials, Food Producers, Healthcare Equipment and Services, Mobile Telecommunications, Personal Goods and Technical Hardware and Equipment) have significant coefficients in relation to the risk-return parameter.

But this coefficient was negative for the Food Producers and Technical Hardware and Equipment industries.

The results for the unexpected ECU/£ was somewhat similar. 9 industries, which were the same industries reported for the actual ECU/£ and the Oil Equipment and Services industry, had a significant positive coefficient. Also, the magnitude of these coefficients were higher for 6 industries when the unexpected ECU/£ was used in the model. The finding of significant positive coefficients follows the usual interpretation that increased volatility is compensated for by a higher average return while a significant negative coefficient implies that increase in volatility tends to reduce returns. Furthermore, volatility of risk/return was highest for the Automobiles and Auto Parts industry with actual (unexpected) volatility coefficients of 0.0465 (0.0511) respectively. This was closely followed by the Healthcare and Equipment industry with actual (unexpected) coefficients of 0.0401 (0.0429).

On the other hand, for the actual changes in the Euro/£, we find 10 industries with significant risk return coefficients. These comprised of 4 industries (Food and Drug Retailers, Forestry and Paper, Support Services and Travel and leisure) with significant positive coefficients, whereas 6 industries (Electricity, Electronic and Electrical Equipment, Industrial Transport, Leisure Goods, Media and Mining) had significant negative coefficients. Interestingly, none of these industries had significant risk/return coefficients for the actual changes in the ECU/£.

The results of the unexpected Euro/£ are fairly different from that reported for the actual Euro/£. Again, we find 10 industries with significant coefficients, but only 2 industries (Support Services and Travel and Leisure) have significant positive coefficients while 8 industries (Chemicals, Electricity, Electronic and Electrical Equipment, Forestry and Paper, Industrial Engineering, Industrial Transport, Leisure Goods and Media) have significant negative coefficients. The prevalence of negative coefficients clearly contrasts the results reported for the ECU/£ where the coefficients were predominantly positive. Then the relatively high positive coefficient of 0.0054 for the Forestry and Paper industry when actual changes were used became a negative coefficient of -0.0049 when unexpected changes were used instead. In addition, for the actual Euro/£, the effect of volatility on return was more detrimental for the Industrial Transport industry with a coefficient of -0.1469 whereas for the unexpected Euro/£, the Chemicals industry with a coefficient of -0.2710 was affected the most.

In Tables A6.5 and A6.6, the results of the variance equation are presented for the ECU/£ and Euro/£ respectively. In brief, for the constant term (α_0), 23 (74%) industries had significant negative coefficients for the actual and unexpected ECU/£, whereas for the Euro/£, we find 26 (84%) industries with significant negative coefficients respectively indicating that for these industries, there is a significant time-invariant component in the return generating process. Then more importantly, the results for the asymmetric term (α_1) shows that for the actual ECU/£, 11 industries (35%) had significant coefficients. These were Chemicals, Construction and Materials, Electronic and Electrical Equipment, Food and Drug Retailers, Healthcare and Equipment Services, Household Goods, Mining, Support Services which have significant negative coefficients while for the Beverages, Oil and Gas Producers and Technical Hardware and Equipment industries, significant positive coefficients were found instead. This result was slightly different for the unexpected changes as 13 industries exhibited significant coefficients. These included all the 11 industries listed for the actual changes, plus the Food Producers industry which had a positive coefficient and the Travel and Leisure industry with a significant negative coefficient.

For the actual changes in the Euro/£, 12 industries (39%) had significant coefficients, 5 of which also had significant coefficients for the ECU/£. 3 of these industries (Food and Drug Retailers, Household Goods, and Support Services) have negative coefficients (which was the same for the ECU/£) but the Electronic and Electrical Equipment and Mining industry now have positive coefficients which is of the opposite sign for the ECU/£. Other industries with significant negative coefficients were Automobiles and Auto Parts, Food Producers, Gas, Water and Multi-Utilities, Industrial Engineering, Oil Equipment and Services and Travel and Leisure, while Industrial Transport has a significant positive coefficient.

The results for the unexpected Euro/£ were fairly similar. 14 industries had significant coefficients, 12 of which were the same as the actual Euro/£ while the other 2 industries were Chemicals and Healthcare Equipment and Services which had significant positive and negative coefficients, respectively. Generally there were predominantly more significant negative coefficients than positive coefficients. These are summarised as follows: negative (positive) coefficients for actual ECU/£ was 8 (3), unexpected ECU/£ were 9 (4), actual Euro/£ were 9 (3) while unexpected Euro/£ these were 10 (4) significant coefficients respectively.

In addition, for the ARCH term (α_2), 15 (14) industries had significant coefficients for the actual (unexpected) ECU/£. All of these coefficients were positive i.e. $\alpha_2 >$

0. Then for actual (unexpected) Euro/£, we find significant coefficients for 19 (18) industries. Almost all of these industries had positive coefficients with the exception of Food Producers and Industrial Engineering industries which had negative coefficients with regards to both actual and unexpected Euro/£, then the Tobacco industry also had a negative coefficient but for the actual Euro/£ only, and Food and Drug Retailers exhibited a significant negative coefficient for the unexpected Euro/£ only. The finding of significant negative coefficients seems to counteract the features of volatility clustering in financial time series data since it implies that conditional volatility has a propensity to rise(fall) when the absolute value of the standardised residual is smaller (larger). The results for the persistence parameter (φ_1) indicate that only 19 (21) industries have significant coefficients for the actual (unexpected) changes in the ECU/£ respectively whereas for the actual and unexpected Euro/£, 25 industries had significant coefficients in each model.

Specifically, for the Aerospace and Defence industry, the persistence coefficient does not satisfy the condition that $\varphi < 1$ for both the actual and unexpected changes in the ECU/£. Therefore the time varying variance process is not stable. In addition, Healthcare Equipment and Services have significant negative coefficients for both the actual and unexpected ECU/£ whereas the Construction and Materials industry (coefficient for unexpected changes negative but statistically insignificant) and Gas, Water and Multi-Utilities industries (coefficient for unexpected changes positive and significant) have significant negative coefficients with respect to the actual ECU/£ only. Consequently for these industries, volatility does not seem to persist. Nonetheless, Fixed-Line

Telecommunications had the lowest persistence coefficient of 0.6905 (0.6754) for actual (unexpected) changes whereas Support Services with 0.9946 (0.9951) has the highest persistence coefficient suggesting that impact of old news on volatility is greatest for this industry.

Regarding the Euro/£, Aerospace and Defence industry had a significant negative persistence coefficients for actual and unexpected changes, while Forestry and Paper had a significant negative coefficient with regards to the actual changes only. Then for Food Producers, the persistence coefficient was not stable since the condition $\varphi < 1$ was not satisfied in the models for the actual and unexpected changes in the Euro/£. Generally, the persistent parameters were very high in comparison to the ECU/£ ranging from 0.9163-0.9979 with the exception of Forestry and Paper which has a value of 0.6251 for actual Euro/£ and Oil Equipment and Services Industry with 0.7185 (0.7268) for actual (unexpected) Euro/£, respectively. Even so, volatility persistence was highest for Oil and Gas Producers, Software and Computer Services and Electricity Industries suggesting that volatility in these industries might remain higher over several periods. However, these industries had insignificant persistence coefficients for the actual and unexpected ECU/£.

Table 4.4 A summary of non-financial industries exposure to actual and unexpected changes in the foreign exchange rate ECU for the sample period before the Euro 01/01/90-31/12/98 - Estimated coefficients from the mean equation

	ACTUAL CHANGES IN ECU/£			UNEXPECTED CHANGES IN ECU/£		
INDUSTRY	λ	INDt-1	ECU/£	λ	INDt-1	ECU/£
Aerospace and Defence	-0.0008	0.2383***	-0.0134	-0.0007	0.2371***	-0.0129
Automobiles and Auto Parts	0.0465***	0.5058***	-0.1409*	0.0511***	0.5067***	-0.1331**
Beverages	0.0035**	0.0928**	0.0248	0.0033**	0.0963**	0.0160
Chemicals	0.0010	0.2137***	0.0973	0.0011	0.2204***	0.0705
Construction And Materials	0.0334**	0.4796***	0.0588	0.0355**	0.4937***	0.0445
Electricity	-1.9624	-0.0183	0.1226	-1.2828	-0.0160	0.0939
Electronic And Electrical Equipment	-0.0004	0.2523***	0.0237	-0.0007	0.2569***	0.0036
Fixed-line Telecommunications	0.0087	-0.1288***	-0.1370	0.0090	-0.1272***	-0.0944
Food and Drug Retailers	-0.0014	-0.0397	0.1333	-0.0013	-0.0403	0.0863
Food Producers	-0.0044**	-0.0115	-0.0438	-0.0046**	-0.0115	-0.0393
Forestry And Paper	-156.8848	0.0640	0.0477	-4.2283	0.0415	0.0210
Gas, Water And Multi-Utilities	-4.6922	-0.0400	0.1409	-11.0091	-0.0275	0.1368
General Industrial	0.1059	0.2013***	-0.1710*	0.1460	0.2117***	-0.1309*
General Retailers	0.0004	0.1569***	0.1324*	0.0001	0.1595***	0.0772
Healthcare Equipment and Services	0.0401*	0.3702***	0.0080	0.0429*	0.3771***	0.0104
Household Goods	-0.0029	0.1156***	-0.0209	-0.0028	0.1206***	-0.0085
Industrial Engineering	-0.0020	0.3705***	0.1207**	-0.0020	0.3755***	0.0847*
Industrial Transport	0.0771	0.4586***	-1.1067	0.0828	0.4509***	-0.0998*
Leisure Goods	-0.0024	0.0901**	-0.1472	-0.0026	0.0919**	-0.0939

Table 4.4 continued A summary of non-financial industries exposure to actual and unexpected changes in the foreign exchange rate ECU/£ for the sample period before the Euro 01/01/90-31/12/98 - Estimated coefficients from the mean equation

	ACTUAL CHANGES IN ECU/£			UNEXPECTED CHANGES IN ECU/£		
INDUSTRY	λ	INDt-1	ECU/£	λ	INDt-1	ECU/£
Media	-0.0025	0.0917**	-0.1588	-0.0026	0.0929**	-0.1030
Mining	0.0015	0.0013	-0.1997	0.0006	0.0028	-0.1691
Mobile Telecommunications	0.0029*	0.1866***	0.1093	0.0031*	0.1893***	0.0919*
Oil and Gas Producers	0.0027	-0.1026**	-0.1341	0.0028	-0.1041***	-0.0933
Oil Equipment And Services	0.2111	0.7167***	0.0509	0.2557**	0.7559***	0.0293
Personal Goods	0.0018*	0.2503***	0.0915*	0.0018*	0.2522***	0.0653*
Pharmaceuticals and Biotechnology	1.0405	0.3435***	0.0757	10.6817	0.3277**	0.0528
Software and Computer Services	0.0862	0.4698***	0.0608	0.0951	0.4743***	0.0354
Support Services	0.0001	0.2214***	0.0115	0.0004	0.2197***	-0.0038
Technical Hardware and Equipment	-0.0861***	0.378***	0.0927	-0.1110***	0.3868***	0.0527
Tobacco	0.0013	-0.1517***	-0.1506	0.0012	-0.1504***	-0.1203
Travel and Leisure	0.0019	0.1497***	0.1400	0.0014	0.1258***	0.0589

Note: λ is the risk-return trade-off parameter coefficient, INDt-1 is the autoregressive lag parameter, ECU/£ is the exchange rate exposure coefficient for the ECU while ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

Table 4.5 A summary of non-financial industries exposure to actual and unexpected changes in the foreign exchange rate EURO/£ for the sample period after the Euro 01/01/99-31/12/06 - Estimated coefficients from the mean equation

	ACTUAL CHANGES IN Euro/£			UNEXPECTED CHANGES IN Euro/£		
INDUSTRY	λ	INDt-1	Euro/£	λ	INDt-1	Euro/£
Aerospace and Defence	-0.0056	-0.0256	0.0830	-0.0062	-0.0222	0.0438
Automobiles and Auto Parts	0.0048	0.0785**	-0.1520	0.0042	0.0709*	-0.0996
Beverages	-0.0031	0.0828	0.0248	-0.0033	0.0830	0.0122
Chemicals	-0.3557	0.6007***	-0.0351	-0.2710***	0.5932***	-0.0296
Construction And Materials	0.0022	0.0320	0.0669	0.1018	0.4911***	-0.0190
Electricity	-0.0031*	0.0078	0.1239	-0.0030*	0.0091	0.1182
Electronic And Electrical Equipment	-0.0633**	0.4584***	0.0209	-0.0627**	0.4574***	-0.0033
Fixed-line Telecommunications	-0.0016	-0.0734**	-0.0638	-0.0019	-0.0766**	-0.0652
Food and Drug Retailers	0.0028*	-0.0329	-0.0476	0.0022	-0.0290	0.0004
Food Producers	0.0002	0.1243***	-0.1585**	0.0002	0.1260***	-0.0705
Forestry And Paper	0.0054**	-0.0346	0.1803	-0.0049***	0.0144	0.0654
Gas, Water And Multi-Utilities	-0.0010	-0.0209	-0.0666	-0.0017	-0.0186	0.0075
General Industrial	0.0011	0.0254	-0.1015	0.0011	0.0233	-0.0794
General Retailers	0.0013	0.1296***	0.1629	0.0016	0.1304***	0.1142
Healthcare Equipment and Services	0.0005	-0.0041	-0.1094	-0.0038	0.0090	-0.1448
Household Goods	0.0086	-0.0259	-0.0375	0.0069	-0.0290	-0.0234
Industrial Engineering	-0.0002	0.2819***	-0.0423	-0.0001***	0.2731***	-0.0496
Industrial Transport	-0.1469*	0.6708***	-0.1056	-0.1671*	0.6641***	-0.0886*
Leisure Goods	-0.0058*	0.0234	0.3361	-0.0066*	0.0268	0.0545

Table 4.5 continued A summary of non-financial industries exposure to actual and unexpected changes in the foreign exchange rate EURO/£, for the sample period after the Euro 01/01/99-31/12/06 - Estimated coefficients from the mean equation

	ACTUAL CHANGES IN Euro/£			UNEXPECTED CHANGES IN Euro/£		
INDUSTRY	λ	INDt-1	Euro/£	λ	INDt-1	Euro/£
Media	-0.0060*	0.0236	0.3375	-0.0068*	0.0246	0.0517
Mining	-0.0013***	-0.0175	-0.2442	-0.0014	-0.0159	-0.2091*
Mobile Telecommunications	0.0008	0.0345	0.1066	0.0008	0.0350	0.0534
Oil and Gas Producers	0.0041	-0.0548	-0.2090*	0.0036	-0.0583	-0.1348*
Oil Equipment And Services	0.0045	0.0045	0.0462	0.0046	0.0049	0.0539
Personal Goods	-0.0022	0.0982**	0.0058	-0.0023	0.0987**	0.0085
Pharmaceuticals and Biotechnology	-0.0004	0.0279	0.0311	-0.0010	0.0266	0.0456
Software and Computer Services	0.0006	0.0334	0.2810*	0.0008	0.0354	0.1453
Support Services	0.0035***	0.1561***	0.0713	0.0032***	0.1562***	0.0651
Technical Hardware and Equipment	0.0036	0.0886**	0.4902**	0.0037	0.0875***	0.2302
Tobacco	0.0015	-0.0792*	-0.0594	-0.0008	-0.0705	-0.0228
Travel and Leisure	0.0235**	0.1709***	-0.0860	0.0205**	0.1379**	-0.0568

Note: λ represents the risk-return trade-off parameter coefficient, INDt-1 is the autoregressive lag parameter, Euro/£ is the exchange rate exposure coefficient for the EURO. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

Other industries that had diverse results for ECU/£ and Euro/£ included the Chemicals industry in which the persistence parameter was insignificant for both ECU/£ models but significant in the models for Euro/£. Then industries such as Food Producers, Forestry and Paper, General Industrial, Healthcare Equipment and Services, Oil Equipment and Services and Technical Hardware and Equipment had significant coefficients for the Euro/£ models but not for the ECU/£. Overall, the incidence of leverage effects, volatility clustering and persistence of volatility seems to be more severe for the Euro/£ than the ECU/£.

Furthermore, Table A6.7 in Appendix 6 shows the summary results for the ratio of leverage effects to asymmetric effects and the half-life of persistence for the actual and unexpected changes in the ECU/£ and Euro/£, respectively. The results indicate that for the ECU/£, the leverage/asymmetry ratio of 1.4559 for the Construction and Materials industry is highest. This implies that the impact of bad news is approximately one and half times more than the impact of good news. Then for the Euro/£, the Travel and Leisure industry has the highest ratio of 1.7177. We also note that the Oil Equipment and Services industry also had a high ratio of 1.6514. Additionally, we find that for the ECU/£, the Support Services industry exhibits the highest half-life of persistence with 143 weeks while Fixed-Line and Telecommunications has the lowest with 1.7666 which is just about 2 weeks. With reference to the Euro/£, the half-life measure is considerably higher for most industries than for the ECU/£. Particularly, Oil and Gas Producers and Software and Computer Services Industries had very high values of approximately 216 weeks and 244 weeks correspondingly. On the other hand, the lowest half-life measures were for Oil Equipment and Services with approximately 2 weeks and

Household Goods with approximately 8 weeks. Again, the overall results indicated that it takes a longer period for half of the volatility to dissipate in the period after the Euro.

4.4.2 Changes in market risk, exchange rate risk and interest rate risk after the introduction of the euro

The change in market risk, exchange rate risk and interest rate risk following the introduction of the Euro is determined for the TWI, US$/£ and JP¥/£ by extending the mean equation 4.1a to include dummy variables. We also test the impact of introduction of the Euro on industry return volatility (log h^2_t) by including a dummy variable in the variance equation 4.2c. The model is estimated as:

$$R_{i,t} = \alpha_i + \beta_{a,i}R_{it-1} + \beta_{m,i}RM_t + \beta_{Eurom,i}RM_tD_{Eurot} + \beta_{r,i}XR_t + \beta_{Euror,i}XR_tD_{Eurot} + \beta_{s,i}SR_t + \beta_{Euros,i}SR_tD_{Eurot} + \beta_{l,i}LR_t + \beta_{Eurol,i}LR_tD_{Eurot} + \lambda\log(h^2_{i,t}) + \varepsilon_{i,t} \qquad 4.2a$$

$$\varepsilon_{i,t}|I_{t-1} \sim t(0, h^2_{i,t}, \upsilon_{i,t}) \qquad 4.2b$$

$$\log h^2_{i,t} = \alpha_o + \alpha_1\frac{\varepsilon_{i,t-1}}{h_{i,t-1}} + \alpha_2\left(\left|\frac{\varepsilon_{i,t-1}}{h_{i,t-1}}\right|\right) + \varphi_1\log h^2_{i,t-1} + \beta_{e,i}EURDUM \qquad 4.2c$$

In equation 4.2a, α_i is the intercept term for industry i, R_{it} is the return of industry i, RM_t is the rate of return of the market portfolio, XR_t is the percentage change in the exchange rate index in week t, SR_t is the change in the short term interest rate in week t and LR_t is the change in the long-term interest in week t, $\log(h^2_{i,t})$ is the log of conditional industry volatility, while the coefficient λ reflects the fundamental trade-off relationship between expected returns. D_{Eurot} is a dummy variable that takes the value of 1 from 1st January 1999 and 0 before that date and $\varepsilon_{i,t}$ is the error term for industry i. In addition, other coefficients are:

$\beta_{a,i}$ = autoregressive coefficient for industry i

$\beta_{m,i}$ = market risk exposure coefficient for industry i before the euro

$\beta_{r,i}$ = foreign exchange rate exposure coefficient of industry i before the euro

$\beta_{s,i}$ = short term interest rate exposure coefficient of industry i before the euro

$\beta_{l,i}$ = long term interest rate exposure coefficient of industry i before the euro

$\beta_{Eurom,i}$ = change in the market risk for industry i after the euro

$\beta_{Euror,i}$ = change in exchange rate exposure for industry i after the euro

$\beta_{Euros,i}$ = change in the short term interest rate exposure for industry i after the euro

$\beta_{Eurol,i}$ = change in the long term interest rate exposure for industry i after the euro

All the components of the 4.2b and the variance equation (4.2c) are as explained previously in Equation 4.1b and 4.1c respectively, except EURDUM which is used to assess the impact of the introduction of the euro on the volatility of industry returns. This binary variable has a value of 1 from 1st January 1999 and 0 before that date. Again, all the models were checked for multicollinearity. In all the estimates, (actual and unexpected), the condition index and VIF had values in the range of 1.000-3.564 and 1.379-2.750 respectively. Evidently, multicollinearity is not a problem with these models.

The results for the market risk before and after the euro are only presented in the model estimated with the actual changes in the TWI, since these result are comparable irrespective of the exchange rate index used in the model. Then for the same reason, the findings for interest rate exposure are only reported in the models for the actual and unexpected TWI. Tables 4.6 and 4.7 presents the findings for the mean equation for the actual and unexpected changes in the TWI whereas for the US$/£ and JP¥/£, these are shown in Tables 4.8 and 4.9.

In Table 4.6, the FTSEALLSH which primarily represents the coefficient for the market risk before the Euro is positive for all industries but insignificant for the Forestry and Paper industry. Then for the change in market risk following the introduction of the Euro (FTSEDUM), we find that 9 industries have significant positive coefficients suggesting an increase in market risk whereas 10 industries had significant negative coefficients indicating a reduction in market risk. This finding is quite similar to the results obtained from the OLS estimate (Table A12.4) as 8 (11) industries had significant positive (negative) coefficients respectively, but the industries were not all the same in both instances. Incidentally, the results from this GARCH estimate are just as strong as that previously obtained from the OLS.

Table 4.6 also shows the summary of exposure to the actual changes in the TWI, while for the US$/£ and JP¥/£, these are presented in Tables 4.8 and 4.9. We find that for the TWI, 10 (32%) industries have significant ERINDEX coefficients which primarily represent the exposure before the introduction of the euro. These comprised of 7 industries with positive coefficients indicating that higher (lower) returns are related to an appreciation (depreciation) of the pound whereas for the 3 industries with negative coefficients, higher (lower) returns are associated with the depreciation (appreciation) of the pound. For the actual US$/£, 10 (32%) industries also have significant exposure coefficients which are made up of 7 (3) positive (negative) coefficients whereas for the JP¥/£, only 3 (10%) industries had significant coefficients comprising of just 1 (2) positive (negative) coefficients, respectively. Then for the unexpected changes in the TWI, US$/£ and JP¥/£, these are reported in Table 4.7, Table 4.8 and 4.9 correspondingly. For the TWI, 11

(35%) industries have significant coefficients comprising of 7 (4) positive (negative) coefficients. For the US$/£, 9 (29%) industries have significant coefficients made up of 6 (3) positive (negative) coefficients respectively, whereas for the JP¥/£, 7 (23%) industries have significant coefficients which consist of 4 (3) positive (negative) coefficients. Apparently, there are slightly more significant coefficients for the unexpected changes than the actual changes but generally, there are predominantly more significant positive exposure coefficients than negative for all the exchange rate indices. The results here are somewhat stronger than that obtained from the OLS estimates (Tables A12.5-A12.6) in which significant actual (unexpected) coefficients were 6 (6) for the TWI, 6 (4) for the US$/£ and 4 (5) for the JP¥/£ respectively, suggesting that GARCH type models are probably more effective in detecting exchange rate exposure.

Another important result from Tables 4.6, 4.7, 4.8 and 4.9 is the change in the exchange rate exposure coefficient following the introduction of the euro. For the actual TWI, we find only 5 industries with significant coefficients. 4 of these industries did not have significant coefficients in the period before the euro. These were Leisure Goods and Media which have significant positive coefficients which were negative but insignificant before the euro, whereas for the Software and Computer Services and Technical Hardware and Equipment industries, these coefficients were also positive, but insignificant and positive before the euro. On the other hand, the Gas, Water and Multi-Utilities industry has a significant negative coefficient which had been significant and positive before the euro. Then regarding the actual US$/£, we find 6 industries with significant coefficients. Of these, Gas, Water and Multi-Utilities and Mining had significant negative and positive coefficients correspondingly which had been of the opposite sign and significant in the period before the euro. The result here for the Gas, Water and Multi-Utilities industry was also the same for the TWI. Then Automobiles and Auto Parts and Technical Hardware and Equipment industries have significant positive coefficients which were statistically insignificant and negative before the Euro. Again, the finding of a positive coefficient for the Technical Hardware and Equipment industries is the same for the TWI. The Electronic and Electrical Equipment and Oil Equipment and Services Industries also exhibit significant positive coefficients but these had been positive but insignificant in the period before the euro.

For the JPY/£, 4 industries exhibited significant coefficients. These included the Leisure Goods and Media industries which had significant positive coefficients, for the TWI as well. But their coefficients before the euro were positive and insignificant. In addition, the Food Producers industry also had a significant positive coefficient, but in the period before the euro, this had been negative and insignificant. Regarding the Chemicals industry, the coefficient was negative and significant, but this had been insignificant and positive before the euro.

The findings for the unexpected changes in the TWI, US$/£ and JPY/£ are quite similar to that reported above. To begin with, 6 industries have significant coefficients. These include the 5 industries with significant coefficients for the actual TWI (the sign of the coefficients were also the same), and the Industrial Engineering industry with a significant negative coefficient, but this had been significant and positive before the euro. Next we discuss the results for the US$/£ wherein 6 industries have significant coefficients. These were 5 of the 6 industries listed for actual US$ (Oil Equipment and Services has an insignificant positive coefficient) and Forestry and Paper which has a significant positive coefficient but this had been insignificant and negative before the euro. Again for the first five industries, the sign of the coefficient was the same as that of the actual changes. For the unexpected JP¥/£, only the Chemicals industry has a significant coefficient which was negative. Overall, significant coefficients for actual (unexpected) TWI were 5 (6), US$/£ 6 (6) and then for the JP¥/£ 4 (1) correspondingly. This is quite similar to the results reported for the OLS (Tables A12.5-A12.6) where actual (unexpected) TWI were 6 (6), US$/£ 6 (4), while for JP¥/£, these were 4 (5) significant exchange exposure coefficients respectively. Generally, most of the significant coefficients are positive and the number of industries with significant coefficients before the euro is more than those after the introduction of the euro.

Overall, for most of the industries that had significant coefficients in the period after the euro, their pre-euro coefficients were sometimes of the opposite sign but insignificant. But only a few industries had significant pre-euro and post-euro coefficients and these were of opposite signs. The finding here, which is similar to that obtained from the OLS estimates, infers that the introduction of the euro has led to a reduction in foreign exchange rate exposure for some UK industries, most especially importers. Nonetheless, for most of the industries with significant negative coefficients (most probably exporters), the change in coefficient in the period after the euro was mostly positive, but these were statistically insignificant.

Tables 4.6 and 4.7 also present the findings for the actual and unexpected changes in the short-term and long-term interest rate. We find that in the period before the euro, 7 industries have significant coefficients regarding the actual changes in the short-term interest rate, which are all negative, indicating that an increase in short-term interest rates leads to a decline in industry returns whereas a fall in rates leads to an increase in returns. In contrast, only 5 industries had significant coefficients when the unexpected changes were used instead, and one of these industries had a positive coefficient implying that an increase in short-term rates leads to an increase in industry returns while a decrease in rates leads to a decline in industry returns. This result is slightly weaker than that obtained from the OLS in which we find 10 (8) significant coefficients regarding the actual (unexpected) changes.

In the period after the euro, we find 7 (5) industries with significant coefficients with respect to the actual (unexpected) changes in the short-term interest rate. For the actual changes, 5 industries (Beverages, Food and Drug Retailers, Gas, Water and Multi-Utilities, Healthcare Equipment and Services and Oil and Gas Producers) had significant positive coefficients. Although they all had negative coefficients in the period before the euro, this had been insignificant except for the Oil and Gas Producers industry. The results obtained for the unexpected changes were quite similar to that reported for the actual changes since the same industries excluding Healthcare Equipment and Services industry also had significant positive coefficients. On the other hand, 2 industries (Aerospace and Defence and Construction and Materials) had significant negative coefficients. The coefficient for the Aerospace and Defence industry was positive but insignificant in the period before the euro, but for the Construction and Material industry, a significant negative coefficient was found indicating an increase in exposure to the short-term interest rate. For the unexpected changes in the short-term interest rate, only the Construction and Material industry had a significant negative coefficient. However in the period before the euro, this had been negative but statistically insignificant. The results here are only slightly stronger than the OLS estimates (Table A12.5) where 4 (5) significant coefficients with regards to actual (unexpected) changes were found.

Concerning the long-term interest rate, we find 9 industries each had significant coefficients to the actual and unexpected changes, and 8 of these were also significant for the OLS model (Table A12.5). Furthermore, the sign of the coefficients were mostly positive, i.e. 7 (2) positive (negative) coefficients for the actual changes and 6 (3) for the unexpected changes. By implication, for these industries, an increase in long-term rates leads to an increase in industry returns while a decrease in rates leads to a decline in industry returns. Furthermore, the significant coefficients found for the long-term interest rates were predominantly positive, which contrasts the results for the short-term rates, where the significant coefficients were mainly negative. In the period after the euro, 2 industries (Gas, Water and Multi-Utilities and Mobile Telecommunications) had significant positive coefficients regarding the actual changes. These coefficients were negative before the euro but only significant for the Gas, Water and Multi-Utilities industry. Then for the Construction and Materials Industry, a significant negative coefficient was found and this had been positive and significant in the period before the euro. The results for the unexpected changes in the long-term interest rate were quite different. 3 industries (Chemicals, Mining and Mobile Telecommunications) have significant positive coefficients which had all being insignificant in the period before the euro. Then the Tobacco industry had a significant negative coefficient but this had been negative but insignificant before the euro. Another important finding was that a majority of the industries had significant coefficients with regards to either the short-term interest rate or the long-term interest rate. Nevertheless, the Construction and Materials industry exhibited significant negative and positive exposure coefficients to the actual changes in the short-term and long-term interest rate, respectively, but the exposure to the short-term interest rate increases after the euro, whereas a reduction is noticed for the long-term interest rate.

On the other hand, the Gas, Water and Multi-Utilities industry had significant negative coefficients to the unexpected changes in the short-term and long-term interest rate measures before the euro. Although the coefficients for both interest rate measures were positive after the euro, only that of the short-term interest rate was significant. Then the Industrial Transport industry had significant coefficients to the actual and unexpected changes in the interest rate measures, which were negative for the short-term interest rate and positive for the long-term interest rate. But the coefficients in the period after the euro were both positive and insignificant. Overall, most of the industries with significant exposure coefficients to the short-term and/or long-term interest rate in the period before the euro had insignificant coefficients after the euro. Then for the majority of industries with significant exposure after the euro, the coefficient before the euro was insignificant. Furthermore the sign of the coefficient in the period before the euro was usually of the opposite sign to that found in the period after the euro, reinforcing the findings from the OLS that the introduction of the euro led to a net reduction in interest rate exposure for some UK industries. Furthermore, our findings indicate that for industries with significant interest rate coefficients before the euro, these became insignificant or reduced in magnitude in the period after the euro. This result is similar to that of Korkeamäki (2007) in which interest rate exposure, which was significant prior to 1999 for the UK and other EU countries that have chosen not to adopt the euro, became insignificant in the post euro era. Rajan and Zingales (2003) and Korkeamäki (2007) also point out that this reduction in interest rate risk corresponds to the significant growth in fixed income related markets which is attributable to the introduction of the euro.

In Tables A6.8, A6.9, A6.10 and A6.11 in Appendix 6 presents the results from the variance equation. However due to the intricate specification of the GARCH model, it is not possible to integrate additional parameters to the usual functional specification. Taking this into account, we intend to rely on the results for the total period and sub-period (ECU/£ and Euro/£) for the ARCH and GARCH specific parameters in the variance equations, and even the risk return parameter in the mean equation. Furthermore, the EURDUM coefficient (from the variance equation) examines the impact of the introduction of the euro on the volatility of industry returns. This binary variable has a value of 1 from 1st January 1999 and 0 before that date, and the results which are shown in Tables A6.8 - A6.11 are discussed here.

For the actual changes in the TWI and JPY/£, we find 13 industries with significant coefficients. 12 of these coefficients were positive and were in relation to Beverages, Chemicals, Construction and Materials, Forestry and Paper, Healthcare Equipment Services, Household Goods, Leisure Goods, Media, Mining, Oil Equipment and Services, Personal Goods and Travel and Leisure industries, indicating that the riskiness of these industries returns increased in the period after the euro. On the other hand, the Support Services industry had a significant negative coefficient suggesting that for this industry, the overall riskiness of its returns declined in the period after the introduction of the euro.

The results for the unexpected TWI, US$ and JP¥/£ are quite similar. We find 11 industries with significant positive coefficients. These are the same industries listed for the actual changes in the TWI and JP¥/£ except Construction and Materials and Healthcare Equipment Services. Then for the actual US$/£, we find 11 industries with significant positive coefficients. These were Beverages, Chemicals, Construction and Materials, Forestry and Paper, Household Goods, Leisure Goods, Media, Mining, Oil Equipment and Services, Personal Goods and Travel and Leisure industries whereas Support Services has a significant negative coefficient. This result is also similar to that reported for the other models.

Table A6.12 in Appendix 6 presents a summary of industries with significant difference in volatility in the period after the euro as denoted by the coefficient for the EURDUM in the variance equation, but only the magnitude of the coefficient is reported. The returns of Forestry and Paper industry and Oil Equipment and Services have the highest increase in riskiness irrespective of the exchange rate index used in the model while Travel and Leisure, Construction and Materials and Household Goods have the lowest increase. Additionally, the Support Services industry has a decline in the overall riskiness of its returns after the euro. Furthermore the industry's half-life of volatility went down from an average of 136 weeks before the euro to 51 weeks after the euro.

Table 4.6 A summary of non-financial industries' exposure to market risk and actual changes in the Trade weighted nominal exchange rate, 3 Month Treasury bill (TB) and 10 Year Government Bond (GB) before the euro and after the introduction of the euro - Estimated coefficients from the mean equation

INDUSTRY	λ	INDt-1	FTSEALLSH	FTSEDUM	ER INDEX	ERDUM	UKTBTND	TBTNDUM	UKMBRYD	BRYDUM
Aerospace and Defence	0.0005	0.1268***	0.4340***	0.1583*	-0.0210	0.1745	0.0503	-0.1824*	0.0453	-0.0500
Automobiles and Auto Parts	-0.0002	0.1512***	0.4477***	0.2032***	-0.0548	0.1200	0.0089	-0.0549	0.1186***	0.0013
Beverages	0.0013	0.1121***	0.4376***	-0.1948***	0.0681	0.0209	-0.0407	0.1458**	0.0428	-0.0703
Chemicals	0.0009	0.2039***	0.5572***	-0.1275**	0.1131	-0.1802	-0.0211	0.0127	0.0525	0.0667
Construction And Materials	0.1111**	0.5706***	0.3605***	-0.1176***	0.0623	-0.0228	-0.0450*	-0.1456***	0.1012***	-0.0622*
Electricity	-0.0036	-0.0043	0.5304***	0.1094	0.2129*	-0.0067	-0.0156	0.0094	-0.1762***	0.0242
Electronic And Electrical Equipment	0.0004	0.1892***	0.6841***	-0.0051	0.0839	0.1200	-0.0427	0.0367	0.0779**	-0.0382
Fixed-line Telecommunications	-0.0010	-0.1057***	1.1606***	0.1564	-0.1843	0.3374	0.0855	0.0008	-0.0318	0.0226
Food and Drug Retailers	0.0003	-0.0231	0.7499***	-0.3501***	0.2584**	-0.2049	-0.0187	0.2341**	-0.0453	0.0556
Food Producers	-0.0004	0.0518**	0.6391***	-0.1565***	-0.0394	-0.0448	0.0220	0.0305	-0.0409	-0.0344
Forestry And Paper	-0.0015*	0.0476**	0.0586	0.1484**	0.0072	0.2738	-0.0217	0.0128	-0.0217	0.0630
Gas, Water And Multi-Utilities	-0.0023	-0.0306	0.4455***	-0.1078	0.3423***	-0.3990**	-0.1074	0.2386**	-0.3028***	0.1534**
General Industrial	0.0011	0.0542**	0.8435***	-0.0248	-0.1337	0.0707	-0.0735*	0.0517	-0.0188	0.0884
General Retailers	0.0005	0.1489***	0.8278***	-0.0252	0.1354*	0.1058	0.0366	-0.0389	0.0468	-0.0528
Healthcare Equipment and Services	0.0005	0.0793***	0.3594***	0.2413***	0.0264	-0.0356	0.0185	0.2064*	0.0004	-0.1024
Household Goods	0.0020	0.0788***	0.7956***	-0.1793**	-0.0234	0.0848	-0.1372**	0.0896	0.0603	-0.0166
Industrial Engineering	-0.0010	0.3507***	0.5165***	-0.1529***	0.1079*	-0.1604	0.0122	-0.0756	0.0832***	-0.0642
Industrial Transport	0.0012	0.1475***	0.5549***	-0.1655***	-0.0220	0.0976	-0.0572*	0.0115	0.0960**	0.0079
Leisure Goods	-0.0021*	0.0692***	0.2486***	0.8246***	-0.0072	0.7224**	-0.0538	-0.2902	0.1205*	-0.1334

Table 4.6 continued A summary of non-financial industries' exposure to market risk and actual changes in the Trade weighted nominal exchange rate, 3 Month Treasury bill (TB) and 10 Year Government Bond (GB) before the euro and after the introduction of the euro - Estimated coefficients from the mean equation

INDUSTRY	λ	INDt-1	FTSEALLSH	FTSEDUM	ER INDEX	ERDUM	UKTBTND	TBTNDUM	UKMBRYD	BRYDUM
Media	-0.0021*	0.0698***	0.2559***	0.8212***	-0.0141	0.7289**	-0.0489	-0.2967	0.1196*	-0.1317
Mining	0.0052**	0.0135	0.7425***	0.1505	-0.3437**	0.1962	0.0474	-0.2182	0.0827	0.1347
Mobile Telecommunications	0.0018**	0.1179***	0.6085***	-0.0754	0.1642**	-0.0248	-0.0057	0.0221	-0.0267	0.0899*
Oil and Gas Producers	-0.0012	-0.0803***	0.8669***	0.0877	-0.2734***	-0.2167	-0.0909*	0.3284***	0.0568	-0.0380
Oil Equipment And Services	0.0004	0.1142***	0.1811***	0.2091**	0.0794	0.3123	0.0631	-0.0692	0.0172	0.0581
Personal Goods	0.0013**	0.1799***	0.2373***	-0.0668	0.0614	-0.1638	-0.0222	0.0994	0.0385	-0.0139
Pharmaceuticals and Biotechnology	0.3100	0.2577**	0.3767***	-0.1315	0.1983*	-0.0831	-0.1586***	0.1533	0.0123	0.0537
Software and Computer Services	0.0010	0.1079***	0.7372***	0.6838***	0.0024	0.3654*	-0.0855*	-0.0752	0.0612	0.0470
Support Services	0.0011	0.1869***	0.6299***	0.0550	0.0759	-0.0018	-0.0027	-0.0723	-0.0255	0.0394
Technical Hardware and Equipment	-0.0017	0.1331***	0.7695***	0.5567***	0.0170	0.8213***	0.0429	0.0216	-0.0131	0.0679
Tobacco	0.0006	-0.1311***	0.9818***	-0.6986***	-0.2980***	0.1378	-0.0059	0.0650	-0.0232	-0.1349
Travel and Leisure	0.0009	0.0740***	0.8547***	-0.2102***	0.1297	0.0004	-0.0441	0.0365	0.0396	-0.0547

Note: λ is the risk-return trade-off parameter coefficient, INDt-1 is the autoregressive lag parameter. FTSEALLSH refers to the market risk before the euro, FTSEDUM is the change in market risk following the introduction of the Euro, ERINDEX is the Trade-weighted nominal exchange rate exposure coefficient before the euro and ERDUM is the change in exposure after the Euro. UKTBTND and UKMBRYD are the exposure coefficients for the 3 Month TB and 10 Year GB before the euro while TBTNDUM and BRYDUM are changes in the exposure after the euro for the TB and GB respectively. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

Table 4.7 A summary of non-financial industries' exposure to market risk and unexpected changes in the Trade weighted nominal exchange rate, 3 Month Treasury bill (TB) and 10 Year Government Bond (GB) before the euro and after the introduction of the euro - Estimated coefficients from the mean equation

INDUSTRY	λ	INDt-1	ER INDEX	ERDUM	UKTBTND	TBTNDUM	UKMBRYD	BRYDUM
Aerospace and Defence	0.0008	0.1281***	-0.0004	0.0020	0.0484	-0.1577	0.0057	-0.0067
Automobiles and Auto Parts	-0.0004	0.1494***	-0.0008	0.0015	0.0085	0.0079	0.0122**	0.0118
Beverages	0.0013	0.1144***	0.0009	0.0000	-0.0428	0.1661**	0.0045	-0.0105
Chemicals	0.0007	0.2069***	0.0011	-0.0017	-0.0026	0.0208	0.0038	0.0196*
Construction And Materials	0.1368	0.5614***	0.0009	-0.0006	-0.0419	-0.1301**	0.0111***	-0.0035
Electricity	-0.0036	-0.0024	0.0028**	-0.0008	-0.0057	-0.0532	-0.0155*	-0.0157
Electronic And Electrical Equipment	0.0001	0.1912***	0.0010	0.0009	-0.0417	0.0228	0.0067*	0.0024
Fixed-line Telecommunications	-0.0010	-0.1043***	-0.0021	0.0038	0.1091*	-0.0362	-0.0041	0.0039
Food and Drug Retailers	0.0001	-0.0236	0.0029**	-0.0024	-0.0222	0.2363**	-0.0053	0.0069
Food Producers	-0.0004	0.0532**	-0.0004	-0.0004	0.0290	0.0115	-0.0061	-0.0099
Forestry And Paper	-0.0015*	0.0481**	0.0000	0.0029	-0.0157	0.0118	-0.0027	0.0117
Gas, Water And Multi-Utilities	-0.0019	-0.0292	0.0039***	-0.0044**	-0.1273*	0.2123**	-0.0333***	0.0016
General Industrial	0.0013	0.0546**	-0.0018*	0.0013	-0.0545	0.0683	-0.0033	0.0185
General Retailers	0.0004	0.1489***	0.0014*	0.0010	0.0537	-0.0543	0.0018	-0.0031
Healthcare Equipment and Services	0.0005	0.0793***	0.0003	-0.0005	0.0232	0.1921	0.0031	-0.0256
Household Goods	0.0021	0.0778***	-0.0003	0.0007	-0.1219**	0.1657	0.0063	0.0040
Industrial Engineering	-0.0010	0.3518***	0.0012*	-0.0018*	0.0202	-0.0741	0.0096**	-0.0046
Industrial Transport	0.0007	0.1454***	-0.0001	0.0008	-0.0717**	0.0473	0.0094*	0.0131
Leisure Goods	-0.0020*	0.0707***	0.0000	0.0065*	-0.0681	-0.1618	0.0134*	-0.0132

Table 4.7 continued A summary of non-financial industries' exposure to market risk and unexpected changes in the Trade weighted nominal exchange rate, 3 Month Treasury bill (TB) and 10 Year Government Bond (GB) before the euro and after the introduction of the euro - Estimated coefficients from the mean equation

INDUSTRY	λ	INDt-1	ER INDEX	ERDUM	UKTBTND	TBTNDUM	UKMBRYD	BRYDUM
Media	-0.0021*	0.0707***	-0.0001	0.0066**	-0.0671	-0.1644	0.0131	-0.0127
Mining	0.0048*	0.0134	-0.0037**	0.0019	0.0485	-0.1629	0.0105	0.0403**
Mobile Telecommunications	0.0018**	0.1180***	0.0016**	-0.0002	-0.0028	0.0162	-0.0034	0.0169**
Oil and Gas Producers	-0.0014	-0.0796***	-0.0031***	-0.0017	-0.0863	0.3450***	0.0080	-0.0025
Oil Equipment And Services	0.0002	0.1120***	0.0012	0.0025	0.0467	-0.0292	0.0030	0.0130
Personal Goods	0.0012**	0.1833***	0.0008*	-0.0018	-0.0150	0.1128	0.0043	0.0019
Pharmaceuticals and Biotechnology	0.5156	0.3442***	0.0017	-0.0002	-0.1665***	0.0927	-0.0019	0.0150
Software and Computer Services	0.0013	0.1091***	-0.0002	0.0041*	-0.0751	-0.1003	0.0074	0.0154
Support Services	0.0015***	0.1896***	0.0008	-0.0002	0.0070	-0.0533	-0.0069**	0.0098
Technical Hardware and Equipment	-0.0017	0.1316***	0.0001	0.0083***	0.0414	0.0457	-0.0014	0.0150
Tobacco	0.0008	-0.1300***	-0.0032**	0.0013	-0.0300	0.1274	-0.0008	-0.0303*
Travel and Leisure	0.0010	0.0733***	0.0015	-0.0003	-0.0595	0.0765	0.0041	-0.0058

Note: λ is the risk-return trade-off parameter coefficient, INDt-1 is the autoregressive lag parameter. ERINDEX is the Trade-weighted nominal exchange rate exposure coefficient before the Euro and ERDUM is the change in exposure after the Euro. UKTBTND and UKMBRYD are the exposure coefficients for the 3 Month TB and 10 Year GB before the euro while TBTNDUM and BRYDUM are changes in the exposure after the Euro for the TB and GB respectively. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

Table 4.8 A summary of non-financial industries' exposure to actual and unexpected changes in the US$/£ before the euro and after the introduction of the euro - Estimated coefficients from the mean equation

	ACTUAL US$				UNEXPECTED US$			
INDUSTRY	λ	INDt-1	ER INDEX	ERDUM	λ	INDt-1	ER INDEX	ERDUM
Aerospace and Defence	0.0005	0.1254***	0.0232	0.0340	0.0008	0.1262***	0.0089	0.0302
Automobiles and Auto Parts	-0.0002	0.1501***	-0.0614	0.3115**	-0.0004	0.1480***	-0.0446	0.1835**
Beverages	0.0013	0.1128***	0.0871**	-0.0834	0.0013	0.1159***	0.0493**	-0.0570
Chemicals	0.0008	0.2041***	0.0808*	0.0292	0.0007	0.2069***	0.0380	0.0184
Construction And Materials	0.1169*	0.5794***	0.0267	-0.0114	0.1330	0.5710***	0.0202	-0.0227
Electricity	-0.0033	-0.0029	0.1355*	-0.0301	-0.0037	-0.0009	0.10120**	-0.0457
Electronic And Electrical Equipment	0.0004	0.1918***	0.0659	0.1897**	0.0002	0.1952***	0.0452*	0.0928*
Fixed-line Telecommunications	-0.0011	-0.1032***	-0.0901	0.2655	-0.0011	-0.1012***	-0.0518	0.1478
Food and Drug Retailers	0.0004	-0.0217	0.2101***	-0.0956	0.0002	-0.0218	0.1269***	-0.0467
Food Producers	-0.0004	0.0524**	-0.0247	0.0484	-0.0004	0.0528**	-0.0148	0.0313
Forestry And Paper	-0.0014*	0.0467**	-0.0299	0.2035	-0.0015*	0.0469**	-0.0246	0.1328*
Gas, Water And Multi-Utilities	-0.0023	-0.0258	0.2185***	-0.2459**	-0.0022	-0.0264	0.1388***	-0.1586**
General Industrial	0.0011	0.0538**	0.0328	-0.0730	0.0011	0.0542**	0.0077	-0.0438
General Retailers	0.0006	0.1512***	0.0358	0.0989	0.0006	0.1521***	0.0007	0.0802
Healthcare Equipment and Services	0.0003	0.0830***	-0.0010	0.1966	0.0005	0.0805***	-0.0061	0.1197
Household Goods	0.0020	0.0792***	0.0115	0.0360	0.0021	0.0787***	-0.0001	0.0060
Industrial Engineering	-0.0012	0.3503***	0.0147	0.0294	-0.0012	0.3492***	0.0139	0.0024
Industrial Transport	0.0012	0.1470***	-0.0067	0.1194	0.0007	0.1447***	-0.0024	0.0796
Leisure Goods	-0.0021*	0.0696***	0.1009	0.3728	-0.0020*	0.0697***	0.0702	0.1759

Table 4.8 continued A summary of non-financial industries' exposure to actual and unexpected changes in the US$/£ before the euro and after the introduction of the euro - Estimated coefficients from the mean equation

	ACTUAL US$				UNEXPECTED US$			
INDUSTRY	λ	INDt-1	ER INDEX	ERDUM	λ	INDt-1	ER INDEX	ERDUM
Media	-0.0021*	0.0706***	0.1056	0.3669	-0.0021*	0.0719***	0.0676	0.1783
Mining	0.0050**	0.0172	-0.2327**	0.4382***	0.0049**	0.0162	-0.1349**	0.2376**
Mobile Telecommunications	0.0019**	0.1185***	0.1019**	-0.0672	0.0018**	0.1167***	0.0447	-0.0279
Oil and Gas Producers	-0.0013	-0.0770***	-0.2732***	0.0437	-0.0013	-0.0758***	-0.1667***	0.0478
Oil Equipment And Services	0.0004	0.1144***	0.0088	0.2771*	0.0003	0.1125***	0.0260	0.1157
Personal Goods	0.0013**	0.1721***	-0.0132	-0.0270	0.0013**	0.1728***	-0.0074	-0.0300
Pharmaceuticals and Biotechnology	0.5249	0.2998***	0.1802**	-0.1032	0.5593	0.3549***	0.0833*	-0.0335
Software and Computer Services	0.0010	0.1063***	-0.0408	0.1511	0.0011	0.1077***	-0.0212	0.0858
Support Services	0.0010	0.1894***	0.0134	0.0735	0.0013**	0.1934***	0.0151	0.0197
Technical Hardware and Equipment	-0.0016	0.1306***	-0.0167	0.3952*	-0.0016	0.1304***	-0.0184	0.2378*
Tobacco	0.0007	-0.1261***	-0.2172***	0.1017	0.0009	-0.1243***	-0.1230***	0.0491
Travel and Leisure	0.0006	0.0727***	0.0569	0.1179	0.0007	0.0724***	0.0356	0.0630

Note: λ represents the risk-return trade-off parameter coefficient, INDt-1 is the autoregressive lag parameter. ERINDEX is the exchange rate exposure coefficient for actual and unexpected changes in US$/£ before the euro. ERDUM refers to the change in the exposure to the US$/£ after the introduction of the euro. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

Table 4.9 A summary of non-financial industries' exposure to actual and unexpected changes in the JP¥/£ before the euro and after the introduction of the euro - Estimated coefficients from the mean equation

	ACTUAL JP¥/£				UNEXPECTED JP¥/£			
INDUSTRY	λ	INDt-1	ER INDEX	ERDUM	λ	INDt-1	ER INDEX	ERDUM
Aerospace and Defence	0.0007	0.1275***	-0.0115	0.0462	0.0009	0.1278***	0.0000	0.0001
Automobiles and Auto Parts	-0.0002	0.1513***	0.0262	0.0018	-0.0004	0.1492***	0.0002	0.0000
Beverages	0.0014	0.1136***	0.0180	0.0482	0.0012	0.1161***	0.0000	0.0004
Chemicals	0.0008	0.2017***	0.0408	-0.1485*	0.0007	0.2063***	0.0002	-0.0007*
Construction And Materials	0.1092***	0.5659***	0.0405	-0.0402	0.1278	0.5604***	0.0002*	-0.0003
Electricity	-0.0035	-0.0055	0.0669	-0.0338	-0.0037*	-0.0053	0.0005	-0.0005
Electronic And Electrical Equipment	0.0004	0.1884***	0.0293	-0.0091	0.0001	0.1930***	0.0002	-0.0002
Fixed-line Telecommunications	-0.0010	-0.1064***	-0.1097*	0.0948	-0.0010	-0.1052***	-0.0005*	0.0005
Food and Drug Retailers	0.0001	-0.0222	0.0250	0.0372	-0.0001	-0.0228	0.0000	0.0004
Food Producers	-0.0005	0.0544**	-0.0368	0.1070*	-0.0005	0.0547**	-0.0002	0.0005
Forestry And Paper	-0.0014	0.0479**	0.0076	0.0319	-0.0014*	0.0487**	0.0000	0.0002
Gas, Water And Multi-Utilities	-0.0021	-0.0270	0.1014	-0.0020	-0.0019	-0.0280	0.0005*	0.0000
General Industrial	0.0010	0.0510***	-0.0145	-0.0469	0.0011	0.0510**	-0.0001	-0.0002
General Retailers	0.0006	0.1469***	0.0112	0.0553	0.0006	0.1500***	0.0000	0.0005
Healthcare Equipment and Services	0.0005	0.0798***	-0.0158	0.0154	0.0006	0.0814***	-0.0001	0.0002
Household Goods	0.0021	0.0783***	-0.0093	0.0284	0.0020	0.0780***	-0.0001	0.0002
Industrial Engineering	-0.0011	0.3508***	0.0430	-0.0283	-0.0010	0.3522***	0.0002*	-0.0002
Industrial Transport	0.0017	0.1485***	0.0657	-0.0540	0.0010	0.1458***	0.0003	-0.0002
Leisure Goods	-0.0021*	0.0679***	0.0035	0.3568**	-0.0022*	0.0703***	0.0002	0.0016

Table 4.9 continued A summary of non-financial industries' exposure to actual and unexpected changes in the JP¥/£ before the euro and after the introduction of the euro - Estimated coefficients from the mean equation

	ACTUAL JP¥/£				UNEXPECTED JP¥/£			
INDUSTRY	λ	INDt-1	ER INDEX	ERDUM	λ	INDt-1	ER INDEX	ERDUM
Media	-0.0022*	0.0683***	0.0102	0.3468*	-0.0022*	0.0714***	0.0002	0.0016
Mining	0.0054**	0.0160	-0.0423	0.1073	0.0050**	0.0171	-0.0002	0.0006
Mobile Telecommunications	0.0018**	0.1133***	0.0061	0.0118	0.0018**	0.1137***	0.0000	0.0001
Oil and Gas Producers	-0.0015	-0.0792***	-0.0828	-0.0533	-0.0014	-0.0795***	-0.0005*	-0.0002
Oil Equipment And Services	0.0003	0.1112***	0.0298	-0.0384	0.0002	0.1097***	0.0001	-0.0002
Personal Goods	0.0012**	0.1800***	0.0483*	-0.0448	0.0012**	0.1802***	0.0002*	-0.0003
Pharmaceuticals and Biotechnology	0.5754	0.3050***	-0.0113	0.0465	0.4888	0.3318***	0.0000	0.0001
Software and Computer Services	0.0011	0.1062***	-0.0240	0.0293	0.0012	0.1084***	-0.0001	0.0003
Support Services	0.0011**	0.1853***	0.0347	-0.0728	0.0013**	0.1818***	0.0000	-0.0003
Technical Hardware and Equipment	-0.0015	0.1314***	0.0232	-0.0806	-0.0015	0.1307***	0.0000	-0.0004
Tobacco	0.0005	-0.1268***	-0.1481**	0.0998	0.0005	-0.1268***	-0.0007**	0.0004
Travel and Leisure	0.0008	0.0694***	0.0258	0.1118	0.0008	0.0687***	0.0001	0.0006

Note: λ is the risk-return trade-off parameter coefficient, INDt-1 represents the autoregressive lag parameter. ERINDEX is the exchange rate exposure coefficient for actual and unexpected changes in JP¥/£ before the euro. ERDUM is the change in the exposure to the JP¥/£ after the introduction of the euro. ***,** and * indicates statistical significance at the 1%, 5% and 10% level.

Nevertheless, the incidence of increased riskiness in industry returns is generally more prevalent in the period after the Euro. Morana and Beltratti (2002) also use a GARCH (1,1) specification to examine the volatility in UK stock returns. Although the coefficient for the euro dummy (in the variance equation) was positive, it was statistically insignificant. But using time series plot to depict volatility regimes, they indicated that the UK was in a high volatility regime at the time of the introduction of the euro, which is consistent with the period of updating stock valuations in the European markets.

4.5 Lagged exchange rate and interest rate exposure

The mis-pricing hypothesis, as it relates to exchange rate and interest rate risk of UK industries is examined here using the model stated below.

$$R_{it} = \alpha_i + \beta_{ai} R_{it-1} + \beta_{mi} RM_t + \beta_{xi} XR_{t-1} + \beta_{si} SR_{t-1} + \beta_{li} LR_{t-1} + \lambda \log(h^2_{i,t}) + \varepsilon_{it} \qquad 4.3a$$

$$\varepsilon_{i,t} | I_{t-1} \sim t(0, h^2_{i,t}, \upsilon_{i,t}) \qquad 4.3b$$

$$\log h^2_{i,t} = \alpha_0 + \alpha_1 \frac{\varepsilon_{i,t-1}}{h_{i,t-1}} + \alpha_2 \left(\left| \frac{\varepsilon_{i,t-1}}{h_{i,t-1}} \right| \right) + \varphi_1 \log h^2_{i,t-1} \qquad 4.3c$$

where in Equation 4.3a, α_i is the intercept term for industry i, $R_{i,t}$ is the return of industry i at time t, R_{it-1} is the autoregressive lag parameter for industry i at time t-1, RM_t is the rate of return of the market portfolio at time t, XR_{t-1}, SR_{t-1} and LR_{t-1} are the lagged changes in the exchange rate, short-term interest rate and long-term interest rate, respectively. Each lag is one week. All the components of equation 4.3b and 4.3c have been previously explained. Besides, only the risk premium coefficients, exchange rate and interest rates coefficients from the mean equation are discussed since the autoregressive term is similar to that reported for the contemporaneous changes. Then for the interest rates, these are presented with the actual and unexpected TWI only.

Regarding the lagged actual TWI in Table 4.10, we find 7 industries with significant coefficients. 2 of these industries, Electricity and General Retailers had significant positive coefficients when the contemporaneous changes were used. On the contrary, the other 5 industries (Chemicals, Construction and Materials, Household Goods, Leisure Goods and Media) all have negative coefficients but these had been insignificant for the contemporaneous changes. Overall, the incidence of significant coefficients is higher for the contemporaneous changes as 11 industries had significant coefficients and these were mostly positive. The result for the lagged unexpected TWI is quite similar as only 6 industries had significant coefficients. 5 of these industries were those with significant negative coefficients for the actual changes. But only the Construction and Materials industry had a significant coefficient for the contemporaneous actual changes as well, but the sign of the coefficient was positive. Then for the Gas, Water and Multi-Utilities industry, a significant positive coefficient was found for the lagged changes. Again, these results are not as strong as that reported for the contemporaneous changes where 11 industries had significant coefficients which were predominantly positive. Furthermore, we observe that from the lagged actual OLS results (Table A12.7), 3 industries had significant coefficients whereas for the unexpected lagged changes, 4 industries exhibited significant coefficients. Evidently the incidence of significant coefficients is relatively less than those found for the GARCH estimates.

The results for the lagged actual and unexpected US$/£ are presented in Table 4.11. We find that 5 industries have significant coefficients regarding the actual lagged changes. This included the Industrial Transport industry, which has a significant positive coefficient, and which was also positive when contemporaneous changes were employed in the model, while for the Tobacco industry, a significant negative coefficient was found and this had also been negative for contemporaneous changes. On the other hand, the Travel and Leisure industry exhibited a significant negative coefficient, but this had been of the opposite sign for contemporaneous changes. Additionally, the Healthcare Equipment and Services and Household Goods industries have significant negative coefficients, but these had been statistically insignificant for contemporaneous changes. The results for the unexpected changes indicate that 7 industries have significant coefficients. These were all the 5 industries listed for the actual changes as well as the Aerospace and Defence and Chemicals industries. Of all these 7 industries, only the Industrial Transport with a positive coefficient and Tobacco industry with a negative coefficient had the same sign of coefficient for the lagged as well as for the contemporaneous US$/£.

In contrast, the Chemicals and Travel and Leisure industries exhibited significant negative coefficients, but these had been significantly positive for contemporaneous changes, whereas for the Aerospace and Defence, Healthcare Equipment and Services and Household Goods industries, significant negative coefficients are also found but these had been statistically insignificant for the contemporaneous changes. Generally the results for the contemporaneous actual and unexpected changes with 13 industries each having significant coefficients, outweigh those found for the lagged changes. But there is not much difference with the findings observed here for the lagged changes and that of the OLS model (Table A12.8), since the results then showed that 5 (6) industries exhibited significant coefficients regarding the lagged actual (unexpected) changes in the US$/£.

In Table 4.12, the results for the lagged actual and unexpected changes in the JP¥/£ are shown. It is found that 6 industries exhibit significant coefficients for both the actual changes and unexpected changes. For the actual changes, the Chemicals, Industrial Engineering, Leisure Goods, Media and Pharmaceuticals and Biotechnology industries have significant negative coefficients, whereas the Electricity industry has a significant positive coefficient. But none of these industries had significant coefficients for the contemporaneous changes. All the 5 industries with significant negative coefficients for the actual changes were also the same industries with significant coefficients for the unexpected changes, in addition to the Automobiles and Auto Parts industry which also had a significant negative coefficient. Again none of these industries had significant coefficients when contemporaneous changes were used. In comparison, concerning the contemporaneous actual (unexpected) changes, 3 (5) industries have significant coefficients making the results slightly weaker. Additionally for the OLS lagged JPY/£ results (Table A12.8), 6 (7) industries were reported with significant coefficients for the actual (unexpected) changes respectively, thereby making the result from this lagged GARCH estimation more similar to that observed for the lagged OLS estimates.

The findings for the lagged actual and unexpected changes in the short-term and long-term interest rates are presented in Table 4.10. The results showed that 4 industries each have significant coefficients regarding the actual and unexpected short-term interest rates. These are the Food and Drug Retailers and Industrial Transport industries with significant positive coefficients and Software and Computer Services industries with significant negative coefficients to both the actual and unexpected changes. Furthermore, the Mining industry has a significant negative coefficient, but regarding the actual changes alone, while the General Industrial industry has a significant positive coefficient relating to the unexpected changes only. Nevertheless when contemporaneous changes were used, only the Software and Computer Services industry had a significant coefficient for the actual changes. But on the whole, the impact of actual (unexpected) contemporaneous changes is stronger with 7 (5) industries exhibiting significant coefficients.

The finding for the long-term interest rate indicates that contemporaneous changes have a more profound effect on the returns of UK industries than lagged changes. Only 3 industries had significant coefficients for the lagged actual changes and 4 industries had significant coefficients regarding the lagged unexpected changes, which is staggeringly lower than the 14 significant coefficients reported for both the contemporaneous actual and unexpected changes. The industries with significant coefficients regarding the lagged actual and unexpected changes were Gas, Water and Multi-Utilities with a negative coefficient, which had also been negative and significant for contemporaneous changes. Also General Retailers and Healthcare and Equipment and Services had positive coefficients but these were previously insignificant for the contemporaneous changes. Then the Automobiles and Auto Parts industry also has a significant negative coefficient but with regards to the unexpected changes only. However this coefficient had been positive and significant when contemporaneous changes were used instead.

An evaluation of the findings here, against that of the OLS (Table A12.7) in which only 1 industry had a significant coefficient for the actual lagged and 2 industries regarding the unexpected lagged changes, seems to further substantiate our claim that lagged increases (decreases) in the long-term interest rate do not contain information that is otherwise adequate so as to exert a detrimental (beneficial) impact on the returns of most UK industries.

In Tables 4.10, 4.11 and 4.12 are the results for the risk-return trade off parameter in the models using the actual and unexpected changes in the TWI, US$/£ and JP¥/£, respectively. Regarding the TWI, we find 6 industries with significant coefficients for the actual changes and 7 industries for the unexpected changes. Then regarding the JP¥/£, 5 industries have significant coefficients irrespective of whether actual or unexpected changes were used in the model. The results for the US$/£ show that 5 industries had significant coefficients for the actual changes, while there were 6 industries with significant coefficients for the unexpected changes. The industries with significant positive coefficients for the TWI, JP¥/£ and US$/£ were Construction and Materials, Industrial Transport, Mobile Telecommunications and Personal Goods. We note that the coefficient for the Industrial Transport industry was insignificant for the actual US$/£, whereas the Tobacco industry had a significant positive coefficient with regards to just the unexpected TWI and US$/£. The occurrence of positive coefficients infers that an increase in volatility is compensated for by a higher average return. Additionally, the Industrial Engineering industry has significant negative coefficients for all the exchange rate measures, whereas for the Electricity industry, significant negative coefficients were for the TWI and unexpected US$/£ only. The finding of negative coefficients for these industries implies that an increase in volatility leads to lower average returns. We further observe that for some of the industries listed, the coefficient of the risk premium parameter is significant for all the exchange rate measures. Overall, the numbers of industries with significant risk-return parameter coefficients are still considerably low and similar to the findings for the contemporaneous changes, indicating that during the total period investigated, there is no trade-off between volatility and expected returns for most UK industries. Another explanation proffered in Joseph (2003) where insignificant coefficients were found for the returns of US financial industries is that the use of aggregate estimates has the potential of masking those incidences when the risk parameter could have been significant. Incidentally the use of firm level returns might yield a different result.

In Tables A6.13, A6.14 and A6.15 of Appendix 6, the findings from the variance equations are presented for the actual and unexpected TWI, US$/£ and JPY/£. It is found that 13 (42%) industries have significant asymmetric parameter coefficients (α_1) for the TWI, whereas for the US$/£, 11 (35%) industries were found, and for the JP¥/£, 12 (39%) industries had significant coefficients. These results were the same for both actual and unexpected changes in the TWI and JPY/£. Then in all instances, that is TWI, US$/£ and JP¥/£ models, almost all the coefficients were negative. In more detail, 12 industries, namely Automobiles and Auto Parts, Chemicals, Electronic and Electrical Equipment, Food and Drug Retailers, General Industrial, Household Goods, Industrial Transport, Oil Equipment and Services, Support Services, Technical Hardware and Equipment, Tobacco and Travel and Leisure have significant negative coefficients for the TWI, while the Software and Computer Services industry has a significant positive coefficient.

All these industries with significant coefficients for the TWI, except the Food and Drug Retailers industry, also had significant coefficients for the JP¥/£. Furthermore, we find that for the actual and unexpected US$, the results are quite similar to that reported above for the TWI and JP¥/£. The exceptions were that for the actual US$/£, the Food and Drug Retailers and Industrial Transport industries had insignificant coefficients, but for the unexpected US$/£, the Food and Drug Retailers as well as the Technical Hardware and Equipment industries have insignificant coefficients. The findings here are very similar to that reported for the contemporaneous changes, where we also found that detrimental effects of exchange rates and /or interest rates increase the riskiness in the returns of most UK industries more than favourable effects. Furthermore the ARCH parameter (α_2), which represents the presence of volatility clustering is significant for 28 industries in the TWI, US$/£ and JP¥/£ models. In all the models, the ARCH parameter coefficient is positive, indicating that conditional volatility tends to rise (fall) when the absolute value of the standardised error is larger (smaller). Then for the GARCH parameter (φ_1), which denotes the persistence of volatility, we find 28 industries with significant coefficients in the TWI, actual US$/£ and JP¥/£ models. In particular, the Forestry and Paper, Industrial Transport and Pharmaceuticals and Biotechnology industries have insignificant coefficients, but with regards to the unexpected US$/£, these coefficients are significant. We also observe that for almost all the industries, the persistence of volatility is strong. However, for the Leisure Goods and Media industries, where $\varphi_1 > 1$ in all models, volatility tends to persists indefinitely thereby making the system unstable. Yet again, these findings are akin to that reported for the contemporaneous changes in terms of number of industries with significant coefficients. But since the magnitude of the coefficients is different, we employ the ratio of negative innovations to positive innovations and the half-life of persistence to unmask any significant differences that might be inherent in the results. Furthermore, Table A6.16 of Appendix 6 reveals that on average, negative innovations have about 1.1 times as large an effect on volatility than do positive innovations, which is apparently not different to that reported for the contemporaneous changes. The half-life of innovation-measure also shows that the Software and Computer Services industry with average half-life of 366 weeks has the highest persistence of volatility. We also note that there is a variation in the half-life measure of the industry, depending on the exchange rate measure used in the model. For instance, the actual US$/£ model had the lowest with 336 weeks, whereas for the unexpected JP¥/£, the half-life is highest with 412 weeks. Although the Software and Computer Services industry also had the highest persistence when the contemporaneous changes were used, the average half-life of 419 weeks is higher than that reported for the lagged changes. The lowest significant persistence of volatility of less than half a week was found for the Forestry and Paper and Pharmaceuticals and Biotechnology industries but only regarding the unexpected US$/£ since the GARCH terms were insignificant in all the other models.

Table 4.10 A summary of non-financial industries' exposure to lagged changes in the Trade weighted nominal exchange rate, short-term interest rate and long-term interest rate of the total sample period from January 1990 to December 2006 - Estimated coefficients from the mean equation

	ACTUAL BOEGBPR				UNEXPECTED BOEGBPR			
INDUSTRY	λ	BOEGBPR	UKTBTND	UKMBRYD	λ	BOEGBPR	UKTBTND	UKMBRYD
Aerospace and Defence	0.0013	-0.1030	0.0487	-0.0524	0.0012	-0.0013	0.0514	-0.0045
Automobiles and Auto Parts	0.0000	-0.0720	-0.0319	-0.0479	0.0000	-0.0008	-0.0188	-0.0082**
Beverages	0.0009	-0.0589	0.0111	0.0195	0.0008	-0.0005	0.0170	0.0016
Chemicals	0.0008	-0.1383**	0.0268	-0.0153	0.0008	-0.0016***	0.0419	-0.0028
Construction And Materials	0.0020**	-0.0905*	-0.0391	0.0060	0.0022**	-0.0010*	-0.0250	-0.0010
Electricity	-0.0037*	0.1570*	-0.0434	-0.0550	-0.0037*	0.0016	-0.0267	-0.0052
Electronic And Electrical Equipment	0.0000	-0.0177	-0.0246	-0.0077	0.0001	-0.0002	-0.0205	-0.0029
Fixed-line Telecommunications	-0.0008	0.0594	0.0748	0.0161	-0.0007	0.0011	-0.0488	0.0046
Food and Drug Retailers	0.0001	0.1139	0.0954**	-0.0258	-0.0002	0.0010	0.0999**	-0.0027
Food Producers	-0.0004	-0.0160	0.0216	-0.0220	-0.0004	-0.0001	0.0209	-0.0016
Forestry And Paper	-0.0011	-0.0569	-0.0008	-0.0187	-0.0012	-0.0006	0.0148	-0.0026
Gas, Water And Multi-Utilities	-0.0022	0.1319	0.0139	-0.0720**	-0.0020	0.0015*	0.0033	-0.0129**
General Industrial	0.0014	-0.0412	0.0462	-0.0061	0.0014	-0.0009	0.0784*	-0.0026
General Retailers	0.0008	0.1103*	-0.0613	0.0506*	0.0006	0.0009	-0.0588	0.0066*
Healthcare Equipment and Services	0.0011	0.0271	-0.0364	0.0650**	0.0011	0.0001	-0.0269	0.0092**
Household Goods	0.0020	-0.2259***	-0.0335	-0.0540	0.0020	-0.0024***	-0.0223	-0.0053
Industrial Engineering	-0.0019*	-0.0654	0.0091	0.0261	-0.0019*	-0.0006	0.0209	0.0036
Industrial Transport	0.2927***	-0.0769	0.0749**	0.0153	0.2203***	-0.0008	0.0828**	0.0034
Leisure Goods	-0.0012	-0.2134**	0.0014	-0.0074	-0.0011	-0.0023**	0.0036	-0.0024

Table 4.10 continued A summary of non-financial industries' exposure to lagged changes in the Trade weighted nominal exchange rate, short-term interest rate and long-term interest rate of the total sample period from January 1990 to December 2006 - Estimated coefficients from the mean equation

	ACTUAL BOEGBPR				UNEXPECTED BOEGBPR			
INDUSTRY	λ	BOEGBPR	UKTBTND	UKMBRYD	λ	BOEGBPR	UKTBTND	UKMBRYD
Media	-0.0012	-0.2189**	0.0032	-0.0095	-0.0011	-0.0023**	0.0052	-0.0028
Mining	0.0032	-0.0405	-0.1208*	-0.0620	0.0037	-0.0005	-0.0845	-0.0042
Mobile Telecommunications	0.0016**	-0.0147	0.0098	-0.0178	0.0015**	-0.0001	0.0099	-0.0033
Oil and Gas Producers	-0.0009	-0.1038	-0.0049	-0.0027	-0.0009	-0.0012	-0.0104	-0.0011
Oil Equipment And Services	0.0006	-0.0853	-0.0051	-0.0056	0.0006	-0.0012	-0.0167	-0.0012
Personal Goods	0.0012**	-0.0296	-0.0153	-0.0245	0.0012**	-0.0004	-0.0011	-0.0036
Pharmaceuticals and Biotechnology	0.6668	-0.1174	0.0206	0.0090	0.8458	-0.0011	-0.0296	0.0002
Software and Computer Services	0.0010	0.0536	-0.0827**	-0.0602	0.0012	0.0004	-0.0717*	-0.0058
Support Services	0.0010	-0.0015	-0.0330	0.0075	0.0009	0.0000	-0.0138	0.0003
Technical Hardware and Equipment	-0.0009	-0.0080	0.0501	0.0051	-0.0009	0.0000	0.0545	0.0003
Tobacco	0.0016	-0.1311	-0.0229	-0.0158	0.0017*	-0.0015	-0.0223	-0.0046
Travel and Leisure	-0.0002	-0.0598	0.0272	-0.0173	-0.0004	-0.0006	0.0295	-0.0037

Note: λ is the risk-return trade-off parameter coefficient, BOEGBPR is the Trade-weighted nominal exchange rate exposure coefficient, UKTBTND and UKMBRYD are the exposure coefficients for the 3 Month TB and 10 Year GB respectively. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

Table 4.11 A summary of non-financial industries' exposure to lagged changes in the US$/£ for the total sample period from January 1990 to December 2006 - Estimated coefficients from the mean equation

	ACTUAL US$/£		UNEXPECTED US$/£	
INDUSTRY	λ	ER INDEX	λ	ER INDEX
Aerospace and Defence	0.0013	-0.0779	0.0011	-0.0499*
Automobiles and Auto Parts	-0.0001	-0.0517	0.0000	-0.0234
Beverages	0.0009	-0.0121	0.0008	-0.0045
Chemicals	0.0007	-0.0590	0.0007	-0.0363*
Construction And Materials	0.0020**	-0.0426	0.0022**	-0.0217
Electricity	-0.0037*	0.0722	-0.0037	0.0424
Electronic And Electrical Equipment	0.0000	-0.0196	0.0001	-0.0091
Fixed-line Telecommunications	-0.0005	0.0710	-0.0005	0.0433
Food and Drug Retailers	-0.0003	-0.0383	-0.0004	-0.0313
Food Producers	-0.0004	-0.0086	-0.0004	-0.0024
Forestry And Paper	-0.0012	-0.0018	-0.0014	-0.0032
Gas. Water And Multi-Utilities	-0.0023	0.0368	-0.0022	0.0188
General Industrial	0.0013	-0.0438	0.0013	-0.0237
General Retailers	0.0008	0.0461	0.0006	0.0265
Healthcare Equipment and Services	0.0011	-0.0821**	0.0011	-0.0585**
Household Goods	0.0025	-0.1292**	0.0026	-0.0718**
Industrial Engineering	-0.0020*	-0.0365	-0.0019*	-0.0254
Industrial Transport	0.3605	0.0927**	0.1703***	0.0572***
Leisure Goods	-0.0011	-0.0991	-0.0010	-0.0615
Media	-0.0011	-0.1011	-0.0010	-0.0631
Mining	0.0030	-0.0499	0.0036	-0.0204
Mobile Telecommunications	0.0016**	0.0222	0.0015*	0.0167
Oil and Gas Producers	-0.0009	-0.0854	-0.0009	-0.0487
Oil Equipment And Services	0.0006	-0.0731	0.0006	-0.0444
Personal Goods	0.0012**	-0.0276	0.0012**	-0.0151
Pharmaceuticals and Biotechnology	0.6753	-0.0087	0.9571	-0.0021
Software and Computer Services	0.0009	0.0484	0.0012	0.0285
Support Services	0.0009	-0.0409	0.0009	-0.0178
Technical Hardware and Equipment	-0.0009	-0.0396	-0.0009	-0.0194
Tobacco	0.0016	-0.1822***	0.0017*	-0.1106***
Travel and Leisure	-0.0002	-0.0904*	-0.0004	-0.0566*

Note: λ represents the risk-return trade-off parameter coefficient, ER INDEX is the US$ exchange rate exposure coefficient. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

Table 4.12 A summary of non-financial industries' exposure to lagged changes in the JP¥/£ for the total sample period from January 1990 to December 2006 - Estimated coefficients from the mean equation

	ACTUAL JP¥/£		UNEXPECTED JP¥/£	
INDUSTRY	λ	ER INDEX	λ	ER INDEX
Aerospace and Defence	0.0012	0.0100	0.0011	0.0000
Automobiles and Auto Parts	-0.0001	-0.0585	-0.0001	-0.0003*
Beverages	0.0009	-0.0021	0.0009	0.0001
Chemicals	0.0006	-0.0661**	0.0006	-0.0003*
Construction And Materials	0.0019**	-0.0316	0.0020**	-0.0002
Electricity	-0.0037	0.0849*	-0.0035	0.0004
Electronic And Electrical Equipment	0.0000	-0.0186	0.0000	-0.0001
Fixed-line Telecommunications	-0.0004	0.0774	-0.0006	0.0003
Food and Drug Retailers	-0.0003	-0.0183	-0.0002	-0.0001
Food Producers	-0.0005	-0.0382	-0.0004	-0.0002
Forestry And Paper	-0.0011	-0.0145	-0.0013	0.0000
Gas, Water And Multi-Utilities	-0.0023	0.0238	-0.0021	0.0002
General Industrial	0.0014	0.0172	0.0013	0.0000
General Retailers	0.0009	0.0197	0.0006	0.0000
Healthcare Equipment and Services	0.0011	0.0005	0.0012	-0.0001
Household Goods	0.0027	-0.0205	0.0029	-0.0001
Industrial Engineering	-0.0021*	-0.0431*	-0.0020*	-0.0002*
Industrial Transport	0.2599***	-0.0388	0.3642***	-0.0002
Leisure Goods	-0.0011	-0.1596***	-0.0010	-0.0007***
Media	-0.0011	-0.1573***	-0.0010	-0.0007***
Mining	0.0031	-0.0658	0.0033	-0.0004
Mobile Telecommunications	0.0016**	-0.0040	0.0015*	0.0000
Oil and Gas Producers	-0.0009	-0.0240	-0.0009	-0.0001
Oil Equipment And Services	0.0006	0.0246	0.0006	0.0000
Personal Goods	0.0012**	-0.0132	0.0012**	-0.0001
Pharmaceuticals and Biotechnology	0.7269	-0.1002**	0.5973	-0.0005**
Software and Computer Services	0.0010	0.0017	0.0012	-0.0001
Support Services	0.0009	-0.0308	0.0008	-0.0002
Technical Hardware and Equipment	-0.0009	-0.0283	-0.0009	-0.0002
Tobacco	0.0015	-0.0481	0.0015	-0.0005
Travel and Leisure	-0.0002	0.0040	-0.0003	0.0000

Note: λ represents the risk-return trade-off parameter coefficient, ER INDEX is the JP¥ exchange rate exposure coefficient. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

But more notably is the Beverages industry, whose GARCH term was significant in all the models. The industry has an average half-life of 9 weeks, which is just a little under the 10 weeks reported for the contemporaneous changes. Overall, for some industries, the half-life was slightly higher for the contemporaneous changes than lagged changes, whereas, for other industries, the reverse was the case.

Regarding the sub-period analysis, we also introduce lagged changes in the ECU/£ for the period before the Euro and Euro/£ for the period after the Euro. The results from the mean equation presented in Tables 4.13 and 4.14 indicates that 9 (29%) industries have significant coefficients regarding the actual ECU/£, while for the unexpected ECU/£, 11 (35%) industries had significant coefficients. These were the Food and Drug Retailers, General Retailers, Support Services and Technical Hardware and Equipment with positive coefficients, while Household Goods, Industrial Transport, Leisure Goods, Oil and Gas Producers and Pharmaceuticals and Biotechnology have negative coefficients for both the actual and unexpected changes. Then, the modelling scenario for the Media industry with a significant negative coefficient and Software and Computer Services with a significant positive coefficient was with regard to the unexpected ECU/£ only.

Regarding the Euro/£, 7 (23%) industries had significant coefficients for the actual changes, while for the unexpected changes, 10 (32%) industries exhibited significant coefficients. These were the Food and Drug Retailers, Gas, Water and Multi-Utilities and Healthcare Equipment and Services which have positive coefficients, whereas Aerospace and Defence, Chemicals, Forestry and Paper and Industrial Transport have negative coefficients. These industries were the same for the unexpected Euro/£, in addition to the Construction and Materials, Electronic and Electrical Equipment and Technical Hardware and Equipment industries, which all have significant negative coefficients. We also find that the General Retailers industry is the only industry here that had a significant coefficient when contemporaneous actual changes for the ECU/£ were used, while for the Euro/£, this was the Industrial Transport industry but with regards to only the unexpected Euro/£.

Generally, we find overwhelming support of lagged effects on industry returns since, for contemporaneous actual (unexpected) changes, just 5 (6) industries had significant coefficients for the ECU/£, and 4 (3) industries for the Euro/£. However, the results from the OLS (Table A12.9) indicates that for the lagged changes in the ECU/£, 4 industries each had significant coefficients to the actual and unexpected change while, for the Euro/£, 3 industries exhibited significant coefficients for the actual changes and 8 industries for the unexpected changes, suggesting that the GARCH model was more successful in detecting the lagged effects of the ECU/£ and Euro/£ on the returns of UK non-financial industries. What's more, we find that the incidence of significant lagged exposure coefficients to the ECU/£ was just marginally higher than that reported for the Euro/£, which is rather similar to our findings for the contemporaneous changes.

Also in Tables 4.13 and 4.14 are the coefficients of the risk premium parameters for the ECU/£ and Euro/£, respectively. Regarding the ECU/£, we find 10 industries with significant coefficients for the actual changes. These include Automobiles and Auto Parts, Beverages, Construction and Materials, Healthcare Equipment and Services, Media, Oil Equipment and Services, Personal Goods and the Software and Computer Services industries which had positive coefficients, while the Food Producers and Leisure Goods industries have negative coefficients. The result for the unexpected changes was fairly similar as we find 7 industries with significant coefficients. Some of these industries were mainly those listed for the actual changes, except Automobiles and Auto Parts, Leisure Goods, Media and Oil Equipment and Services industries. Additionally, the General Industrial industry was found to have a significant positive coefficient. But the result here for the lagged changes is again a bit different to that reported for the contemporaneous changes where 8 industries had significant coefficients for the actual changes, and for the unexpected changes, 9 industries were found with significant coefficients. Notwithstanding, a majority of the industries reported here for lagged changes also had significant coefficients when contemporaneous changes were previously used. Additionally, the results for the Euro/£ indicate that 12 industries have significant risk-return coefficients for the actual changes and 11 industries for the unexpected changes. In detail, these were the Food and Drug Retailers, Household Goods, Mining and Oil and Gas Producers industries which have significant positive coefficients, while the Electricity, Electronic and Electrical Equipment, Forestry and Paper, Industrial Transport, Leisure Goods and Media industries have significant negative coefficients for both the actual and unexpected Euro/£. Other industries that had significant coefficients were Aerospace and Defence with a negative coefficient and the Chemicals industry with a positive coefficient but this was for the actual Euro/£ alone, while Automobiles and Auto Parts had a significant positive coefficient for the unexpected changes only.

This result is just slightly different to that reported for the contemporaneous changes in terms of number of industries with significant coefficients as 10 industries each had significant coefficients regarding the actual and unexpected changes. But in terms of the sign of the coefficients, the contemporaneous change in the unexpected Euro/£ had 80% of its significant coefficients negative in comparison with 60% reported for its corresponding actual changes and even 58% and 54% for the lagged actual and unexpected changes, respectively. Furthermore, we find again that the incidence of negative coefficients for the lagged Euro/£ far outweighs that of the lagged ECU/£, where only 25% of the coefficients were negative for actual ECU/£ and for the unexpected ECU/£, a very low 14%.

In the period before the Euro (ECU/£), volatility of returns was highest for the Construction and Materials industry and Automobiles and Auto Parts (which also had the highest volatility for contemporaneous changes) when actual changes were used, whereas, for unexpected changes, volatility was highest for the Software and Computer Services and General Industrial industries. Then for the actual and unexpected Euro/£, Household Goods and Automobiles and Auto Parts respectively had the highest coefficients. But since all these coefficients are positive, expected average returns should be higher as well. Then we also find that only the Leisure Goods and Media industries have significant risk premium coefficients for the ECU/£ as well as the Euro/£.

In Tables A6.17 and A6.18 (Appendix 6), we present the findings from the variance equations. Firstly, for the asymmetric term (α_1), we find 11 (35%) industries with significant coefficients for the actual ECU/£. These were Construction and Materials, Electronic and Electrical Equipment, Food and Drug

Retailers, Health Equipment and Services, Household Goods, Software and Computer Services and Support Services with negative coefficients, while Beverages, Food Producers, Mining and Travel and Leisure industries have positive coefficients. Then for the unexpected changes, 12 (39%) industries have significant coefficients. These were the same industries with significant coefficients for the actual changes as well as the Automobiles and Auto Parts industry with a negative coefficient. Then we also find that some of these industries had significant coefficients for the contemporaneous changes as well. Overall, the results reported here for lagged changes were not particularly different to that of the contemporaneous where we found that, for the actual changes, 11 industries have significant coefficients, whereas for the unexpected changes, 13 industries had significant coefficients.

For the actual Euro, 13 (42%) industries have significant coefficients. These were made up of Automobiles and Auto Parts, Chemicals, Food and Drug Retailers, Food Producers, Gas, Water and Multi-Utilities, Household Goods, Oil Equipment and Services and Travel and Leisure with negative coefficients, whereas Electronic and Electrical Equipment, Industrial Transport, Media, Mining and Software and Computer Services have positive coefficients. Then for the unexpected changes, we find 11 (35%) industries with significant coefficients. These were the industries listed for the actual changes except the Chemicals and Media industries. Furthermore, we observed that a few of these industries also exhibited significant coefficients for the contemporaneous changes, wherein 12 (14) had significant coefficients for the actual (unexpected) changes, respectively. Then for the Food Producers, Software and Computer Services and Travel and

Leisure industries, we find that the sign of the coefficient for the lagged Euro/£ was of the opposite sign for the lagged ECU/£.

We also recall that 2 industries, the Electronic and Electrical Equipment and Mining, also had differences in the sign of their coefficients for the ECU/£ and Euro/£ as well. Overall there were more significant negative coefficients summarised as follows: negative (positive) for actual ECU/£ was 7 (4), unexpected ECU/£ were 8 (4), actual Euro/£ were 8 (5) while for unexpected Euro/£, these were 7 (4) respectively, signifying that for most of these industries, negative (bad) news has a higher impact on the volatility of their returns than positive (good) news. This result also substantiates the findings from the contemporaneous changes.

Furthermore, the ARCH term (α_2), which provides evidence of volatility clustering was a bit more pronounced for the lagged ECU/£ and Euro/£ than their contemporaneous counterparts. The results show that 19 industries each had significant coefficients for the actual and unexpected ECU/£, which were all positive, although not all the same industries had significant coefficients for both measures. Regarding the Euro/£, 21 industries each had significant coefficients for the actual and the unexpected changes, but again, these were not necessarily the same industries for both measures. Then in both instances, 4 industries each had negative ARCH coefficients for the actual and unexpected changes.

For the persistence parameter or GARCH term (φ_1), the incidence of significant coefficients for actual (unexpected) changes in the ECU/£ were for 18 (20) industries, respectively whereas for actual (unexpected) Euro/£, these were 26 (24) industries. It was also observed that the condition $\varphi_1<1$ was breached: in the

ECU/£ models for the Aerospace and Defence industry; in the actual Euro/£ model, this was the Food Producers industry; and in the unexpected Euro/£ we have the Oil and Gas Producers industry. Incidentally, volatility tends to persist indefinitely for these industries, thereby making the system unstable. Overall, there are as many significant volatility persistence parameters for the lagged ECU/£ changes as there are for the contemporaneous changes in the ECU/£.

However, since the coefficients are of different magnitudes, the degree of persistence for individual industries varies. This finding is also applicable to the contemporaneous and lagged changes in the Euro/£. But when we compared the result of the ECU/£ with that of the Euro/£, the number of industries with significant coefficients for the volatility persistence parameter was more for the Euro/£ than the ECU/£. In addition, in industries for which the ARCH and GARCH parameters are significant for the ECU/£ and Euro/£, it is implied that the volatility of the industry's returns is time varying, and that volatility is a function of its own lag in addition to the intensity of the shock that occurred in the last period.

For almost all the industries, the magnitude of the coefficient for the GARCH (φ) parameter is larger than that of the ARCH (α_2) parameter suggesting that volatility is more responsive to old news than it is to news about volatility from the previous period. Furthermore, the high values found for the GARCH parameter coefficient suggests that volatility persists for a long period. Incidentally the same outcome was observed when contemporaneous changes in the ECU/£ and Euro/£ had been previously employed in the model.

To present a more insightful explanation, the estimated ratio of the leverage parameter to the asymmetric parameter, as well as the half-life measure of persistence, is presented in Table A6.19 of Appendix 6. The table shows that for the ECU/£, the leverage/asymmetry ratio of 1.3723 was highest for the Construction and Materials industry, a finding that is also analogous to that from the contemporaneous changes. Then for the Euro/£, the Oil Equipment and Services industry had the highest ratio of 1.6347. In both instances, impact of bad news on volatility was 1.3 times and 1.6 times respectively more than the impact of good news. It is also pertinent to note that for industries with a ratio less than 1, this implies that good news has more impact on the volatility of industry's returns than bad news. Generally, the half-life measure is higher for most industries in the period after the Euro suggesting that the persistence of volatility is higher during the more recent period and that it takes a longer period on average for half the magnitude of volatility on the industry's returns to dissipate.

4.6 Competitive vs. Concentrated industries exposure to exchange rates and interest rates

The impact of fluctuations in exchange rates and interest rates on the returns of competitive and concentrated industries in the UK is also investigated using the AR (1)-EGARCH-M model. The returns of all industries classified as concentrated are pooled and the same procedure is repeated for the competitive industries. Subsequently a pooled regression analysis is then carried out using the model stated thus for the total sample period and sub-period analysis.

$$R_t = \alpha + \beta_{ai}R_{t-1} + \beta_m RM_t + \beta_r XR_t + \beta_s SR_t + \beta_l LR_t + \lambda \log(h^2_t) + \varepsilon_t \qquad 4.4a$$

$$\varepsilon_t|I_{t-1} \sim t(0, h^2_t, \upsilon_t) \qquad 4.4b$$

$$\log h^2_t = \alpha_0 + \alpha_1\frac{\varepsilon_{t-1}}{h_{t-1}} + \alpha_2\left(\left|\frac{\varepsilon_{t-1}}{h_{t-1}}\right|\right) + \varphi_1 \log h^2_{t-1} \qquad 4.4c$$

Equation 4.4a is the mean equation wherein, α is the intercept term, R_t is the pooled return of the concentrated or competitive industries, R_{t-1} is the autoregressive lag parameter, RM_t is the rate of return of the market portfolio, XR_t is the percentage change in the exchange rate index, SR_t is the change in the short term interest rate at time t and LR_t is the change in the long-term interest, ε_t is the error term. Additionally, using models 4.5 (a,b,c), we further test for any significant difference between concentrated and competitive industries. Therefore, R_t is the pooled return of both concentrated or competitive industries, while INDUM is the industry dummy which takes the value of 1 for concentrated industries and 0 for competitive industries.

$$R_t = \alpha + \beta_{ai}R_{t-1} + \beta_{mi}RM_t + \beta_{ri}XR_t + \beta_{si}SR_t + \beta_{li}LR_t + \beta_{in}INDUM + \lambda \log(h^2_t) + \varepsilon_t \qquad 4.5a$$

$$\varepsilon_t | I_{t-1} \sim t(0, h^2_t, \upsilon_t) \qquad 4.5b$$

$$\log h^2_t = \alpha_0 + \alpha_1\frac{\varepsilon_{t-1}}{h_{t-1}} + \alpha_2\left(\left|\frac{\varepsilon_{t-1}}{h_{t-1}}\right|\right) + \varphi_1 \log h^2_{t-1} \qquad 4.5c$$

All the ARCH and GARCH parameters are as previously explained in 4.1b and 4.1c.

In Table 4.15, we present the results from the mean equation for the contemporaneous actual and unexpected changes in the TWI model. We find that the concentrated, competitive and concentrated plus competitive industries have significant positive coefficients regarding the actual and unexpected TWI.

Table 4.13 A summary of non-financial industries' exposure to lagged changes in the ECU/£ for the period January 1990 to December 1998 - Estimated coefficients from the mean equation

	ACTUAL ECU/£		UNEXPECTED ECU/£	
INDUSTRY	λ	ER INDEX	λ	ER INDEX
Aerospace and Defence	-0.0007	0.0570	-0.0009	0.0514
Automobiles and Auto Parts	0.0500***	-0.0734	0.0003	-0.0333
Beverages	0.0026*	-0.0467	0.0026*	-0.0406
Chemicals	0.0010	-0.1134	0.0009	-0.0909
Construction And Materials	0.0523*	-0.0071	0.0449**	-0.0114
Electricity	-0.2616	0.0951	-0.2803	0.0613
Electronic And Electrical Equipment	-0.0007	0.0195	-0.0008	0.0103
Fixed-line Telecommunications	0.0091	0.1894	0.0085	0.1449
Food and Drug Retailers	-0.0013	0.2126*	-0.0014	0.1658*
Food Producers	-0.0040**	-0.0087	-0.0038**	-0.0031
Forestry And Paper	-4.0615	-0.0167	-53.9432	-0.0203
Gas. Water And Multi-Utilities	0.0035	0.0720	0.0038	0.0546
General Industrial	0.0567	-0.0283	0.0829*	-0.0198
General Retailers	0.0009	0.1928**	-0.0001	0.1359**
Healthcare Equipment and Services	0.0479*	0.0265	0.0437*	0.0283
Household Goods	-0.0021	-0.3324***	-0.0018	-0.2635***
Industrial Engineering	-0.0011	-0.0693	-0.0013	-0.0612
Industrial Transport	0.1514	-0.1189*	0.1230	-0.1200**
Leisure Goods	-0.0031*	-0.2924**	-0.0026	-0.2325**
Media	0.0121*	-0.2007	-0.0025	-0.2423**
Mining	-0.0102	0.0217	-0.0096	0.0040
Mobile Telecommunications	0.0024	-0.0448	0.0025	-0.0301
Oil and Gas Producers	0.0017	-0.2104*	0.0012	-0.1801**
Oil Equipment And Services	0.3184*	0.0223	0.2957	0.0071
Personal Goods	0.0019*	0.0399	0.0018*	0.0300
Pharmaceuticals and Biotechnology	0.6888	-0.2484*	0.8618	-0.2404**
Software and Computer Services	0.1456***	0.1347	0.0972**	0.1151*
Support Services	0.0003	0.1190*	0.0003	0.0836*
Technical Hardware and Equipment	0.0928	0.1546*	0.1020	0.1406**
Tobacco	0.0014	-0.1159	0.0017	-0.1073
Travel and Leisure	0.0009	0.0497	0.0008	0.0360

Note: λ represents the risk-return trade-off parameter coefficient, ER INDEX is the ECU exchange rate exposure coefficient. ***,** and * denotes statistical significance at the 1%, 5% and 10% level

Table 4.14 A summary of non-financial industries' exposure to lagged changes in the Euro/£ for the sample period from January 1999 to December 2006 - Estimated coefficients from the mean equation

	ACTUAL EURO/£		UNEXPECTED EURO/£	
INDUSTRY	λ	ER INDEX	λ	ER INDEX
Aerospace and Defence	-0.0126*	-0.2490**	-0.0129	-0.1509**
Automobiles and Auto Parts	0.0043	-0.0509	0.0446**	-0.0145
Beverages	-0.0031	-0.0729	-0.0032	-0.0362
Chemicals	0.0120***	-0.2874***	0.2011	-0.0971*
Construction And Materials	0.1251	-0.0902	0.1096	-0.1122**
Electricity	-0.0035**	0.1982	-0.0032*	0.1286
Electronic And Electrical Equipment	-0.0631*	-0.1172	-0.0734*	-0.1115*
Fixed-line Telecommunications	-0.0011	-0.1704	-0.0015	-0.1242
Food and Drug Retailers	0.0031**	0.2258**	0.0029***	0.1731***
Food Producers	0.0004	0.0063	0.0006	0.0359
Forestry And Paper	-0.0054*	-0.2956**	-0.0052**	-0.1965**
Gas, Water And Multi-Utilities	-0.0019	0.2587**	-0.0017	0.2100***
General Industrial	0.0013	-0.1154	0.0011	-0.0792
General Retailers	0.0016	-0.0101	0.0015	-0.0081
Healthcare Equipment and Services	0.0016	0.2488*	0.0014	0.1776*
Household Goods	0.0344*	0.0272	0.0325*	-0.0147
Industrial Engineering	0.0036	-0.0420	0.0036	-0.0335
Industrial Transport	-0.1087***	-0.1629**	-0.1532**	-0.1248***
Leisure Goods	-0.0065*	-0.1534	-0.0069*	-0.2590
Media	-0.0068*	-0.1517	-0.0069*	-0.2531
Mining	0.0005***	-0.1440	0.0005***	-0.1445
Mobile Telecommunications	0.0008	-0.0382	0.0008	-0.0393
Oil and Gas Producers	0.0044*	-0.0479	0.0046*	-0.0373
Oil Equipment And Services	0.0034	-0.0940	0.0033	-0.0589
Personal Goods	-0.0027	-0.1666	-0.0027	-0.1000
Pharmaceuticals and Biotechnology	-0.0025	-0.0197	-0.0028	0.0160
Software and Computer Services	0.0007	-0.1454	0.0005	-0.1443
Support Services	0.0027	-0.1014	0.0024	-0.0706
Technical Hardware and Equipment	0.0041	-0.2184	0.0027	-0.2873*
Tobacco	0.0011	0.2443	0.0019	0.1725
Travel and Leisure	-0.0016	-0.1466	-0.0015	-0.1048

Note: λ represents the risk-return trade-off parameter coefficient, ER INDEX is the euro exchange rate exposure coefficient. ***,** and * denotes statistical significance at the 1%, 5% and 10% level

However, the magnitude of the exposure coefficient was highest for the competitive industries implying that concentrated industries are less exposed to change in the TWI. But from the OLS model (Table A12.10), only the concentrated industries and concentrated plus competitive industries had significant coefficients regarding the actual changes.

In Table 4.16, the results for the US$/£ show that the concentrated, competitive and concentrated plus competitive industries all have significant positive coefficients for the actual changes, as well as the unexpected changes. Again the exposure coefficient for the competitive industries is the highest in terms of magnitude. This finding was the same observed from the OLS estimates (Table A12.11). In Table 4.17, we present the results for the JPY/£. The results here are different from that previously estimated using the OLS (Table A12.11). In this instance, all the coefficients are positive for the actual and unexpected changes but only significant for the competitive and concentrated plus competitive industries. But for the OLS, only the concentrated plus competitive industries had a significant coefficient regarding the actual changes while for the unexpected changes, it was the competitive and concentrated plus competitive industries.

Regarding the actual and unexpected short-term interest rate results in Table 4.15, significant negative coefficients are found for the competitive and concentrated plus competitive industries whereas for the long-term interest rates, these coefficients are positive but significant for the competitive and concentrated plus competitive industries only. The only difference between this result and that previously found from the OLS (Table A12.10) is that the unexpected short-term interest rate coefficients, although negative, were insignificant for the concentrated and competitive industries. Furthermore all the industry dummy coefficients in the mean equation and risk-return parameter coefficients are insignificant for all exchange rate measures. In Tables A7.1, A7.2 and A7.3 of Appendix 7, the results of the variance equation are presented. The asymmetric parameter coefficient (α_1) is negative and significant while for the ARCH (α_2) and GARCH (φ_1) term, the coefficients are significant and positive in all the models indicating the presence of volatility clustering and persistence of volatility. Furthermore, the magnitude of the ARCH term is lower than that of the GARCH parameter in all cases. The ratio of negative news to positive news and half-life of persistence measures are shown in Table A7.4. It is observed that the ratio of negative innovations to positive innovations is similar for both concentrated and competitive industries. However, for the half-life of persistence, the average was 114 weeks for competitive industries and 96 weeks for concentrated industries implying that volatility persists more in competitive industries.

The results of the sub-period analysis for the contemporaneous ECU/£ and Euro/£ are presented in Tables 4.18 and 4.19 respectively for the mean equation and Tables A7.5 and A7.6 (Appendix 7) for the variance equation. We find from the mean equations of the ECU/£ that the risk parameter is significant and negative for the competitive and concentrated plus competitive industries regarding the actual ECU/£ but for the unexpected ECU/£, only the concentrated plus competitive industries have a significant coefficient which is also negative. However for the Euro/£, only the risk parameter coefficients of the concentrated and competitive industries for the unexpected changes are significant but these are positive.

Table 4.15 A summary of non-financial concentrated and competitive industries' exposure to actual and unexpected changes in the trade weighted nominal exchange rate, short-term interest rate and long-term interest rate for the total sample period from January 1990 to December 2006 - Estimated coefficients from the mean equation

ACTUAL BOEGBPR						
INDUSTRY COMPETITION	COMPETITION DUMMY	λ	INDt-1	BOEGBPR	UKTBTND	UKMBRYD
CONCENTRATED		0.0000	0.0447***	0.0373**	-0.0109	-0.0041
COMPETITIVE		0.0000	0.1496***	0.0680***	-0.0264***	0.0400***
CONC AND COMP	NOT SIGNIFICANT (NEGATIVE)	0.0000	0.0860***	0.0528***	-0.0193***	0.0171***
UNEXPECTED BOEGBPR						
INDUSTRY COMPETITION	COMPETITION DUMMY	λ	INDt-1	BOEGBPR	UKTBTND	UKMBRYD
CONCENTRATED		0.0000	0.0449***	0.0004**	-0.0078	-0.0005
COMPETITIVE		0.0000	0.1499***	0.0008***	-0.0208**	0.0051***
CONC AND COMP	NOT SIGNIFICANT (NEGATIVE)	0.0000	0.0862***	0.0006***	-0.0147**	0.0022***

Note: λ is the risk-return trade-off parameter coefficient. BOEGBPR is the Trade-weighted nominal exchange rate exposure coefficient. UKTBTND and UKMBRYD are the exposure coefficients for the 3 Month TB and 10 Year GB respectively. The industry dummy coefficient is negative but not significant. CONC and COMP represents the pooled returns of concentrated and competitive industries. *** and ** denotes statistical significance at the 1% and 5% level.

Table 4.16 A summary of non-financial concentrated and competitive industries' exposure to actual and unexpected changes in the foreign exchange rate US$/£ of the total sample period from January 1990 to December 2006 - Estimated coefficients from the mean equation

		ACTUAL US$/£		UNEXPECTED US$/£	
INDUSTRY COMPETITION	COMPETITION DUMMY	λ	ER INDEX	λ	ER INDEX
CONCENTRATED		0.0000	-0.0336***	0.0000	0.0179**
COMPETITIVE		0.0000	-0.0371***	0.0000	0.0211***
CONC AND COMP	NOT SIGNIFICANT (NEGATIVE)	0.0000	-0.0357***	0.0000	0.0197***

Note: λ represents the risk-return trade-off parameter coefficient, ER INDEX is the US$/£ exchange rate exposure coefficient, The industry dummy coefficient is negative but not significant. CONC and COMP represents the returns of concentrated and competitive industries. *** and ** denotes statistical significance at the 1% and 5% level.

Table 4.17 A summary of non-financial concentrated and competitive industries' exposure to actual and unexpected changes in the foreign exchange rate JP¥/£ of the total sample period from January 1990 to December 2006 - Estimated coefficients from the mean equation

		ACTUAL JP¥/£		UNEXPECTED JP¥/£	
INDUSTRY COMPETITION	COMPETITION DUMMY	λ	ER INDEX	λ	ER INDEX
CONCENTRATED		0.0000	0.0094	0.0000	0.0000
COMPETITIVE		0.0001	0.0311***	0.0000	0.0001***
CONC AND COMP	NOT SIGNIFICANT (NEGATIVE)	0.0000	0.0196***	0.0000	0.0001***

Note: λ represents the risk-return trade-off parameter coefficient, ER INDEX is the JP¥/£ exchange rate exposure coefficient, The industry dummy coefficient is negative but not significant. CONC and COMP represents the returns of concentrated and competitive industries. *** denotes statistical significance at the 1% level.

Table 4.18 A summary of non-financial concentrated and competitive industries' exposure to actual and unexpected changes in the foreign exchange rate ECU/£ - Estimated coefficients from the mean equation

		ACTUAL ECU/£		UNEXPECTED ECU/£	
INDUSTRY COMPETITION	COMPETITION DUMMY	λ	ER INDEX	λ	ER INDEX
CONCENTRATED		0.0008	0.0331	-0.0006	0.0156
COMPETITIVE		-0.0005**	0.0382**	-0.0004	0.0344**
CONC AND COMP	NOT SIGNIFICANT (POSITIVE)	-0.0004*	0.0400**	-0.0004*	0.0252**

Note: λ represents the risk-return trade-off parameter coefficient, BOEGBPR is the Trade-weighted nominal exchange rate exposure coefficient, UKTBTND and UKMBRYD are the exposure coefficients for the 3 Month TB and 10 Year GB respectively. The industry dummy coefficient is positive but not significant. CONC and COMP represents the pooled returns of concentrated and competitive industries. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

Table 4.19 A summary of non-financial concentrated and competitive industries' exposure to actual and unexpected changes in the foreign exchange rate Euro/£ - Estimated coefficients from the mean equation

		ACTUAL Euro/£		UNEXPECTED Euro/£	
INDUSTRY COMPETITION	COMPETITION DUMMY	λ	ER INDEX	λ	ER INDEX
CONCENTRATED		-0.0004	-0.0043	0.0017***	-0.0077***
COMPETITIVE		0.0001	0.0193	0.0153***	0.0000
CONC AND COMP	NOT SIGNIFICANT (POSITIVE)	-0.0001	0.0162	-0.0001	0.0016

Note: λ represents the risk-return trade-off parameter coefficient, BOEGBPR is the Trade-weighted nominal exchange rate exposure coefficient, UKTBTND and UKMBRYD are the exposure coefficients for the 3 Month TB and 10 Year GB respectively. The industry dummy coefficient is positive but insignificant. CONC and COMP represents the pooled returns of concentrated and competitive industries. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

Then regarding the exchange rate measures, we find that for the actual and unexpected ECU, competitive industries and competitive plus concentrated industries have significant positive coefficients. On the other hand, the results for the Euro/£ indicates that just the concentrated industries have a significant negative coefficient but for only the unexpected changes. This result implies that before the Euro, influence of changes in exchange rates was higher for the competitive industries, but in the period after the euro, the impact of fluctuations in the exchange rates seems to be higher for concentrated industries. However, earlier result from the OLS analysis (Table A12.12) was particularly different as all the exchange rate coefficients for the ECU/£ and Euro/£ turned out to be statistically insignificant.

The results from the variance equation presented in Tables A7.5 and A7.6 of Appendix 7 indicates that the leverage parameters are significant and negative for the concentrated, competitive and concentrated plus competitive industries in respect of the actual changes in the ECU/£ and Euro/£. Then for the unexpected changes in the ECU/£ and Euro/£, competitive and concentrated plus competitive industries have significant negative coefficients whereas for the concentrated industries, this coefficient is insignificant for the ECU/£ and significant but positive for the Euro/£. We also observe that all the coefficients for the ARCH and GARCH parameters are significant indicating a strong persistence in volatility. In Table A7.7, we present the ratio of negative innovations to positive innovations and half-life of volatility for the ECU/£ and Euro/£. The result shows that the ratio of negative innovations to positive innovations is just above 1 for both competitive and concentrated industries in most cases. The only noticeable difference is for the concentrated industries where we find that for unexpected changes in the Euro/£, positive innovations is 0.5 times more than the effect of negative innovations. Then the results for the half-life measure reveals that volatility was more persistent for the competitive and concentrated industries in the period after the euro when actual changes of the ECU/£ and Euro/£ were used. However the reverse is the case for the unexpected changes as we observe that volatility is generally more persistent in the period before the euro. Overall, our result indicates that averagely, persistence of volatility is higher for competitive industries than it is for concentrated industries.

Next we explore the change in exposure before and after the euro for the market risk, exchange rate risk and interest rate risk for concentrated and competitive industries.

$$R_t = \alpha + \beta_{ai}R_{t-1} + \beta_m RM_t + \beta_{Eurom} RM_t D_{Eurot} + \beta_r XR_t + \beta_{Euror} XR_t D_{Eurot} + \beta_s SR_t + \beta_{Euros} SR_t D_{Eurot} + \beta_l LR_t + \beta_{Eurol} LR_t D_{Eurot} + \beta_{in} INDUM + \lambda \log(h^2_t) + \varepsilon_t \quad 4.6a$$

$$\varepsilon_t \mid I_{t-1} \sim t(0, h^2_t, \upsilon_t) \quad 4.6b$$

$$\log h^2_t = \alpha_o + \alpha_1 \frac{\varepsilon_{t-1}}{h_{t-1}} + \alpha_2\left(\left|\frac{\varepsilon_{t-1}}{h_{t-1}}\right|\right) + \varphi_1 \log h^2_{t-1} + EURDUM \quad 4.6c$$

All the parameters and coefficients for the mean and variance equations are as previously explained. In Tables 4.20 and 4.21, we present the findings for the actual and unexpected changes in the contemporaneous TWI from the mean equation. The result indicates that the risk return coefficients are not statistically significant at any level. We also observe that the market risk is significant and positive for the concentrated, competitive and concentrated plus competitive industries in the period before the euro. But in the period after the euro, all the change in the market risk coefficients are negative, but significant for only concentrated and concentrated plus competitive industries indicating a reduction in market risk. Regarding the actual and unexpected movements in the contemporaneous TWI, only the coefficients for the competitive and concentrated plus competitive industries are significant and these are positive. However in the period after the euro, the changes in the exposure coefficients are all insignificant.

In Table 4.22 and 4.23, the findings for the contemporaneous actual and unexpected changes in the US$/£ and JP¥/£ are shown. Regarding the actual changes in the US$/£, only the concentrated and concentrated plus competitive industries have significant coefficients whereas for the unexpected changes, just the concentrated plus competitive industries have a significant coefficient. Furthermore all these significant coefficients are positive. Concerning the change in the exposure for the actual and unexpected movements, significant coefficients were found for the competitive and concentrated plus competitive industries. Since these coefficients are positive, this implies an increase in exchange rate exposure. Then for the actual and unexpected JP¥/£, the exchange rate coefficients for the competitive and concentrated plus competitive industries are significant and positive whereas the change in the exchange rate exposure coefficient is insignificant for concentrated, competitive, and concentrated plus competitive industries. Overall, this finding is similar to that found previously for the OLS (Tables A12.14 and A12.15) as competitive industries seem to be slightly more exposed to exchange rates in the period before the Euro. Then regarding the change in exposure after the euro, we observe that for competitive industries, the exchange rate exposure increased but this was in respect of the actual changes in the US$/£ only.

Furthermore, for the actual and unexpected movements in the short-term interest rates in Tables 4.20 and 4.21, concentrated, competitive and concentrated plus competitive industries have significant negative coefficients in the period before the euro while the change in exposure after the euro is positive and significant for concentrated and concentrated plus competitive industries indicating that their exposure to the short-term interest rate reduced after the euro. The result for the actual and unexpected movements in the long-term interest rate (Tables 4.20 and 4.21), only the competitive and concentrated plus competitive industries have significant coefficients and these are positive, while for the change in exposure after the euro, the coefficients for the concentrated, competitive and concentrated plus competitive industries are insignificant. This finding suggests that there is a significant reduction in exposure to short-term interest rates for concentrated industries after the euro but no exposure to the long-term interest rate in either period. Conversely, the competitive industries are exposed to the short-term and long-term interest rates before the euro and there is no indication of a reduction in the period after the euro. This finding corroborates our earlier finding from the OLS model (Table A12.14).

Furthermore all the coefficients for the risk return parameter in the US$/£ and JP¥/£ were insignificant. This result is the same reported for the total period but for reasons previously mentioned, the findings from the sub-period analysis are used to represent the risk/return in the period before and after the euro instead. This also applies to the asymmetric term, ARCH and GARCH parameters in the variance equation. Furthermore, it is observed from Tables A7.8, A7.9 and A7.10 that the EURDUM, which denotes the impact of the euro on volatility, is significant and positive for competitive industries with regards to the actual TWI, actual and unexpected US$/£ and JP¥/£ respectively. This implies that the volatility of competitive industries returns increased after the euro.

Furthermore, the significance of the mispricing hypothesis is examined by incorporating lagged changes in exchange rates and interest rates on the returns of competitive and concentrated industries. Consequently Equation 4.1a for the total period analysis is adjusted to include a lag for the market index, exchange rate and interest rate measures.

$$R_t = \alpha + \beta_{ai}R_{t-1} + \beta_{mi}RM_t + \beta_{ri}XR_{t-1} + \beta_{si}SR_{t-1} + \beta_{li}LR_{t-1} + \beta_{in}INDUM + \lambda\log(h^2_t) + \varepsilon_{it} \ldots T \qquad 4.7a$$

$$\varepsilon_t \mid I_{t-1} \sim t(0, h^2_t, \upsilon_t) \qquad 4.7b$$

$$\log h^2_t = \alpha_o + \alpha_1\frac{\varepsilon_{t-1}}{h_{t-1}} + \alpha_2\left(\left|\frac{\varepsilon_{t-1}}{h_{t-1}}\right|\right) + \varphi_1\log h^2_{t-1} \qquad 4.7c$$

Where each lag represents 1 week and all regressors, regressands and GARCH parameters are as explained previously.

In Table 4.24, we find that for the lagged actual and unexpected movements in the TWI, all the exchange rate coefficients are negative but only significant for the competitive and concentrated plus competitive industries. On the other hand, regarding the lagged actual and unexpected changes in the US$/£ shown in Table 4.25, all the coefficients are negative and significant but the magnitude of the coefficient is higher for the competitive industries suggesting that their returns are more affected by the movements in the lagged US$/£ than the concentrated industries.

Table 4.20 A summary of non-financial concentrated and competitive industries' exposure to market risk and actual changes in the trade weighted nominal exchange rate, short-term interest rate and long-term interest rate before and after the euro - Estimated coefficients from the mean equation

INDUSTRY COMPETITION	λ	FTSEALLSH	FTSEDUM	BOEGBPR	ERDUM	UKTBTND	TBTNDUM	UKMBRYD	BRYDUM
CONCENTRATION	0.0000	0.5607***	-0.0548***	0.0307	0.0106	-0.0216**	0.0692***	0.0057	-0.0052
COMPETITIVE	0.0001	0.5644***	-0.0172	0.0577***	0.0396	-0.0216**	-0.0286	0.0459***	-0.0117
CONC AND COMP	0.0000	0.5630***	-0.0394***	0.0434***	0.0279	-0.0233***	0.0289*	0.0275***	-0.0130

Note: λ is the risk-return trade-off parameter coefficient, BOEGBPR is the Trade-weighted nominal exchange rate exposure coefficient, UKTBTND and UKMBRYD are the exposure coefficients for the 3 Month TB and 10 Year GB before the Euro respectively. ERDUM is the change in the trade weighted exchange rate exposure after the Euro while TBTNDUM and BRYDUM are changes in the exposure after the Euro for the TB and GB respectively. *** and ** denotes statistical significance at the 1% and 5% level.

Table 4.21 A summary of non-financial concentrated and competitive industries' exposure to unexpected changes in the trade weighted nominal exchange rate, short-term interest rate and long-term interest rate before and after the euro - Estimated coefficients from the mean equation

INDUSTRY COMPETITION	λ	BOEGBPR	ERDUM	UKTBTND	TBTNDUM	UKMBRYD	BRYDUM
CONCENTRATION	0.0000	0.0004	0.0001	-0.0203*	0.0738***	0.0006	0.0002
COMPETITIVE	0.0001	0.0007***	0.0002	-0.0193*	-0.0098	0.0047***	0.0035
CONC AND COMP	0.0000	0.0005***	0.0001	-0.0210***	0.0414**	0.00275***	0.0012

Note: λ represents the risk-return trade-off parameter coefficient, BOEGBPR is the Trade-weighted nominal exchange rate exposure coefficient before the Euro and ERDUM is the change in exposure after the Euro. UKTBTND and UKMBRYD are the exposure coefficients for the 3 Month TB and 10 Year GB before the euro while TBTNDUM and BRYDUM are changes in the exposure after the Euro for the TB and GB respectively. The industry dummy coefficient is negative but not significant. *** and * denotes statistical significance at the 1% and 10% level.

Table 4.22 A summary of non-financial concentrated and competitive industries' exposure to actual changes and unexpected changes in the foreign exchange rate US$/£ before and after the euro - Estimated coefficients from the mean equation

		ACTUAL US$/£			UNEXPECTED US$/£		
INDUSTRY COMPETITION	COMPETITION DUMMY	λ	ER INDEX	ERDUM	λ	ER INDEX	ERDUM
CONCENTRATION		0.0000	0.0252*	0.0290	0.0000	0.0133	0.0159
COMPETITIVE		0.0001	0.0164	0.0816***	0.0001	0.0095	0.0438**
CONC AND COMP	NOT SIGNIFICANT (NEGATIVE)	0.0000	0.0208**	0.0545***	0.0000	0.0111*	0.0291**

Note: λ is the risk-return trade-off parameter coefficient, ERINDEX represents the exchange rate exposure coefficient for actual and unexpected US$/£ before the introduction of the euro. ERDUM refers to the change in the exposure for the US$/£ after the introduction of the Euro. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

Table 4.23 A summary of non-financial concentrated and competitive industries' exposure to actual changes and unexpected changes in the foreign exchange rate JP¥/£ before and after the Euro - Estimated coefficients from the mean equation

		ACTUAL JP¥/£			UNEXPECTED JP¥/£		
INDUSTRY COMPETITION	COMPETITION DUMMY	λ	ER INDEX	ERDUM	λ	ER INDEX	ERDUM
CONCENTRATION		0.0000	0.0044	0.0243	0.0000	0.0000	0.0001
COMPETITIVE		0.0001	0.0354***	-0.0160	0.0001	0.0001***	-0.0001
CONC AND COMP	NOT SIGNIFICANT (NEGATIVE)	0.0000	0.0201**	0.0070	0.0000	0.0001**	0.0000

Note: λ is the risk-return trade-off parameter coefficient, ERINDEX represents the exchange rate exposure coefficient for actual and unexpected JP¥/£ before the introduction of the Euro. ERDUM refers to the change in the exposure for the JP¥/£ after the introduction of the Euro.. The industry dummy coefficient is negative but not significant. CONC and COMP represents the pooled returns of concentrated and competitive industries. *** and** indicate statistical significance at the 1% and 5% level respectively.

The results are quite similar for the unexpected JP¥/£ in Table 4.26 where it was observed that all exchange rate exposure coefficients are negative and significant but of the same magnitude. Then for the lagged actual changes, all the exchange rate coefficients are negative but significant for just the competitive and concentrated plus competitive industries. The only noticeable difference between the results here and that estimated with the OLS (Tables A12.16-A12.17) is that the concentrated industries had insignificant coefficients for the lagged actual and unexpected TWI and also the lagged unexpected JP¥/£. Then in comparison to the results obtained for the contemporaneous changes, all the coefficients for the contemporaneous TWI were significant but of the opposite sign to that reported here for the lagged changes while the coefficient for the concentrated industries regarding the contemporaneous unexpected JP¥/£ was insignificant. Overall the differences between the results are marginal. Additionally, the risk return coefficients and industry dummy coefficients were all found to be statistically insignificant in every exchange rate model.

In Table 4.24, the findings for the lagged movements in the short-term and long-term interest rate measures are presented. It was found that for the lagged actual and unexpected short-term interest rates, all the coefficients are statistically insignificant. This result is incongruent to that from the OLS model (Table A12.16) where significant positive coefficients to the lagged unexpected changes in the short-term interest rate were found for the concentrated and concentrated plus competitive industries. Nevertheless, when contemporaneous changes were previously used in the GARCH model, the competitive and concentrated plus competitive had significant negative coefficients.

Subsequently for the lagged actual and unexpected changes in the long-term interest rate, significant negative coefficients are found for the concentrated and concentrated plus competitive industries. However, only competitive and concentrated plus competitive industries exhibited significant coefficients which were positive for the contemporaneous long-term interest rate. But all the coefficients for the lagged changes in the long-term interest rates had been insignificant for the OLS model (Table A12.16). The results from the mean equation for the sub-period analysis using the lagged changes in the ECU/£ and the Euro/£ are presented in Tables 4.27 and 4.28 respectively. We find that for the lagged actual and unexpected changes in the ECU/£, all the coefficients are insignificant which is also the same result found for the OLS (Table A12.18). Nevertheless, for the contemporaneous changes using the GARCH model, significant positive coefficients were found for the competitive and concentrated plus competitive industries. Furthermore, we find for the lagged actual and unexpected Euro/£, all the coefficients are significant and negative. But the magnitude of the coefficient is higher for concentrated industries. However, from the OLS (Table A12.18), significant coefficients were only found for the concentrated plus competitive industries. But the GARCH estimates of the contemporaneous changes indicated that only the concentrated industries had a significant coefficient regarding the unexpected changes. Invariably, concentrated industries seem to be more exposed to movements in the Euro/£ while competitive industries are more exposed to movements in the ECU/£.

Regarding the risk return parameters, significant negative coefficients are found for competitive and concentrated plus competitive industries to the lagged actual

ECU/£. Then for the unexpected ECU/£, only the concentrated plus competitive industries had a significant negative coefficient. However for the lagged Euro/£, significant positive coefficients are reported for the concentrated and competitive industries suggesting that higher volatility is compensated for by higher returns. But the magnitude of the coefficient was higher for the concentrated industries. Although all the industry dummy coefficients were positive but insignificant.

In Tables A7.11 - A7.15 in Appendix 7, the results from the variance equations for the actual and unexpected TWI, US$/£, JPY/£, ECU/£ and Euro respectively are presented. It is observed that all the asymmetric parameter coefficients (α_1) are significant except for the concentrated industries with regards to the lagged unexpected ECU/£. Then almost all the significant asymmetric parameter coefficients are negative with the exception of the lagged unexpected Euro/£ where concentrated and competitive industries have significant positive coefficients instead. We also observe that all the ARCH (α_2) and GARCH (φ) parameter coefficients are positive and significant indicating that the persistence of volatility is strong.

In Table A7.16, we present the ratio of negative innovations to positive innovations and half-life of persistence for the lagged changes in the TWI, US$/£, JP¥/£, ECU/£ and EURO/£. We find that the impact of negative news is just marginally stronger than the impact of good news in almost all the models. Then it is also observed that the persistence of volatility is generally stronger for competitive industries than for concentrated industries. This finding corroborates our results from the contemporaneous changes.

Table 4.24 A summary of non-financial concentrated and competitive industries' exposure to lagged changes in the trade weighted nominal exchange rate, short-term interest rate and long-term interest rate for the total sample period from January 1990 to December 2006 - Estimated coefficients from the mean equation

	ACTUAL BOEGBPR				UNEXPECTED BOEGBPR			
INDUSTRY COMPETITION	λ	BOEGBPR	UKTBTND	UKMBRYD	λ	BOEGBPR	UKTBTND	UKMBRYD
CONCENTRATION	0.0000	-0.0240	0.0053	-0.0133*	0.0000	-0.0003	0.0129	-0.0019*
COMPETITIVE	0.0000	-0.0538***	-0.0079	-0.0033	0.0000	-0.0006***	0.0008	-0.0008
CONC AND COMP	0.0000	-0.0377***	-0.0012	-0.0097*	0.0000	-0.0004***	0.0072	-0.0016*

Note: λ is the risk-return trade-off parameter coefficient, BOEGBPR is the Trade-weighted nominal exchange rate exposure coefficient, UKTBTND and UKMBRYD are the exposure coefficients for the 3 Month TB and 10 Year GB respectively. The industry dummy coefficient is negative but not significant. CONC and COMP represents the pooled returns of concentrated and competitive industries. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

Table 4.25 A summary of non-financial concentrated and competitive industries' exposure to lagged changes in the foreign exchange rate US$/£ of the total sample period from January 1990 to December 2006 - Estimated coefficients from the mean equation

		ACTUAL US$/£		UNEXPECTED US$/£	
INDUSTRY COMPETITION	COMPETITION DUMMY	λ	ERINDEX	λ	ERINDEX
CONCENTRATION		0.0001	-0.0258**	0.0000	-0.0145**
COMPETITIVE		0.0000	-0.0370***	0.0000	-0.0211***
CONC AND COMP	NEGATIVE(INSIGNIFICANT)	0.0000	-0.0319***	0.0000	-0.0179***

Note: λ represents the risk-return trade-off parameter coefficient, BOEGBPR is the Trade-weighted nominal exchange rate exposure coefficient, UKTBTND and UKMBRYD are the exposure coefficients for the 3 Month TB and 10 Year GB respectively. The industry dummy coefficient is negative but not significant. CONC and COMP represents the pooled returns of concentrated and competitive industries. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

Table 4.26 A summary of non-financial concentrated and competitive industries' exposure to lagged changes in the foreign exchange rate JP¥/£ of the total sample period from January 1990 to December 2006 - Estimated coefficients from the mean equation

		ACTUAL JP¥/£		UNEXPECTED JP¥/£	
INDUSTRY COMPETITION	COMPETITION DUMMY	λ	ERINDEX	λ	ERINDEX
CONCENTRATION		0.0000	-0.0133	0.0000	-0.0001*
COMPETITIVE		0.0000	-0.0219**	0.0000	-0.0001**
CONC AND COMP	NEGATIVE(INSIGNIFICANT)	-0.0001	-0.0179**	0.0000	-0.0001***

Note: λ represents the risk-return trade-off parameter coefficient, BOEGBPR is the Trade-weighted nominal exchange rate exposure coefficient, UKTBTND and UKMBRYD are the exposure coefficients for the 3 Month TB and 10 Year GB respectively. The industry dummy coefficient is negative but not significant. CONC and COMP represents the pooled returns of concentrated and competitive industries. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

Table 4.27 A summary of non-financial concentrated and competitive industries' exposure to lagged changes in the foreign exchange rate ECU/£ - Estimated coefficients from the mean equation

		ACTUALECU/£		UNEXPECTED ECU/£	
INDUSTRY COMPETITION	COMPETITION DUMMY	λ	ERINDEX	λ	ERINDEX
CONCENTRATION		-0.0007	-0.0383	-0.0006	0.0043
COMPETITIVE		-0.0005**	0.0159	-0.0004	-0.0023
CONC AND COMP	NOT SIGNIFICANT (POSITIVE)	-0.0004*	0.0067	-0.0004*	-0.0018

Note: λ represents the risk-return trade-off parameter coefficient, ECU/£ represents the exchange rate exposure coefficients of the ECU. The industry dummy coefficient is positive but not significant. CONC and COMP represents the returns of concentrated and competitive industries. ** and * denotes statistical significance at the 5% and 10% level respectively.

Table 4.28 A summary of non-financial concentrated and competitive industries' exposure to lagged changes in the foreign exchange rate Euro/£ - Estimated coefficients from the mean equation

		ACTUAL EURO/£		UNEXPECTED EURO/£	
INDUSTRY COMPETITION	COMPETITION DUMMY	λ	ERINDEX	λ	ERINDEX
CONCENTRATION		-0.0002	-0.1355**	0.0017***	-0.0049***
COMPETITIVE		0.0001	-0.0454**	0.0006***	-0.0030***
CONC AND COMP	NOT SIGNIFICANT (POSITIVE)	0.0000	-0.0606***	-0.0001	-0.0502***

Note: λ represents the risk-return trade-off parameter coefficient, BOEGBPR is the Trade-weighted nominal exchange rate exposure coefficient, UKTBTND and UKMBRYD are the exposure coefficients for the 3 Month TB and 10 Year GB respectively. The industry dummy coefficient is negative but not significant. CONC and COMP represents the pooled returns of concentrated and competitive industries. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

4.7 Summary of diagnostics on model residuals

Due to space constraints and presentational purposes, the diagnostic results for all the models are not presented here, but are available on request. In general, the Ljung-Box statistics for the standardised residuals (Q) and for the squared standardised residuals (Q^2) are used to test for autocorrelation and heteroskedasticity, respectively, at the 7^{th} and 21^{st} lag. The Q and Q^2 statistic are not significant at the 10% level for an average of 25 (81%) industries in all the time series regression analyses indicating that there are no autocorrelation or autoregressive conditional heteroskedasticity (ARCH) effects in the residuals. We further substantiate the absence of residual heteroskedasticity by performing the ARCH test, which is a Lagrange multiplier (LM) test for ARCH in the residuals. The results are similar to that reported for the squared standardised residuals. This is a vast improvement in comparison to the diagnostic results from the OLS model, where the regression residuals of 28 (90%) industries exhibited autocorrelation and heteroskedasticity, i.e. only 3 (10%) industries did not exhibit residual autocorrelation and heteroscedasticity.

However, the fit of the t-distribution is not adequate in any of the estimated models, since the p-value is significant at the 1% level in each case. The Jarque-Bera statistic is also significant at the 1% level for all estimated models thereby authenticating that the errors are non-normally distributed. This finding is consistent with some other studies which point out that GARCH-type models are incapable of capturing all the non-linearity or leptokurtosis that is a particular characteristic of time series data (Brooks 1996; Elyasiani and Mansur, 1998; Chang, 2002; Joseph, 2002; Joseph, 2003; Ryan and Worthington, 2004; Joseph and Vezos, 2006; Brewer *et al.* 2007; Jayasinghe and Tsui, 2008; Léon, 2008). Considering all the above, we still prefer to rely on the results from the EGARCH-M model since it seems to provide a better fit for the data, and the results are more informative than that from the OLS model.

4.8 Conclusion

The AR(1)EGARCH-M (hereafter GARCH model) methodology is used to examine the sensitivity of UK non-financial industries to movements in exchange rates and interest rates. Our findings suggest that the impact of changes in the long-term interest rate on industry returns is stronger than that of changes in the foreign exchange rate measures and even stronger than the changes in the short-term interest rate. Nevertheless, the detection of few significant exposure coefficients, in all instances, is a probable indication that the risk management strategies employed by non-financial industries has been effective in eradicating most of the impacts of the changes in the exchange rate and interest rate. Another plausible explanation is that industries maybe comprised of heterogeneous firms, whose exposure coefficients to exchange rates and interest rates might be of opposite signs thereby leading to cancelling effects. Invariably, the use of portfolio returns rather than individual firm level returns may have obscured some of the instances where exposure to changes in exchange rates and/or interest rates may have been significant. Subsequently, in the next chapter, the impact of exchange rate and interest rate on returns is explored in greater depth, using UK firm level data. Furthermore, although the results from the GARCH model are stronger than that initially estimated with the OLS model, the inferences are generally the same. We infer that the stronger result reported using the GARCH methodology might be attributable to the fact that it has been more successful in capturing the time varying properties inherent with the series used in this study.

The study also reveals that for most UK industries, increased risk will not necessarily lead to an increase in the returns as the number of industries with significant positive risk-return trade-off coefficients is considerably low. However, the magnitude of the risk premium coefficient seemed to vary with different exchange rate factors. Conversely, we find more evidence of leverage effects as the asymmetric parameter, which measures asymmetric impact of past innovations on current volatility, was predominantly negative when significant, indicating that negative surprises increases the volatility of industry returns more than positive surprises. Therefore, severe contrary movements in the exchange rates and/or interest rates will potentially make the industry's returns more volatile. More so, contrary to Joseph (2002), we find evidence of leverage effects on the returns of the Chemical and Electrical industries.

Furthermore, the coefficients of the industry's returns' conditional volatility indicates that for a majority of UK industries, current volatility is time varying, is a function of past innovations and past volatility and persistence of volatility is very high, suggesting that volatility has a long memory, and once volatility increases, it may probably remain high over several periods. Additionally, the magnitude of significant persistence parameters (GARCH parameter) was generally higher than that of the significant ARCH parameter (presence of volatility clustering) in all the models, implying that the market has a memory longer than one period, volatility is more sensitive to old news than it is to news about volatility from the previous period. Even so, it was observed that for most industries, the magnitude of the conditional variance tends to vary with the exchange rate index in the model. Incidentally, volatility persistence in the returns of UK industries is relatively high, but some industries are better able to absorb the volatility more than others. We attribute the finding of high persistence of volatility to the use of weekly data and which may have also been exacerbated by an increase in exchange rate and interest rate risk. Nevertheless, the persistence of volatility on UK industries, measured by the half-life tends to dissipate much faster in some industries than others suggesting that, for these industries, inherent volatility is probably more effectively contained.

We also observe that the introduction of the euro has led to a net reduction in foreign exchange rate exposure, particularly for importers, and also interest rate exposure. Furthermore, the riskiness of UK industries returns increased in the period after the euro. This finding was further corroborated from the sub-period analysis where it was found that the incidence of leverage effects, volatility clustering and persistence of volatility seems to be more severe for the Euro/£ than the ECU/£. In addition, the results from the half-life measure also indicated that it takes a longer period for half of the volatility in returns to dissipate in the Euro/£ than ECU/£. Finally, we also observed that competitive industries were generally more exposed to exchange rate and interest rate risk, and also exhibited higher persistence of volatility than concentrated industries.

However, the AR(1)-EGARCH-M model used in this study does not seem to have captured all the non-normality in the residuals. This finding is consistent with some other studies which point out that GARCH-type models are incapable of capturing all the non-linearity that is particularly characteristic of time series data. However, this specification of GARCH model generally provided a better fit to the data and even produced more instructive results than the OLS model.

CHAPTER 5 FOREIGN EXCHANGE AND INTEREST RATE EXPOSURE OF UK FIRMS - AR(1)-EGARCH-M ESTIMATES

5.1 Introduction

Following the inadequacies of the OLS, the AR(1)-EGARCH-M model is also used here to estimate the sensitivity of UK non-financial firms' stock returns to changes in exchange rates and interest rates. Besides, the earlier AR(1)-EGARCH-M portfolio level analysis of UK non-financial industries' stock returns, seemed to provide near satisfactory evidence of exchange rate and interest rate exposure, leverage effects and volatility, but little for the trade-off between expected risk and return. However, Joseph (2003) points out that the finding of insignificant trade-off coefficients might be due to the use of aggregate estimates, which may have masked those instances when the trade-off coefficient might have been statistically different from zero. Similarly, Ryan and Worthington (2004) posit that the results for portfolio returns might not accurately describe the return generating process inherent to individual stock returns, while Elyasiani and Mansur (1998) suggest that the use of portfolio level data masks out the dissimilarities among firms within the industry. Most notably, Joseph (2002) examined the impact of interest rate and exchange rate changes on 4 UK non-financial industries namely Chemical, Electrical, Engineering and Pharmaceutical using the EGARCH and EGARCH-M specifications. The results indicated that the trade-off coefficient was only significant in one instance, while there was no evidence of leverage effects. He stresses strongly that the findings might not be applicable for the individual firm.

Therefore, enthused by this apparent gap in literature, the sensitivity of 402 UK firms' stock returns is re-examined here, using the AR(1)-EGARCH-M model, which was also previously utilised for the industry level analysis. Subsequently, the results for the total sample period are presented in Section 5.2. Also reported in this section are the results for the sub-period analysis, segregated into the periods before and after the euro (ECU/£ and Euro/£). Then in Section 5.3, the results for the change in exposure after the introduction of the euro for the other exchange rate indices (Bank of England Trade Weighted Nominal Exchange Rate (TWI), US$/£ and JP¥/£) as well as the interest rate measures (short-term and long-term interest rate). In Section 5.4, the results for the lagged changes in the independent variables are shown. In Section 5.5, we report issues concerning the goodness-of-fit of the model and finally, the chapter ends with the summary of findings in Section 5.6. In addition, a the summary of the exchange rate and interest rate exposure coefficients of UK non-financial firms, estimated using the OLS model, is presented in Appendix 13.

5.2 Foreign exchange and interest rate exposure of UK non-financial firms

All models have been estimated to include a measure of the market return index, exchange rate (Bank of England Trade Weighted Nominal, US$/£ or the JP¥/£), the short term interest rate (3 month Treasury bill) and the long-term interest rate (10 year Government Bond). For reasons previously explained, the result on exposure to interest rates (short-term and long-term) is only reported in the model with the trade weighted nominal index. Then, due to space constraints, we only present the comprehensive results of the most important parameters in the mean and variance equations. However, in all instances, the full results table is available on request.

5.2.1 Total sample period

5.2.1.1 Actual and unexpected changes in exchange rates and interest rates

Equation 5.1(a,b,c) is the AR(1)-EGARCH(1,1)-M model used to examine the sensitivity of UK non-financial firms stock returns to contemporaneous changes in exchange rates and interest rates for the total period January 1990 to December 2006.

$$R_{it} = \alpha_i + \beta_{ai}R_{it-1} + \beta_{m,i}RM_t + \beta_{r,i}XR_t + \beta_{s,i}SR_t + \beta_{l,i}LR_t + \lambda \log(h^2_{i,t}) + \varepsilon_{i,t} \quad 5.1a$$

$$\varepsilon_{i,t}|I_{t-1} \sim t(0, h^2_{i,t}, \upsilon_{i,t}) \quad 5.1b$$

$$\log h^2_{i,t} = \alpha_o + \alpha_1 \frac{\varepsilon_{i,t-1}}{h_{i,t-1}} + \alpha_2\left(\left|\frac{\varepsilon_{i,t-1}}{h_{i,t-1}}\right|\right) + \varphi_1 \log h^2_{i,t-1} \quad 5.1c$$

Equation 5.1a is the mean equation wherein, α_i is the intercept term for firm i, R_{it} is the return of firm i at time t, R_{it-1} (autoregressive lag parameter) is the returns for firm i at time t-1 accounting for autocorrelation, RM_t is the rate of return of the market portfolio at time t, XR_t is the percentage change in the exchange rate index at time t, SR_t is the change in the short term interest rate at time t and LR_t is the change in the long-term interest at time t, $\log(h^2_{i,t})$ is the log of conditional volatility, while the coefficient λ reflects the fundamental trade-off relationship between expected returns and the measure of previous conditional volatility, capturing the risk pattern over time, and $\varepsilon_{i,t}$ is the error term. In 5.1b, the error term, $\varepsilon_{i,t}$ has a mean 0, variance $h^2_{i,t}$ (time varying) and a t-density distribution with $\upsilon_{i,t}$ degrees of freedom, while I_{t-1} is information available at time t-1. Then, Equation 5.1c is the variance equation where $\log(h^2_{i,t})$, the log of the conditional variance, is the current volatility forecast, conditional upon the previous period's conditional variance and error. α_o is the constant term, α_1 measures the asymmetric impact of past innovations on current volatility; therefore, there are leverage effects when $\alpha_1<0$ and asymmetric effects when

$\alpha_1 \neq 0$. α_2 is the ARCH term which links current volatility (conditional variance) to the asymmetric function of past innovations. The log $h^2_{i,t-1}$ is the past period variance and φ_1 is the GARCH term which denotes the persistence parameter that associates current volatility with past volatility.

The result for the market risk shows that 70% of the firms have significant positive coefficients.[1] Furthermore, the detailed result for the autoregressive term R_{t-1}, (not shown), is very similar in all the exchange rate models, as we find that the autoregressive coefficient is significant for 229 (57%) firms in the TWI model, 232 (58%) firms in the US$/£ model and 226 (56%) firms in the JP¥/£ model, at the 1%, 5% and 10% level, respectively, and 86% of these significant coefficients are positive in all the models. This finding indicates that for these firms, the previous period's return is a determinant of the current period's return. More importantly, in Table 5.1, we present a summary of the exchange rate coefficients (TWI, the US$/£ exchange rate and the JP¥/£ exchange rate) and the risk premium parameter coefficients from the mean equation. Additionally, the corresponding descriptive statistics for the total sample period is also reported. The results show that for the risk-return trade-off parameter, the mean of the coefficients is 0.0058 (-0.0020) for the actual (unexpected) TWI, 0.0269 (-0.2515) for the actual (unexpected) US$/£ and -0.0064 (0.4715) for the actual (unexpected) JP¥/£. Furthermore, we find that 28% (26%) of the risk-return coefficients are significant for the actual (unexpected) TWI, and 51% of these coefficients are positive in each case. The results for the actual and unexpected US$/£ are quite similar as 27% of the firms in each case have significant coefficients, and 56% of these were positive for the actual US$/£ whereas for the unexpected US$/£, positive coefficients accounted for 52% of the significant coefficients.

[1] The full results table for the market risk for all the firms is available on request.

On the other hand, the results for the JP¥/£ showed that for the actual (unexpected) changes, 26% (22%) of the risk-return coefficients were significant and 48% (56%) of these coefficients were positive. The finding of a statistically significant positive trade-off coefficient infers that increase in the volatility of their returns is compensated for by a higher average return, whereas a significant negative trade-off coefficient suggests that increase in volatility leads to lower average returns. Similar to the industry level analysis results, it is also observed here that for all the chosen currencies, firms with significant risk-return coefficients are few. Moreover, in all the exchange rate models, except the actual JP¥/£, the number of firms that experienced increased returns, as a result of increased volatility, are just marginally more than those which experienced a decline in returns.

Overall, the result suggests that for a majority of UK firms, volatility is not a significant factor in asset pricing: increased volatility will not usually increase the firms' returns. Therefore, investors are not generally rewarded for risks they take by holding the stock. Furthermore, it was also observed that higher numbers of significant positive exchange rate exposure coefficients were found from the OLS model (Table A13.1) Therefore, the OLS seemed to have slightly outperformed the GARCH model, since more significant coefficients were found from the OLS analysis. Specifically, regarding the GARCH results from the actual (unexpected) TWI, 14% (15%) significant exchange rate exposure coefficients were found while, from the OLS, 18% of the firms had significant coefficients for the actual as well as the unexpected changes. Similarly, for the US$/£, it was found that 11% of firms had significant exchange rate exposure coefficients for the actual and unexpected changes when the GARCH model was utilised. However, previous estimates from the OLS indicated that for the actual changes, 12% of firms had significant coefficients while, for the unexpected changes, 14% of the firms exhibited significant coefficients. The results for the actual (unexpected) JP¥/£ showed that 13% (12%) of firms had significant coefficients, which is a little lower than the 15% found from the OLS for both actual and unexpected changes. In all the exchange rate models, the incidence of higher numbers of positive coefficients suggests that more firms, presumably importers, benefit (suffer) from the appreciation (depreciation) of the pound, in the total sample period. More so, in all the exchange rate models, the exchange rate exposure results relating to the actual and unexpected changes have been somewhat similar. Subsequently, regarding the exposure to changes in the interest rates, presented in Table 5.2, the mean of the exposure coefficients, for the actual (unexpected) short-term interest rate is negative with a value of -0.0135 (-0.0085), but for the long-term interest rate, the mean of the exposure coefficients for the actual (unexpected) changes is positive with a value of 0.0174 (0.0019). Furthermore, the results for the exposure to the short-term and long-term interest rate indicate that the number of significant coefficients found for the GARCH model is lower than that found for the OLS. In detail, 10% (9%) of the firms have significant coefficients regarding the actual (unexpected) short-term interest rate when the GARCH model was estimated here, whereas the result from the OLS (Table A13.1) indicated that 12% (10%) of firms had significant short-term interest rate exposure coefficients for the actual and unexpected changes, respectively. Furthermore, the result for the exposure to the long-term interest rate showed that 21% of firms had significant coefficients to the actual as well as the unexpected changes when the GARCH model was utilised. But previously, 26% (30%) of firms had exhibited significant long-term interest rate exposure coefficients for the actual (unexpected) changes when the OLS model (Table A13.1) was used. Notwithstanding, the conclusions that would have been reported for the OLS results, based on the direction of the interest rate exposure coefficients, are the same here for the GARCH results, since for the GARCH, it was also observed that the incidence of significant negative exposure coefficients is higher than that of the significant positive exposure coefficients for the short-term interest rate, while for the long-tem interest rate, the occurrence of significant positive exposure coefficients was more prevalent.

Tables A8.1, A8.2 and A8.3 in Appendix 8 report the most important estimated parameter coefficients from the variance equations and their related descriptive statistics, from the models estimated with the TWI, US$/£ and JPY/£ exchange rates, respectively. Firstly, regarding the asymmetric term, α_1, which measures the asymmetric impact of past innovations on current volatility, the mean of the coefficient for all the exchange rate models were negative. Specifically, regarding the actual (unexpected) TWI, the mean coefficient is -0.0817 (-0.0731); for the US$/£, it is -0.1206 (-0.0727); while the mean for the JPY/£ is found to be -0.0718 (-0.0982). Furthermore, it is found that the frequency of significant asymmetric coefficients, as well as the incidence of more significant negative coefficients than significant positive coefficients, was comparable in all the estimated models. In detail, from Table A8.1, the actual (unexpected) TWI result indicates that 48% (49%) of the asymmetric coefficients were significant, and 22% (21%) of these were positive. Similarly, the actual (unexpected) US$/£ results in Table A8.2 shows that 47% (49%) of the asymmetric coefficients were significant, with 19% (21%) of these exhibiting positive coefficients, while for the actual (unexpected) JPY/£ in Table A8.3, 48% (47%) of the asymmetric coefficients were significant, with 20% (19%) reported as positive. Generally, in all models, almost half of the firms in the sample had a significant asymmetric coefficient. More so, for about 80% of these firms, the significant coefficient was negative. The finding of significant negative asymmetric coefficients provides evidence of leverage effects. This follows on from Black (1976) that negative returns will generally reduce the stock price and market value of the firms, ultimately leading to an increase in leverage (higher debt to equity ratio), and certainly an increase in volatility or risk in holding the stock. Evidently, stock returns have a negative correlation with changes in volatility, such that volatility tends to rise in response to bad news and fall in response to good news. So if bad news has a higher impact on stock returns volatility than good news of similar magnitude, therefore negative rather than positive increment in exchange rate and interest rate effects will cause firms' returns to be more volatile or risky, and given the downward movement, increase the leverage effect. Conversely, for the very few firms with significant positive coefficients, this implies the presence of asymmetric effects, wherein good news has a higher impact on the volatility of their returns than that of bad news, or as articulately suggested by Léon (2008), volatility is higher during a market boom (higher returns) than when the market declines (lower returns). On the other hand, regarding firms with statistically insignificant coefficients, the effects of positive or negative innovations on the volatility of the firms' return are of the same magnitude. Consequently, a contrary or favourable movement in exchange rates or interest rates, as it impacts on the asymmetric term does not appear to make the returns of these firms more risky. Also presented in Tables A8.1, A8.2 and A8.3 are the results for the ARCH term (size effects of current volatility) represented by α_2, and the GARCH term denoted by φ_1, for the TWI, US$/£ and JP¥/£ exchange rate models respectively. Regarding the ARCH term, it is found that the mean of all the coefficients are positive, since the actual (unexpected) mean coefficient for the TWI, is 0.4121 (0.4065); for the US$/£ this is 1.3952 (1.3535); while, the mean for the JP¥/£, this is found to be 1.3692 (1.3027). Additionally, the occurrence of significant ARCH coefficients, as well as the prevalence of significant positive coefficients than significant negative coefficients is very similar in all the estimated models. From Table A8.1, regarding the actual (unexpected) TWI, 70% (69%) of the ARCH coefficients were significant, and 98% (97%) of these were positive. Likewise, for the actual (unexpected) US$/£ in Table A8.2, it was found that 69% (70%) of the ARCH coefficients were significant, with 98% (97%) of these displaying positive coefficients, while for the actual (unexpected) JP¥/£ in Table A8.3, 69% (70%) of the ARCH coefficients were significant, and 98% of the coefficients were positive for both the actual and unexpected changes. In general, up to 70% of the firms in the sample had significant ARCH coefficients, of which about 98% were positive. The finding of predominantly significant positive coefficients provides overwhelming support of the presence of volatility clustering. This finding also signifies that conditional volatility has a propensity to rise (fall) when the absolute value of the standardised error is larger (smaller). Also, the results for the GARCH term (φ_1), which represents the persistence parameter and associates current volatility with past volatility, show that all the mean GARCH coefficients are positive. Then again, the significant coefficients are predominantly positive. In this instance, the actual (unexpected) mean coefficient for the TWI, reported in Table A8.1, is 0.8274 (0.8277). For the US$/£, this is found to be 0.8326 (0.8341), whereas the mean for the JP¥/£ is 0.8320 (0.8272). In addition, it was found that regarding the actual and unexpected TWI, 94% of the firms exhibited significant GARCH coefficients, and 99% of these were positive in each case. Similarly, for the actual (unexpected) US$/£ in Table A8.2, it was found that 94% (95%) of the GARCH coefficients were significant, with 99% (100%) of these displaying positive coefficients, while for the actual (unexpected) JP¥/£ in Table A8.3, 94% (93%) of the GARCH coefficients were significant, and 99% (100%) of these were positive.

Generally, the mean of the GARCH coefficient is very high, comparable in all the models, but highest for the US$/£ model and lowest for the TWI index. More so, the high frequency of significant GARCH coefficients, which are almost all positive, provides further evidence that volatility has a long memory, implying that once volatility increases, it may probably remain high over several periods. Then again, the finding that a lot of firms had significant α_2 and φ_1 coefficients, signifies that the current volatility of the firm's returns (conditional variance) is time varying, is a function of past innovations and past volatility. Then for firms with significant ARCH and GARCH parameter coefficients, the magnitude of significant persistence parameter GARCH coefficients was higher than that of the significant ARCH parameter coefficients in all the models (TWI, US$/£ and JP¥/£), suggesting that the market has a memory longer than one period, the volatility of firm's returns is more sensitive to old news (its own lagged value) than it is to news about volatility from the previous period (recent surprises in the market). Besides, this finding substantiates our previous results from the industry level analysis, where we also found that the persistence of volatility in the returns of UK industries was relatively high and consequently, persisted for several periods. Then in Table A9.1 of Appendix 9, we present the results of the direction of the exchange rate exposure coefficients as well as the risk-return coefficient of the firms according to their industry group. The findings indicate that for some firms, within the same industry, the exposure coefficients to changes in the exchange rates and the coefficient for the risk return parameters are of opposite directions. Nevertheless, some of the instances where the direction of the coefficients for the firms were the same included the Beverages and Mobile Telecommunications industries, wherein the exchange rate exposure coefficients and risk parameter coefficients were statistically insignificant in all the exchange rate models.

Table 5.1 A summary of non-financial firms' exposure to actual and unexpected changes in the foreign exchange rates of the total sample period from January 1990 to December 2006 - Estimated coefficients from the mean equation

	A.BOEGBPR		U.BOEGBPR		A.US$/£		U.US$/£		A.JP¥/£		U.JP¥/£	
STATISTICS	λ	TWI	λ	TWI	λ	US$/£	λ	US$/£	λ	JP¥/£	λ	JP¥/£
Mean	0.0058	0.0199	-0.0020	0.0002	0.0296	0.0171	-0.2515	0.0100	-0.0064	0.0106	-0.4715	0.0001
Minimum	-1.0274	-0.5132	-1.6194	-0.0055	-1.0894	-0.3031	-98.5264	-0.1770	-5.9105	-0.2908	-185.7272	-0.0018
Median	0.0000	0.0023	0.0000	0.0000	0.0000	0.0027	0.0000	0.0019	0.0000	0.0030	0.0000	0.0000
Maximum	3.1013	0.5176	1.2027	0.0087	13.8413	0.3498	0.3318	0.2093	3.1264	0.2697	0.3332	0.0017
Standard deviation	0.1717	0.1287	0.1098	0.0014	0.6945	0.0780	4.9144	0.0464	0.3545	0.0644	9.2635	0.0003
Firms with significant exposure	28%	14%	26%	15%	27%	11%	27%	11%	26%	13%	22%	12%
Positive exposure coefficients	51%	58%	51%	65%	56%	69%	52%	70%	48%	64%	56%	63%
Significant coefficients at 1%	46%	44%	42%	33%	50%	33%	49%	40%	46%	28%	51%	31%
Significant coefficients at 5%	33%	30%	35%	37%	31%	33%	27%	30%	36%	36%	31%	33%
Significant coefficients at 10%	21%	26%	23%	30%	19%	33%	24%	30%	18%	36%	18%	37%

Notes: This table reports the statistics of the estimated exchange rate exposure coefficients of 402 non-financial UK firms. A. represents actual changes while U. stands for unexpected changes. BOEGBPR is the Trade weighted nominal exchange rate index, US$/£ is the US$ exchange rate and JP¥/£ is the JP¥ exchange rate. λ denotes the risk-return trade-off parameter coefficient. Firms with significant exposure signify the percentage of firms with significant exposure coefficients in the total sample whereas positive exposure coefficients are the percentage of significant positive coefficients out of the significant coefficients. Additionally, significant coefficients at the 1%, 5% and 10% represents the percentage of firms with significant coefficients, out of all the total significant coefficients, at the 1%, 5% and 10% level respectively.

Table 5.2 A summary of non-financial firms' exposure to actual and unexpected changes in the interest rates of the total sample period from January 1990 to December 2006 - Estimated coefficients from the mean equation

	UKTBTND		UKMBRYD	
STATISTICS	ACTUAL	UNEXP.	ACTUAL	UNEXP.
Mean	-0.0135	-0.0085	0.0174	0.0019
Minimum	-0.2707	-0.2308	-0.2753	-0.0433
Median	-0.0019	-0.0007	0.0031	0.0002
Maximum	0.2065	0.2120	0.3138	0.0452
Standard deviation	0.0546	0.0559	0.0743	0.0110
Firms with significant exposure	10%	9%	21%	21%
Positive exposure coefficients	24%	35%	71%	67%
Significant coefficients at 1%	24%	14%	48%	49%
Significant coefficients at 5%	39%	49%	34%	23%
Significant coefficients at 10%	37%	38%	18%	28%

Note: Actual and Unexp. are the actual and unexpected changes in the interest rate. UKTBTND is the exposure coefficients for the 3 Month TB while UKMBRYD is the exposure coefficient for the 10 Year GB. Firms with significant exposure represent the percentage of firms with significant exposure coefficients in the total sample, whereas positive exposure coefficients are the percentage of significant positive coefficients out of the significant coefficients. Additionally, significant coefficients at the 1%, 5% and 10% signifies the percentage of firms with significant coefficients, out of all the total significant coefficients, at the 1%, 5% and 10% level, respectively.

Furthermore, for firms in the Food and Drug Industry, all the significant risk premium coefficients were negative, while the significant exchange rate coefficients were positive. Another interesting observation was for the Oil and Gas Producers industry where it was found that all the significant risk premium coefficients (4 in each model) were negative except for the unexpected JP¥/£ model, where a significant positive coefficient was found in addition to the 4 significant negative coefficients. Another industry with similar results was the Software and Computer Services wherein all the significant risk premium coefficients were negative except for the JP¥/£ model, where a significant positive coefficient was found for the actual and the unexpected changes. Other noticeable observations were for the Electricity industry, where all the significant risk premium coefficients are positive but all the exchange rate exposure coefficients are insignificant. Additionally, for Gas, Water and Multi-Utilities industry, the significant risk premium coefficients are positive, except for a significant negative coefficient reported for the actual TWI. Then, regarding the significant exchange exposure coefficients, these were all positive, except for a significant negative coefficient for the actual US$/£. Overall, for most of the industries, the inherent firms do not follow a designated exposure pattern to exchange rates and/or the risk-return parameter. Subsequently, for most UK industries, the exposure to exchange rate risk or risk-return premium of their constituent firms is sometimes not homogeneous. Similarly, a summary of the direction of exposure to changes in the short-term and long-term interest rate is presented in Table A9.2 of Appendix 9. For firms with significant interest rate exposure in industries, such as Aerospace and Defence, Automobiles and Auto Parts, Beverages, Food and Drug Retailers, Gas, Water and Multi-Utilities, and Technical Hardware and Equipment, these were for the long-term interest rate only. On the other hand, for firms with significant interest rate exposure coefficients in the Forestry and Paper, Healthcare Equipment Services and Oil Equipment and Services industries, these were in respect of the short-term interest rate only. For all the other industries, except the Electricity industry, where none of the firms had significant interest rate exposure coefficients, firms in the industries were significantly exposed to the short-term interest rate and long-term interest rate. Nevertheless, in some of the instances where significant interest rate exposure coefficients had been detected, these were not of the same direction for firms in the same industry.

5.2.2 Exchange rate exposure to the ECU/£ versus exposure to the Euro/£

The sensitivity of firms' returns to movements in the ECU/£ and Euro/£ is examined here using equation 5.1a -5.1c. For the period before the Euro (01/01/90-31/12/98), the ECU/£ is used, while for the period after the Euro (01/01/99-31/12/06), the Euro/£ exchange rate is used instead. A summary of the risk return parameter and exchange rate coefficients, in addition to the relevant descriptive is presented in Table 5.3. Regarding the mean of the risk premium coefficients, it is 0.7839 (-0.0874) for the actual (unexpected) ECU/£, whereas for the Euro/£, this is reported to be 0.0190 (0.0105). Apparently, only the mean risk return coefficient for the unexpected ECU/£ model is negative. In addition, it was found that for the actual (unexpected) ECU/£, 29% (27%) of the firms exhibited significant coefficients for the risk return parameter, of which 61% of these were positive in each instance. On the other hand, it is found that for the actual (unexpected) Euro/£, 20% (22%) of the firms had significant coefficients wherein 69% (67%) of these were found to be positive. It is also observed that the frequency of significant risk return parameter coefficients for the ECU/£ sub-period is somewhat similar to that reported in the total period, however, a higher number of positive coefficients was reported for the sub-period ECU/£ and Euro/£ than the total period TWI, US$/£ and JP¥/£. Generally, the result of a low incidence of significant risk return coefficients indicates that for a majority of UK firms, increased volatility will not usually increase the firms' returns. But for those few firms, which had significant risk return coefficients, these were mostly positive, indicating that increased volatility in their returns is compensated for by a higher average return. Additionally, there are more firms with significant risk return parameter coefficients and more significant positive risk return coefficients in the period before the euro than there were after the euro. Then for the mean of the exchange rate exposure coefficients, regarding the actual (unexpected) ECU/£, this is 0.0212 (0.0143) while for the actual (unexpected) Euro/£, this is 0.0074 (-0.0084). Here it is observed that all the mean exposure coefficients are positive except in the model estimated with the unexpected changes in the Euro/£. Furthermore, for the actual (unexpected) ECU/£, it was found that only 14% (15%) of the firms had significant exchange rate exposure coefficients, of which 69% (64%) of these were positive. This finding is comparable to that of Rees and Unni (2005) and El-Masry *et al.* (2007), who also found that most UK firms benefit (suffer) from the appreciation (depreciation) of the British pound against the ECU/£. Although the result here is also similar to that previously found for the OLS model (Table A13.4) in terms of incidence of significant positive coefficients, the number of firms that were reported to have significant exposure coefficients for the actual (unexpected) ECU/£ was 16% (17%) for the OLS, which is slightly higher than that reported here for the GARCH model. The results were quite different for the actual (unexpected) Euro/£ as the GARCH model detected that just 9% (10%) of the firms had significant coefficients, and only 46% (40%) of these coefficients were positive. However, the OLS model (Table A13.4) found that 14% (13%) of the firms had significant exposure coefficients for the actual (unexpected) Euro/£, but there were marginally more significant positive coefficients than negative for the OLS actual Euro/£ and more significant negative coefficients than positive for the unexpected OLS Euro/£. In any case, the OLS seems to have outperformed the GARCH model again in this sub-period analysis in terms of detecting exposure to changes in the ECU/£ and Euro/£ exchange rates. Furthermore, it is observed, from the GARCH model estimates, that exchange rate exposure was reduced by an average of 5% after the euro, which is about 2% more than the 3% reduction reported for the OLS model. Consequently, the inference still remains that the introduction of the euro has not significantly changed the European exchange rate exposure of UK non-financial firms. Tables A8.4 in Appendix 8 reports the important estimated parameter coefficients from the variance equations and related descriptive statistics in the models for the ECU/£ and Euro/£ exchange rates. Regarding the asymmetric term, α_1, which measures the asymmetric impact of past innovations on current volatility, the mean coefficient is -0.0829 (0.0798) for the actual (unexpected) ECU/£, while for the actual (unexpected) Euro/£, this is -0.1711 (-0.0627). Furthermore, it was found that 31% of the firms had significant asymmetric coefficients for the actual ECU/£ as well as the unexpected ECU/£. Then, of these significant coefficients, 19% (17%) were positive. On the other hand, the results for the actual (unexpected) Euro/£ showed that 29% (26%) of the firms had significant asymmetric coefficients, of which 12% (14%) were positive. Evidently, there are significantly more negative coefficients than positive coefficients in the ECU/£ and Euro/£ models, indicating that for the majority of firms exhibiting significant coefficients, unexpected bad news increases predictable volatility of these firms returns more than unexpected good news. In addition, there were also more firms with significant asymmetric coefficients for the ECU/£ model than there were for the Euro/£. Then, concerning the handful of firms with significant positive coefficients, good news has a higher impact on the volatility of their returns than that of bad news. Nevertheless, for most of the firms investigated, the effects of positive or negative surprises on the volatility of the firms' return are of the same magnitude. Table A8.4 also shows the results for the ARCH term (α_2) and the GARCH term (φ_1) for the ECU/£ and Euro/£ exchange rate models. Regarding the ARCH term, it is found that the mean of the coefficients is 2.4831 (2.0532) for the actual (unexpected) ECU/£, while that of the actual (unexpected) Euro is 2.0807 (1.4958). In addition, it is found that 42% (44%) of the firms have significant ARCH parameter coefficients for the actual (unexpected) ECU/£. However, this is lower than the 50% of firms reported for the actual and unexpected Euro. Moreover, in the ECU/£ and Euro/£ models, over 90% (except the actual Euro/£ with 89%) of the significant ARCH coefficients were positive. The finding of significant positive coefficient indicates the presence of volatility clustering (tendency of shocks to persist) for most of these firms. Furthermore, regarding the results for the GARCH term (φ_1), the mean of the GARCH coefficient in the actual (unexpected) ECU/£ model is 0.5567 (0.5589) while for the actual (unexpected) Euro/£, this is 0.5123 (0.5099). These persistence values are quite low in comparison to those reported for the total period. We also found that 77% of the firms have significant GARCH coefficients for the actual and unexpected ECU/£, and 96% of these were positive in both models. For the actual (unexpected) Euro/£, 70% (67%) of the firms had significant coefficients, of which 93% of these were positive in both instances. However, the results indicate that persistence of volatility in returns, was higher in the period before the Euro (ECU/£) than the period after the Euro (Euro/£). The results of the direction of the exchange rate exposure coefficients as well as the risk-return coefficient by industry group, for the ECU/£ and Euro/£ are also presented in Table A9.3 of Appendix 9. Again for most of the industries, the direction of the exposure coefficient and the risk premium coefficient is not the same for firms within the industry, thus providing further evidence that firms within the same industry may have different operational strategies i.e. exporters versus importers, and increased risk for firms in the same industry, does not usually lead to an increase or decrease in returns of all the firms within the industry.

5.3 Changes in market risk, exchange rate risk and interest rate risk after the introduction of the euro

This section reports the changes in market risk, exchange rate and interest rate risk after the introduction of the Euro. All the models have been estimated with the market return index, an exchange rate variable (Bank of England Nominal Trade weighted, US$/£ or JP¥/£). Each variable has an interactive dummy which takes the value of one from the 1st of January 1999 to determine the change in exposure after the introduction of the common currency. We report the change in market risk and interest rate risk only in the model estimated using the Bank of England Trade-weighted exchange rate since these results are similar when either the US$/£ or JP¥/£ is used in both the actual and unexpected models.

Table 5.3 A summary of non-financial firms' exposure to actual and unexpected changes in the foreign exchange rate ECU/£ and Euro/£ - Parameter estimates from the mean equation

	A.ECU/£		U.ECU/£		A.Euro/£		U.Euro/£	
STATISTICS	λ	ECU/£	λ	ECU/£	λ	EURO/£	λ	EURO/£
Mean	0.7839	0.0212	-0.0874	0.0143	0.0190	0.0074	0.0105	-0.0084
Minimum	-27.5539	-0.6075	-21.8417	-0.4323	-4.4219	-0.6283	-3.6209	-0.4357
Median	0.0000	0.0018	0.0000	0.0012	0.0001	-0.0008	0.0003	-0.0046
Maximum	320.9061	0.8614	14.7158	0.6566	8.5161	1.0802	3.8567	0.5616
Standard deviation	16.1537	0.1687	1.7655	0.1283	0.6344	0.2086	0.4451	0.1326
Firms with significant exposure	29%	14%	27%	15%	20%	9%	22%	10%
Positive exposure coefficients	61%	69%	61%	64%	69%	46%	67%	40%
Significant coefficients at 1%	53%	33%	51%	39%	30%	23%	25%	14%
Significant coefficients at 5%	25%	33%	25%	21%	43%	49%	39%	45%
Significant coefficients at 10%	22%	35%	23%	39%	28%	29%	36%	40%

Note: λ signifies the risk-return trade-off parameter coefficient. ECU/£ represents the exchange rate exposure coefficients of the ECU while Euro/£ represents the exchange rate exposure for the Euro. A. and U. represent the actual and unexpected changes respectively. Firms with significant exposure signify the percentage of firms with significant exposure coefficients in the total sample whereas positive exposure coefficients are the percentage of significant positive coefficients out of the significant coefficients. Furthermore, significant coefficients are at the 1%, 5% and 10% level.

Furthermore, we also include a dummy variable in the variance equation to establish the volatility of firm's returns after the introduction of the Euro. Also, for reasons previously specified, the results for the sub-period analysis are relied upon for the risk-return, ARCH and GARCH parameters. Therefore, only the result for the euro dummy is reported from the variance equation. The model is stated thus:

$$R_{it} = \alpha_i + \beta_{a,i}R_{it-1} + \beta_{m,i}RM_t + \beta_{Eurom,i}RM_tD_{Eurot} + \beta_{r,i}XR_t + \beta_{Euror,i}XR_tD_{Eurot} + \beta_{s,i}SR_t + \beta_{Euros,i}SR_tD_{Eurot} + \beta_{l,i}LR_t + \beta_{Eurol,i}LR_tD_{Eurot} + \lambda\log(h^2_{i,t}) + \varepsilon_{i,t} \qquad 5.2a$$

$$\varepsilon_{i,t}|I_{t-1} \sim t(0, h^2_{i,t}, \upsilon_{i,t}) \qquad 5.2b$$

$$\log h^2_{i,t} = \alpha_o + \alpha_1\frac{\varepsilon_{i,t-1}}{h_{i,t-1}} + \alpha_2\left(\left|\frac{\varepsilon_{i,t-1}}{h_{i,t-1}}\right|\right) + \varphi_1\log h^2_{i,t-1} + \beta_e EURDUM \qquad 5.2c$$

In equation 5.2a, α_i is the intercept term for industry i, R_{it} is the return of firm i, RM_t is the rate of return of the market portfolio, XR_t is the percentage change in the exchange rate index at time t, SR_t is the change in the short term interest rate at time t and LR_t is the change in the long-term interest at time t, D_{Eurot} is a dummy variable that takes the value of 1 from 1st January 1999 and 0 before that date and $\varepsilon_{i,t}$ is the error term for industry i. In addition, other coefficients are:

$\beta_{a,i}$ = autoregressive coefficient for firm i

$\beta_{m,i}$ = market risk exposure coefficient for firm i before the euro

$\beta_{r,i}$ = foreign exchange rate exposure coefficient of firm i before the euro

$\beta_{s,i}$ = short term interest rate exposure coefficient of firm i before the euro

$\beta_{l,i}$ = long term interest rate exposure coefficient of firm i before the euro

$\beta_{Eurom,i}$ = change in the market risk for firm i after the euro

$\beta_{Euror,i}$ = change in exchange rate exposure for firm i after the euro

$\beta_{Euros,i}$ = change in the short term interest rate exposure for firm i after the euro

$\beta_{Eurol,i}$ = change in the long term interest rate exposure for firm i after the euro

Furthermore, $\log(h^2_{i,t})$ is the log of the conditional volatility, while the coefficient λ reflects the fundamental trade-off relationship between expected returns and the measure of previous conditional volatility, capturing the risk pattern over time. In 5.2b, the error term, $\varepsilon_{i,t}$ has a mean 0, variance $h^2_{i,t}$ and a t-density distribution with $\upsilon_{i,t}$ degrees of freedom, while I_{t-1} is information available at time t-1. In Equation 5.2c, the variance equation, $\log(h^2_{i,t})$ is the log of the conditional variance indicating that the current volatility forecast is conditional upon the previous period's conditional variance and error, α_o is the constant term which represents the time independent component of volatility, α_1 is the asymmetric impact of past innovations on current volatility, α_2 is the ARCH term in which a significant positive coefficient i.e. $\alpha_2>0$ signifies the presence of volatility clustering. The log $h^2_{i,t-1}$ is the past period variance (impact of old news on volatility) while φ_1 denotes the GARCH term or persistence parameter. Then EURDUM is the euro dummy which examines the impact of the introduction of the Euro on the volatility of firm's returns. This binary variable also has a value of 1 from 1st January 1999 and 0 before that date. The estimated exposure coefficients for the market risk, foreign exchange and interest rate risk from this model are reported separately by the direction of the exposure, first in the period before the introduction of the euro, with the corresponding coefficient denoting the period after the euro.

In Table 5.4, the summary of the market risk exposure coefficients (FTALLSH) as well as the corresponding coefficient representing the period after the introduction of the euro (FTSEDUM) are reported. The Table also presents the descriptive statistics of the coefficients. The mean of the market coefficient, FTALLSH, for firms with positive coefficients is 0.3403, and we find that 67% of these firms have significant positive coefficients. Furthermore, the corresponding change in the market exposure coefficient after the Euro has a mean of 0.0843, and 48% of the firms with positive coefficients before the euro, had significant coefficients after the Euro, hereafter FTSEDUM, out of which 64% of these were positive, suggesting that their exposure to the market risk increased after the Euro. In contrast, 36% of the firms had significant negative coefficients, indicating a reduction in their exposure to the market risk after the introduction of the euro. Additionally, it was also observed that none of negative coefficients for the market risk was significant. However, regarding the result for the change in market exposure coefficient after the euro, FTSEDUM, it was found that 71% of the firms had significant coefficients, which were all positive. Overall, some UK firms experienced a decrease in their exposure to the market risk, but these were not as much as those found initially from the OLS (Table A13.6).

Table 5.4 A summary of UK non-financial firms' exposure to market risk before the euro and after the introduction of the euro

STATISTICS	FTSEALLSH (+)	FTSEDUM (+)	FTSEALLSH (-)	FTSEDUM (-)
Mean	0.3403	0.0843	-0.0038	0.3985
Minimum	0.0000	-0.9032	-0.0352	-0.0483
Median	0.2046	0.0354	-0.0010	0.3507
Maximum	1.5289	1.3807	-0.0001	0.9637
Standard deviation	0.3595	0.3232	0.0084	0.3296
Number of firms	385	234 (-151)	17	+16 (-1)
Firms with significant exposure	67%	48%	0%	71%
Positive exposure coefficients	100%	64%	0%	100%
Negative exposure coefficients	0%	36%	0%	0%
Significant coefficients at 1%	87%	63%	0%	92%
Significant coefficients at 5%	10%	20%	0%	0%
Significant coefficients at 10%	3%	17%	0%	8%

Note: FTSEALLSH is the market risk before the Euro, FTSEDUM denotes the change in market risk following the introduction of the euro. + represents a positive coefficient whereas (-) indicates a negative coefficient. Number of firms is the total number of firms in the sample. Firms with significant exposure represent firms which have significant coefficients. Positive exposure coefficients and negative exposure coefficients stands for firms with significant positive or negative coefficients respectively. Levels of significance are at the 1%, 5% and 10% level and indicate the percentage of firms with significant coefficients at each level.

In Tables 5.5 and 5.6, the results for the exposure to the actual and unexpected TWI, and change in the exposure following the introduction of the euro, each from the mean equation, are reported. For the US$/£, these results are shown in Tables 5.7 and 5.8 while regarding the JP¥/£, this result is presented in Tables 5.9 and 5.10. Also shown on all the Tables is the EURDUM coefficient from the variance equation, which indicates whether the riskiness of firm's returns increased or decreased after the introduction of the euro. This coefficient is also reported according to the direction of the exchange rate exposure in the period before the euro.

The results in Table 5.5 shows that for the exposure to the actual trade weighted index before the Euro, ERINDEX, the mean of the exposure for the positive (negative) coefficients is 0.1098 (-0.0938), while the mean of the exposure coefficient in the period after the euro, ERDUM, for these positive (negative) coefficients is -0.0769 (0.0873). Additionally, the mean of the EURDUM coefficient for firms with positive (negative) coefficients is 0.3426 (0.2391). On the other hand, regarding the unexpected TWI, in Table 5.6, the mean of the exposure for the positive (negative) coefficients is 0.0011 (-0.0014), whereas the mean of the exposure coefficient in the period after the euro, ERDUM, for the positive (negative) coefficients is -0.0008 (0.0014). Furthermore, the mean of the EURDUM coefficient for firms with positive (negative) coefficients is 0.3908 (0.0717).

In Table 5.7, the mean positive (negative) coefficients for the exposure to the actual US$/£ before the Euro, ERINDEX, is 0.0608 (-0.0607) and in the period after the euro, ERDUM, the mean of the exposure coefficients is -0.0055 (0.0908) correspondingly. Furthermore, the mean of the EURDUM coefficient for firms with positive (negative) coefficients is 0.3359 (0.2252). Then again, for the unexpected US$/£, in Table 5.8, the mean of the exposure for the positive (negative) coefficients before the euro, ERINDEX, is 0.0371 (-0.0360) while the mean of the exposure coefficient for the period after the Euro, ERDUM, is -0.0096 (0.0619) for the positive (negative) coefficients. Regarding the mean of the EURDUM coefficient for firms with positive (negative) coefficients, this is 0.3391 (0.2348). Furthermore, for the actual JP¥/£ in Table 5.9, the mean positive (negative) exposure coefficients for the period before the euro, ERINDEX, is 0.0562 (-0.0447) and in the period after the euro, ERDUM, the mean of the exposure coefficients is -0.0658 (0.0011). Also, regarding the EURDUM coefficient, the mean for firms with positive (negative) coefficients is 0.3359 (0.2252). The results for the unexpected JP¥/£ presented in Table 5.10 shows that the mean of the exposure for the positive (negative) coefficients before the euro, ERINDEX, is 0.0002 (-0.0003), whereas the mean of the exposure coefficient for the period after the euro, ERDUM, is -0.0003 (0.0001) for the positive (negative) coefficients. As regards the mean of the EURDUM coefficients, it is found to be 0.3463 (0.0440) for firms with positive (negative) coefficients. The results for significant exposure coefficients are quite similar for the actual and unexpected changes in all the exchange rate models. Furthermore, regarding the actual (unexpected) exposure to the TWI in the period before the euro, ERINDEX, presented in Tables 5.5 and 5.6, it was found that 15% (12%) of firms have significant positive coefficients. For the US$/£ in Tables 5.7 and 5.8, 12% (11%) of the firms had significant positive coefficients for the actual (unexpected) ERINDEX, while for the JPY/£ in Tables 5.9 and 5.10, 15% (12%) of firms had significant positive coefficients respectively. The finding of significant positive coefficients for these firms suggests that they experience an increase (decrease) in firm value when the domestic currency appreciates (depreciates).

Additionally, for the corresponding exposure coefficient representing the period after the introduction of the euro, ERDUM, in Tables 5.5 - 5.10, it was found that 13% (11%) of the firms had significant coefficients for the actual (unexpected) TWI, and 69% (72%) of these were negative. For the USS/£, 12% (10%) of the firms had significant ERDUM coefficients of which 53% (65%) were negative whereas for the JP¥/£, 11% of the firms had significant ERDUM coefficients in the actual changes model as well the model for the unexpected changes. However, 90% of the significant ERDUM coefficients for the actual JP¥/£ were negative whereas this was 82% for the unexpected JP¥/£. In all the exchange rate models, the reported result of opposite signed significant ERDUM coefficients suggests a reduction in the absolute exchange rate exposure of the firms. On the other hand, for firms with the same sign ERINDEX and ERDUM coefficient (i.e. a positive ERINDEX as well as a positive ERDUM coefficient), this implies an increase in their absolute exchange rate exposure in the period after the euro.

Next, as regards firms with negative exchange rate coefficients before the euro, it was found in Tables 5.5 and 5.6 that for the actual (unexpected) TWI, 12% (15%) of the firms had significant ERINDEX coefficients. Then, regarding the actual and unexpected US$/£ in Table 5.7 and 5.8, 10% of the firms had significant negative ERINDEX coefficients in the period before the euro, while for the actual and unexpected JP¥/£ in Tables 5.9 and 5.10, 13% (14%) of the firms had significant negative ERINDEX coefficients. The finding of significant negative coefficients for these firms suggests that they experience an increase (decrease) in firm value when the domestic currency depreciates (appreciates). Also, for the corresponding exposure coefficient for the TWI, US$/£ and JP¥/£ after the introduction of the euro, ERDUM, in Tables 5.5-5.10, it was found that 10% of the firms in each case had significant coefficients for the actual TWI as well as the unexpected TWI, and 94% (92%) of these were positive. For the USS/£, 11% (15%) of firms had significant ERDUM coefficients of which 82% (83%) were positive whereas for the actual (unexpected) JP¥/£, 7% (8%) of the firms had significant ERDUM of which 22% (43%) were positive. Again, in all the exchange rate models, the finding of an opposite signed significant ERDUM coefficients suggests a reduction in absolute exchange rate exposure for the firms after the euro.

Generally, in all the exchange rate models, there were more firms with significant positive exchange rate exposure coefficients, ERINDEX, in the period before the euro than significant negative exposure coefficients. Moreover, for firms with positive ERINDEX coefficients before the euro, the incidence of significant coefficients was generally low in all instances, but there were more firms with significant exposure coefficients for the JP¥/£, followed by the TWI. Then, for the corresponding coefficient, ERDUM, representing the period after the euro, fewer significant coefficients were found in all the exchange rate models except the actual US$/£ where the number of significant ERINDEX were the same as that of the ERDUM. Nevertheless, most of the ERDUM coefficients were of the opposite sign (i.e. negative) to the ERINDEX, signifying a reduction in their absolute exchange rate exposure after the euro. But the reduction in absolute exposure, in the period after the euro, was highest for firms with pre-euro positive JP¥/£ exposure coefficients and followed by firms with pre-euro positive coefficients for the TWI.

Additionally, regarding firms with negative ERINDEX coefficients in the period before the Euro, again the incidence of firms with significant coefficients was very low. However, there were more significant negative coefficients for the US$/£ in the period before the Euro, followed by the TWI. Furthermore the results for the corresponding coefficient, ERDUM, denoting the period after the euro, indicated that fewer significant coefficients were found for the TWI and JP¥/£ exchange rate models than in the period before the euro, but for the US$/£, the number of significant ERINDEX was less than the number of significant coefficients found for the ERDUM. Even so, most of the ERDUM coefficients were of the opposite sign (i.e. positive) to the ERINDEX, signifying a reduction in their absolute exchange rate exposure after the euro. However, the reduction in absolute exposure, in the period after the euro, was highest for firms with negative US$/£ coefficients before the euro, and then followed by firms with negative coefficients for the TWI before the euro. Overall, taking into consideration the results for both positive and negative coefficients before the Euro, absolute reduction in exchange rate exposure, ERDUM, was highest for firms with positive ERINDEX coefficients to the JP¥/£, followed by firms with positive ERINDEX coefficients for the TWI and then firms with negative coefficients for the US$/£, while the lowest reduction in net exposure was for firms with negative ERINDEX coefficients for the JP¥/£. The results here are somewhat similar to that found for the OLS (Tables A13.7-A13.9) as net reduction in exposure was also highest for the 3 aforementioned exchange rate measures from this GARCH analysis. However, for the OLS, the lowest reduction in exposure was for firms with positive US$/£ ERINDEX coefficients. Then in instances when significant coefficients had been found, this had been higher for the OLS than the GARCH model in most instances.

Another important result from Tables 5.5-5.10 is the EURDUM coefficient which measures the volatility of firm's returns following the introduction of the euro. Regarding firms with positive exchange rate coefficients (ERINDEX) for the actual (unexpected) TWI, 65% (66%) of these firms had significant EURDUM coefficients, out of which 82% (84%) were positive. The results for the actual (unexpected) US$/£ were quite similar as 64% (62%) of firms with positive ERINDEX coefficients had significant EURDUM coefficients and 81% (82%) of these were positive. More so, regarding the actual (unexpected) JP¥/£, 66% (68%) of the firms with positive ERINDEX coefficients had significant EURDUM coefficients of which 81% (80%) were positive. Conversely, for firms with negative exchange rate coefficients (ERINDEX) for the actual (unexpected) TWI, 59% (51%) of these firms had significant EURDUM coefficients, out of which 79% (72%) were positive. Regarding the actual (unexpected) US$/£, 55% (61%) of firms with negative ERINDEX coefficients had significant EURDUM coefficients and 80% (76%) of these coefficients were positive. Then for the actual (unexpected) JP¥/£, 56% (38%) of the firms with negative ERINDEX coefficients had significant EURDUM coefficients of which 79% (76%) were positive. In all instances, the finding of significant positive (negative) EURDUM coefficients indicates that the riskiness of firms' returns increased (declined) in the period after the introduction of the Euro. Generally, the actual (unexpected) JP¥/£ model, had the highest number of firms with significant EURDUM coefficients, this was closely followed by the TWI and lowest for the USS/£ models. Notwithstanding, the incidence of significant EURDUM coefficients was somewhat similar in all the models, while the occurrence of significant positive coefficients was higher than that of significant negative coefficients for firms with positive or negative exchange rate coefficients in the period before the euro. Then it was also observed that for some firms with reduction in their absolute exchange rate exposure after the euro, the volatility of their returns still increased after the introduction of the Euro.

The result here is also similar to that of the industry level analysis where it was found that most of the significant EURDUM coefficients were positive. More so, since reduction in exposure to exchange rate exposure after the euro did not necessarily guarantee a reduction in volatility of returns for UK firms, we follow on from Morana and Beltratti (2002), and also posit that the increase in volatility of returns after the euro may have been further instigated by the update of stock valuations to the formal introduction of the Euro for the European markets.

Table 5.5 A summary of non-financial firms' exposure to actual changes in the Trade weighted nominal exchange rate before and after the introduction of the euro

	ACTUAL BOEGBPR					
STATISTICS	ERINDEX (+)	ERDUM (+)	EURDUM (+)	ERINDEX (-)	ERDUM (-)	EURDUM (-)
Mean	0.1098	-0.0769	0.3426	-0.0938	0.0873	0.2391
Minimum	0.0000	-0.7585	-3.8706	-0.4786	-0.5410	-3.8502
Median	0.0609	-0.0836	0.0521	-0.0352	0.0461	0.0169
Maximum	0.8816	0.8749	4.0159	-0.0001	1.0079	4.2467
Standard deviation	0.1352	0.2437	0.8352	0.1220	0.2535	0.8385
Number of firms	243	+72 (-171)	+174 (-69)	159	+100 (-59)	+104 (-55)
Firms with significant exposure	15%	13%	65%	12%	10%	59%
Positive exposure coefficients	100%	31%	82%	0%	94%	79%
Negative exposure coefficients	0%	69%	18%	100%	6%	21%
Significant coefficients at 1%	57%	16%	73%	42%	19%	81%
Significant coefficients at 5%	24%	31%	16%	42%	38%	14%
Significant coefficients at 10%	19%	53%	11%	16%	44%	5%

Note: The table reports the exposure to changes in the actual changes in the Trade weighted nominal exchange rate (BOEGBPR) in the period before and after the Euro. ERINDEX represents the Trade-weighted nominal exchange rate exposure coefficient before the Euro and ERDUM is the corresponding exposure after the euro. EURDUM is the coefficient from the variance equation which reports the volatility of firms' returns after the introduction of the euro. + refers to positive coefficients while (-) corresponds to negative coefficients. The number of firms is the total number of firms in the sample. Firms with significant exposure refer to firms with significant coefficients. Positive exposure coefficients and negative exposure coefficients are firms with significant positive or negative coefficients respectively. The levels of significance are at the 1%, 5% and 10% level.

Table 5.6 A summary of non-financial firms' exposure to unexpected changes in the Trade weighted nominal exchange rate before and after the introduction of the euro

	UNEXPECTED BOEGBPR					
STATISTICS	ERINDEX (+)	ERDUM (+)	EURDUM (+)	ERINDEX (-)	ERDUM (-)	EURDUM (-)
Mean	0.0011	-0.0008	0.3908	-0.0014	0.0014	0.0717
Minimum	0.0000	-0.0088	-3.4500	-0.0053	-0.0050	-3.7828
Median	0.0005	-0.0007	0.0714	-0.0008	0.0011	0.0042
Maximum	0.0099	0.0092	5.9899	-0.0001	0.0100	1.5271
Standard deviation	0.0015	0.0025	0.9081	0.0014	0.0027	0.4677
Number of firms	284	+99 (-185)	+210 (-74)	118	+85 (-33)	+69 (-49)
Firms with significant exposure	12%	11%	66%	15%	10%	51%
Positive exposure coefficients	100%	28%	84%	0%	92%	72%
Negative exposure coefficients	0%	72%	16%	100%	8%	28%
Significant coefficients at 1%	56%	19%	76%	22%	8%	72%
Significant coefficients at 5%	26%	44%	14%	67%	58%	15%
Significant coefficients at 10%	18%	38%	9%	11%	33%	13%

Note: The result for the unexpected changes in the Trade weighted nominal exchange rate (BOEGBPR) in the period before and after the euro are reported here. The levels of significance are at the 1%, 5% and 10% level.

Table 5.7 A summary of non-financial firms' exposure to actual changes in the in the US$/£ exchange rate before and after the introduction of the euro

	ACTUAL US$/£					
STATISTICS	ERINDEX (+)	ERDUM (+)	EURDUM (+)	ERINDEX (-)	ERDUM (-)	EURDUM (-)
Mean	0.0608	-0.0055	0.3359	-0.0607	0.0908	0.2252
Minimum	0.0000	-0.4681	-3.2782	-0.4564	-0.3638	-3.8551
Median	0.0336	-0.0044	0.0428	-0.0265	0.0753	0.0131
Maximum	0.4293	0.7401	6.2707	-0.0001	0.6341	3.6422
Standard deviation	0.0736	0.1693	0.8837	0.0791	0.1549	0.7597
Number of firms	245	+115 (-130)	+176 (-69)	157	+117 (-40)	+107 (-50)
Firms with significant exposure	12	12	64	10	11	55
Positive exposure coefficients	100	47	81	0	82	80
Negative exposure coefficients	0	53	19	100	18	20
Significant coefficients at 1%	43	17	76	33	12	80
Significant coefficients at 5%	30	33	15	33	41	9
Significant coefficients at 10%	27	50	9	33	47	10

Note: ACTUAL US$/£ is the actual changes in US/£ exchange rate. ERINDEX is the US$/£ exchange rate exposure coefficient before the euro and ERDUM is the corresponding exposure after the Euro.

Table 5.8 A summary of non-financial firms' exposure to unexpected changes in the in the US$/£ exchange rate before and after the introduction of the euro

	UNEXPECTED US$/£					
STATISTICS	ERINDEX (+)	ERDUM (+)	EURDUM (+)	ERINDEX (-)	ERDUM (-)	EURDUM (-)
Mean	0.0371	-0.0096	0.3391	-0.0360	0.0619	0.2348
Minimum	0.0000	-0.2817	-3.5814	-0.1988	-0.2247	-3.8394
Median	0.0226	-0.0111	0.0445	-0.0166	0.0522	0.0188
Maximum	0.2453	0.3645	6.4614	-0.0001	0.4336	3.4138
Standard deviation	0.0447	0.0920	0.8730	0.0445	0.1040	0.7552
Number of firms	237	+108 (-129)	+167 (-70)	165	+124 (-41)	+109 (-56)
Firms with significant exposure	11%	10%	62%	10%	15%	61%
Positive exposure coefficients	100%	35%	82%	0%	83%	76%
Negative exposure coefficients	0%	65%	18%	100%	17%	24%
Significant coefficients at 1%	40%	13%	76%	29%	13%	77%
Significant coefficients at 5%	20%	48%	15%	35%	46%	11%
Significant coefficients at 10%	40%	39%	10%	35%	42%	12%

Note: The result for the unexpected changes in the USS/£ exchange rate in the period before and after the Euro are reported here. ERINDEX is the USS/£ exchange rate exposure coefficient before the euro and ERDUM is the corresponding exposure after the euro. The EURDUM coefficient reports the volatility of firms' returns after the introduction of the euro. + represents positive coefficients while (-) refers to negative coefficients. Positive exposure coefficients and negative exposure coefficients are firms with significant positive or negative coefficients respectively. The levels of significance are at the 1%, 5% and 10% level and indicate the percentage of firms with significant coefficients at each level.

Table 5.9 A summary of non-financial firms' exposure actual changes in the JP¥/£ exchange rate before and after the introduction of the euro

	ACTUAL JP¥/£					
STATISTICS	ERINDEX (+)	ERDUM (+)	EURDUM (+)	ERINDEX (-)	ERDUM (-)	EURDUM (-)
Mean	0.0562	-0.0658	0.3375	-0.0447	0.0011	0.2279
Minimum	0.0000	-0.5762	-3.8078	-0.3007	-0.3981	-2.5893
Median	0.0389	-0.0482	0.0569	-0.0226	0.0147	0.0153
Maximum	0.3766	0.4048	4.4261	-0.0001	0.3767	4.1598
Standard deviation	0.0625	0.1324	0.8890	0.0580	0.1361	0.6419
Number of firms	275	+81 (-194)	+193 (-82)	127	+71 (-56)	+85 (-42)
Firms with significant exposure	15%	11%	66%	13%	7%	56%
Positive exposure coefficients	100%	10%	81%	0%	22%	79%
Negative exposure coefficients	0%	90%	19%	100%	78%	21%
Significant coefficients at 1%	29%	10%	73%	18%	22%	77%
Significant coefficients at 5%	33%	50%	17%	47%	44%	15%
Significant coefficients at 10%	38%	40%	10%	35%	33%	7%

Note: ACTUAL JP¥/£ is the actual changes in JP¥/£exchange rate. ERINDEX is the JP¥/£ exchange rate exposure coefficient before the Euro and ERDUM is the corresponding exposure after the euro.

Table 5.10 A summary of non-financial firms' exposure unexpected changes in the JP¥/£ exchange rate before and after the introduction of the euro

	UNEXPECTED JP¥/£					
STATISTICS	ERINDEX (+)	ERDUM (+)	EURDUM (+)	ERINDEX (-)	ERDUM (-)	EURDUM (-)
Mean	0.0002	-0.0003	0.3463	-0.0003	0.0001	0.0440
Minimum	0.0000	-0.0034	-3.7396	-0.0016	-0.0020	-2.5875
Median	0.0001	-0.0002	0.0696	-0.0002	0.0002	0.0032
Maximum	0.0019	0.0018	5.6318	-0.0001	0.0020	1.0704
Standard deviation	0.0003	0.0007	0.8876	0.0003	0.0007	0.3469
Number of firms	315	+123(-192)	+227 (-88)	87	+51 (-36)	+52 (-35)
Firms with significant exposure	12%	11%	68%	14%	8%	38%
Positive exposure coefficients	100%	18%	80%	0%	43%	76%
Negative exposure coefficients	0%	82%	20%	100%	57%	24%
Significant coefficients at 1%	22%	12%	79%	25%	29%	58%
Significant coefficients at 5%	32%	47%	12%	50%	14%	30%
Significant coefficients at 10%	46%	41%	9%	25%	57%	12%

Note: The result for the unexpected changes in the JP¥/£ exchange rate in the period before and after the Euro are reported here. ERINDEX is the JP¥/£ exchange rate exposure coefficient before the Euro and ERDUM is the corresponding exposure after the euro. The EURDUM coefficient reports the volatility of firms' returns after the introduction of the euro. + represents positive coefficients while (-) refers to negative coefficients. Positive exposure coefficients and negative exposure coefficients are firms with significant positive or negative coefficients respectively. The levels of significance are at the 1%, 5% and 10% level and indicate the percentage of firms with significant coefficients at each level.

In Tables 5.11 and 5.12, the results for the actual and unexpected short-term interest rate exposure are presented. The mean of the positive (negative) exposure coefficients for the actual changes is 0.0328 (-0.0459) whereas for the unexpected changes, the mean of the positive (negative) coefficients is 0.0335 (-0.0477). The results indicate that of the firms with positive short-term interest rate exposure coefficients before the euro, UKTBTND, only 8% (9%) of these were significant for the actual (unexpected) changes. The finding of significant positive coefficients follows the standard interpretation that firms' returns increase when interest rates rise. Then it was found that the corresponding coefficient in the short-term interest rate exposure, TBTNDUM, representing the period after the euro, 7% (10%) of the firms had significant coefficients, of which 70% (69%) were of the opposite sign to that of the UKTBTND coefficient i.e. negative, implying a reduction in their absolute exposure to the short-term interest rate following the introduction of the euro. Conversely, for firms with significant positive TBTNDUM coefficients (same sign as the UKTBTND coefficient), these experienced an increase in their absolute short-term interest rate exposure after the euro.

In addition, the results for the firms with negative coefficients to the short-term interest rate in the period before the euro, UKTBTND, showed that 15% (12%) of the firms had significant coefficients to the actual (unexpected) changes. The finding of significant negative coefficients implies that firms' returns decrease when interest rates rise. Regarding the corresponding exposure, TBTNDUM, which denotes the period after the euro, it was found that 14% (12%) of firms had significant coefficients and 78% (83%) of these significant coefficients were positive, implying a reduction in the absolute exposure to the short-term interest rate after the euro. In contrast, for firms with negative TBTNDUM coefficients, an increase in their absolute short-term interest rate exposure after the euro might be expected. Generally, there were more firms with significant negative short-term interest rate exposure coefficient than positive in the period before the euro. Moreover, firms with negative short-term interest rate exposure coefficients had more opposite signed significant TBTNDUM coefficients than firms with positive short-term interest rate exposure coefficients, and opposite signed significant TBTNDUM coefficients after the euro. Furthermore, it was also observed that there were marginally a bit more significant positive short-term interest rate coefficients reported here from the GARCH model than the OLS (Table A13.10), but for the negative short-term interest rate coefficients, and all the corresponding coefficients denoting the period after the euro TBTNDUM (+) and TBTNDUM (-), there were more significant coefficients from the OLS model than there were for the GARCH model.

In Tables 5.13 and 5.14, we present the results for the actual and unexpected long-term interest rate exposure. The mean of the positive (negative) exposure coefficients for the actual changes is 0.0563 (-0.0465) whereas for the unexpected changes, the mean of the positive (negative) coefficients is 0.0057 (-0.0072). The results show that for firms with positive long-term interest rate exposure coefficients before the euro, UKMBRYD, 15% (13%) of these were significant for the actual (unexpected) changes. The finding of significant positive coefficients implies that firms' returns increase when interest rates rise. Furthermore, it was found that regarding the corresponding coefficient in the long-term interest rate exposure, BRYDUM, which denotes the period after the euro, only 4% (6%) of the firms had significant coefficients, out of which 50% (47%) were of the opposite sign as that of the UKMBRYD coefficient. i.e. negative, implying a reduction in their absolute exposure to the long-term interest rate following the introduction of the euro. Nevertheless, slightly more firms experienced an increase in their absolute exposure to the long-term interest rate after the euro than those that witnessed a decrease.

Furthermore, regarding firms with negative coefficients to the long-term interest rate in the period before the euro, UKMBRYD, it was found that 9% (13%) of these firms had significant coefficients to the actual (unexpected) changes. The finding of significant negative coefficients implies that firms' returns decrease when interest rates rise. Regarding the corresponding exposure, BRYDUM, which represents the period after the euro, it was found that 14% (13%) of firms had significant coefficients and 78% (88%) of the significant coefficients were positive, indicating a reduction in the absolute exposure to the long-term interest rate after the euro. Then for firms with negative BRYDUM coefficients as well as negative UKMBRYD coefficients, this suggested that they experienced an increase in their absolute long-term interest rate exposure after the euro.

Generally, there were more firms with significant positive long-term interest rate exposure coefficient than negative in the period before the euro. Moreover, firms with negative long-term interest rate exposure coefficients had more opposite signed significant BRYDUM coefficients than firms with positive long-term interest rate exposure coefficients, and opposite signed significant BRYDUM coefficients after the euro. Although there were more firms with significant exposure coefficients to the long-term interest rate than short-term interest rate exposure before the euro, a higher number of firms experienced reductions in their absolute exposure to the short-term interest rate exposure than the long-term interest rate exposure, after the euro. A possible explanation might be that in the period after the Euro, there have been noticeable periodic decreases in the UK short-term interest rate, and this has been more pronounced than the reductions in the long-term interest rate. It was also noticed that the UK short-term interest rate seemed move in the same direction as the euro area 3 month Euribor, which also happens to have undergone noticeable reductions since 1999.

Table 5.11 A summary of non-financial firms' exposure actual changes in the short-term interest rate (3 Month Treasury bill) before and after the introduction of the Euro

	ACTUAL UKTBTND			
STATISTICS	UKTBTND (+)	TBTNDUM (+)	UKTBTND (-)	TBTNDUM (-)
Mean	0.0328	-0.0423	-0.0459	0.0386
Minimum	0.0000	-0.5211	-0.3653	-0.5424
Median	0.0134	-0.0332	-0.0260	0.0276
Maximum	0.2379	0.6355	-0.0001	0.5191
Standard deviation	0.0433	0.1465	0.0532	0.1558
Number of firms	148	+53 (-95)	254	+166 (-88)
Firms with significant exposure	8%	7%	15%	14%
Positive exposure coefficients	100%	30%	0%	78%
Negative exposure coefficients	0%	70%	100%	22%
Significant coefficients at 1%	17%	20%	22%	8%
Significant coefficients at 5%	25%	40%	41%	53%
Significant coefficients at 10%	58%	40%	38%	39%

Note: Actual UKTBTND is the exposure coefficients to the actual changes in the 3 Month Treasury bill before the euro while TBTNDUM denotes corresponding exposure after the Euro. + corresponds to the positive coefficients whereas (-) represents the negative coefficients. The levels of significance are at the 1%, 5% and 10% levels and indicate the percentage of firms with significant coefficients at each level.

5.4 Lagged exchange rate and interest rate exposure

The impact of lagged changes in exchange rates and interest rates on UK firms' stock returns is examined using the AR(1)-EGARCH(1,1)-M model stated thus:

$$R_t = \alpha_i + \beta_{ai}R_{t-1} + \beta_{mi}RM_t + \beta_{ij}XR_{t-1} + \beta_{si}SR_{t-1} + \beta_{li}LR_{t-1} + \lambda\log(h^2_{it}) + \varepsilon_{it} \quad 5.3a$$

$$\varepsilon_{i,t}|I_{t-1} \sim t(0, h^2_{i,t}, \upsilon_{i,t}) \quad 5.3b$$

$$\log h^2_{i,t} = \alpha_0 + \alpha_1\frac{\varepsilon_{i,t-1}}{h_{i,t-1}} + \alpha_2\left(\left|\frac{\varepsilon_{i,t-1}}{h_{i,t-1}}\right|\right) + \varphi_1\log h^2_{i,t-1} \quad 5.3c$$

where in the mean Equation 5.3a, α_i is the intercept term for firm i, $R_{i,t}$ is the return of firm i at time t, R_{it-1} is the autoregressive lag parameter for firm i at time t-1, RM_t is the rate of return of the market portfolio at time t, XR_{t-1}, SR_{t-1} and LR_{t-1} are the lagged changes in the exchange rate, short-term interest rate and long-term interest rate, respectively at time t-1. Each lag is 1 week. Then for Equation 5.3b and 5.3c (variance equation), all the parameters are as explained before. In the mean equation, only the results for the risk premium parameter, exchange rate and interest rate exposure coefficients are presented. Then from the variance equation, only the coefficients for the leverage, ARCH and GARCH parameters are discussed.

In Table 5.15, a summary of the relationship between firms' stock returns and the lagged exchange rate (TWI, the US$/£ exchange rate and the JP¥/£ exchange rate) as well as the risk-return coefficients are presented. Furthermore, the corresponding descriptive statistics for the period are also reported. It is found that for the risk-return trade-off parameter, the mean of the coefficients is -0.0044 (0.0014) for the actual (unexpected) TWI, -0.0050 (-0.0012) for the actual (unexpected) US$/£ and -0.0218 (-0.0071) for the actual (unexpected) JP¥/£. The results also showed that 26% (25%) of the risk-return coefficients are significant for the actual (unexpected) TWI, and 50% (55%) of these coefficients are positive. The finding for the actual (unexpected) US$/£ are somewhat similar as 27% (24%) of the firms have significant coefficients, and 51% (57%) of these were positive. Similarly, for the actual (unexpected) JP¥/£, 27% (24%) of the risk-return coefficients were significant and 50% (54%) of these coefficients were positive. The results here indicate that for a majority of UK firms, increased volatility does not usually increase the firms' returns. Moreover, even for firms that experienced increased returns as a result of increased volatility, these are just marginally more than those which had a decline in their returns due to increase in volatility. These inferences made here are also the same as those reported for the contemporaneous exchange rate models.

Table 5.12 A summary of non-financial firms' exposure unexpected changes in the short-term interest rate (3 Month Treasury bill) before and after the introduction of the Euro

	UNEXPECTED UKTBTND			
STATISTICS	UKTBTND (+)	TBTNDUM (+)	UKTBTND (-)	TBTNDUM (-)
Mean	0.0335	-0.0308	-0.0477	0.0515
Minimum	0.0000	-0.6034	-0.3660	-0.4527
Median	0.0121	-0.0198	-0.0281	0.0343
Maximum	0.2602	0.5433	-0.0001	0.6665
Standard deviation	0.0492	0.1684	0.0549	0.1572
Number of firms	165	+73 (-92)	237	+156 (-81)
Firms with significant exposure	9%	10%	12%	12%
Positive exposure coefficients	100%	31%	0%	83%
Negative exposure coefficients	0%	69%	100%	17%
Significant coefficients at 1%	20%	25%	4%	17%
Significant coefficients at 5%	33%	31%	64%	38%
Significant coefficients at 10%	47%	44%	32%	45%

Note: unexpected UKTBTND is the exposure coefficients to the unexpected changes in the 3 Month Treasury bill before the euro while TBTNDUM denotes the corresponding exposure after the Euro. + corresponds to the positive coefficients whereas (-) represents the negative coefficients. Number of firms is the total number of firms in the sample. Positive exposure coefficients and negative exposure coefficients represent firms with significant positive or negative coefficients respectively. The levels of significance are at the 1%, 5% and 10% levels and indicate the percentage of firms with significant coefficients at each level.

Table 5.13 A summary of non-financial firms' exposure actual changes in the 10 Year Government Bond (GB) before and after the introduction of the Euro

	ACTUAL UKMBRYD			
STATISTICS	UKMBRYD (+)	BRYDUM (+)	UKMBRYD (-)	BRYDUM (-)
mean	0.0563	-0.0239	-0.0465	0.0560
minimum	0.0000	-0.2738	-0.3318	-0.2247
median	0.0382	-0.0183	-0.0178	0.0406
maximum	0.2994	0.3277	-0.0001	0.4390
standard deviation	0.0599	0.0923	0.0667	0.1022
number of firms	240	+90 (-150)	162	+119 (-43)
firms with significant exposure	15%	4%	9%	14%
positive exposure coefficients	100%	50%	0%	78%
negative exposure coefficients	0%	50%	100%	22%
significant coefficients at 1%	17%	10%	67%	17%
significant coefficients at 5%	46%	40%	27%	39%
significant coefficients at 10%	37%	50%	7%	43%

Note: Actual UKMBRYD is the exposure coefficients to the actual changes in the 10 year Government bond before the euro while BRYDUM represents the corresponding exposure after the Euro. + corresponds to the positive coefficients whereas (-) represents the negative coefficients. The levels of significance are at the 1%, 5% and 10% levels and indicate the percentage of firms with significant coefficients at each level.

Table 5.14 A summary of non-financial firms' exposure unexpected changes in the 10 Year Government Bond (GB) before and after the introduction of the Euro

	UNEXPECTED UKMBRYD			
STATISTICS	UKMBRYD (+)	BRYDUM (+)	UKMBRYD (-)	BRYDUM (-)
Mean	0.0057	-0.0001	-0.0072	0.0102
Minimum	0.0000	-0.0678	-0.0393	-0.0630
Median	0.0028	0.0000	-0.0044	0.0066
Maximum	0.0341	0.0717	-0.0001	0.0622
Standard deviation	0.0072	0.0174	0.0083	0.0186
Number of firms	267	+137 (-130)	135	+100 (-35)
Firms with significant exposure	13%	6%	13%	13%
Positive exposure coefficients	100%	47%	0%	88%
Negative exposure coefficients	0%	53%	100%	12%
Significant coefficients at 1%	31%	13%	59%	24%
Significant coefficients at 5%	39%	33%	18%	24%
Significant coefficients at 10%	31%	53%	24%	53%

Note: unexpected UKMBRYD is the exposure coefficients to the unexpected changes in the 10 year Government bond before the euro whereas BRYDUM denotes the corresponding exposure after the Euro. + relates to the positive coefficients whereas (-) represents the negative coefficients. Number of firms is the total number of firms in the sample. Positive exposure coefficients and negative exposure coefficients represent firms with significant positive or negative coefficients respectively. The levels of significance are at the 1%, 5% and 10% levels and indicate the percentage of firms with significant coefficients at each level.

Furthermore for the exchange rate exposure results for the lagged actual (unexpected) TWI, 8% (9%) significant exchange rate exposure coefficients were found but from the OLS estimation (Table A13.12), 16% (17%) of the firms had significant coefficients respectively. Likewise, for the actual (unexpected) US$/£, 9% (10%) of firms had significant exchange rate exposure coefficients, but earlier estimates from the OLS model (Table A13.12) showed that for the actual and unexpected changes, 14% of the firms had significant coefficients. Then regarding the actual and unexpected JP¥/£, it was found that 8% of the firms had significant coefficients in each case, which was lower than the 12% (13%) reported for the OLS estimate (Table A13.12). Additionally, it was observed that in contrast to the results from the contemporaneous changes in the exchange rate, the majority of the significant coefficients for the lagged exchange rate models were negative, indicating that most firms, typically exporters, benefit (suffer) from the depreciation (appreciation) of the pound, in the total sample period. Then again, the results for the actual and unexpected changes have been similar in all instances.

Next, in Table 5.16, the exposure results to changes in the lagged interest rates are presented. The mean of the actual (unexpected) short-term interest rate exposure coefficients is 0.0007 (0.0069) but for the actual (unexpected) long-term interest rate, this is -0.0124 (-0.0026). Furthermore, regarding the actual (unexpected) short-term interest, we find 8% (9%) of firms with significant coefficients, but for the actual and unexpected long-term interest rate, 12% of the firms had significant coefficients in each model. Moreover, there were more significant positive coefficients for the short-term lagged interest rate exposure whereas for the long-term lagged interest rate exposure, the number of negative significant coefficients was higher. Once more, there were fewer significant coefficients detected here (except for the unexpected long-term interest rate) in comparison to that for the OLS model where 16% of the firms had significant coefficients for the actual as well as the unexpected changes in the short-term interest rate, and 13% (11%) for the actual (unexpected) long-term interest. Nevertheless, the inferences made for both models were generally similar.

Tables A8.5, A8.6 and A8.7 in Appendix 8, reports the leverage/asymmetric, ARCH and GARCH parameters from the variance equations and the relative descriptive statistics for the TWI, US$/£ and JP¥/£ exchange rates models, respectively. Firstly, regarding the asymmetric/leverage term, α_1, which measures the asymmetric impact of past innovations on current volatility, the mean of the coefficient for all the exchange rate models were negative. Regarding the actual (unexpected) TWI, the mean coefficient is -0.0535 (-0.0600), for the US$/£, this is -0.0417 (-0.0446) while for the mean of the JP¥/£, this is found to be -0.0658 (-0.0765) respectively. In addition, for the actual (unexpected) TWI in Table A8.5, 46% (47%) of the asymmetric coefficients were significant, and 19% of these were positive in both models. Equally, regarding the actual (unexpected) US$/£ in Table A8.6, 46% (45%) of the asymmetric coefficients were significant, and 17% (19%) of these coefficients were positive, whereas for the actual (unexpected) JP¥/£ in Table A8.7, 48% (46%) of the asymmetric coefficients were significant, with 20% (18%) reported as positive.

Overall, in all the exchange rate models, almost half of the firms had significant asymmetric coefficients. Then for about 80% of these firms, the significant coefficient was negative indicating leverage effects. This implies that unexpected bad news increases the predictable volatility of these firms returns more than unexpected good news. Consequently, contrary movements in the exchange rate and interest rate measures may cause these firms' returns to be more volatile. On the other hand, for the firms with significant positive coefficients, this indicates that good news has a higher impact on the volatility of their returns than that of bad news. Then regarding firms with statistically insignificant coefficients, the effects of positive or negative surprises, on the volatility of the firms' return, are of the same magnitude. As a result, negative movements in exchange rates or interest rates will not make the returns of these firms more risky. Furthermore, the results of the ARCH term signified by α_2 and the GARCH term indicated by φ_1 are also shown in Tables A8.5, A8.6 and A8.7 which present the results for the TWI, US$/£ and JP¥/£ models, respectively. Regarding the ARCH term, the mean the actual (unexpected) TWI is 1.4785 (1.5275), for the US$/£, this is 1.4469 (1.6192) whereas the mean for the JP¥/£ is 1.3010 (1.4700). In addition, for the actual (unexpected) TWI, 69% (68%) of the ARCH coefficients were significant, and 97% of these coefficients were positive in both models. Similarly, for the actual (unexpected) US$/£, 69% (70%) of the ARCH coefficients were significant, and 98% of these exhibited positive coefficients in both models. Then for the actual and unexpected JP¥/£, 70% of the ARCH coefficients were significant in both cases, while 98% of the coefficients were positive for both the actual and unexpected changes.

Generally, up to 70% of the firms in the sample had significant ARCH coefficients, of which about 98% was positive. The incidence of predominantly significant positive coefficient provides very strong evidence of the presence of volatility clustering (tendency of shocks to persist). This result also infers that conditional volatility has a propensity to rise (fall) when the absolute value of the standardised error is larger (smaller). Also, regarding the results for the GARCH term (φ_1), the actual (unexpected) mean coefficient for the TWI is 0.8168 (0.8306). For the US$/£, this was 0.8289 (0.8296) while the mean for the JP¥/£ was 0.8295 (0.8332). Furthermore, for the actual (unexpected) TWI, 93% (94%) of the firms exhibited significant GARCH coefficients and 99% (100%) of these were positive. The results for the actual (unexpected) US$/£ showed that 94% of the GARCH coefficients were significant for the actual as well as the unexpected changes, and 99% (100%) of these exhibited positive coefficients. Then for the actual (unexpected) JP¥/£ 95% (94%) of the GARCH coefficients were significant, and 99% (100%) of these were positive. Generally, the mean of the GARCH coefficient, is very high, comparable for all the models, although highest for the US$/£ model and lowest for the TWI index. Overall, the results reported here for the lagged changes in the exchange rate and interest rate measure are very similar to that for the contemporaneous changes as there was also a high frequency of significant GARCH coefficients, which were also almost all positive.

Additionally, the finding here further substantiates our previous assertion that volatility has a long memory and when volatility increases, it may probably remain high over several periods. Another similar find was that a lot of firms had significant α_2 and φ_1 coefficient. Again this confirms that the current volatility of most UK firm's returns is time varying, is a function of past innovations and past volatility. Then since for firms with significant ARCH and GARCH parameter coefficients, the magnitude of significant GARCH coefficients or persistence parameter was mainly higher than that of the significant ARCH parameter coefficients in all the models (TWI, US$/£ and JP¥/£), we surmise that that the UK market has a memory longer than one period, volatility of firm's returns is more sensitive to old news (its own lagged value) than it is to news about volatility from the previous period (recent surprises in the market). Consequently, persistence of volatility is very high for UK firm's returns and similar for models estimated with actual or unexpected changes in the contemporaneous or lagged exchange rate and interest rate measures.

For the sub-period analysis, we introduce lagged changes in the ECU/£ for the period before the euro and lagged changes in the Euro/£ for the period after the euro. In Table 5.17, the results from the mean equation, for the ECU/£ and Euro/£ are presented. The mean of the risk premium coefficients is 0.0535 (-0.0309) for the actual (unexpected) ECU/£, while for the Euro/£, this is 0.0397 (-0.0413).

Additionally, regarding the actual (unexpected) ECU/£, 28% (26%) of the firms exhibited significant coefficients for the risk return parameter and 60% (63%) of these were positive. The result for the actual (unexpected) Euro/£ showed that 22% (19%) of the firms had significant coefficients and 64% (67%) of these were positive. Generally, there were few firms with significant risk-return coefficients. Nevertheless, for the minority of firms with significant risk return coefficients, these were mainly positive. Also, there are more firms with significant risk return parameter coefficients and significant positive risk return coefficients in the period before the euro than there were after the euro.

Table 5.15 A summary of non-financial firms' exposure to lagged actual and unexpected changes in the foreign exchange rates of the total sample period from January 1990 to December 2006 - Estimated coefficients from the mean equation

	A.BOEGBPR		U.BOEGBPR		A.US$/£		U.US$/£		A.JP¥/£		U.JP¥/£	
Statistics	λ	TWI	λ	UNEXP.	λ	TWI	λ	UNEXP.	λ	TWI	λ	UNEXP.
Mean	-0.0044	-0.0290	0.0014	-0.0004	-0.0050	-0.0219	-0.0012	-0.0131	-0.0218	-0.0106	-0.0071	-0.0001
Minimum	-2.1183	-0.5841	-0.6282	-0.0059	-1.2977	-0.3266	-0.5752	-0.1875	-6.9827	-0.3743	-1.1998	-0.0017
Median	0.0000	-0.0056	0.0000	-0.0001	0.0000	-0.0027	0.0000	-0.0022	0.0000	-0.0008	0.0000	0.0000
Maximum	1.4943	0.3395	2.7679	0.0034	0.3533	0.2277	1.8490	0.1214	0.2948	0.1958	0.3132	0.0010
Standard deviation	0.1390	0.1076	0.1542	0.0012	0.0815	0.0695	0.1136	0.0417	0.3562	0.0555	0.0842	0.0003
Firms with significant exposure	26%	8%	25%	9%	27%	9%	24%	10%	27%	8%	24%	8%
Positive exposure coefficients	50%	24%	55%	29%	51%	25%	57%	24%	50%	30%	54%	35%
Significant coefficients at 1%	53%	15%	45%	21%	45%	17%	51%	15%	50%	30%	45%	16%
Significant coefficients at 5%	28%	55%	32%	39%	31%	47%	25%	34%	24%	18%	28%	35%
Significant coefficients at 10%	19%	30%	23%	39%	24%	36%	24%	51%	26%	52%	27%	48%

Notes: The table reports the statistics of the estimated exchange rate exposure coefficients of 402 non-financial UK firms. A. denotes the actual changes while U. represents the unexpected changes. BOEGBPR is the Trade weighted nominal exchange rate index, US$/£ is the US$ exchange rate and JP¥/£ is the JP¥ exchange rate. λ is the risk-return trade-off parameter coefficient. Firms with significant exposure signify the percentage of firms with significant exposure coefficients in the total sample whereas positive exposure coefficients are the percentage of significant positive coefficients out of the significant coefficients. Additionally, significant coefficients at the 1%, 5% and 10% represents the percentage of firms with significant coefficients, out of all the total significant coefficients, at the 1%, 5% and 10% level respectively.

Table 5.16 A summary of non-financial firms' exposure to lagged actual and unexpected changes in the interest rates of the total sample period from January 1990 to December 2006 - Estimated coefficients from the mean equation

	UKTBTND		UKMBRYD	
STATISTICS	ACTUAL	UNEXP.	ACTUAL	UNEXP.
Mean	0.0007	0.0069	-0.0124	-0.0026
Minimum	-0.2073	-0.1946	-0.2289	-0.0433
Median	0.0000	0.0003	-0.0016	-0.0004
Maximum	0.1838	0.1754	0.1644	0.0234
Standard deviation	0.0507	0.0540	0.0465	0.0068
Firms with significant exposure	8%	9%	12%	12%
Positive exposure coefficients	53%	60%	21%	17%
Significant coefficients at 1%	21%	17%	23%	30%
Significant coefficients at 5%	32%	31%	32%	34%
Significant coefficients at 10%	47%	51%	45%	36%

Note: Actual and Unexp. are the actual and unexpected changes in the interest rate. UKTBTND represents the exposure coefficient for the 3 Month TB while UKMBRYD stands for the exposure coefficient to the 10 Year GB. Firms with significant exposure signifies the percentage of firms with significant exposure coefficients in the total sample, while positive exposure coefficients are the percentage of significant positive coefficients out of the significant coefficients. Additionally, significant coefficients at the 1%, 5% and 10% signifies the percentage of firms with significant coefficients, out of all the total significant coefficients, at the 1%, 5% and 10% level respectively.

Furthermore regarding the mean of the exchange rate exposure coefficients, for actual (unexpected) ECU/£, this was -0.0022 (-0.0119) and for the actual (unexpected) Euro/£, this is -0.0840 (-0.0678). In addition, for the actual (unexpected) ECU/£, 8% (7%) of firms had significant exchange rate exposure coefficients, of which 37% (47%) were positive. For the actual (unexpected) Euro/£, 12% (16%) of the firms had significant coefficients and 20% of these were positive in both models. Generally, there were more significant negative coefficients than positive for both the ECU/£ and the Euro/£. More so, the number of significant coefficients found here are lower than that for the OLS (Table A13.13), where regarding the actual (unexpected) ECU/£, 11% (10%) significant exposure coefficients were found. Then for the actual (unexpected) Euro/£, 15% (20%) significant exposure coefficients were found.

Table 5.17 A summary of non-financial firms' exposure to actual and unexpected changes in the foreign exchange rate ECU/£ and Euro/£ - Parameter estimates from the mean equation

	A.ECU/£		U.ECU/£		A.EURO/£		U.EURO/£	
STATISTICS	λ	ECU/£	λ	ECU/£	λ	EURO/£	λ	EURO/£
Mean	0.0535	-0.0022	-0.0309	-0.0119	0.0397	-0.0840	-0.0413	-0.0678
Minimum	-43.2756	-0.6315	-16.3666	-0.6006	-2.9718	-0.7315	-45.3219	-0.5761
Median	0.0000	0.0000	0.0000	-0.0001	0.0004	-0.0739	0.0005	-0.0500
Maximum	50.9329	0.7937	11.5118	0.6432	15.1301	0.6105	19.1205	0.3692
Standard deviation	3.4696	0.1468	1.1416	0.1149	0.8777	0.1877	2.5388	0.1303
Firms with significant exposure	28%	8%	26%	7%	22%	12%	19%	16%
Positive exposure coefficients	60%	47%	63%	37%	64%	20%	67%	20%
Significant coefficients at 1%	53%	24%	51%	40%	28%	18%	25%	20%
Significant coefficients at 5%	19%	32%	27%	27%	43%	31%	49%	27%
Significant coefficients at 10%	28%	44%	22%	33%	28%	51%	25%	53%

Note: λ signifies the risk-return trade-off parameter coefficient. ECU/£ represents the exchange rate exposure coefficients of the ECU while Euro/£ represents the exchange rate exposure for the Euro. A. and U. represent the actual and unexpected changes respectively. Firms with significant exposure signify the percentage of firms with significant exposure coefficients in the total sample whereas positive exposure coefficients are the percentage of significant positive coefficients out of the significant coefficients. Furthermore, significant coefficients are at the 1%, 5% and 10% level.

Nevertheless, more firms exhibited significant exchange rate exposure coefficients for the contemporaneous ECU/£ than lagged but the incidence of significant Euro/£ exchange rate exposure coefficients was lower for the contemporaneous. It is also observed that there were more firms with significant coefficients for the Euro/£, than there were for ECU/£.

In Table A8.8 of Appendix 8, the estimated parameter coefficients from the variance equations and their descriptive statistics are shown. Regarding the asymmetric term, α_1, the mean coefficient is 0.0313 (-0.2232) for the actual (unexpected) ECU/£, while for the actual (unexpected) Euro/£, this is -0.0959 (-0.0853). Furthermore, for the actual (unexpected) ECU/£, 31% (29%) of the firms had significant asymmetric coefficients, and 21% (19%) of these were positive. The results for the actual (unexpected) Euro/£ showed that 29% (27%) of the firms had significant asymmetric coefficients and 17% (12%) were positive. Apparently, there were significantly more negative coefficients than positive coefficients in the ECU/£ and Euro/£ models. Furthermore, for the ARCH term, the mean of the coefficients is 2.5558 (3.4543) for the actual (unexpected) ECU/£, while that of the actual (unexpected) Euro is 1.7184 (1.5251). It was found that 41% (42%) of the firms had significant ARCH parameter coefficients for the actual (unexpected) ECU/£. But this is lower than the 50% of firms reported for the actual and unexpected Euro. Then 95% (96%) of the significant actual (unexpected) ECU/£ coefficients were positive, whereas for the actual (unexpected) Euro/£, 90% (92%) of the significant coefficients were positive. The finding of a very high proportion of significant positive coefficient indicates the presence of volatility clustering.

Additionally, concerning the results for the GARCH term (φ_1), the mean of the GARCH coefficient in the actual (unexpected) ECU/£ model is 0.5669 (0.5586) whereas for the actual (unexpected) Euro/£, this is 0.4996 (0.5162). We observe that these persistence values are relatively low in comparison to those reported for the total period. It was also found that 78% of the firms have significant GARCH coefficients for the actual and unexpected ECU/£, and 95% (94%) of these were positive for actual (unexpected) ECU/£. The results for actual (unexpected) Euro/£ showed that, 71% (72%) of the firms had significant persistence of volatility in returns, and 91% (92%) of these were positive. But it was observed that persistence of volatility in returns was higher in the period before the Euro (ECU/£) than the period after the Euro (Euro/£). Incidentally, these results are similar to that reported for the contemporaneous changes where we also found that the persistence of volatility was lower after the introduction of the euro than before the euro. However, it was observed that this reduction in volatility was marginal, and can be likened to the almost inconsequential reduction in exchange rate exposure when the Euro/£ replaced the ECU/£.

5.5 Summary of diagnostics on model residuals

Generally, the Ljung-Box statistics for the standardised residuals (Q) and the squared standardised residuals (Q^2) are used to test for autocorrelation and heteroskedasticity, respectively, at the 7^{th} and 21^{st} lag. The Q statistic is not significant at the 10% level for an average of 309 (77%) firms indicating that the regression residuals are devoid of autocorrelation. Additionally, for the Q^2, 312 firms (78%) had insignificant coefficients, indicating that there are no ARCH effects in the residuals. We further verify the absence of residual heteroskedasticity by performing the ARCH test, which is a Lagrange multiplier (LM) test for ARCH in the residuals..

The results are similar to that reported for the squared standardised residuals as we find that 297 firms (74%) of the firms had insignificant coefficients. These diagnostics are a vast improvement in comparison to the diagnostic results from the OLS, where it was found that the regression residuals of only 121 firms (30%) did not exhibit residual autocorrelation, while for residual ARCH, only 105 firms (26%) had insignificant coefficients, indicating the absence of heteroscedasticity in their residuals. However, the fit of the t-distribution is inadequate in all the estimated models, since the p-value is significant at the 1% level. More so, the Jarque-Bera statistic is also significant at the 1% level for all estimated models, so the errors are non-normally distributed.

Although the GARCH model reduced the number of firms with residual autocorrelation and heteroscedasticity, the OLS model generally generated results that were a little bit stronger since fairly more significant exchange rate and interest rate exposure coefficients were detected by the OLS model. However this was not the case for the portfolio analysis as the GARCH models produced stronger results and better residual diagnostics than the OLS model. Taking into account these shortcomings, the results from the EGARCH-M model is still preferred to that of the OLS model, since it also detects the volatility inherent with stock returns and this makes the GARCH model estimates even more instructive.

5.6 Summary of findings

The sensitivity of UK firms' stock returns to changes in various measures of exchange rates and interest rates has been examined, using the AR(1)-E-GARCH-M model. Generally, the empirical result does provide evidence of exposure to exchange rates and interest rates, but this was limited to a few firms. The weak evidence of exposure to exchange rate and interest rate risk might possibly be a sign that more UK firms employ risk management strategies to counteract the undesirable effect that movements in exchange rates and interest rates may have on the firms' returns.

The findings show that in the total sample period, regarding the contemporaneous changes in the 3 exchange rate measures, the effect of the TWI is more pronounced than that of the JP¥/£ and US$/£. More so, positive effects of exchange rate changes seemed to be more prominent for all the firms. This result was also the same for the long-term interest rate as most of the exposure coefficients were positive. On the other hand, the exposure coefficients for the short-term interest rate were mainly negative. Besides, we find support for the assertions of Allayannis (1997) and Bartram (2004) on exposure to exchange rates, and (Bartram, 2002) on exposure to interest rates, that firms within the same industry, sometimes exhibited exposure coefficients that differed in terms of magnitude and direction. Nevertheless, it was found that more firms were significantly exposed to the long-term interest rate than both the short-term interest rate and even all the exchange rate measures. This result is different from that of Wetmore and Brick (1994), Choi and Elyasiani (1997) and Joseph and

Vezos (2006) who all found exposure to exchange rate to be stronger than that of interest rate exposure for US banks. More so, the number of firms exposed to the short-term interest rate was less than those significantly exposed to all the exchange rate measures, which contradicts the findings of Joseph (2002), where exposure to the short-term interest rate was stronger than the exposure to exchange rate, for a selected sample of UK non-financial firms.

Moreover, the result from the variance equation of the EGARCH-M framework used in this study suggests that for a majority of UK firms, volatility is not an important factor for asset pricing. More so, there is no trade off between volatility and return as increased volatility will not usually increase average returns. Therefore, investors are not generally rewarded for risks they take by holding the stock. We also found that the asymmetric coefficient was significant for almost half of the firms examined. In addition, the coefficient was predominantly negative (80% of the firms), implying that negative innovations seemed to affect volatility of returns more than positive innovations (leverage effects). Furthermore, we found overwhelming support of the presence of volatility clustering (ARCH effects) and persistence of volatility (GARCH effects). This suggest that volatility of returns, has a long memory and once volatility increases, it may probably remain high over several periods. It was also observed that majority of the firms had significant ARCH and GARCH parameter coefficients, and in almost all instances, the coefficient of the GARCH parameter had been larger than that of the ARCH parameter. This further entails that the current volatility of firm's returns (conditional variance) is time varying, is a function of past innovations and past volatility. Also, the market has a memory longer than one period and the volatility of firm's returns is more sensitive to old news (its own lagged value) than it is to news about volatility from the previous period (recent surprises in the market). This finding corroborates the GARCH results from the industry level analysis.

Additionally in the sub-period, denoted by the ECU/£ for the period before the euro and Euro/£ for the period after the euro, there was also little evidence of exposure to exchange rate risk. However, the exposure coefficients for the ECU/£ were mostly positive whereas those for the Euro/£ were mainly negative. Additionally, more firms had significant risk return parameter coefficients and more firms with significant positive risk return coefficients in the period before the euro than there were in the period after the euro. The finding for the asymmetric parameter was also similar as the results indicated that more firms showed evidence of leverage effects in the period before the euro than after the euro. But then, the effects of volatility clustering and persistence of volatility were less pronounced in the 2 sub-periods than the total period. Nevertheless, GARCH effects were more prominent for the ECU/£ while for the Euro/£, ARCH effects was more dominant for the firms.

The effect of the introduction of the euro on exposure to the contemporaneous changes in the trade weighted index, US$/£, JP¥/£, short-term interest rate and long-term interest rate was also investigated. Regarding the exposure exchange rate, it was generally observed that the incidence of significant coefficients was generally low in the period before the euro and even much lower after the introduction of the euro. Moreover, in the period before the euro, most of the exchange rate exposure coefficients were positive, and more firms had significant exposure coefficients for the JP¥/£, followed by the TWI and then US$/£. Then in the period after the euro, opposite signed coefficients to the one before the introduction of the euro are more prevalent. Intuitively, the finding of contrary sign of exposure in the period before and the period after the euro suggests a reduction in the absolute exchange rate exposure. Overall, absolute reduction in exchange rate exposure after the euro was highest for firms with before the euro positive exchange rate coefficients to the JP¥/£, followed by firms with positive exchange rate coefficients for the TWI and then firms with negative coefficients for the US$/£, while the lowest reduction in net exposure was for firms with negative exchange rate exposure coefficients for the JP¥/£.

In addition, regarding exposure to contemporaneous changes in the interest rate, it was found that in the period before the euro, negative short-term interest rate exposure coefficients were more predominant whereas for the long-term interest rate, there were more positive exposure coefficients. However in the period after the euro, it was observed that firms with negative short-term exposure coefficients and firms with negative long-term interest rate exposure coefficients, had more significant opposite signed interest rate exposure coefficients after the euro. Consequently, absolute reduction in interest rate exposure after the euro was more evident for firms with negative signed interest rate exposure coefficient than positive signed interest rate exposure before the euro. A possible explanation for the reduction in the short-term interest rate exposure after the euro is that the UK short-term interest rate, which the seems to move in the same direction as the Euro area 3 month Euribor has experienced large decreases since 1999. Moreover, corresponding decreases in the short-term interest rate vis-à-vis the 3 month

Euribor may be a deliberate action by the Bank of England's Monetary Policy Committee (MPC) to make UK firms as competitive as their euro area counterparts.

Furthermore, the impact of the introduction of the euro on the volatility of UK firms' stock returns is also examined. In all cases, the finding of a significant positive (negative) coefficient for the test parameter indicates that the riskiness of firms' returns increased (declined) in the period after the introduction of the euro. Generally, the JP¥/£ model had the highest number of firms with significant coefficients, followed by the TWI and then the USS/£ models. However in all these models, the occurrence of significant positive coefficients was higher than that of significant negative coefficients. But it was also observed that even for some firms with reduction in their absolute exchange rate exposure after the euro, the volatility of their returns still increased after the introduction of the Euro. We follow on from Morana and Beltratti (2002) and also posit that increase in volatility of returns after the euro could also have been exacerbated by the update in stock valuation of European markets after the introduction of the Euro.

The mispricing hypothesis is tested by using lagged changes in the exchange rate and interest rate factor. The result for the exposure to the lagged exchange rates in the total period showed that the majority of the significant coefficients were negative for all the exchange rate measures, which is contrary to the earlier results from the contemporaneous changes in the exchange rates. Similarly, contradictory results were also found for the exposure to interest rates as there were more significant positive coefficients for the lagged short-term interest rate exposure whereas for the lagged long-term interest rate exposure, significant negative coefficients were predominant. Then in the sub-period, there were generally more significant negative coefficients than positive for both the ECU/£ and the Euro/£. Although this was the same result for the contemporaneous Euro/£, it contrasts that of the contemporaneous ECU/£. Moreover for contemporaneous changes, there were more firms with significant coefficients for the ECU/£ than there were for the Euro/£, whereas for the lagged changes, there were more firms with significant coefficients for the Euro/£ than for the ECU/£. Nevertheless, in the total period and sub-periods, the results pertaining to risk-return, leverage effects, ARCH and GARCH effects from the lagged models were similar to that reported for the contemporaneous models.

Overall, the exchange rate and interest rate exposure ascertained from the OLS model were slightly stronger than that found here for the GARCH model. Although the GARCH model substantially reduced residual autocorrelation and heteroscedasticity, it was unable to capture all the non-linearity in the series since the errors from the residual still showed evidence of non-normality. Despite this, we still prefer to rely on the GARCH results as it is more informative than the results from the OLS model.

CHAPTER 6 THE DETERMINANTS OF FOREIGN EXCHANGE RATE AND INTEREST RATE EXPOSURE OF UK NON-FINANCIAL FIRMS

6.1 Introduction

Risk management strategies have often been used by finance directors, corporate treasurers and portfolio managers to reduce the firm's risk exposure. The aim of covering exposure is to minimise the volatility of the firm's profits or cash flows and invariably reduce the volatility of the firm's value. If the firm is at risk because of changes in the exchange rates or interest rates, then hedging will act as a buffer preventing the firm from the unexpected loss of cash flow (Buckley, 2000). According to optimal hedging theories, the degree to which a firm is exposed to risks, such as exchange rate risks, interests rate risks and even risk accruing from fluctuating commodity prices, affects the level of financial hedging instruments it adopts (i.e. the greater the exposure, the higher the use of hedging instruments). More so, optimal hedging theories also postulate that firms which hedge their exposure should be less exposed to contrary movements in exchange rates and interest rates than non-hedging firms. In essence, if firms have effectively hedged their exposure, this may partially explain the weak empirical evidence regarding exposure to exchange rates and interest rates for firms in this study.

However, data on hedging activities is usually incomplete and difficult to obtain since firms do not disclose in great detail their use of derivative instruments. This unavailability of comprehensive hedging data poses a limitation on how the foreign exchange and interest rate risk hedging behaviour at the firm level can be investigated. For instance, Allayannis and Ofek (2001) proposed that firms are able to hedge currency risks in numerous ways. They can lend internationally thereby building a positive correlation between exchange rate and cash flows shocks or operationally by engaging in foreign direct investment in export markets and so generating production costs and revenue in the same currency. Whereas data on foreign currency forwards and option contracts are readily available, adequate data on foreign currency borrowing/lending and foreign direct investment are difficult to acquire at the firm level. Subsequently, previous studies on exchange rates (Howton and Perfect, 1998; Hagelin, 2003; Nguyen and Faff, 2003; Shu and Chen, 2003; Bartram, 2004; Hagelin and Pramborg, 2004; Chiang and Lin, 2005; Davies *et al.* 2006; El-Masry, 2005b; Judge, 2006b; Kim *et al.* 2006; Muller and Verschoor, 2007; Nguyen *et al.* 2007; Clark and Judge, 2008; Faseruk and Mishra, 2008; Al-Shboul and Alison, 2009) and interest rates (Hakkarainen *et al.* 1997; Adedeji and Baker, 2002; Bartram, 2002; Graham and Rogers, 2002; and Faulkender, 2005) have overcome this limitation by the use of firm specific characteristics as proxies in the determination of the firm's motive to hedge and to also investigate the connection between the firms' hedging activities and the estimated exchange rate and interest rate exposures.

Furthermore, survey studies on the UK, focusing on the use of derivatives in risk management, have found that exposure to exchange rate and interest rate risk is more important for UK firms, and therefore more managed with derivative instruments, than the risk arising from other sources such as fluctuations in commodity prices and equity prices. For instance, Mallin *et al.* (2001), Bailly *et* *al.* (2003) and El-Masry (2006b) find that for firms using derivatives, foreign exchange rate risk is the most commonly managed by UK firms, followed by interest rate risk. On the other hand, Grant and Marshall (1997) find that the use of derivatives for risk management is higher for interest rate risk, followed by exchange rate risk. Therefore, if exchange risk and interest rate risk are so important for UK firms, then the question arises: are the determinants of exchange rate exposure and firms' motives for hedging exchange rate exposure the same as the determinants of interest rate exposure and the motives for hedging interest rate exposure? This question was initially put forward by Adedeji and Baker (2002), who compare their results on factors that motivate UK firms' use of interest rate derivatives with the results of Geczy *et al.* (1997), who investigate factors that motivate US firms' use of currency derivatives. Although, the evidence from Adedeji and Baker (2002) suggests that there is a difference between the factors that prompt UK firms to manage their exchange rate exposure and factors that prompt firms to manage their interest rate exposure, however, the basis of comparison is subject to scrutiny. First and most obvious, Geczy *et al.* (1997) examines US firms, which operate under economic conditions that are probably different from that of the UK. Moreover, the open economy hypothesis dictates that firms in least open economies are less susceptible to financial risk in comparison to firms in open companies. For instance, Bodnar and Gentry (1993) test the concept that small and open economies were more sensitive to changes in exchange rates than firms in large and less open economies. Their results reveal that the exposure variance is less significant for the US than for Canada and Japan. This finding is also supported in Nyadhl (1999) who find that a substantial number of Swedish firms in his study display significant exposure to exchange rates when compared to results using data from the US and Japan. Furthermore, Bodnar and Gebhardt (1999) found that the proportion of German companies using derivatives is significantly more than that of US companies. Jong *et al.* (2006) also finds that the number of Dutch firms with significant exposure coefficients is considerably much higher than those obtained from US studies. Other studies which support the open economy hypothesis includes He and Ng (1998) and Friberg and Nydahl (1999). It therefore suffices to say that if firms in small open economies, such as Canada, Germany, Sweden, Netherlands and even the UK, are more exposed to exchange risk or financial risk in general than those firms in the US, which is considered as one of the least open economies in the world, then their use of and motives for the use of risk management instruments might also probably not be comparable. Other studies that have attempted to compare the motives for exchange rate hedging to that of interest rate hedging include Mian (1996) and Howton and Perfect (1996). However these studies have focused on the US.

Additionally, the determinants of exchange rate and interest rate exposure are only examined at the firm level, since for some of the industries in this study the numbers of firms are too few to make a generalised conclusion. Subsequently, Section 6.2 provides a description of the explanatory variables employed as proxies in the models as well as the theoretical rationale for their use. Section 6.3 presents the descriptive statistics of the explanatory variables. Section 6.4 provides the results for the determinants of exchange rate and interest exposure of UK non-financial firms while Section 6.5 reports the results when the factors that determine exchange rate exposure are compared with the factors that influence exposure to interest rates. Then in Section 6.6, we examine the determinants of exchange rate exposure and interest rate exposure in the period before and after the Euro, while Section 6.7 concludes the chapter with a summary of the findings.

6.2 Description and relevance of the explanatory variables

A description of all the explanatory variables used in this section and their theoretical relevance in determining the extent to which the firm is exposed to exchange rate and interest rate exposure is discussed here.

Size: Nance *et al.* (1993) indicate that size may be positively or negatively related to the firm's hedging activity. For larger firms, economies of scale are usually the case, especially if the benefits are higher than the costs, therefore a positive relationship will be expected. This is supported by Muller and Verschoor (2007) who also point out that exposure management, either for exchange rate or even interest rate risk, can be expensive. Consequently, larger firms with economies of scale in hedging costs are more likely to hedge than smaller firms. However, if the expected cost of financial distress is higher for smaller firms or if smaller firms face higher bankruptcy costs, then hedging activity will be negatively related to size. Furthermore, regarding interest rates, Faulkender (2005) insinuates that larger firms are more likely to have fixed rate debt, whereas smaller firms usually borrow at floating rates, which are usually associated with interest rate exposure. If that is the case, smaller firms are likely to be more exposed to movements in interest rates than larger firms, and therefore may have a higher propensity to hedge away the undesirable effects of the exposure with derivatives. Following on from other similar studies such as Geczy *et al.* (1997), Shu and Chen (2003), El-Masry (2005b), Pramborg (2005), Chiang and Lin (2006), Jong *et al.* (2006), Judge (2006b), Kim *et al.* (2006), Judge (2008) and Al-Shboul and Alison (2009), size (LOGASS) is measured using the natural log of the total assets.

Cost of external finance: Judge (2008) explains that firms with high levels of liquidity will most likely not require access to costly external funds to finance their investment projects. Froot *et al.* (1993) point out that the level of cash available for investments is negatively related to the need for external financing, and consequently derivative use, implying that firms with higher liquidity have greater flexibility in meeting their cash flow needs and may usually hedge less with derivatives. This notion is also supported by Berkman and Bradbury (1996), Hakkarainen *et al.* (1997) and Bartram (2002), who claim that firms with more liquid assets usually have a financial buffer, which absorbs the shocks from unfavourable movements in exchange rates or interest rate, thereby minimising the need of the firm's use of risk management strategies. Howton and Perfect (1998), Haushalter (2000), Muller and Verschoor (2006b) use the quick ratio (QUICK), defined as current assets less inventory divided by current liabilities, as a proxy for liquidity. Bartram (2002 and 2004) also utilise the ratio of the firm's cash flows to total assets (CFTA), where the cash flow is measured as the operating income less interest expense, less cash dividends and less net taxes and then scaled by total assets. Another influencing factor in the firms' use of derivatives under this category is dividend policy. Dividend payout (PAYOUT) is measured as the ratio of dividends per share to earnings per share. Subsequently, a firm with a lower dividend payout is more likely to have funds available to pay fixed claimholders, and therefore better able to reduce agency conflict (conflict between shareholders and bondholders). Furthermore, Berkman and Bradbury (1996), He and Ng (1998), El-Masry (2005), and Muller and Verschoor (2007) explain that firms with low dividend payout are less motivated to hedge and are therefore more exposed to exchange rate risk. On the contrary, Adedeji and Baker (2002) found that dividend payout did not have any significant influence on the management of interest rate risk. In this study, CFTA, PAYOUT and QUICK are used to understudy the impact of the cost of external finance on the firm's exposure to exchange rate and interest rate risk.

Expected cost of financial distress: Smith and Stulz (1985) and Berkman and Bradbury (1996) suggest that hedging can reduce the expected cost of financial distress, by reducing the variation in the firm's value, and thereby the likelihood of encountering financial distress. Faulkender (2005) also indicates that firms with less debt should be less concerned about the volatility of their interest payments. Clark and Judge (2008) point out that firms with greater variability in their cash flows are most likely to encounter financial distress. Furthermore, Judge (2006b) indicates that firms with lower interest cover ratio have a greater probability of experiencing financial distress. This notion is supported by Schiozer and Saito (2009) who posit that firms with high interest cover are less financially distressed and therefore their incentive to hedge will be lower. The commonest proxy for financial distress used in most studies [Geczy *et al.* (1997), Bartram (2002), Shu and Chen (2003), Muller and Verschoor (2006b)] is leverage. However, Clark and Judge (2008) argue that leverage as a proxy for financial distress may be misleading and thus not indicative of the company's financial distress. They explain that if firms with access to foreign debt markets use foreign currency debt and derivatives interchangeably, then there is the likelihood that the firms with higher leverage are more likely to utilise foreign debt than firms with lower leverage ratio since the firms with higher leverage arguably have more debt which is denominated in foreign currency. Therefore, a significant positive coefficient for leverage could merely be because firms in the sample have higher leverage resulting from the use of foreign debt and not financial distress. They further explain that it is not the level of debt that matters, but the ability to service the debt. Nevertheless, we posit that since most of the firms in this study have positive exchange rate exposure coefficients (importers), and as a result the inclination to borrow in foreign currency may not be appealing. Therefore, the use of leverage here is justifiable. In addition, Bartram (2002) suggests that leverage, which originates from the liability side, is usually distinguished as the most important measurable determinant of interest rate exposure just as the percentage of foreign sales is important for exchange rate exposure. Subsequently, we follow on from Geczy *et al.* (1997), Hakkarainen *et al.* (1997), Haushalter (2000), Allayannis and Weston (2001), Adedeji and Baker (2002), Berkman *et al.* (2002), Allayannis *et al.* (2003), Shu and Chen (2003), Guay and Kothari, (2004), Faulkender (2005), Davies *et al.* (2006), Judge (2006b), Muller and Verschoor (2006), Clark and Judge (2008), Al-Shboul and Alison (2009) and Schiozer and Saito (2009) and use interest cover (ICBT), defined as the ratio of interest to profit before interest and tax, and leverage (TOTDEBT) which measures the ratio of long-term debt to total equity and reserves.

The ratio of tangible assets to total assets (TANG) is also used by Howton and Perfect (1998) as a proxy for the direct cost of financial distress. They posit that when a firm is compelled to liquidate its assets, tangible assets are easier to dispose at near book value than intangible assets, which are usually only valuable if the firm continues as a going concern. Consequently, they hypothesise a negative relationship between tangible assets and use of derivative. This might imply that for firms with low TANG ratios, the direct cost of financial distress and incentive to use hedging instruments will be higher. The ratio of tangible assets to total assets is also employed in this study to assess the impact of direct cost of financial distress. In line with hedging theory, TANG is expected to have a positive relationship with the exchange rate and interest rate exposure of UK firms.

Growth Opportunities: Gay and Nam (1998) explain that internally generated cash flow, which is essential for the investment process, can be disrupted by external factors such as changes in exchange rates, interest rates and even commodity prices. They use the market to book value because it measures the possibility that the firms will have positive-NPV projects or growth opportunities. They explain that the market value embodies both the values of the firm's assets in place and future growth opportunities whereas the book value captures the value of assets in place.

Froot *et al.* (1993) explain that hedging ensures that firms have sufficient internal funds to undertake investment opportunities and also avoid costly external financing, thereby increasing the firms' value. Allayannis and Ofek (2001) indicate that firms with more growth opportunities could face higher underinvestment cost and may be more motivated to hedge. Similar to Geczy *et al.* (1997), Graham and Rogers (2002), Guay and Kothari (2003), Hagelin (2003), Faulkender (2005), Chiang and Lin (2005), Pramborg (2005), Davies et al (2006), Nguyen *et al.* (2007), Clark and Judge (2008), we use the market value to book value (MVBV) which is defined as the ratio of the sum of the market value of equity and book value of debt to total assets and research and development expenditure (RDSA) which is the ratio of research and development expenditure to total sales as proxies for growth opportunity. Incidentally, firms with high growth opportunities should be less exposed to exchange rate or interest rate risk.

Degree of Internationalisation: the degree to which firm's cash flows are influenced by movements in exchange rates may depend on the nature of its activities such as export, import, involvement in foreign activities or ownership of foreign assets (Clark and Judge, 2008). This assumption is also supported by Allayannis and Ofek (2001), Dominguez and Tesar (2001) and Williamson (2001) who also posit that the degree of a firm's foreign exchange exposure is influenced by the firm's level of foreign operations such as foreign assets, foreign sales and any other international activity. Booth and Rotenberg (1990) use foreign assets and foreign debt ratios in addition to foreign sales to determine the sensitivity of Canadian stocks to changes in the US dollar. They find that firms with a higher proportion of foreign debt have more negative foreign exchange exposure while firms with higher foreign sales have more positive exchange rate exposure. Moreover, Jesswein *et al.* (1995) find a significant positive relationship between foreign assets, foreign sales and foreign income and derivative use of 173 Fortune

500 firms. Furthermore, Nydahl (1999) finds that for Swedish firms, the level of exchange rate exposure increased with the fraction of foreign sales. Also using foreign sale to total sales, Jorion (1990), Harris *et al.* (1991), Choi and Prasad (1995) and Miller and Reuer (1998) found that exchange rate exposure for firms varied with the extent of their foreign operations. Additionally, El-Masry (2005) finds that all the variables for foreign operations have a significant negative exposure on the exchange rate indices (apart from JP¥/£), suggesting that firms which have a higher percentage of foreign sales and foreign assets are less exposed to the fluctuations in exchange rates. On the contrary, Adedeji and Baker (2002) found that foreign sales had no significant impact on the use of interest rate derivatives. Albeit, in line with other studies such as Jorion (1990), Donnelly and Sheehy (1996), Moles (2002), Chiang and Lin (2005) Davies *et al.* (2006), Capstaff *et al.* (2007), Nguyen *et al.* (2007), Clark and Judge (2008), Al-Shboul and Alison (2009), we denote firm's involvement in foreign activities by the ratio of foreign assets to total assets (FATA), ratio of foreign income to total income (FITI) and the ratio of foreign sales to total sales (FSTS).

Other motives: Nance *et al.* (1993) suggest that firms can mitigate the probability of financial distress by issuing preference capital rather than debt, since payment of dividend to preference shareholders can be delayed without any risk of bankruptcy, while default on debt interest can lead to insolvency. Geczy *et al.* (1997) point out that preference capital is effectively considered as debt, and therefore constitutes additional leverage. Impliedly, this might have a constraint on the firm's access to external funds. Consequently, they predict a positive relationship between preference capital and hedging. Similar to Judge (2006b) and

Clark and Judge (2008), we also use the ratio of book value of preference capital to total assets (PREFASS) to test the validity of this hypothesis regarding the firm's exchange rate and interest rate exposure.

6.3 Summary of descriptive statistics

In Table A10.1 of Appendix 10, a summary of descriptive statistics for the independent variables used as proxies for the determinants of exchange rate and interest rate exposure, during the period 1990-2006 is presented. Then for the sub-periods, Table A10.2 reports the descriptive for the period before the euro (1990-1998) while Table A10.3 provides the statistics for the period after the euro (1999-2006). The data on size, cost of external finance, expected cost of financial distress, growth opportunities and other motives are from DataStream while the data for degree of internationalisation are from Worldscope.

It is observed that the mean for the variables measuring the degree of internationalisation is highest in the period after the euro than the period before the euro and even during the total sample period. For instance, in the total sample period, presented in Table A10.1, it is found that on average, foreign assets are 12% of total assets, foreign income makes up an average of 22% of total income while average foreign sales is 43% of total sales. However, in the period before the euro, presented in Table A10.2, these percentages were a lot lower as average foreign assets was 7% of total assets, foreign income was on average 16% of total income whereas average foreign sales was 26% of total sales. These percentages rose significantly in the period after the euro as observed in Table A10.3 where it was found that foreign assets averaged 17% of total assets, average foreign income was 31% of total income and foreign sales was on average 61% of total sales. Another interesting observation worth mentioning is the high level of debt, especially noticeable in the total period (Table A10.1) where the average leverage ratio was found to be approximately 52%, and the period before the euro (Table A10.2) where the average leverage ratio was 62%. But in the period after the euro (A10.3), the average leverage ratio reduces dramatically to 39%.

Table A10.4 of Appendix 10 reports the correlation coefficients of the independent variables used in this chapter. Most of the significant coefficients are very low, and should therefore pose no problem of multicollinearity. However, the only concern is the significant and high positive correlation of 0.8930 between MVBV and TOTDEBT. This issue is further discussed in the next section

6.4 The determinants of exchange rate and interest rate exposure of UK non- financial firms

In this section, we investigate the determinants of exchange rate and interest rate exposure of UK firms using a cross-sectional regression analysis. Intuitively, the exchange rate and interest rate exposure coefficients are regressed on specified firm-level attributes. However, taking into consideration the potential problem of multicollinearity which may occur as a result of using the MVBV and TOTDEBT variables together in the same equation, we create two models, model 1 and model 2. In model 1, TOTDEBT is included in the model whereas in Model 2, TOTDEBT is excluded from the model. Furthermore, we formally test for the presence of harmful multicollinearity using the condition index and the Variance Inflation Factor (VIF). In model 1, the condition index and the VIF had values in the range of 1.426 -20.316 and 1.003-5.466 respectively, whereas for model 2, the condition index and the variance inflation factor (VIF) were between 1.741-20.033 and 1.003-1.393 correspondingly. It is observed that the multicollinearity statistics of model 2 is lower than that of model 1. Nevertheless, multicollinearity does not seem to pose a problem in either of the models. Therefore we maintain both models 1 and 2, and present the results from both cross-sectional models accordingly. This will also facilitate a comparison of the performance of both models, especially in the event that the result differs.

Therefore, for the **determinants of exchange rate exposure**, the models are:

$$\beta_{ri} = \delta_0 + \delta_1 CFTA_i + \delta_2 PAYOUT_i + \delta_3 FATA_i + \delta_4 FITI_i + \delta_5 FSTS_i + \delta_6 ICBT_i + \delta_7 LOGASS_i + \delta_8 MVBV_i + \delta_9 PREFASS_i + \delta_{10} QUICK_i + \delta_{11} RDSA_i + \delta_{12} TANG_i + \delta_{13} TOTDEBT_i + \varepsilon_{it}, \quad i=1,.....,N \tag{6.1}$$

$$\beta_{ri} = \delta_0 + \delta_1 CFTA_i + \delta_2 PAYOUT_i + \delta_3 FATA_i + \delta_4 FITI_i + \delta_5 FSTS_i + \delta_6 ICBT_i + \delta_7 LOGASS_i + \delta_8 MVBV_i + \delta_9 PREFASS_i + \delta_{10} QUICK_i + \delta_{11} RDSA_i + \delta_{12} TANG_i + \varepsilon_{it}, \quad i=1,.....,N \tag{6.2}$$

For the **determinants of short-term interest rate exposure**, these are

$$\beta_{si} = \delta_0 + \delta_1 CFTA_i + \delta_2 PAYOUT_i + \delta_3 FATA_i + \delta_4 FITI_i + \delta_5 FSTS_i + \delta_6 ICBT_i + \delta_7 LOGASS_i + \delta_8 MVBV_i + \delta_9 PREFASS_i + \delta_{10} QUICK_i + \delta_{11} RDSA_i + \delta_{12} TANG_i + \delta_{13} TOTDEBT_i + \varepsilon_{it}, \quad i=1,.....,N \tag{6.3}$$

$\beta_{si} = \delta_0 + \delta_1 CFTA_i + \delta_2 PAYOUT_i + \delta_3 FATA_i + \delta_4 FITI_i + \delta_5 FSTS_i + \delta_6 ICBT_i + \delta_7 LOGASS_i + \delta_8 MVBV_i + \delta_9 PREFASS_i + \delta_{10} QUICK_i + \delta_{11} RDSA_i + \delta_{12} TANG_i + \varepsilon_{it}, \quad i=1,.....,N$

6.4

Then regarding the **determinants of exposure to the long-term interest rate,** these will be

$\beta_{li} = \delta_0 + \delta_1 CFTA_i + \delta_2 PAYOUT_i + \delta_3 FATA_i + \delta_4 FITI_i + \delta_5 FSTS_i + \delta_6 ICBT_i + \delta_7 LOGASS_i + \delta_8 MVBV_i + \delta_9 PREFASS_i + \delta_{10} QUICK_i + \delta_{11} RDSA_i + \delta_{12} TANG_i + \delta_{13} TOTDEBT_i + \varepsilon_{it}, \quad i=1,.....,N$

6.5

$\beta_{li} = \delta_0 + \delta_1 CFTA_i + \delta_2 PAYOUT_i + \delta_3 FATA_i + \delta_4 FITI_i + \delta_5 FSTS_i + \delta_6 ICBT_i + \delta_7 LOGASS_i + \delta_8 MVBV_i + \delta_9 PREFASS_i + \delta_{10} QUICK_i + \delta_{11} RDSA_i + \delta_{12} TANG_i + \varepsilon_{it}, \quad i=1,.....,N$

6.6

Where β_{ri} is the exchange rate exposure coefficient of a firm i, β_{si} is the short-term interest rate exposure coefficient of a firm i and β_{li} is the long-term interest rate exposure coefficient of a firm i. Regarding the total period, all the exposure coefficients are initially those estimated using the OLS model of equation 3.8a. This is based on the premise that the OLS performed slightly better in explaining exchange rate and interest rate exposure at the firm level. Nevertheless, the models are re-estimated again by substituting the exposure coefficients with those obtained from equation 5.1a of the GARCH methodology. Furthermore, regarding the exchange rate exposure coefficients for the total period, these have been for the Bank of England trade weighted index (BOEGBPR), the US$ exchange rate to the UK£ (US$/£) and the Japanese Yen exchange rate to the UK£ (JP¥/£). Then for the short-term and long-term interest rate, these had been represented by the 3 month Treasury bill and 10 year Government bond respectively. Furthermore, in the sub-period analysis, the exposure coefficients for the exchange rate ECU/£ and Euro/£ have been derived using equation 3.8a (OLS) and 5.1a (GARCH) as well. Additionally, regarding the coefficients for the short-term interest rate and long-term interest rates, in the period before and after the Euro, these are from equation 3.8a when the OLS exposure coefficients are used as the dependents and from equation 5.1a when the GARCH exposure coefficients are been used instead.

Then in all the models, the explanatory variables are defined as follows: $CFTA_i$ is the ratio of cash flow to total assets, $PAYOUT_i$ is the dividend payout ratio, $FATA_i$ is the ratio of foreign assets to total assets, $FITI_i$ is the ratio of foreign income to total income, $FSTS_i$ is the ratio of foreign sales to total sales, $ICBT_i$ is the interest cover ratio, $LOGASS_i$ is the log of total assets, $MVBV_i$ is the ratio of market value to book value of equity, $PREFASS_i$ is the ratio of preference capital to total assets, $QUICK_i$ is the quick ratio, $RDSA_i$ is the ratio of research and development expenditure to total sales and $TANG_i$ is the ratio of tangible assets to total assets, TOTDEBT measures the ratio of long-term debt to total equity and reserves while ε_{it} is the error term. In all the models, the slope coefficient examines the influence of the explanatory variable, using the firm level data on the firms' exchange rate exposure coefficient and where applicable, the influence on the interest rate exposure coefficient.

Another issue is the choice of exposure coefficient to use as the dependent variable i.e. the absolute value or raw value of the exposure coefficient. Choi and Prasad (1995) and Faff and Marshall (2005) point out that the sign of the coefficient just measures the direction of the risk exposure (i.e. importer or exporter), but what is really essential is the magnitude of the exposure, irrespective of the designated sign of the exposure. El-Masry (2005b) explains that some studies which model exchange rate exposure as a function of firm specific or even industry specific variables use the absolute value of the exchange rate exposure as firms or industries have different signed exposure coefficients i.e. positive or negative, which might obscure the detection a significant relationship with the firm specific variable, if it exists. Kim *et al.* (2006) utilise the absolute value of the foreign exchange risk exposure to investigate the determinants of exchange rate exposure of 424 US firms. They posit that if the objective is to examine how risk management strategies influence exposure to exchange rate risk, then the magnitude of the exposure is more important than the sign of the exposure. Furthermore, Faseruk and Mishra (2008) also make use of the absolute value of the exchange rate exposure. They propose that a firm with a negative exposure cannot be regarded as being exposed less than a firm with zero exposure. Other studies that have used the absolute value of the exchange rate exposure as well include Hagelin and Pramborg (2004), Doidge *et al.* (2006), Muller and Verschoor (2006b) and Al-Shboul and Alison (2009). On the other hand, studies by Nguyen and Faff (2003), Faff and Marshall (2005) and Nguyen *et al.* (2007) have employed both the raw exposure coefficients as well as the absolute exchange rate exposure coefficients. Bartram (2002, 2003) explains that for some determinants such as degree of internationalisation, these are usually influenced (positively) by the size and direction of the exposure. Similarly, firm size is normally presumed to be related to the degree of internationalisation, and should therefore have an impact on the direction of the exposure. Consequently, these variables should be estimated using the raw exposure coefficient. Conversely, firm liquidity variables should be estimated using the absolute exposure coefficient since they are expected to be only related to the size and not sign of the exposure i.e. liquidity reduces exposure in either direction. Subsequently, this study uses the absolute values of the exchange rate and interest rate exposure coefficients in the first instance, and then for comparative purposes, we also make use of the raw exchange rate and interest rate exposure coefficients. More so, it is pertinent to note that in chapter 5, the results for total period indicated that there were more positive exchange rate exposure coefficients than negative. This result was also the same for the OLS. Consequently, the mean of the raw exchange rate exposure coefficients were positive during this period. But in the sub-periods (ECU/£ and Euro/£), the mean of the ECU/£ raw exchange rate exposure coefficients were positive in all models, while for the Euro/£, only the mean of the actual OLS Euro/£ coefficients were positive. Regarding the unexpected OLS Euro/£ and the actual and unexpected GARCH Euro/£, these all had negative mean exposure coefficients. Furthermore, regarding the short-term interest rate exposure coefficients, the mean of the raw exposure coefficients was negative in the total period as well as the sub-periods whereas that of the long-term interest rate was positive for the total period and also the sub-periods. Therefore, where raw coefficients have been used, it will be interesting to know if the prominence of a particular coefficient sign will influence the results, such that it deviates from that reported when the absolute betas had been used instead. Furthermore, due to the comprehensive nature of the analysis in this chapter, all the tables for the summary results are presented in Appendix 11.

In Tables A11.1 and A11.2, we present the results for the cross-sectional analysis in the total period using the estimated actual and unexpected OLS exchange rate exposure coefficient as the dependent variable. These are then replaced by the actual and unexpected GARCH exchange rate exposure coefficients, and the results are reported in Tables A11.3 and A11.4. In addition, all the results shown here are for the total period 1990 - 2006.

In Tables A11.1 and A11.2, LOGASS has a negative influence on all the exchange rate exposure coefficients in models 1 and 2 but only significant in the models where the raw exchange rate exposure betas have been used as the dependent variable. Considering the positive influence of the raw exchange rate exposure beta, this finding suggests that larger are less susceptible to exchange rate exposure irrespective of whether the exposure is negative or positive than smaller firms. However the results from Tables A11.3 and A11.4 are contradictory as it was found that LOGASS was significant and positive in all the models where the absolute value of the exchange rate exposure had been used as the dependent variable. This result suggests that larger firms are more exposed to exchange rate risk than smaller firms. Although significant negative coefficients were also found, this was only with regard to the raw values of the BOEGBPR, in Table A11.4 alone. This finding is similar to that of El-Masry (2004) and Faff and Marshall (2005) who also find different significant negative and positive coefficients for size effects on the exchange rate exposure from separately estimated model (different from that used here). Unsurprisingly, literature on size effects and exchange rate exposure has not being too clear cut either as the results remain inconclusive. This is even more evident since Choi and Prasad (1995), Chow and Chen (1998), Allayanis and Ofek (2001), Nguyen and Faff (2003) Pramborg (2005), Al-Shboul and Alison (2009) all find that firm size has a positive influence on exchange rate exposure. Conversely, Nance *et al.* (1993), Chow *et al.* (1997a, b), Doukas *et al.* (1999), Nguyen and Faff (2003), Hagelin and Pramborg (2004), Chiang and Lin (2006), Doidge *et al.* (2006), Nguyen and Faff (2006) and Schiozer and Saito (2009) find a negative relationship between size and exchange rate exposure. However Shu and Chen (2003) argue that firm size might be positively or negatively related to the firm's hedging activities. Smaller firms with higher cost of financial distress may be more inclined to use derivatives than larger firms while larger firms with economies of scale and expertise on hedging techniques will hedge more than smaller firms. All the same, Jesswein *et al.* (1995) and Kim *et al.* (2006) could not find any support for the hedging hypothesis on size.

Davies *et al.* (2006) explains that if external finance options are more costly than internal finance, then firms may be motivated to reduce the exposure of their expected cash flow to exchange rate risk. The results in Table A11.1 indicate that CFTA is significantly and negatively related to the absolute exchange rate exposure coefficients of the BOEGBPR and US$/£ in models 1 and 2, and the raw exchange rate exposure beta of the US$/£ in model 2. However in Table A11.2, significant negative coefficients were found for only the absolute betas of the

US$/£. The finding here is also congruent with that of Bartram (2004) who finds that cash flow/total assets has a significant negative effect on exchange rate exposure. This follows that for firms with high liquidity, this acts as a buffer against adverse movements in foreign exchange rates. Likewise, Howton and Perfect (1998) find that the cash flow ratio is significantly positively related to the use of currency derivatives, implying that firms with high cash flow ratio make more use of derivatives and are expected to exhibit lower exposure to exchange rate risk. However in Tables A11.3 and A11.4, all the coefficients for CFTA were insignificant. Similarly, we found insignificant coefficients for PAYOUT and QUICK in Tables A11.1 - A11.4, suggesting that these variables have no influence on the exchange rate exposure of UK firms, and possibly not an important factor on firms' motives for hedging. This finding contradicts that of He and Ng (1998) and El-Masry (2005a) who find that firms with a lower dividend ratio and higher quick ratio are less likely to hedge and may therefore be more susceptible to exchange rate exposure. Furthermore, Berkman and Badbury (1996) and Bartram *et al.* (2004) find that dividend payout had a significant positive influence on hedging while Muller and Verschoor (2006b) find a significant negative relationship between dividend payout and exchange rate exposure. Nevertheless, Chiao and Hung (2000) found that quick ratio did not have any impact on exchange rate exposure of Taiwanese firms.

Furthermore, it is sometimes asserted that hedging can reduce the expected cost of financial distress and invariably exposure to exchange rate risk. In Tables A11.1 - A11.4, ICBT was found to be statistically insignificant. This finding is similar to the results of Nance *et al.* (1993), Géczy *et al.* (1997), Gay and Nam (1998), Howton and Perfect (1998), Shu and Chen (2003) and Davies *et al.* (2006) but opposes the findings of Berkman and Badbury (1996) on New-Zealand firms, Judge (2006b) on UK firms and Schiozer and Saito (2009) on Latin American non-financial firms as their findings indicated that firms with low interest cover had more incentives to hedge, and should therefore be less exposed to exchange rate risk. However regarding TOTDEBT, significant negative coefficients were found for the raw beta values of the BOEGBPR and US$/£ in model 1 of Tables A11.1 and A11.2. Then for the JP¥/£, significant negative coefficients were found for the absolute beta values of model 1 in Tables A11.3 and A11.4 while in Tables A11.1 and A11.2, the significant coefficients for the JP¥/£ were positive in respect of the raw coefficient values in model 1 only. Ultimately, the evidence of a negative relationship between exchange rate exposure and leverage is more pronounced. The outcome of a significant negative relationship for leverage is consistent with that of Graham and Rogers (2000), Allayannis and Ofek (2001), Nguyen and Faff (2002), Shu and Chen (2003) and Al-Shboul and Alison (2009) who also found that firms with higher level of leverage face a higher cost of financial distress and are therefore more likely to hedge. Consequently, they are less exposed to exchange rate exposure. But Judge (2006a) points out that the inclusion of firms that hedge interest rate exposure in a sample of firms of non-hedger may bias the results. Therefore using a sample that excludes other hedgers from the non-foreign currency hedging sample, he finds that leverage was not a determinant of foreign currency hedging. Similarly, Nguyen and Faff (2003) found no support that leverage has any impact on exchange rate exposure while Bartram *et al.* (2004) found that leverage did not influence UK firms' use of exchange rate derivatives. Although Clark and Judge (2008) also found a significant positive relationship between leverage and exchange rate exposure hedging and a significant negative relationship between interest cover and exchange rate exposure hedging, this finding was only relevant for firms which hedged using foreign debt. They further explained that for firms which hedged with foreign currency derivatives, leverage and interest cover did not influence their hedging of foreign exchange rate exposure. They further reiterate that the inclusion of foreign currency debt users in a sample comprising of foreign currency hedgers can sometimes drive the results pertaining to the leverage variables.

Additionally, it is found in Tables A11.1 and A11.2 that TANG is significant and negative for only the absolute values of the JP¥/£ exposure coefficient in models 1 and 2. Although in Table A11.4, the absolute value of the JP¥/£ exposure coefficient is also negative and significant but this is only applicable to model 1. Also, the raw exposure coefficient for the BOEGBPR in model 1, exhibited a significant negative as well, but only in Table A11.2. Although this implies that firms with low TANG have higher exchange rate exposure, but intuitively, TANG does not seem to be a very popular determinant of exchange rate exposure. More so, the finding here contradicts the suggested hypothesis of Howton and Perfect (1998) that firms with low tangible asset ratios, face higher indirect cost of financial distress, should have a greater incentive to hedge and therefore have lower exchange rate exposure. Nonetheless, Howton and Perfect (1998) could find no support for this hypothesis in their study of US S&P firms.

We also explore the possibility that firms with higher growth opportunities usually exhibit lower exposure to exchange rate risk. The results in Tables A11.1 and A11.2 shows that significant positive coefficients were found for the MVBV using the raw value US$/£ beta of model 1. But when the raw values of the US$/£ beta were used instead in model 2, the significant coefficients were found to be negative. The results here are also the same for Tables A11.3 and A11.4 as we found significant negative coefficients for the raw value of the US$ in model 2. Furthermore, in Tables A11.1 - A11.4, significant negative coefficients were found for MVBV when the raw exposure coefficient of the JP¥/£ was utilised in model 1, but in Tables A11.2 and A11.4, significant positive coefficients were found for the absolute value of the JP¥/£, but only in model 1. Additionally in Tables A11.3 and A11.4, the MVBV coefficients were found to be significant and negative for the raw values of the BOEGBPR exchange rate exposure coefficient in model 2 whereas a significant positive coefficient was found for the raw value of the model 1 BOEGBPR in Table A11.2. Overall, the results slightly lend more support for a negative relationship between MVBV and exchange rate exposure as out of the reported significant coefficients, 10 of these are negative and correspond to the raw exposure coefficients, 5 coefficients are positive for the raw exposure coefficients as well, while only 3 of the significant coefficients were for the absolute exposure betas, and these were positive. In part, the finding of significant positive MVBV coefficients supports the findings of El-Masry (2005 a and b) where he explains that UK firms with higher growth opportunities should have greater incentives to hedge. But with a strong pound, their desire to hedge declines since they become less concerned with volatility and underinvestment cost. Conversely Froot *et al.* (1993), Nance *et al.* (1993), Géczy *et al.* (1997), Hagelin (2003), Shu and Chen (2003), and Davies *et al.* (2006) find evidence that firms with more growth opportunities could face higher underinvestment costs and are therefore more likely to hedge. Consequently, their exposure to exchange rate risk should be lower. This also partly supports our finding of significant negative MVBV coefficients. Nevertheless, Nguyen *et al.* (2007) could find no support in favour of this conjecture for their study on French firms, and Clark and Judge (2008) found that market to book value had no influence on the foreign currency hedging activities UK firms. Then regarding the RDSA, all the coefficients in Tables A11.1 - A11.4 were found to be statistically insignificant. Our finding here contradicts that of Smith and Stulz (1985), Froot *et al.* (1993), Géczy *et al.*(1997), Howton and Perfect (1998), Allayannis and Ofek (2001) and Clark and Judge (2008) who find that firms with higher R&D expenditures are more likely to hedge and should therefore exhibit lower exchange rate exposure.

Given that hedging is not perfect, a firm's exposure to exchange rate risk might increase with its degree of internationalisation. In Table A11.1, FATA is positively significant for all the JP¥/£ exchange rate exposure coefficients in models 1 and 2. But in Table A11.2, only the coefficients estimated with the raw values of the JP¥/£ were significant and also positive. However, in Tables A11.3 and A11.4, all the coefficients for FATA were insignificant; therefore the evidence here in support of foreign assets is slightly weak. Nevertheless, the result is somewhat similar to that of Moles (2002) who also finds a significant positive relationship between the ratio of foreign assets to total assets and exchange rate sensitivity of UK non-financial firms. On the other hand, El-Masry (2005a) finds significant negative coefficients between exchange rate exposure and all the exchange rate measures (TWI, ECU/£, Equally Weighted and US$/£) in his study while the JP¥/£ had a significant positive relationship instead. Then our finding of statistically insignificant FATA coefficients in some instances is also congruent with that of Berkman and Badbury (1996), as they could not find any support that the ratio of foreign assets to total assets had any influence on the firms' motives for hedging. Regarding the FITI, we find significant negative coefficients for all the model 1 and 2 raw beta values of BOEGBPR in Tables A11.1, A11.3 and A11.4. We also find that all the absolute JP¥/£ betas yielded significant negative relationship with FITI in Tables A11.2, A11.2 and A11.4 while in Tables A11.3 and A11.4, FITI exhibited significant negative relationship with all the raw JP¥/£ betas. The result of here for significant negative coefficients for foreign income indicates that firms with high foreign income relative to total income have lower exchange rate exposure. This finding is also similar to that reported in El-Masry (2005a). However for all the absolute betas of the US$/£ from models 1 and 2 (4 in total) in Tables A11.1 and A11.2, the FITI coefficients were significant and positive. Again, this result was the same found in El-Masry (2005a). But regarding the FSTS variable, these were found to be insignificant in all the tables. This finding is similar to that of Nguyen and Faff (2003), Kim *et al.* (2006), Nguyen *et al.* (2007), Al-Shboul and Alison (2009) but contradictory to that of Jorion (1990), Chiao and Hung (2000), Allayannis and Ofek (2001), Moles (2002), Chiang and Lin (2005), Faff and Marshall (2005), Doidge *et al.* (2006), Dominguez and Tesar (2006) and Jong *et al.* (2006) who found that a firm's exchange rate exposure is positively related to its ratio of foreign sales to total sales. In contrast, Allayannis and Weston (2001) maintain that increase in foreign sales indicates operational diversification and should therefore mitigate the firm's exposure to exchange rate risk. Additionally, Clark and Judge (2008) find that firms using foreign currency derivative had high import/export activity whereas firms that hedged with foreign currency debt had high level of foreign operations. This finding is also congruent with that of Judge (2006b). Consequently, their deliberation infers that firms use operational hedges or hedging instruments to alleviate the inherent risks associated with foreign activities or operation.

We also examine other potential factors that can explain the firm's exposure to exchange rate risk. The results from Table A11.1, indicates a significant negative coefficient between PREFASS and the raw beta of BOEGBPR in model 1. In Tables A11.1 - A11.4, all the raw US$/£ betas were significantly negatively related to PREFASS. More so, all the raw values of the JP¥/£ betas in Tables A11.3 and A11.4 exhibited significant negative coefficients but in Tables A11.1 and A11.2, only the absolute value of the JP¥/£ betas were significant but positive instead. Overall, the evidence suggests that firms with high preference stock have lower exchange rate exposure. This result is similar to that of Froot *et al.* (1993) and Gay and Nam (1998) who also found that preference stock had a positive influence on the firms hedging motives. Incidentally, firms with higher preference stock are more likely to hedge as this constitutes additional leverage and should therefore exhibit lower exchange rate exposure. On the other hand, Nance *et al.* (1993), Géczy *et al.* (1997) and Clark and Judge (2008) find that preference stock was not a relevant factor in the decision to hedge exchange rate risk but Smith and

Stulz (1985) posit that preference stock is negatively related to the use of foreign currency derivatives.

Furthermore, in Tables A11.5 and A11.6, we present the results for the determinants of short-term interest rate exposure in the total period 1990 - 2006 using the estimated actual and unexpected interest rate exposure coefficients from the OLS model as the dependent variables. Then in Tables A11.7 and A11.8, the estimated actual and unexpected short-term interest rate exposure coefficient from the GARCH model is used instead. In Tables A11.5 and A11.6, we find that the coefficients for CFTA are significant and positive for all the model 1 and 2 raw interest rate exposure coefficients. Considering that the mean raw exposure coefficient for the short-term interest rate is negative, this suggests that firms with high CFTA have lower exposure levels to the short-term interest rate. Similar results were also found for the absolute value of the short-term interest rate exposure betas from models 1 and 2 as the significant coefficients were negative. On the contrary for PAYOUT, the raw interest rate exposure coefficients exhibited significant negative relationship while for the absolute value of the interest rate exposure beta, significant positive coefficients were found. Consequently, firms with higher payout have worse exposure levels for the short-term interest rate.

Furthermore, regarding FSTS, all the significant coefficients are positive, but these were for the model 1 and 2 raw interest rate exposure coefficients only. Therefore, in the context of mainly negative short-term interest rate exposure coefficients, this suggests that an increase in the foreign sales ratio would lead to a decrease in the absolute short-term interest rate risk. Additionally, we find significant negative coefficients for ICBT, LOGASS and TANG (TANG was significant in Table A11.5 alone), but these were only in models 1 and 2 that had been estimated with the absolute value of the interest rate exposure coefficient. The result here of significant negative ICBT and LOGASS coefficients is similar to that of Adedeji and Baker (2002) for UK firms and Borokhovich *et al.* (2004) on US firms, who found that size and interest cover had a positive influence on the use of interest rate derivatives. Their results implied that larger firms and firms with high interest cover are more engaged in hedging and should have lower interest rate exposure than smaller firms or firms with low interest cover respectively. Mian (1996), who also finds that size has a positive effect on the use of interest rate derivatives, explains that the relationship between size and hedging is highly influenced by the economies of scale in risk management activities than by cost of financial distress or even the cost relating to external finance. However this finding is only relevant for the OLS estimated short-term interest rate exposure. It was also found that all the significant coefficients for MVBV were negative but only for the raw and absolute BOEGBPR coefficient, raw JP¥/£ coefficient and absolute US$/£ of model 2. The finding of significant negative MVBV when the dependent variable had being the raw short-term interest rate exposure coefficients can be explained thus: Firstly, firms with higher MVBV have lower raw exposure but possibly higher absolute exposure to the short-term interest rate. Another viewpoint is that for firms with high positive raw exposure, a small increase in MVBV would decrease the absolute exposure because the MVBV coefficient is negative. But for firms with high negative raw exposure, a small increase in MVBV would increase in absolute the negative raw exposure, because the MVBV coefficient is negative. However, on the basis that the raw exposures were generally negative, higher MVBV's are associated with worse exposure levels. On the other hand, when the MVBV is negative when the absolute value of the short-term interest rate exposure had been used instead, this suggests that firms with high MVBV have lower absolute exposure to the short-term interest rate. Incidentally, the finding here seems to be inconclusive. Then for RDSA, this was only significant and positive in Table A11.6 for all the absolute model 1and 2 exposure coefficients. Implicitly, firms with high growth options are more exposed the short-term interest rate. Nevertheless, FATA, FITI, PREFASS, QUICK and TOTDEBT did not have any significant influence on the exposure to short-term interest rate risk.

It was also observed that the results from Tables A11.7 and A11.8 were in some instances different from those reported above. Firstly, all the coefficients for CFTA, FSTS, ICBT, TANG, MVBV, and RDSA were statistically insignificant. But these had been significant in A11.5 and A11.6. Then although all the significant LOGASS coefficients were also for the absolute values of the interest rate exposure coefficient, these were positive instead. But the results on PAYOUT was comparable as all the significant coefficients using the raw interest rate exposure coefficients were negative, while those for the absolute coefficients were positive in both models 1 and 2. Furthermore, similar to the results from the OLS coefficients, FATA, FITI, PREFASS, QUICK and TOTDEBT lacked predictive power as they also failed to explain the cross-sectional variations in the association between stock returns and short-term interest rate exposure.

The results for the determinants of exposure to the long-term interest rate for the total period 1990-2006 are presented in Tables A11.9 and A11.10, where the actual and unexpected estimated interest rate exposure coefficients from the OLS model have been utilised as dependents. Then in Tables A11.11 and A11.12, the results are in respect of the actual and unexpected interest rate exposure coefficients estimated from the GARCH model. The results show that CFTA is positive and significant in Table A11.10 only when the raw interest rate exposure coefficients have been used as the dependent variable in models 1 and 2. Since the raw exposure coefficients of the long-term interest rate coefficient were generally positive, this finding contradicts that of Bartram (2002), who finds a significant negative coefficient between the absolute value of the long-term interest rate exposure coefficient and cash flow/total assets ratio in his study of German non-financial firms. However, we observed that in Tables A11.5 and A11.6, the absolute value of the short-term interest rate exposure had a significant negative relationship with the cash flow/total assets ratio. Furthermore, in Tables A11.9 and A11.10, PAYOUT is significant and negative but for the absolute values of the interest rate exposure coefficient in models 1 and 2, implying that firms with lower payout are more willing to be susceptible to greater exposure and yet regard themselves as having less incentive to hedge. Therefore, they are probably more exposed to the long-term interest rate risk. However in Tables A11.11 and A11.12, all the coefficients for PAYOUT were statistically insignificant.

Furthermore, we find support that MVBV has an influence on the firms' long-term interest rate exposure. In Tables A11.9 and A11.10, all the absolute values of the long-term interest rate exposure in model 1 were significant and positive. In

Table A11.11, all the absolute exposure coefficients for models 1 and 2 were significant, and these also exhibited positive coefficients. Then, the results in Table A11.12 showed that all the raw and absolute exposure coefficients of model 1 were significant and positive. But in model 2, a significant positive coefficient was found only for the absolute value of the interest rate coefficient from the JP¥/£ exchange rate model. The result here suggests that firms with high MVBV are more exposed to changes in the long-term interest rate. In addition, in Tables A11.9 and A11.10, PREFASS was also found to exhibit significant negative coefficients but only in respect of the model 1 and 2 raw long-term interest rate exposure coefficients. Geczy *et al.* (1997) explains that preference capital is similar to debt; therefore they posit that firms with high preference shares have more incentives to hedge. Our result here infers that firms with high PREFASS exhibit lower exposure levels to the long-term interest rate risk. However, all the coefficients for PREFASS in Tables A11.11 and A11.12 were statistically insignificant. The findings here for PREFASS corresponds to that of Adeddeji and Baker (2002) who also report that preference capital/total assets had no influence on the use of interest rate derivatives. The result for QUICK shows that all the absolute long-term interest rate exposure coefficients (except that for US$/£ in model 1) in Table A11.10 alone have significant positive coefficients. Impliedly firms with high QUICK ratios have higher absolute exposure to the long-term interest rate. But evidence of this hypothesis is quite weak. Bartram *et al.* (2004) also found that the quick ratio had a significant negative impact on the use of interest rate derivatives, but only for US and German firms. Also in Table A11.10, we find overwhelming evidence that TANG has an influence on long-term interest rate exposure as model 1 and 2 raw and absolute coefficients were significant and negative. The results were somewhat similar in Table A11.9 except that the raw interest rate exposure coefficients of model 2, although negative, were statistically insignificant. Then in Tables A11.11 and A11.12, significant negative coefficients were also found for TANG, but only in the models for the raw interest rate exposure coefficients. The result of significant negative TANG coefficients implies that for firms with high TANG, this is associated with lower exposure levels to the long-term interest rate. But considering that firms with high TANG are expected to have lower direct cost of financial distress, a significant positive coefficient would have been more logical.

Furthermore regarding TOTDEBT, we find in Table A11.12 that the raw and absolute interest rate exposure coefficients from model 1 are significant and negative. Similar results are found for model 1 in Table A11.11 as the raw and absolute interest rate exposure coefficients (except that of the raw JP¥/£) are significant and also negative. This result agrees with that of Bartram *et al.* (2004) who find that leverage has a positive influence on US, UK, Japanese, German and Canadian firms' use of interest rate derivatives. In contrast, all the coefficients for TOTDEBT were statistically insignificant in Table A11.9 whereas in Table A11.10, only the absolute value of the interest rate exposure beta in the US$/£ model 1 was marginally significant. The result of insignificant TOTDEBT coefficients shown here partly supports that of Hakkarainen *et al.* (1997) who find no relationship between interest rate exposure and leverage of Finnish firms, and Bartram (2002), who also finds a statistically insignificant relationship between leverage of German firms and the long-term interest rate. We also found that in

Tables A11.11 and A11.12, LOGASS was significant and positive for the absolute long-term interest rate betas of model 1 and 2. This finding provides some evidence that small firms, with higher cost of financial distress, have more incentives to hedge, and therefore have lower absolute exposure to long-term interest rate risk. However, all the LOGASS coefficients were found to be statistically insignificant in Tables A11.9 and A11.10, while FATA, FITI, FSTS, ICBT and RDSA were insignificant in Tables A11.9 - A11.12.

It was also observed that in some instances, the determinants for exposure to the short-term interest rate hereafter STIR were the same as that for the long-term interest rate hereafter LTIR, although the sign of the coefficient sometimes varied. From the exposure coefficients estimated with the OLS model, the similarities were in respect of PAYOUT (positive for absolute and negative for raw STIR coefficients whereas negative for absolute LTIR coefficients), TANG (negative absolute coefficients for STIR while LTIR had negative raw and absolute coefficients) and CFTA (positive raw coefficients for STIR and LTIR). But Adedeji and Baker (2002) could not find any support that dividend payout had an influence on UK firms' use of interest rate derivatives whereas Bartram *et al.* (2004) found a significant positive association. This finding is therefore more relevant for the long-term interest rate than the short-term interest rate.

Furthermore, although MVBV was significant for both short-term and long-term interest rate exposure, negative MVBV coefficients were found in the raw and absolute STIR coefficients while positive MVBV coefficients were found for the raw and absolute LTIR exposure coefficients. Mian (1996) finds a significant negative relationship between the market-to book value ratio and the use of interest rate derivatives for US firms and Bartram *et al.* (2004) for UK firms. Their work suggests that firms are less likely to hedge interest rate risk if they have higher market-to-book value. Inherently they have a higher exposure to interest rate risk in comparison to hedgers who have lower market-to-book value for the same implied international activities. This supposition supports our finding of a significant positive coefficient between MVBV and long-term interest rate exposure. In the context that the raw STIR exposure coefficients were mainly negative, the finding of a significant negative relationship between MVBV with the STIR, suggests that firms with high MVBV are expected to exhibit worse exposure levels to the short-term interest rate. Furthermore, Mian (1996) explains that firms with more growth options will have market values that are in excess of their book values. Therefore if firms need to maintain their income flows to meet growth opportunities, then firms with higher MVBV ratios might be expected to exhibit lower interest rate exposure. Again this finding partly supports the results for the short-term interest rate.

On the other hand, for the interest rate exposure coefficients estimated using the GARCH model, the only similarity was for LOGASS which was significant and positive for the absolute STIR and LTIR exposure coefficients. Nevertheless, this result is contradictory to the findings of Mian (1996) and Adedeji and Baker (2002). Furthermore, it was also found that FATA and FITI had no influence of the short-term and long-term interest rate exposure of UK firms. More so, there were also some instances where the determinant was significant for either the short-term interest rate or the long-term interest rate. These noticeable differences were FSTS and ICBT which were only significant for the short-term interest rate whereas PREFASS, QUICK and TOTDEBT were only relevant for the long-term interest rate. The results here are comparable to that of Adedeji and Baker (2002) in some ways, especially for interest coverage, which has been previously discussed. Then for leverage, they found this had a positive influence on the use of interest rate derivatives, implying that firms with high level of leverage use more interest rate derivatives and should have lower interest exposure. Our finding here indicates a significant negative relationship between long-term interest rate exposure and leverage. Intuitively, firms with high leverage should be less exposed to the risks arising from movements in the long-term interest rate. Regarding liquidity, Adedeji and Baker (2002) also found this to have a negative influence on interest rate derivative use, suggesting that firms with high liquidity have less incentive to use interest rate derivative instruments, therefore are expected to exhibit higher long-term interest rate exposure. The result here, although weak, also finds a significant positive relationship between the long-term interest rate exposure and QUICK. This implies that firms with high QUICK are more exposed to movements in the long-term interest rate. Conversely regarding foreign sales to total sales, they found that this had no influence on the use of interest rate derivative. However, we find some evidence here that an increase in the firm's FSTS would decrease the absolute short-term interest rate exposure.

6.5 A comparison of the determinants of exchange rate exposure and interest rate exposure of UK non-financial firms.

We also compared our findings regarding the determinants of interest rate exposure with the determinants of exposure to exchange rate risk in the total period. From the exposure coefficients estimated using the OLS model, it was observed that CFTA, MVBV and TANG are determinants of exchange rate, short-term and long-term interest rate exposure. Furthermore, LOGASS is only relevant for exposure to short-term interest rate and exchange rate risk, whereas PREFASS and TOTDEBT are only significant determinants for exposure to long-term interest rate and exchange rate risk. It was also found that PAYOUT and RDSA are significant determinants for exposure to short-term and long-term interest rate exposure only. But regarding FATA and FITI, these are relevant determinants of exposure to exchange rates only, while FSTS and ICBT are only significant for the exposure to short-term interest rate, whereas QUICK is only important for exposure to the long-term interest rate. Additionally, a comparison of the determinants of short-term and long-term interest rate exposure with the determinants of exchange rate exposure, using the exposure coefficients estimated from the GARCH models indicated that CFTA, FATA, FSTS, ICBT, QUICK and RDSA were not relevant for exposure to exchange rate, short-term interest rate and long-term interest rate risk. Conversely, LOGASS was a significant determinant for the exposure to exchange rate, short-term interest rate and long-term interest rate. Furthermore, MVBV, PREFASS, TANG and TOTDEBT could only explain the exposure to the long-term interest rate and exchange rate risk. In addition, PAYOUT was only significant for the exposure to short-term interest rate and FITI was only relevant for exposure to exchange rate risk.

Overall, our findings indicate that size is a significant factor for UK firms' exposure to exchange rate and interest rate risk (short-term and long-term). This result is similar to that of Adedeji and Baker (2002) and Bartram *et al.* (2004).

Another significant factor found here was for MVBV, but this was only applicable to the findings of Bartram *et al.* (2004). However, we point out that in some of the instances where the determinants have been the same with that of Adedeji and Baker (2002) and Bartram *et al.* (2004), the sign of the coefficient sometimes varied and consequently the interpretation of the result. Furthermore, although there were a few similarities for the determinants of exchange rate and interest exposure, this was overpowered by the greater incidence of dissimilarities. Therefore, despite the divergence of techniques employed here, overall our results suggest that the determinants of exchange rate exposure of UK firms are not usually the same with the determinants of interest rate exposure. Consequently this finding substantiates that of Adedeji and Baker (2002) and Bartram *et al.* (2004) whose results imply that the factors which motivate UK firms' use of foreign exchange rate derivatives were different from those which prompted the use of interest rate derivatives. Then another important observation was that the determinants of exposure to the short-term interest rate and long-term interest rate were in most cases comparable.

6.6 The determinants of exchange rate exposure and interest rate exposure of UK non-financial firms in the period before and after the Euro

In this section, we briefly discuss the determinants of exchange rate exposure and interest rate exposure of UK firms in the period before the Euro (01/01/90-31/12/98) using the ECU/£ model and the period after the Euro (01/01/99-31/12/06) using the Euro/£ model. The results from the OLS and GARCH models are presented in Table A11.13-Table A11.18.

Firstly, regarding the determinants of exchange rate exposure ECU/£ (OLS and GARCH model), denoting the period before the euro, this is presented in Table A11.13 We find significant negative coefficients for PAYOUT, FSTS, RDSA and TANG (GARCH model only) when the absolute value of the exchange rate exposure had being used, but for FATA, this is only significant when the raw value of the exchange rate exposure was employed instead. Then for QUICK and CFTA, the significant coefficients were positive, but only for the absolute value of the exchange rate exposure. However for LOGASS, the significant coefficients were negative for the raw OLS exchange rate exposure coefficients and positive for the absolute GARCH exchange rate exposure coefficients. As mentioned previously, the mean of the ECU/£ exposure coefficient was positive, therefore the interpretation for the raw exposure coefficients will be similar to that reported for the absolute exposure coefficients.

Then in the period after the euro (OLS and GARCH Euro/£), presented in Table A11.16, the interpretation of the results for the actual OLS Euro/£, which generally had positive exposure coefficients, may be different to that of the unexpected OLS Euro/£ and actual and unexpected GARCH Euro/£, which had mostly negative coefficients. Regarding FITI, we found significant negative coefficients for the raw actual and unexpected exposure coefficients in the OLS model only. Therefore, regarding the raw actual coefficients, this suggests that firms with high FITI have lower absolute exposure to the Euro/£. Conversely for the raw unexpected coefficients, this implies that higher FITIS's are generally associated with worse exposure levels to the Euro/£. Nevertheless, all the FITI coefficients are insignificant before the euro. The results were also similar for the

FSTS since only the raw actual and unexpected exposure coefficients from the OLS model were significant and negative. Nevertheless, the result here for FSTS from the actual raw OLS model is somewhat similar to that obtained before the euro from the actual absolute GARCH model. In addition, we found overwhelming support for PAYOUT since all the absolute values of the exchange rate exposure exhibited significant negative coefficients. This result had also being the same in the period before the euro. Then regarding TANG, significant negative coefficients were found for the actual absolute and raw unexpected coefficients from the OLS model only. However this result is very weak and also similar to the period before the euro where only 2 absolute coefficients were significant and negative.

Conversely for TOTDEBT, significant negative coefficients were found for all the actual and unexpected raw and absolute exchange rate exposure coefficients from the GARCH model and also the actual raw and absolute exposure coefficients from the OLS model. Although the evidence marginally lend more support for the rationale that higher debt is associated with lower exposure, TOTDEBT had no influence on exchange rate exposure in the period before the euro.

Furthermore, we found significant positive coefficients for ICBT with regards to all the raw beta coefficients. Instinctively, only the interpretation for the actual raw exposure coefficients from the OLS model will be different. Then regarding PREFASS, all the absolute exposure coefficients from the OLS model were significant and positive. But ICBT and PREFASS were insignificant in the period before the euro. Then for MVBV, significant positive coefficients were found for model 1 actual raw and absolute coefficients from the OLS and GARCH models, and the unexpected absolute coefficient from the GARCH model. Since only the explanation for the raw actual GARCH coefficient is different, there is more support that firms with higher MVBV are more exposed to Euro/£. But in the period before the euro, there was no empirical evidence to indicate that MVBV had an influence on exchange rate exposure. Furthermore, it was found that regarding RDSA, all the raw and absolute coefficients from the GARCH model are positive and significant, except the unexpected absolute exposure coefficient from model 2. All the same, this finding partly supports that in the period before the euro where all the significant RDSA were negative for the absolute exposure coefficients. Additionally, all the LOGASSS coefficients from the actual and unexpected OLS model were significant and negative. Conversely for the GARCH model, only the absolute coefficients were significant, but positive. Mixed results were also found for LOGASS in the period before the euro too as the raw OLS coefficients were negative whereas the absolute GARCH coefficients were positive and significant. Generally, from the results in Tables A11.13 and A11.16, it is observed that FITI, TOTDEBT, PREFASS, ICBT and MVBV were not significant in the period before the euro but significant after the euro. Conversely, CFTA, FATA and QUICK were significant before the euro but not after the euro. However, PAYOUT, FSTS, RDSA, TANG and LOGASS were significant before and after the euro.

Next, regarding the determinants of short-term interest rate exposure, the period before the euro (1990-1998) is presented in Table A11.14. The results indicate that RDSA (GARCH model only), TANG (actual OLS only) and TOTDEBT (actual model 1 OLS only) had significant negative coefficients for the absolute value of the short-term interest rate exposure. This suggests that firms with high RDSA, TANG and TOTDEBT have lower short-term interest rate exposure. But the result for TANG and TOTDEBT are very weak. However for CFTA and PAYOUT, all the raw and absolute coefficients from the OLS model as well as the actual absolute coefficients from the GARCH model were negative and significant. But since the raw short-term interest rate exposure coefficients were generally negative, higher CFTA or PAYOUT could be associated with a higher absolute exposure to the short-term interest rate, whereas for the absolute coefficient, firms with high CFTA or PAYOUT have a lower absolute exposure to the short-term interest rate. Similarly regarding FATA, significant positive coefficients were found for the unexpected raw coefficients from the OLS model in addition to all the raw and absolute coefficients from the GARCH model. Similarly, regarding QUICK, significant negative coefficients were found for all the raw OLS coefficients. Significant positive coefficients were found for all the absolute GARCH coefficients and so, intuitively, firms with high QUICK have higher absolute short-term interest rate exposure. A similar result was also found for LOGASS since significant negative coefficients were found for the actual absolute OLS whereas significant positive coefficients were found for all the absolute GARCH exposure coefficients. Then regarding PREFASS, positive coefficients were found for only the actual absolute GARCH coefficients, indicating that firms with high PREFASS are more exposed to the short-term interest rate risk. But this evidence is relatively weak.

In the period after the euro (1999-2006), shown in Table A11.17, it was found that PAYOUT had significant negative coefficients for all the absolute OLS and

GARCH coefficients. This finding, which also partly supports that in the period before the euro, indicates that firms with low PAYOUT have high exposure. Then for FATA, significant negative coefficients were found for all the raw OLS coefficients whereas positive coefficients were found for only the actual absolute OLS coefficients. This finding implies that firms with higher FATA's have higher absolute exposure to the short-term interest rate. This finding is also similar to that reported in the period before the euro.

Furthermore, the results for ICBT showed that the raw GARCH coefficients had significant negative coefficients whereas the absolute GARCH coefficients had significant positive coefficients. However ICBT had no significant influence on short-term interest rate exposure before the euro. Then we found mixed results for LOGASS as all the raw and absolute OLS coefficients were negative while all the absolute GARCH coefficients except those relating to the raw actual were significant and positive. Regarding the result for FITI, this was somewhat weak since only the actual GARCH absolute coefficients were significant and negative, suggesting that firms with high FITI have lower absolute short-term interest rate exposure. Similarly for MVBV and TOTDEBT, only the absolute GARCH coefficients for model 1 were significantly positive and negative respectively. But FITI and MVBV had been found to be statistically insignificant before the euro while TOTDEBT was negative but only marginally relevant. Likewise, regarding RDSA, only the coefficient for the unexpected absolute GARCH coefficient from model 2 was significant and positive. Although, not substantial, the result contradicts the finding of significant negative absolute RDSA coefficients in the period before the euro

Additionally, significant positive coefficients were also found for PREFASS, but these were only for the actual absolute OLS and the unexpected raw GARCH coefficients. Though PREFASS was also significant before the euro, the evidence was much weaker. On the other hand, TANG had significant negative coefficients for all the absolute OLS coefficients and significant positive coefficients for the raw unexpected GARCH. Similar results were also found in the period before the euro, but this was not as strong. Overall, CFTA and QUICK were significant in the period before the euro but not significant in the period after the euro. Then MVBV, ICBT and FITI were significant after the euro only. Furthermore, it was observed that TANG, TOTDEBT, PAYOUT, FATA, PREFASS, LOGASS and RDSA were all significant in the period before and after the euro while FSTS was statistically insignificant in both periods.

Finally, the determinants for the exposure to the long-term interest rate, in the period before the euro (1990-1998) are presented in Table A11.15. It was found that PAYOUT had significant negative coefficients for all the absolute coefficients in the OLS model. Then for RDSA, all the absolute exposure coefficients from the GARCH model were negative and significant. This implies that firms with low PAYOUT and low RDSA are more exposed to the long-term interest rate. Furthermore, we also found significant negative coefficients for PREFASS, but these were only for the raw coefficients in the OLS model. But since the raw long-term exposure coefficients were generally positive, then firms with higher PREFASS should exhibit lower exposure to the long-term interest rate. In addition, it was found that CFTA and FSTS exhibited significant positive coefficients but for the raw OLS coefficients only. This finding suggests that firms with high CFTA and FSTS have higher absolute exposure to the long-term interest rate. Furthermore, LOGASS exhibited significant negative coefficients for all the raw OLS coefficients and the unexpected raw GARCH coefficients whereas all the absolute GARCH LOGASS coefficients were significant and positive. Therefore the results are somewhat mixed. Then for QUICK, significant positive coefficients were found for all the raw OLS coefficients while significant positive coefficients were found for all the absolute GARCH coefficients. This suggests that firms with high QUICK are expected to be more exposed to the long-term interest rate. Conversely, TANG exhibited significant negative coefficients for all the raw OLS and GARCH coefficients. Therefore, for firms with high TANG, they should have a lower absolute exposure to the long-term interest rate.

However in the period after the euro (1999-2006), presented in Table A11.18, we find significant negative coefficients for CFTA, but only for the raw actual coefficients. Although CFTA was also significant before the euro, this had been positive instead. Furthermore, regarding PAYOUT, all the absolute OLS and GARCH coefficients were negative. The finding here, suggests that firms with low PAYOUT, have higher absolute exposure to the long-term interest rate. But this result only partly supports that found in the period before the euro. In addition, it was found that FATA had significant positive coefficients for the absolute OLS coefficients and significant negative coefficients for the raw OLS coefficients, except the raw actual OLS coefficient for model 1. However FATA was statistically insignificant before the euro. Then the results for FSTS, MVBV, TOTDEBT and ICBT were found to be quite weak. For instance, only the unexpected OLS absolute coefficients were significant but positive for the FSTS and negative for the ICBT. Then for MVBV, only the actual absolute GARCH coefficients from model 1 were significant and positive whereas for TOTDEBT, these were significant but negative. But ICBT, MVBV and TOTDEBT had no significant influence on long-term interest rate exposure in the period before the euro. Nevertheless, it was observed here that FSTS is significant and positive for long-term interest rate exposure in the period before and after the euro. But then TOTDEBT, which was found to be insignificant in the period before the euro, is significant and negative in the period after the euro. A possible explanation could be that if UK firms have a high proportion of foreign sales, presumably from euro area countries, then borrowing foreign currency debt denominated in euro may be an appealing choice of hedging the currency risk. Although this increases the leverage ratio, the finding of a significant negative coefficient, which suggests lower exposure to the long-term interest rate risk, might be an indication that the introduction of the euro has facilitated the efficient management of the currency risk associated with the foreign debt.

Furthermore, LOGASS has only significant positive coefficients for the raw OLS model and absolute GARCH model. This finding implies if the cost of financial distress is higher for small firms, they have more incentives to hedge and should have lower absolute exposure to the long-term interest rate. Then for PREFASS, all the absolute OLS coefficients were significant and positive while only the actual raw absolute GARCH coefficient for model 1 was significant but negative. Although PREFASS was also significant before the euro, this had being mainly negative. Furthermore, regarding the result for TANG, significant positive coefficients were found for the raw OLS coefficients of model 1 while significant negative coefficients were found for the absolute actual OLS coefficients and the absolute unexpected model 2 OLS coefficient. This result partly supports the finding of mainly significant negative coefficients in the period before the euro.

Generally, RDSA and QUICK were only significant in the period before the euro whereas ICBT, MVBV, TOTDEBT and FATA were significant after the euro alone. Furthermore, PAYOUT, PREFASS, TANG, CFTA, FSTS and LOGASS were found to be significant before and after the euro. But no empirical support was found for FITI as it had no statistical significance on the long-term interest rate exposure of UK non-financial firms in the period before and after the Euro.

6.7 Summary of findings

This chapter examined the determinants of exchange rate and interest rate exposure (short-term interest rate and long-term interest rate) using firm specific characteristics, which were categorised into factors such as size, cost of external finance, expected cost of financial distress, growth opportunities and degree of internationalisation to understudy the factors that determines the firm's exposure to exchange rate and interest rate risk. The cross-sectional analysis uses both the exposure coefficients estimated from the OLS and GARCH models as the dependent variable. In some instances, models where the GARCH exposure coefficients had been used generated results that were contrary to that of the OLS exposure coefficients. Nevertheless, the OLS exposure coefficients had more predictive power in explaining the determinants of exchange rate and interest rate exposure of UK firms. Furthermore, the results for the actual and unexpected changes in the exchange rate or interest rate exposure betas had similar impact on the cross-sectional data in almost all the estimations. In addition, we utilised the raw and absolute beta exposure coefficients to determine whether there would be variations in the results. We found that there were instances when only the raw beta was significant while in some instances only the absolute beta would be significant. There were also situations when the sign of the significant explanatory variable was different for the raw and absolute betas. Nevertheless, in all cases, the interpretation of the raw betas depended on the mean of the exposure coefficient being investigated. Although in some instances the results were complimentary, we acknowledge that there is a possibility that the use of raw betas could have driven the results in favour of the mean exposure coefficient. Additionally, we created 2 models: model 1 was estimated with leverage while in model 2; leverage was excluded, to substantiate the absence of multicollinearity which could have biased the results. It was observed that both models generated similar results in almost all the models.

Furthermore, we found that regarding the determinants for exchange rate exposure, size is a significant factor. However, the results were indistinct since the OLS coefficients provide evidence in support of the economies of scale theory while the results for the GARCH coefficients insinuated that smaller firms were less exposed to exchange rate risk. Another instance where mixed results were found was for growth opportunities, using the market value to book value ratio. Here again, the significant coefficients were both negative and positive respectively, but this varied with the exchange rate model i.e. BOEGBPR, US$/£ or JP¥/£ used for the estimation. Moreover, the research and development factor could not substantiate the hypothesis on opportunities for growth as the variable was insignificant in all the models. Furthermore, we also found that for firms with high liquidity, their exposure to exchange rate was lower, probably because liquidity acts as buffer which can absorb the impact of unfavourable movements in exchange rates. But evidence to substantiate this was limited since only the cash flow/total asset was significant whereas the other corresponding proxies: quick ratio and dividend payout were insignificant in all the models. We also investigated the supposition that firms with high cost of financial distress have lower exchange rate exposure. The results suggested that firms, with higher leverage and which face a higher cost of financial distress, had less exchange rate exposure. But for interest cover, this did not influence exposure, whereas regarding the indirect cost of financial distress, proxied by tangible assets, the findings, though weak, were contrary to our expectations as it was found that firms with lower tangible assets had higher exchange rate exposure. Additionally, regarding the influence of foreign activity, significant positive coefficients were found for foreign assets, implying that firms with high foreign assets have high exposure and that an appreciation of the pound is favourable for foreign investment. Indeed, this finding is arguably contrary to our expectations as the value of foreign investments may be adversely affected by an appreciation of the pound. Nevertheless, the support for this result was quite weak, as it was only relevant for the JP¥/£ exchange rate model. On the other hand, significant negative coefficients were found for foreign income suggesting that firms with high foreign income gain when the value of the pound depreciates and lose in comparison to firms with low foreign income when the pound appreciates. This is somewhat expected as a depreciation of the pound is likely to increase the value of the foreign income in domestic currency. Then surprisingly, for foreign sales, which on average were 43% of total sales (Table A10.1), we did not find any empirical support of a relationship with exchange rate exposure. Giving thought to the consideration that firms, with a high proportion of their revenue and probably cost from foreign markets, will have a high percentage of their income and expenses in foreign denominated currency, they should be less susceptible to exchange rate risk. But in light of imperfect hedging, a significant negative coefficient may be justifiable. We also explore the relationship between preference capital and exchange rate exposure, and found this to have a significant negative coefficient. This result infers that UK firms with high preference capital are usually less affected by exchange rate exposure. More so, another benefit of preference capital is the presumption that it reduces the risk of insolvency. Furthermore, regarding the determinants for interest rate exposure, it was found that in some instances, these were similar for both the short-term interest rate and long-term interest rate. Some of these similarities were for size, research and development, payout, tangible assets, cash flow and market-to book value. However, the sign of the significant cross-sectional variable sometimes varied, and consequently the interpretation. In addition, there were also some instances where the determinant was significant only for either the short-term interest rate or the long-term interest rate. These evident differences arose in the case of foreign sales and interest cover which were only significant for the short-term interest rate, whereas preference shares, quick ratio and total debt were found to be significant for the long-term interest rate only. We further compared the firm level factors that influence exposure to interest rate with that of exchange rate exposure. Our findings indicate that cash flow, market value to book value, size and tangible assets were all significant for exposure to exchange rate and interest rate (short-term and long-term interest rate). But again in most cases, the signs of the coefficients were of opposite directions and the result sometimes varied depending on whether the exposure coefficient had been estimated using the OLS or GARCH model. Furthermore preference shares and total debt were only significant determinants for exposure to long-term interest rate and exchange rate risk. Additionally, foreign sales and interest cover were only significant for the short-term interest rate and the quick ratio was only important for the long-term interest rate. However, foreign assets and foreign income proved not to be key factors for short-term and long-term interest rate exposure of UK firms as they were only significant for exchange rate exposure. Nevertheless, the evidence suggested that for UK firms, the determinants for exchange rate exposure are different from that of interest rate exposure.

Finally, we also compared the determinants of exposure in the period before the euro, represented by ECU/£, with the determinants of exposure after the euro represented by Euro/£. Regarding the determinant of exchange rate exposure, it was observed that payout, foreign sales, research and development, tangible assets and size were significant before and after the euro. On the other hand, cash flow, foreign assets and quick were significant before the euro whereas foreign income, total debt, preference assets, interest cover and market value to book value were significant after the euro only. Then regarding the results for the determinants of short-term interest rate exposure, it was found that that cash flow and quick ratio were significant in the period before the euro, while market value to book value, interest cover and foreign income were significant after the euro only. Furthermore, it was also observed that tangible assets, total debt, payout, foreign assets, preference assets, size and research and development were all significant in the period before and after the euro, while foreign sales were statistically insignificant in both periods. Besides, regarding the determinants of the long-term interest exposure, foreign income had no statistical significance in the period before or after the euro. Besides, payout, preference shares, tangible assets, cash flow, foreign sales and size were found to be significant before and after the euro. On the other hand, research and development and quick ratio were only significant in the period before the euro, whereas interest cover, market value to book value, total debt and foreign assets were significant after the euro alone. Generally, in the sub-periods, quick ratio is significant for exchange rate and interest rate exposure before the euro while interest cover and market value to book value are significant after the euro. Additionally, the determinants of exchange rate and interest rate exposure before the euro were different to that after the euro. But the difference was more pronounced for the exchange rate exposure determinants as more similarities were noticeable between the determinants for the exposure to the short-term interest rate and the exposure to long-term interest rate respectively.

CHAPTER 7 SUMMARY AND CONCLUSIONS

7.1 Introduction

Exchange rate and interest rate risk have been considered prima facie as the two most important financial risks that a majority of non-financial firms and industries, even those in the UK, are encumbered with. But despite the evident significance accorded to these risks, only a few empirical studies have examined their relative importance, and most of these have been perceptibly limited in scope. For instance, most studies that have investigated exchange rate exposure have focused on non-financial firms whereas for interest rate exposure, these have mainly been based on financial firms. Although some studies have investigated the effects of exchange rate and interest rate exposure simultaneously, these have either been limited to a sample that is not representative of the market, or focused on portfolios. This is probably because some studies have suggested that the analysis of portfolio level data can sometimes provide stronger results in comparison to firm level analysis. Nevertheless, a major drawback is that firms within the same industry are usually heterogeneous, with regards to their exposure coefficients, thereby possibly leading to cancelling effects. Essentially, the evidence from the portfolio analysis may not be complete except it is substantiated with results from a firm level analysis. Furthermore, most of the empirical studies on the UK that have investigated exchange rate exposure (Donnelly and Sheehy, 1996; Doidge *et al.* 2006; El-Masry, 2006a), interest rate exposure (Madura and Zarruk, 1995; Dinenis and Staikouras, 1998; Oertmann *et al.* 2000) and both exchange rate and interest rate exposure (Prasad and Rajan, 1995 and Rees and Unni, 2005) have utilised linear OLS methods. But there is substantial evidence to suggest that the impact of exchange rate and interest rate exposure on UK stock returns are not constant over time. Incidentally they are time varying, which makes the use of standard OLS models inadequate, since they are unable to capture these time varying components as well as provide coefficient estimates for the time varying parameters. The only known notable study that has adopted a GARCH methodology on exchange rate and interest rate exposure for the UK is Joseph (2002). But the study only examines 4 UK non-financial industries using the EGARCH and EGARCH-M specifications, and he emphasises that the results from the study might not be pertinent for individual firms.

In this study, we attempt to fill the gaps in literature by examining the exchange rate and interest rate exposure of 402 non-financial UK firms, using an AR(1)EGARCH-M methodology, while the exposure to interest rate is further segregated into short-term and long-term interest rate exposure. In addition, a portfolio analysis, comprising of 31 UK non-financial industries is also examined in this study. The estimation entailed the use of high frequency data (weekly) for the total period January 1990 to December 2006. A sub-period analysis, covering the period before the euro and the period after the euro is also estimated, to explore the significance of the introduction of the euro on exchange rate and interest rate exposure. Furthermore, a variety of nominal exchange rate and interest rate measures are adopted to test the various hypotheses developed. Regarding the exposure to exchange rate, the trade weighted index, US$/£, JP¥/£, ECU/£ and Euro/£ were employed. Then for the interest rate measures, the 3 month Treasury bill was utilised as a proxy for the short-term interest rates whereas the long-term interest rate was represented by the 10 year government bond. Additionally, the transformations of these exchange rate and interest rate series varied from contemporaneous, lagged, actual and unexpected changes.

Another dimension investigated was the influence of industry competition on exchange rate and interest rate exposure. The premise was that firms in concentrated industries usually pass the movements in exchange rates and interest rates through to their prices and therefore mainly exhibit high pass through and low exposure. On the contrary, firms in competitive industries, where mark-ups are low, usually have lower pass through into prices and typically exhibit larger significant effects of exposure on their profitability and ultimately firm value. This assertion is explored using a Herfindahl index based on the total sales of each industry group, whereby industries with Herfindahl index greater than 1800 were categorised as highly concentrated while those with Herfindahl index less than 1800 were classified as competitive. Subsequently, 2,128 non-financial firms from 31 industries were categorized into 19 concentrated industries and 12 competitive industries. Also, in an attempt to provide a somewhat complete picture of the significance of exchange rate and interest rate exposure, a quantitative approach was adopted to determine the factors that influence exchange rate and interest rate exposure of UK firms. However, since data on hedging activities are usually incomplete and difficult to obtain, firm specific accounting variables were used instead to understudy the firm's hedging motives and also to examine the relationship between the firms' hedging activities and the estimated exchange rate and interest rate exposures.

Overall, the results from this study, which are provided in a bit more detail in the next section, indicates that exchange rate and interest rate exposure of a majority of UK firms and industries are time varying. In addition, since exchange rate and interest rate exposure had previously being estimated in this study using the OLS method, it was insightful to compare the results to that of the AR(1)EGARCH-M model, that was finally adopted. Subsequently, the comprehensive results from the AR(1)EGARCH-M methodology are compared to that of the OLS methodology, thereby providing a pedestal for the results of 2 diverse methods of estimation to be evaluated, and also facilitating a comparison with earlier studies that have mainly focused on the traditional OLS method. Nevertheless, although the results from the OLS model have only being used here for comparative purposes, a summary of the results are available in Appendices 12 and 13.

7.2 Summary of research findings

The synopsis of our findings starts with the results from the industry level analysis. The empirical evidence indicated that in the total period, the returns of UK industries were more influenced by contemporaneous changes in the long-term interest rate, followed by the foreign exchange rate changes and then short-term interest rate changes. In addition, this result was similar for both actual and unexpected changes. Moreover, most of the exposure coefficients for the exchange rate and long-term interest rate risk were positive whereas the short-term interest rate exposure coefficients were mainly negative. More so, since most of the significant long-term interest rate coefficients are positive, this might suggest that operating business conditions are favourable, therefore businesses are doing well in that period (increase in stock returns), despite the increased financial commitments.

Furthermore, regarding exchange rate risk, the incidence of exposure was highest for the US$/£, then the trade weighted index and lowest for the JP¥/£. Then it was also found that the number of industries with significant positive risk-return trade-off coefficients was considerably low, implying that for most UK industries, increase in the volatility of returns will not necessarily lead to a significant increase in expected returns. This can be explained as a situation whereby fluctuations in the volatility of most UK industries returns are as a result of unsystematic risk rather than systematic risk. On the other hand, there was substantial evidence of leverage effects, since the asymmetric parameter was mainly negative when significant. This finding suggested that negative news increased the volatility of industry returns more than positive news, or expressed colloquially, volatility was higher when the market declined than when there was a market boom. Therefore, from the perspective of exchange rate and interest rate exposure, severe contrary movements in these macro-economic factors can potentially increase volatility in industry's returns.

Moreover, for the sub-period analysis, the number of industries exposed to the ECU/£ was just marginally higher than those exposed to the Euro/£. Additional analysis was then initiated to determine the change in exposure to the other exchange rate and interest rate measures following the introduction of the euro. The findings indicated that in the period before the euro, the hierarchy of exposure was similar to that reported for the total period i.e. more industries were exposed to the long-term interest rate, than exchange rate and short-term interest rate. But in the period after the euro, fewer industries exhibited significant exchange rate and interest rate exposure coefficients. Nevertheless, absolute reduction in exposure was highest for importers and exposure related to the short-term interest rate. Another important discovery was that the riskiness of industries' returns increased in the period after the euro. This result was further substantiated from the sub-period analysis results where it was found that the incidence of leverage effects, volatility clustering and persistence of volatility was more severe in the models estimated using Euro/£ exchange rate than the models estimated using the ECU/£ exchange rate. In addition, the half-life measure for persistence of volatility indicated that it took a longer period for half of the volatility in returns to dissipate in the period after the euro than in the period before the euro. Furthermore, the impact of exchange rate exposure and interest rate exposure was also extended to include concentrated and competitive industries. Generally, industries classified as being competitive were significantly more exposed to exchange rate exposure and interest rate exposure. Additionally, the persistence of volatility was higher for competitive industries than concentrated industries. Then our examination of the mis-pricing hypothesis did not yield impressive results for all the periods examined. Specifically, the lagged changes in exchange rate and interest rate seemed not to have much predictive power in explaining the variations in industry returns.

Moreover, the numbers of industries with significant exposure coefficients were few, in all instances, which might be an indication that risk management strategies have been employed by UK non-financial industries to counteract the detrimental effects of exchange rate and interest rate risk. Another probable explanation could be that the industries were comprised of heterogeneous firms, such that their exchange rate and interest exposure coefficients were of opposite signs, consequently bringing about cancelling effects. This prospect was confirmed in the firm level analysis. These inferences, which were the results of the mean equation from the AR(1)EGARCH-M model, were similar to those achieved from the standard OLS model. In addition, from the variance equation, the coefficients of the industry's returns' conditional volatility indicated that in the total period, the current volatility of most UK industries is time varying, is a function of past innovations and past volatility and persistence of volatility is very high, suggesting that volatility has a long memory, and once volatility increased, it may probably remain high over several periods. Furthermore, the magnitude of significant persistence parameters was in almost all cases higher than that of the coefficient denoting the presence of volatility clustering. This result signified that the UK market has a memory longer than one period, and that volatility is more sensitive to old news than it is to recent surprises in the market. Then although the persistence of volatility of UK industries returns was quite high, some industries still had relatively low persistence, suggesting that some industries seemed to absorb or manage volatility better than others. Moreover, it was also observed that negative innovations in exchange rate and interest rate exposure increased the volatility of portfolio returns 1.1 times more than positive innovations. Generally, the GARCH methodology generated stronger results as it was able to explain more of the effects of exchange rate and interest rate exposure on industry's returns. This may have been further facilitated by the capability of GARCH type models in capturing the time varying properties that elude OLS models.

The results for the firm level in the total period were quite similar to those reported for the industry level, since evidence of exposure to contemporaneous changes in the exchange rates and interest rates was limited to a few firms. Then again, the incidence of exposure to actual and unexpected changes was comparable, and the significant exposure coefficients for exchange rate and long-term interest rate exposure were predominantly positive while those for the short-term interest rate were mainly negative. Another similarity was that more firms were significantly exposed to the long-term interest rate, followed by exchange rate and least exposure was found for the short-term interest rate. But regarding exchange rate exposure, the results were different from that of the industry level, since more firms exhibited significant coefficients for the trade weighted index, followed by the JP¥/£ and then US$/£. All the same, the weak evidence of exchange rate and interest rate exposure seemed to corroborate our earlier assumption that risk management strategies were employed to mitigate the effect of exchange rate and interest rate exposure on firm value.

The result from the variance equation also indicated that for a majority of UK firms, volatility was not a particularly important factor for asset pricing, since only a few firms had significant trade off coefficients that were positive, but this seemed to vary depending on the exchange rate measure that was used in the model. It was also observed that the asymmetric coefficient was significant and predominantly negative for almost half of the firms. This implied that negative innovations seemed to affect the volatility of firms' returns more than positive innovations. Additionally, the presence of ARCH and GARCH effects further substantiated earlier results that volatility of UK stock returns had a long memory, and once volatility increased, it had the propensity to stay high over several periods. Also, for the majority of firms which exhibited significant ARCH and GARCH parameter coefficients, the magnitude of the GARCH coefficient was higher than that of the ARCH coefficient in most cases. This result, provides corroborating evidence that conditional variance is time varying, and is a function of past innovations and past volatility. It also provides further evidence that the UK market has a memory longer than one period and that the volatility of stock returns is more sensitive to old news than it is to news about volatility from the previous period.

Subsequently, in the period before the euro denoted by the ECU/£ and the period after the euro represented by Euro/£, the empirical evidence provided little support for exchange rate exposure. Nevertheless, the exposure coefficients for the ECU/£ were mainly positive whereas those for the Euro/£ were mostly negative. Moreover, more firms exhibited significant risk return coefficients, which were positive, in the period before the euro than the period after the euro. The results for the asymmetric parameter were also similar since that more firms showed evidence of leverage effects in the period before the euro than after the euro. Additionally, GARCH effects were found to be more prominent in the period before the euro, whereas in the period after the euro, ARCH effects were found to be more dominant. Even so, the effects of volatility clustering and persistence of volatility were found to be less prominent in the 2 sub-periods than they were in the total period.

Another important contribution was the investigation of the UK firms' change in exposure to the trade weighted index, US$/£, JP¥/£, short-term interest rate and long-term interest rate following the introduction of the euro. Yet again, it was observed that the incidence of exchange rate exposure was generally low in the period before the euro and even much lower after the introduction of the euro. Then, most of the significant exchange rate exposure coefficients were positive, but more firms were exposed to the JP¥/£, followed by the trade weighted index and then the US$/£. But in the period after the euro, absolute reduction in exchange rate exposure was highest for firms with positive exchange rate coefficients to the JP¥/£ before the euro, followed by firms with positive exchange rate coefficients for the TWI before the euro and then firms with negative coefficients for the US$/£ before the euro. But the lowest reduction in net exposure was reported for firms which had negative exchange rate exposure coefficients for the JP¥/£ in the period before the euro. Then, regarding the exposure to changes in interest rates, it was observed that in the period before the euro, the short-term interest rate exposure coefficients were mostly negative while long-term interest rate exposure coefficients were mainly positive. But in the period after the euro, the results indicated that absolute reduction in interest rate exposure after the euro was evidently more for firms with negatively signed short-term interest rate and long-term interest rate exposure coefficient than positively signed interest rate exposure before the euro. In addition, the impact of the introduction of the euro on the volatility of UK firms' stock returns was similar to that reported for the industry level since the volatility of firms' returns increased after the euro. But interestingly, even for some firms that witnessed a reduction in their absolute exchange rate exposure after the euro, the volatility of stock returns still increased after the introduction of the euro. We suggest that the increase in volatility of firms' returns after the euro may have been amplified by the update of stock valuations.

The significance of the mispricing hypothesis is also investigated for UK firms. Although the inferences pertaining to risk-return, leverage effects, and ARCH and GARCH effects were similar to that reported for the contemporaneous models in the total period and sub-periods, the incidence of significant exchange rate and interest rate exposure coefficients was a lot lower. Therefore, it is surmised that returns of UK firms and industries are more exposed to the contemporaneous changes in exchange rates and interest rates than lagged changes.

Then, very surprisingly, the OLS model seemed to have captured more of the influence of exchange rate and interest rate exposure than the AR(1)EGARCH-M model. Despite this short-coming, the results suggest that the GARCH model is still preferred because it seemed to be more instructive, and also it significantly reduced the presence of autocorrelation and heteroscedasticity in the residuals. Nevertheless, in both the firm level and industry level analysis, the residual errors were non-normal. Impliedly, the AR(1)EGARCH-M was unable to capture all the non-linearity in the model. Furthermore, it is unlikely that any other GARCH model would have improved the estimation or provided a better fit to the data. Moreover, this diagnostic result is synonymous to that of previous studies that have also employed various specifications of GARCH models to capture conditional heteroscedasticity in high frequency financial data.

The final part of the empirical analysis entailed using a cross-sectional framework to identify the firm specific factors that influences the firm's exposure to exchange rate and interest rate risk. Additionally, the firm specific data, which are used as proxies, were categorised into factors, such as size, cost of external finance, expected cost of financial distress, growth opportunities and degree of internationalisation. Furthermore, the emphasis was on evaluating the determinants of exchange rate exposure against that of interest rate exposure, and also determining whether the factors that influenced exchange rate and interest rate exposure in the period before the euro were the same in the period after the euro. Subsequently, the estimation for the interest rate exposure was further segregated into short-term and long-term interest rate exposure. Regarding the cross-sectional analysis, this involved using the exchange rate and interest rate exposure coefficients, estimated with the GARCH model and OLS model, as the dependent variables. But the raw as well as the absolute exposure coefficients were employed so as to establish any variations in the results. However, it is noted that there is a possibility that the raw betas may have influenced the results.

Again, the exposure coefficients from the OLS model provided stronger results on the determinants of exchange rate and interest rate exposure of UK firms than the coefficients from the GARCH procedure. But in some instances, the results from the OLS exposure coefficients seemed to differ from that reported for the GARCH exposure coefficients. Then again in some cases, only the raw beta was significant while in other cases, only the absolute beta was significant. There were also incidences when the sign of the significant explanatory variable was different for the raw and absolute betas. But generally speaking, the results from both the raw and absolute coefficients seemed to complement each other. Additionally, to quash the possible problem of multicollinearity that may arise as a result of using leverage and market-to-book value jointly in the same model, 2 models were created, one estimated with leverage and the other estimated without. The formal tests carried out indicated that multicollinearity was not an issue and both models also generated similar results.

In addition, it was also found that size was a relevant factor for exchange rate exposure. But the finding was not distinct because the model estimated using the OLS exposure coefficients implied that larger firms, arguably with economies of scale, according to the theory of risk management, had lower exchange rate exposure. Conversely, the result from the GARCH exposure coefficients indicated that smaller firms, which usually exhibited a higher cost of financial distress, probably hedge more and should therefore exhibit lower exposure to exchange rate risk. Furthermore, the finding for growth opportunities, represented by market value to book value, as an influential factor for exchange rate exposure was not very satisfactory. Firstly, the results were not clear-cut because the sign of the coefficient varied with the exchange rate exposure coefficient, i.e. trade weighted, US$/£ or JP¥/£, that had been used as the dependent variable. Then, research and development was statistically insignificant in all the estimated models, suggesting that it might not have been an ideal proxy for firms' growth opportunities. On the other hand, it was observed that firms with high liquidity generally had lower exchange rate exposure. But the evidence in support of this hypothesis was fairly limited since only cash flow to total asset was significant out of the 3 proxies that had also included quick ratio and dividend policy. Nevertheless, the overwhelming support for the relevance of cash flow to total asset leads to the suggestion that liquidity functions as a shield, which enabled firms absorb the possible detrimental effects that adverse change in exchange rates may have on firm value. It is also usually asserted that firms with high cost of financial distress have more incentives to hedge and should therefore exhibit lower exchange rate exposure. We use leverage, interest cover and tangible assets to test this assumption. It was found that firms with higher leverage had lower exchange rate exposure, firms with a lower level of tangible assets had higher exchange rate exposure, but no evidence was found to support the influence of interest cover on exposure to exchange rate. Nevertheless, the result for tangible assets did not seem to be economically intuitive. It has also been suggested that the use of preference capital rather than debt mitigates the probability of financial distress since payment of dividend to preference shareholders can be deferred without any risk of bankruptcy, while default on debt interest can lead to insolvency. But the results indicated that UK firms, with high preference capital, had lower exposure to exchange rate risk.

The influence of the firms' foreign activities on exchange rate exposure was also examined using foreign assets, foreign income and foreign sales. The results indicated that firms with high foreign assets exhibited higher exchange rate exposure, while regarding foreign income, the findings implied that firms with high foreign income gained from a depreciation of the pound, but lose when the pound appreciated. This result seemed to be logical since a depreciation of the pound is likely to increase the value of the foreign income in domestic currency. Then, despite the high average percentage of foreign sales, the empirical evidence indicated that it did not have any significant influence on exchange rate exposure. If firms with high foreign sales have a stronger perception of the extent of their exposure, it is likely that exchange exposure might have been managed appropriately through the use of internal hedging or derivatives. Although hedging is seen to be imperfect, the small unhedged portion of exposure might not be easily detectable. Additionally, the determinants for exposure to the short-term interest rate and long-term interest rate seemed to be similar. For instance, size, research and development, payout, tangible assets, cash flow and market-to book value, all had a significant influence on both the short term and long-term interest rate exposure coefficients. Nevertheless, it was observed that the sign of the coefficient and consequently the interpretation sometimes varied. Then on a number of occasions, it was found that the short-term and long-term interest exposure seemed to be influenced by different factors. For instance, foreign sales and interest cover were only relevant for the short-term interest rate, while preference capital, quick ratio and total debt were only significant for the long-term interest rate.

Another interesting aspect of this study was to compare the determinants of exchange rate exposure to that of interest rate exposure. It was observed that cash flow, market value to book value, size and tangible assets were significant determinants of exchange rate exposure and interest rate exposure (short-term and long-term interest rate). Again, despite these similarities, the sign of the coefficient and the interpretation of its influence on exposure were not always the same. In addition, preference capital and total debt were only significant determinants for exchange rate and long-term interest rate exposure. Then concerning foreign sales and interest cover, these were only significant determinants for short-term interest rate exposure, while the quick ratio was only relevant for exposure to the long-term interest rate, but regarding foreign assets and foreign income, these could only explain exchange rate exposure.

Another objective of this study was to compare the determinants of exposure in the period before the euro, represented by ECU/£, with the determinants of exposure after the euro represented by Euro/£. The results indicated that for exchange rate exposure; cash flow, foreign assets and quick ratio were significant in the period before the euro, whereas foreign income, total debt, preference capital, interest cover and market value to book value were only relevant in the period after the euro. However, payout, foreign sales, research and development, tangible assets and size were found to be significant in the periods before and after the euro. Furthermore, it was observed that for short-term interest rate exposure, cash flow and quick ratio were relevant in the period before the euro whereas market value to book value, interest cover and foreign income were significant in the period after the euro. Then, tangible assets, total debt, payout, foreign assets, preference capital, size and research and development were all statistically significant before and after the euro, but foreign sales were found to be insignificant in both periods. In addition, the results for the exposure to the long-term interest rate indicated that research and development and quick ratio were only significant in the period before the euro, while interest cover, market value to book value, total debt and foreign assets were significant after the euro. Furthermore, payout, preference capital, tangible assets, cash flow, foreign sales and size were found to be significant for the periods before and after the euro, while foreign income was found to have no relevance in both periods. Then, a quick comparison of the determinants of exchange rate and interest rate exposure in the 2 sub-periods revealed a few similarities to the results reported for the total period. In the first instance, the determinants of exchange rate exposure were different to that of interest rate exposure. Then, it was observed that some of the determinants for short-term interest rate exposure were similar to the factors that influenced exposure to the long-term interest rate. Furthermore, the quick ratio was found to be a significant determinant of both exchange rate and interest rate exposure in the period before the euro, while interest cover and market value to book value were relevant for exchange rate and interest rate exposure after the euro. However, only market value to book value had been significant for exchange rate and interest rate exposure in the total sample period.

7.3 Limitations of the study

GARCH based methodologies are particularly important since they are capable of exploiting the time varying properties characteristic of financial time series data, and also providing coefficient estimates of the time varying parameters. Furthermore, they are also relevant for estimating volatility, which is normally used to ascertain the degree of risk pertinent to the returns of an asset. Another reason why GARCH methods were considered to be intuitively appealing was because they could offer an explanation for investor's attitude towards expected risks and returns and also market volatility (Floros, 2008). Nevertheless, studies by Brooks (1996), Elyasiani and Mansur (1998), Chang (2002), Joseph (2002), Joseph (2003b), Ryan and Worthington (2004), Joseph and Vezos (2006), Brewer *et al.* (2007), Jayasinghe and Tsui (2008) and Léon (2008) have used diverse specifications of GARCH models, even different from the one used in this study. However they have all resolved that GARCH-type models, although still preferable to traditional OLS models, are unable to capture all the non-linearity in the time series data. However, the main aim of this study was to examine exchange rate exposure and interest rate exposure using the best possible available GARCH specification. Incidentally, the development of a GARCH model, which is capable of capturing all the non-normality in the residuals, would have been better, but the AR(1)EGARCH-M model selected well captured positive and negative volatility impacts. In addition, the GARCH methodology in this study has been used to jointly estimate the impact of exchange rate and interest rate exposure, which is also similar to the methods employed by Joseph (2002), Joseph (2003b), Joseph and Vezos (2006) and Vardar *et al.* (2008). But since it has been demonstrated that exchange rate exposure and interest rate exposure have different impacts on stock returns, then there is a possibility that volatility of returns, initiated by movements in exchange rates might be different to volatility prompted by movements in interest rates. Although this aspect has not been explored in this study, it is considered for future research. Furthermore, in measuring the exposure to movements in exchange rates, the trade weighted index and the currencies of the UK's major trade partners (US$/£, JPY/£, ECU/£ and Euro/£) have been used. Some studies such as by Ihrig (2001), El-Masry (2006a) and Jong *et al.* (2006) have also applied the same methods. But the problem still arises that since it is not possible to determine the specific currencies that firms and industries are exposed to, there is a likelihood that some of the firms and industries in this study may not be susceptible to the chosen currencies, thereby reducing the possibility of detecting significant exchange rate exposure. A possible solution might have been the use of qualitative methods, such as questionnaires and interviews, to determine currencies that are most relevant for firms. But this procedure also has its shortcomings. Firstly, the response rate on questionnaires can be extremely low, since target respondents such as financial directors and company treasurers sometimes decline to be interviewed, under the pretext of being busy or company policy that limits the divulging of information. Therefore, information required to complement the analysis might not be adequate.

In this study, the significance of the lagged response or mis-pricing hypothesis on stock return was also examined. The modelling entailed adjusting the exchange rate and interest rate factors by 1 lag. But since the frequency of our data was weekly, 1 lag would be equivalent to 1 week. Therefore, there is a probability, that increasing the lag length to about 4 weeks might have generated stronger results. But since Joseph (2002) still found that UK firms in the electrical sector were more significantly exposed to interest rate lagged by 1 week, than the contemporaneous change in the interest rate, there is also the possibility that examining additional lag lengths might not influence the inferences made in this study. Then due to the inaccessibility of import data, the use of domestic sales based Herfindahl indices or concentration ratios has featured prominently in studies such as by Krishnamoorthy (2001), Bartram and Karolyi (2006) and Dominguez and Tesar (2006) that have examined the impact of industry concentration on exchange rate exposure. However, Mulhearn *et al.* (2001)

explained that these measures only give an insight into the degree of competition within the industry, but do not provide a clear-cut picture. This supposition is also supported by Nellis and Parker (2002), while Worthington *et al.* (2001) posits that if the level of imports is high, then the use of domestic market concentration would only offer limited insight to market concentration. Nevertheless, we may have counteracted any potential problem that this might have on the empirical analysis by using dummy variables to denote concentrated and competitive industries rather than the estimated industry specific Herfindahl index.

Finally, like most earlier studies by Adedeji and Baker (2002), Bartram (2002), Graham and Rogers (2002), Hagelin (2003), Nguyen and Faff (2003), Shu and Chen (2003), Bartram (2004), Hagelin and Pramborg (2004), Chiang and Lin (2005), Faulkender, (2005) Davies *et al.* (2006), El-Masry (2005b), Judge (2006b), Kim *et al.* (2006), Muller and Verschoor (2007), Nguyen *et al.* (2007), Clark and Judge (2008), Faseruk and Mishra, (2008), Al-Shboul and Alison (2009), we have adopted a quantitative approach, using firm specific accounting variables, to determine the factors that influence firms' exposure to exchange rate and interest rate risk. Although this method overcomes the limitation of data unavailability of firm level use of derivatives; the empirical estimation only provides the best probability of factors that might have an influence on exchange rate and interest rate exposure.

Nevertheless, it is believed that the findings from this thesis will be of significant importance for investors as they demonstrate that increased risk in returns can be attributable to systematic and unsystematic risk. But while increase in volatility due to systematic risks, such as movements in exchange rates and interest rate, should increase expected returns, increased volatility arising from unsystematic risks, such as poor industrial relations and uneconomical research and development programmes and even poor management, though divertible, would not increase returns. In addition, we found evidence of significant exposure to exchange rate and interest rate risk for a few firms and industries, but increased risk in returns was noticeable for most firms and industries. Nevertheless, increase in expected returns was only limited to very few firms and industries. Moreover, the study also reflected that for a majority of UK firms and industries, their stock returns are characterised by high persistence in volatility. But, the degree of persistence is relatively lower in some firms or industries than others, suggesting probably, their superior level of proficiency, in the effective management of the adverse effects that volatility can have on returns. Furthermore, the results should also be beneficial for financial managers and directors since they present a detailed indication of the significance of interest rate exposure, particularly the exposure to the long-term interest rate, which seems not to have been accorded much attention in the literature. Besides, the study also indicated that exchange rate exposure and/or interest rate exposure might be more significant for some firms and industries than others.

7.4 Suggestions for future research

The first area of research proposed by this study would be to examine the direct effects of exchange rate and interest rate on the volatility of UK stock returns. Following on Vardar *et al.*'s (2008) procedure for the Istanbul stock exchange, this can be achieved by including the exchange rate and interest rate in the conditional variance equation. Consequently, the predictive power of exchange rate and interest rate risk on stock return volatility can be determined. Another feasible area for future research would be to investigate the half-life of persistence of individual firms, since only the half-life volatility pertaining to portfolios have been examined, and this may not reflect that of the individual firms within the industry. Furthermore, only the impact of competition, i.e. competitive versus concentrated on exchange rate and interest rate exposure has been examined in this study. Future research can be extended to examine regulated industries such as banks, utilities versus non- regulated industries, such as retailers and support services. Besides, industries can also be segregated into consumer based and institutional based to determine whether the returns of industries which have more reliance on individual customers are more susceptible to fluctuations in exchange rates and interest rates than industries which rely more on institutional consumers.

Finally, the firm-specific factors that influence exchange rate and interest rate exposure have been determined in this study using empirical analysis. However, this approach does not reflect the firms' hedging decision. It is therefore suggested that studies, attempting to examine the determinants of exchange rate and interest rate exposure, could also buttress their empirical findings with information generated from qualitative approaches, such as interviews and questionnaires. Although adequate information from these sources can sometimes be difficult to acquire, it probably may shed more light on the firm specific characteristics that influence the use of hedging instruments as well.

Appendix 1 Further evidence of volatilities of stock returns

Floros (2008) explains that the plight of considerable volatility in the last few years, stemming from mature and emerging financial markets worldwide, has given most investors and financial analysts a cause for concern over the uncertainty of the returns on their investment assets. Vardar *et al.* (2008) posit that exchange rates and interest rates are economic and financial risk factors that can influence the volatility of stock returns, while Alexander (1999) cites instability of business performance as a possible factor for volatile returns.

Furthermore, the CAPM finance theory postulates that for the risk averse investor, increase in volatility should be compensated for by an increase in expected returns. But only volatility arising from systematic risk such as exchange rates and interest rates are rewarded, while those that are firm specific or unsystematic risks are not considered. Therefore an increase in volatility may not always lead to an increase in returns, especially if the fluctuations in volatility are mainly due to shocks from unsystematic risk (Ryan and Worthington, 2004). Additionally, Elyasiani and Mansur (1998) explain that only volatility changes that are persistent allow for an adjustment to the risk premium. Baillie and DeGennaro (1990) and Campbell and Hentschel (1993), Bansal and Lundblad (2002) and Brewer *et al.* (2007) found evidence of a positive relationship between risk and returns, whereas Nelson (1991), Glosten *et al.* (1993) and Elyasiani and Mansur (1998) indicate that stock returns have a negative association with volatility. But Joseph (2002), Joseph (2003b), Ryan and Worthington (2004) and Léon (2008) could find no support that expected stock returns were influenced by fluctuations in volatility. Nevertheless, on the basis of significant exposure to movements in exchange rates and interest rates, this study posits a significant positive relationship between expected stock returns and volatility.

Another perspective of volatility of stock returns is leverage effects, which implies that a fall in returns is followed by an increase in volatility, which is greater than the volatility arising from an increase in returns (Magnus and Fosu, 2006). In addition, Koulakiotis *et al.* (2006) explain that volatility is usually higher after a decrease than after an equal increase. Another insight to leverage effects is given by Black (1976), where it is explained that a decrease in the value of equity generates a higher debt to equity ratio, which subsequently leads to higher volatility of returns on equity. Intuitively, there is a negative relationship between stock returns and volatility. However, Al-Zoubi and Kh.Al-Zu'bi (2007) and Léon (2008) found that volatility had an asymmetric effect on the equity returns of the Amman stock exchange and the index of the West African Economic and Monetary Union regional stock market. In effect, good news had a higher impact on volatility than that of bad news. Furthermore, Schwert (1990) indicates that for the US stock market, negative news (innovations) has an impact that is 2.5 times larger than that of positive news (innovations). Similarly, Koutmos and Saidi (1995) examine the volatility of 30 US stock returns constituted in the Dow Jones Industrial Index. They found that negative innovations increased volatility 2.13 times more than positive innovations. In addition, Joseph and Vezos (2006) found evidence that increase in interest rate and foreign exchange rate risk increased the riskiness and leverage effects of most US bank's stock returns in their study. However Joseph (2002) found no evidence of leverage effects for his sample of 4 UK non-financial industries, since sharp negative increases in exchange rates and interest rates did not make the stock prices more volatile. But the use of portfolio returns rather than firm level returns might have obscured the finding of significant leverage parameters. We overcome this limitation by using firm level returns and also re-examine leverage effects on industry returns, but covering a larger and more representative number of 31 UK non-financial industries. Additionally, Bollerslev *et al.* (1992) point out that stock market volatility is affected by the persistence of shocks. Furthermore, Magnus and Fosu, (2006), Joseph and Vezos (2006) and Al-Zoubi and Kh.Al-Zu'bi (2007) explain that stock market returns usually exhibit the characteristics of volatility clustering, whereby large changes in the return series are usually followed by large changes, whereas small changes are followed by small changes. Additionally, Floros (2008) indicated that volatility clustering is the clustering of the variance over time. Subsequently, the tendency for volatility of returns to display a long trend (clustering and persistence), implies that it is time varying. Besides, Elyasiani and Mansur (1998) and Brewer *et al.* (2007) find empirical evidence that the interest rate exposure of bank and insurance firms' stock returns respectively, exhibited time varying properties, whereas Tai (2000), Muller and Verschoor (2007) and Verschoor and Muller (2007) find that the exchange rate exposure of financial institutions, US multinationals and Asian firms respectively, had time dependent characteristics. Similarly, Joseph (2002), Ryan and Worthington (2004), Joseph and Vezos (2006) and Vardar *et al.* (2008) indicate that the sensitivity of stock returns to exchange rate and interest rate risk were time varying. More so, all these empirical studies have employed financial time series, which exhibit time dependent properties, especially at high frequency.

Appendix 2 Correlation coefficients of explanatory variables

Table A2.1 Correlation coefficients of the actual changes in the exchange rate and interest rate variables (total period)

	FTSEALLSH	BOEGBPR	UKTBTND	UKMBRYD	JAPYEN	USBRITP
FTSEALLSH	1.0000					
BOEGBPR	-0.1102***	1.0000				
UKTBTND	-0.0088	0.1268***	1.0000			
UKMBRYD	-0.1025***	0.0230	0.0406	1.0000		
JAPAYEN	-0.1142***	0.5901***	0.0730**	0.0128	1.0000	
USBRITP	0.2277***	-0.6594***	-0.1164***	-0.0080	-0.4590***	1.0000

Notes: This table presents the correlation coefficients of the actual changes in the explanatory variables for the total sample period. FTSEALLSH is the change in the market index, BOEGBPR is the change in the trade weighted nominal exchange rate, UKTBTND is the change in the 3 month treasury bill, UKMBRYD is the change in the 10 year government bond, JAPYEN is the change in the JP¥/£ exchange rate and USBRITP is the change in the US$/£ exchange rate. *** indicates significant correlation at the 1% level, while ** depicts significant correlation at the 5% level.

Table A2.2 Correlation coefficients of the actual changes in the exchange rate and interest rate variables (sub-period before the euro)

	FTSEALLSH	ECU	UKTBTND	UKMBRYD	JAPAYEN	BOEGBPR	USBRITP
FTSEALLSH	1.0000						
UKECUSN	-0.0622	1.0000					
UKTBTND	-0.0243	-0.1067**	1.0000				
UKMBRYD	-0.4063***	0.0778*	0.0524	1.0000			
JAPAYEN	-0.1291***	-0.4877***	0.1350***	0.0011	1.0000		
BOEGBPR	-0.0948**	-0.8727***	0.1317***	-0.0298	0.6765***	1.0000	
USBRITP	0.2406***	0.3568***	-0.1228***	-0.0552	-0.4773***	-0.7214***	1.0000

Notes: This table presents the correlation coefficients of the actual changes in the explanatory variables for the sub-period before the euro. ECU/£ represents the ECU exchange rate. *** represents significant correlation at the 1% level, ** depicts significant correlation at the 5% level, and * indicates significant correlation at the 10% level.

Table A2.3 Correlation coefficients of the actual changes in the exchange rate and interest rate variables (sub-period after the euro)

	FTSEALLSH	EURO	BOEGBPR	USBRITP	JAPAYEN	UKTBTND	UKMBRYD
FTSEALLSH	1.0000						
UKECBSP	-0.0002	1.0000					
BOEGBPR	-0.1290***	-0.8187***	1.0000				
USBRITP	0.2180***	0.1406***	-0.5634***	1.0000			
JAPAYEN	-0.0966**	-0.1764***	0.4595***	-0.4271***	1.0000		
UKTBTND	0.0200	-0.0954*	0.1216**	-0.1020**	-0.0617	1.0000	
UKMBRYD	0.1864***	-0.1345***	0.0850*	0.0562	0.0243	0.0170	1.0000

Notes: This table shows the correlation coefficients of the actual changes in the explanatory variables for the sub-period after the Euro. FTSEALLSH is the change in the market index, EURO is the change in the Euro/£ exchange rate, BOEGBPR is the change in the trade weighted nominal exchange rate, USBRITP is the change in the US$/£ exchange rate, JAPYEN is the change in the JP¥/£ exchange rate, UKTBTND is the change in the 3 month Treasury bill and UKMBRYD is the change in the 10 year government bond.. *** indicates significant correlation at the 1% level, ** represents significant correlation at the 5% level and * indicates significant correlation at the 10% level.

Table A2.4 Correlation coefficients of the unexpected changes in the exchange rate and interest rate variables (total period)

	FTSEALLSH	BOEGBPR	USBRITP	JAPYEN	UKMBRYD	UKTBTND
FTSEALLSH	1.0000					
BOEGBPR	-0.1117***	1.0000				
USBRITP	-0.2266***	0.6387***	1.0000			
JAPYEN	-0.1201***	0.5761***	0.4497***	1.0000		
UKMBRYD	-0.1929***	0.0026	0.0182	0.0273	1.0000	
UKTBTND	0.0044	0.0974***	0.0789**	0.0438	0.0561*	1.0000

Notes: This table presents the correlation coefficients of the unexpected changes in the explanatory variables for the total sample period. However, FTSEALLSH still represents the actual change in the market index. *** indicates significant correlation at the 1% level, ** indicates significant correlation at the 5% level and * represents significant correlation at the 10% level.

Table A2.5 Correlation coefficients of the unexpected changes in the exchange rate and interest rate variables (sub-period before the euro)

	FTSEALLSH	ECU	BOEGBPR	USBRITP	JAPYEN	UKTBTND	UKMBRYD
FTSEALLSH	1						
ECU	0.0701	1					
BOEGBPR	-0.0956**	0.8515***	1				
USBRITP	-0.2406***	0.3264***	0.7037***	1			
JAPYEN	-0.1421***	0.4540***	0.6626***	0.4632***	1		
UKTBTND	-0.0152	0.0778*	0.0936**	0.0854*	0.0833*	1	
UKMBRYD	-0.4346***	-0.1077**	-0.0459	0.0478	0.0229	0.0603	1

Notes: This table presents the correlation coefficients of the unexpected changes (except FTSEALLSH) in the explanatory variables for the sub-period before the euro. *** indicates significant correlation at the 1% level, ** indicates significant correlation at the 5% level and * represents significant correlation at the 10% level.

Table A2.6 Correlation coefficients of the unexpected changes in the exchange rate and interest rate variables (sub-period after the euro)

	FTSEALLSH	EURO	BOEGBPR	USBRITP	JAPYEN	UKTBTND	UKMBRYD
FTSEALLSH	1						
EURO	-0.0098	1					
BOEGBPR	-0.1282***	0.7843***	1				
USBRITP	-0.2153***	0.1167**	0.5553***	1			
JAPYEN	-0.0933*	0.1684***	0.4592***	0.4237***	1		
UKTBTND	0.0387	0.0898*	0.1086**	0.0637	-0.0507	1	
UKMBRYD	0.1732***	0.1187**	0.0866*	-0.0509	0.0300	0.0359	1

Notes: This table shows the correlation coefficients of the unexpected changes in the explanatory variables for the sub-period after the euro. However FTSEALLSH still represents the actual change in the market index. *** indicates significant correlation at the 1% level, ** indicates significant correlation at the 5% level, and * represents significant correlation at the 10% level.

Appendix 3 Herfindahl Index of UK Non-Financial Industries

Table A3.1 Herfindahl Index for Non-Financial Industries

NUMBER	CONCENTRATED IND.	H.I	NUMBER	COMPETITIVE IND.	H.I
1	Aerospace & Defence	4567.71	1	Construction and Materials	1369.03
2	Automobiles & Auto Parts	7633.39	2	Electronic and Elect Eqpt	1326.23
3	Beverages	2984.81	3	General Retailers	936.42
4	Chemicals	2661.49	4	Household Goods	1081.49
5	Electricity	4331.41	5	Industrial Engineering	687.14
6	Fixed-Line Telecom	7684.53	6	Industrial Transport	1233.62
7	Food & Drug Retailers	3920.58	7	Media	836.12
8	Food Producers	3302.91	8	Personal Goods	964.05
9	Forestry & Paper	5535.94	9	Software & Computer Svs.	1201.91
10	Gas, Water & Multi-Utilities	4278.03	10	Support Services	436.09
11	General Industrial	2170.38	11	Tech Hardware & Equipment	1224.82
12	Healthcare Equipment.Svs.	1934.29	12	Travel & Leisure	768.62
13	Leisure Goods	4465.69			
14	Mining	2312.85			
15	Mobile Telecommunications	9485.62			
16	Oil & Gas Producers	4571.75			
17	Oil Equipment & Services	3005.52			
18	Pharmaceuticals & Biotech	5535.57			
19	Tobacco	10000.00			

Note: Concentrated IND and Competitive IND. represent concentrated and competitive industries respectively. H.I is the Herfindahl index value indicating the degree of concentration in the industry. H.I values>1800 represent concentrated industries. Svs. represents services, Biotech stands for Biotechnology and Elect Eqpt is Electrical Equipment.

Appendix 4 Diagnostic results for OLS model

The results of the Q-statistics for the industry level analysis using equation 3.8a indicated the presence of autocorrelation in up to 85% of all the regression estimates. In addition, the Q^2 statistics and the ARCH test revealed that heteroskedasticity was present in at least 90% of the regression estimates. The Jarque-Bera statistics rejected residual normality at the 1% significance level for all industry estimates.

Then, regarding the firm level analysis, the Q-statistics revealed that autocorrelation was present in 70% of the regression residuals. Furthermore, the Q^2 statistics and the ARCH test indicated that heteroskedasticity was also present in 74% of the regression residuals. Finally, the Jarque-Bera statistic was found to be significant at the 1% level for all the estimated models, indicating that the errors are non-normally distributed.

Additionally, similar results were reported when equation 3.8b was used to examine the change in exchange rate and interest rate exposure of UK non-financial firms and industries following the introduction of the euro.

Appendix 5 Descriptive statistics of industry returns and explanatory variables

Table A5.1 Descriptive statistics of non-financial industries' stock returns

	1990-2006		1990-1998		1999-2006		Test for change
INDUSTRY	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	F-statistic
Aerospace and Defence	0.0030	0.0283	0.0020	0.0268	0.0041	0.0300	1.2526**
Automobiles and Auto Parts	0.0009	0.0314	0.0014	0.0251	0.0003	0.0372	2.2045***
Beverages	0.0022	0.0174	0.0021	0.0161	0.0022	0.0188	1.3603***
Chemicals	0.0013	0.0227	0.0007	0.0214	0.0021	0.0241	1.2700**
Construction And Materials	0.0024	0.0180	0.0003	0.0163	0.0047	0.0195	1.4225***
Electricity	0.0019	0.0231	0.0017	0.0196	0.0022	0.0264	1.9744***
Electronic And Electrical Equipment	0.0022	0.0397	0.0024	0.0453	0.0020	0.0322	1.8185***
Fixed-line Telecommunications	0.0003	0.0453	0.0027	0.0325	-0.0023	0.0563	2.9976***
Food and Drug Retailers	0.0026	0.0269	0.0030	0.0280	0.0020	0.0255	1.2041*
Food Producers	0.0015	0.0196	0.0016	0.0183	0.0014	0.0210	1.3194***
Forestry And Paper	0.0000	0.0480	-0.0008	0.0472	0.0009	0.0490	1.0803
Gas, Water And Multi-Utilities	0.0027	0.0278	0.0032	0.0291	0.0021	0.0263	1.2209**
General Industrial	0.0015	0.0289	0.0017	0.0265	0.0012	0.0315	1.4083***
General Retailers	0.0022	0.0264	0.0018	0.0227	0.0027	0.0300	1.7474***
Healthcare Equipment and Services	0.0014	0.0392	0.0009	0.0213	0.0021	0.0526	6.1187***
Household Goods	0.0024	0.0279	0.0012	0.0275	0.0039	0.0283	1.0574
Industrial Engineering	0.0019	0.0173	0.0011	0.0240	0.0025	0.0169	1.0826
Industrial Transport	0.0025	0.0235	0.0013	0.0176	0.0041	0.0227	1.1152

Table A5.1 continued Descriptive statistics of non-financial industries' stock returns

	1990-2006		1990-1998		1999-2006		Test for change
INDUSTRY	**Mean**	**Std. Dev**	**Mean**	**Std. Dev**	**Mean**	**Std. Dev**	**F-statistic**
Leisure Goods	0.0006	0.0684	0.0003	0.0457	0.0009	0.0872	3.6314***
Media	0.0006	0.0677	0.0004	0.0449	0.0009	0.0865	3.7061***
Mining	0.0021	0.0409	-0.0012	0.0411	0.0059	0.0403	1.0400
Mobile Telecommunications	0.0016	0.0223	0.0026	0.0227	0.0004	0.0219	1.0708
Oil and Gas Producers	0.0023	0.0424	0.0003	0.0338	0.0047	0.0503	1.5826***
Oil Equipment And Services	0.0019	0.0297	0.0022	0.0263	0.0015	0.0331	2.2071***
Personal Goods	0.0018	0.0225	0.0001	0.0158	0.0038	0.0281	3.1485***
Pharmaceuticals and Biotechnology	-0.0005	0.0428	-0.0015	0.0469	0.0006	0.0377	1.5458***
Software and Computer Services	0.0014	0.0426	0.0026	0.0302	0.0002	0.0533	3.1101***
Support Services	0.0019	0.0199	0.0020	0.0192	0.0019	0.0208	1.1767*
Technical Hardware and Equipment	-0.0001	0.0630	0.0007	0.0275	-0.0010	0.0871	10.0676***
Tobacco	0.0033	0.0387	0.0031	0.0368	0.0035	0.0408	1.2288**
Travel and Leisure	0.0013	0.0272	0.0004	0.0273	0.0024	0.0270	1.0218
All	0.0017	0.0363	0.0013	0.0301	0.0021	0.0422	1.9675***

Note: The table provides a summary descriptive of weekly returns for non-financial industries. The total period is from January 1990 to December 2006. This is further separated into the period before the Euro which is from January 1990 to December 1998 and after the Euro which is January 1999-December 2006. The F-statistic is the ratio of the variance of 1990-1998 to the variance in 1999-2006. The statistic at all levels of confidence is a one –tailed test against the alternative hypothesis that the variance between the two periods is different. *** is significant at the 1% level, ** is significant at the 5% level and * is significant at the 10% level.

Table A5.2 Summary of descriptive statistics of actual changes in the independent variables

	1990-2006		1990-1998		1999-2006		Test for change
Variable	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	F-test
FTALLSH	0.0018	0.0196	0.0025	0.0186	0.0010	0.0207	1.2434**
BOEGBPR	0.0002	0.0083	0.0001	0.0088	0.0002	0.0078	1.2593**
US/£	0.0002	0.0127	0.0000	0.0140	0.0004	0.0110	1.6022***
JPY/£	0.0000	0.0160	-0.0005	0.0173	0.0005	0.0143	1.4711***
ECU/£	-	-	0.0001	0.0082	-	-	-
EURO/£	-	-	-	-	0.0001	0.0097	-
UKTBTND	-0.0012	0.0162	-0.0020	0.0190	-0.0002	0.0123	2.4078***
UKMBRYD	-0.0009	0.0193	-0.0018	0.0186	0.0002	0.0200	1.1520

Note: *** is significant at the 1% level, ** is significant at the 5% level and * is significant at the 10% level. The ECU/£ is only available for the period 01/01/90-31/12/98 while the Euro/£ is only available for the period 01/01/99-31/12/06.

Table A5.3 Summary of descriptive statistics of unexpected changes in the independent variables

	1990-2006		1990-1998		1999-2006		Test for change
Variable	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	F-test
BOEGBPR	-0.0001	0.7859	-0.0053	0.7889	0.0058	0.7835	1.0139
US/£	0.0001	0.0211	-0.0002	0.0232	0.0005	0.0184	1.5978***
JPY/£	-0.0005	3.1088	-0.0996	3.4957	0.1111	2.6056	1.8000***
ECU/£	-	-	-0.0004	0.0110	-	-	-
EURO/£	-	-	-	-	-0.0004	0.0147	-
UKTBTND	0.0000	0.0154	-0.0005	0.0180	0.0006	0.0118	2.3296***
UKMBRYD	-0.0018	0.1279	-0.0104	0.1499	0.0080	0.0966	2.4100***

Note: *** is significant at the 1% level, ** is significant at the 5% level and * is significant at the 10% level. The FTALLSH is excluded from this table since unexpected changes in the variable were not required for the estimations.

Appendix 6 Summary of estimated parameter coefficients from the variance equations for non-financial industries

Table A6.1 A summary of non-financial industries' exposure to actual and unexpected changes in the Trade weighted nominal exchange rate (BOEGBPR), short -term interest rate and long-term interest rate of the total sample period from January 1990 to December 2006- Parameter estimates from the variance equation

	ACTUAL BOEGBPR					UNEXPECTED BOEGBPR			
INDUSTRY	α_0	α_1	α_2	α_2^*	φ	α_0	α_1	α_2	φ
Aerospace and Defence	-0.1584**	-0.0157	0.1062***		0.9885***	-0.1544**	-0.0160	0.1043***	0.9889***
Automobiles and Auto Parts	-0.2391***	-0.0848***	0.1718***		0.9809***	-0.2264***	-0.0832**	0.1736***	0.9825***
Beverages	-0.7649***	-0.0162	0.2725***		0.9307***	-0.7823***	-0.0143	0.2769***	0.9290***
Chemicals	-0.1770**	-0.04290**	0.1102***		0.9876***	-0.1974***	-0.0428**	0.1197***	0.9860***
Construction And Materials	-0.2992**	0.0183	0.1217***		0.9731***	-0.3247**	0.0187	0.1295***	0.9707***
Electricity	-0.5133***	-0.0380	0.1665***		0.9447***	-0.5127***	-0.0380	0.1638***	0.9445***
Electronic And Electrical Equipment	-0.1273***	-0.0588***	0.08267***		0.9921***	-0.1226***	-0.0584***	0.081***	0.9924***
Fixed-line Telecommunications	-0.1527***	0.0094	0.1088***		0.9896***	-0.1532***	0.0102	0.1093***	0.9896***
Food and Drug Retailers	-0.2651***	-0.0341	0.1173***		0.9764***	-0.284***	-0.0360	0.1210***	0.9743***
Food Producers	-0.1638***	-0.0099	0.1242***		0.9916***	-0.1648***	-0.0099	0.1248***	0.9915***
Forestry And Paper	-2.1103	-0.2767	3.3004		0.2231	-2.1304	-0.2660	3.2343	0.2254
Gas, Water and Multi-Utilities	-0.1993**	-0.0237	0.0997***		0.9831***	-0.2332**	-0.0333	0.1044***	0.9790***
General Industrial	-0.2997***	-0.0467**	0.1515***		0.9746***	-0.2966***	-0.0446*	0.1516***	0.9751***
General Retailers	-0.1932***	-0.0056	0.1218***		0.9869***	-0.1877***	-0.0078	0.1202***	0.9875***
Healthcare Equipment and Services	-0.1048***	-0.0166	0.1108***		0.9951***	-0.1051***	-0.0170	0.1115***	0.9950***
Household Goods	-0.153**	-0.0399***	0.0681***		0.9863***	-0.1447**	-0.0384***	0.0663***	0.9872***

Table A6.1 continued A summary of non-financial industries' exposure to actual and unexpected changes in the Trade weighted nominal exchange rate (BOEGBPR), short -term interest rate and long-term interest rate of the total sample period from January 1990 to December 2006- Parameter estimates from the variance equation

	ACTUAL BOEGBPR					UNEXPECTED BOEGBPR			
INDUSTRY	α_0	α_1	α_2	α_2*	φ	α_0	α_1	α_2	φ
Industrial Engineering	-0.414**	-0.0412	0.1618***		0.9662***	-0.4174**	-0.0404	0.1622***	0.9659***
Industrial Transport	-7.8294***	-0.0293***	-0.0006		-0.0054	-7.756***	-0.0686***	-0.001	0.0032
Leisure Goods	-0.0994***	-0.0088	0.2379***		1.0000***	-0.0999***	-0.0090	0.2395***	1.0000***
Media	-0.1001***	-0.0102	0.2385***		0.9999***	-0.1006***	-0.0101	0.2391***	0.9998***
Mining	-0.2637***	-0.0037	0.1326***		0.9743***	-0.2808***	-0.0049	0.137***	0.9723***
Mobile Telecommunications	-0.295***	0.0357	0.1751***		0.9791***	-0.2938***	0.0354	0.1753***	0.9792***
Oil and Gas Producers	-0.1695**	0.0006	0.1133***		0.9892***	-0.1672**	0.0013	0.1126***	0.9894***
Oil Equipment And Services	-0.1815***	-0.0731**	0.2291***		0.9864***	-0.1983***	-0.0730*	0.2363***	0.9846***
Personal Goods	-0.3689***	-0.0041	0.2871***		0.9762***	-0.3917***	-0.0017	0.2964***	0.9739***
Pharmaceuticals and Biotechnology	-1.6366	-0.3009	-0.0065	-0.0416	0.0148	-1.0449	-0.2138	-0.016	0.0049
Software and Computer Services	-0.0941***	0.0349**	0.1085***		0.9983***	-0.0952***	0.0348**	0.1096***	0.9982***
Support Services	-0.1434***	-0.0539***	0.0638***		0.9889***	-0.1457***	-0.0543***	0.063***	0.9886***
Technical Hardware and Equipment	-0.1301***	-0.0286*	0.1425***		0.9955***	-0.1304***	-0.0281*	0.143***	0.9955***
Tobacco	-0.1245***	-0.0485***	0.0971***		0.9922***	-0.1197***	-0.0443***	0.0909***	0.9922***
Travel and Leisure	-0.1592***	-0.0728***	0.0711***		0.9864***	-0.159**	-0.0725***	0.0714***	0.9865***

Note: α_0 is the constant term in the variance equation, α_1 represents the coefficient for the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. There is one instance where an AR(1)-EGARCH-M(1,1) could not be fitted due to lack of convergence. In this case, an AR(1)-EGARCH-M(2,1) was used instead, consequently, α_2* represents the coefficient for the second ARCH parameter in that model. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

Table A6.2 A summary of non-financial industries' exposure to actual and unexpected changes in the foreign exchange rate US$/£ of the total sample period from January 1990 to December 2006- Parameter estimates from the variance equation

	ACTUAL US$/£				UNEXPECTED US$/£				
INDUSTRY	α_0	α_1	α_2	φ	α_0	α_1	α_2	α_2*	φ
Aerospace and Defence	-0.1563**	-0.0144	0.1058***	0.9887***	-0.1519**	-0.0147	0.1037***		0.9891***
Automobiles and Auto Parts	-0.2304***	-0.0841***	0.1722***	0.9821***	-0.2185***	-0.0831**	0.1743***		0.9836***
Beverages	-0.7824***	-0.0201	0.2778***	0.9289***	-0.8119***	-0.0176	0.2843***		0.9260***
Chemicals	-0.2035***	-0.0443**	0.1232***	0.9855***	-0.2192***	-0.0441**	0.1307***		0.9842***
Construction And Materials	-0.3066**	0.0203	0.1215***	0.972***	-0.3340**	0.0197	0.1291***		0.9693***
Electricity	-0.5014***	-0.0367	0.1642***	0.9461***	-0.4825***	-0.0356	0.1579***		0.9481***
Electronic And Electrical Equipment	-0.124***	-0.0594***	0.0803***	0.9922***	-0.1221***	-0.0590***	0.0799***		0.9924***
Fixed-line Telecommunications	-0.154***	0.0093	0.1093***	0.9895***	-0.1545***	0.0099	0.1097***		0.9894***
Food and Drug Retailers	-0.2661***	-0.0330	0.1196***	0.9766***	-0.2768***	-0.0343	0.1217***		0.9754***
Food Producers	-0.1655***	-0.0110	0.1248***	0.9914***	-0.1678***	-0.0108	0.1264***		0.9913***
Forestry And Paper	-2.0954	-0.2625	3.3245	0.2284	-2.1048	-0.2612	3.3008		0.2302
Gas, Water and Multi-Utilities	-0.1886**	-0.0235	0.0967***	0.9842***	-0.2241**	-0.0329	0.1015***		0.9799***
General Industrial	-0.2877***	-0.0461**	0.1496***	0.9760***	-0.2875***	-0.0437*	0.1507***		0.9762***
General Retailers	-0.1946***	-0.0030	0.1214***	0.9867***	-0.1922***	-0.0038	0.1197***		0.9869***
Healthcare Equipment and Services	-0.105***	-0.0173	0.1118***	0.9951***	-0.1043***	-0.0171	0.1105***		0.9951***
Household Goods	-0.1534**	-0.0401***	0.0682***	0.9862***	-0.1441**	-0.0382***	0.0661***		0.9873***
Industrial Engineering	-0.4379**	-0.0418	0.1663***	0.9639***	-0.4264**	-0.0403	0.1654***		0.9651***
Industrial Transport	-7.792***	-0.0625***	-0.0004	0.0004	-7.8597***	-0.0429	-0.0005		-0.0084
Leisure Goods	-0.0989***	-0.0071	0.2358***	1.0001***	-0.0976***	-0.0068	0.2351***		1.0002***

Table A6.2 continued A summary of non-financial industries' exposure to actual and unexpected changes in the foreign exchange rate US$/£ of the total sample period from January 1990 to December 2006- Parameter estimates from the variance equation

	ACTUAL US$/£				UNEXPECTED US$/£				
INDUSTRY	α_0	α_1	α_2	φ	α_0	α_1	α_2	α_2*	φ
Media	-0.0997***	-0.0083	0.2367***	0.9999***	-0.0988***	-0.0081	0.2363***		1.0001***
Mining	-0.2574***	-0.0052	0.1315***	0.9752***	-0.2687***	-0.0057	0.1341***		0.9738***
Mobile Telecommunications	-0.2891***	0.0394	0.1697***	0.9792***	-0.2916***	0.0396	0.1719***		0.9792***
Oil and Gas Producers	-0.172**	-0.0025	0.1124***	0.9888***	-0.172**	-0.0024	0.1128***		0.9888***
Oil Equipment And Services	-0.1751***	-0.0728**	0.2240***	0.9871***	-0.1850***	-0.0715**	0.2274***		0.9862***
Personal Goods	-0.3766***	-0.0014	0.2920***	0.9753***	-0.4021***	0.0021	0.3026***		0.9728***
Pharmaceuticals and Biotechnology	-0.3611	-0.3289	-0.0235	0.0069	-1.56804	-0.3387	-0.0072	-0.0387	0.0154
Software and Computer Services	-0.0933***	0.0348**	0.1077***	0.9983***	-0.0939***	0.0348**	0.1087***		0.9983***
Support Services	-0.1519***	-0.0545***	0.0677***	0.9883***	-0.1512***	-0.0547***	0.0663***		0.9882***
Technical Hardware and Equipment	-0.1317***	-0.0289*	0.1436***	0.9953***	-0.1319***	-0.0284*	0.1441***		0.9954***
Tobacco	-0.1255***	-0.0520***	0.0965***	0.9919***	-0.1179***	-0.0463***	0.0879***		0.9921***
Travel and Leisure	-0.1634**	-0.0732***	0.0733***	0.9861***	-0.1628**	-0.0731***	0.0737***		0.9862***

Note: α_0 represents the constant term in the variance equation, α_1 is the coefficient for the asymmetric impact of past innovations on current volatility, α_2 denotes the ARCH parameter coefficient and φ is the GARCH parameter coefficient. In the model for the unexpected changes in the US$/£, there is an instance where the AR(1)-EGARCH-M(1,1) could not be fitted as a result of lack of convergence, consequently, an AR(1)-EGARCH-M(2,1) was fitted instead. Therefore, α_2* stands for the coefficient of the second ARCH parameter. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

Table A6.3 A summary of non-financial industries' exposure to actual changes and unexpected changes in the foreign exchange rate JP¥/£for total sample period from January 1990 to December 2006- Estimated coefficients from the variance equation

	ACTUAL JP¥/£				UNEXPECTED JP¥/£			
INDUSTRY	α_0	α_1	α_2	φ	α_0	α_1	α_2	φ
Aerospace and Defence	-0.1581**	-0.0159	0.1059***	0.9885***	-0.1531**	-0.0161	0.1035***	0.9889***
Automobiles and Auto Parts	-0.2197***	-0.0840***	0.1697***	0.9833***	-0.2126***	-0.0830**	0.1699***	0.9841***
Beverages	-0.7237***	-0.0161	0.2593***	0.9343***	-0.7306***	-0.0156	0.2612***	0.9336***
Chemicals	-0.1838**	-0.0434**	0.1114***	0.9869***	-0.2017***	-0.0430**	0.1207***	0.9855***
Construction And Materials	-0.3038**	0.0200	0.1205***	0.9724***	-0.3354**	0.0213	0.1288***	0.9692***
Electricity	-0.5094***	-0.0376	0.1683***	0.9454***	-0.4217***	-0.0323	0.1465***	0.9555***
Electronic And Electrical Equipment	-0.1346***	-0.0576***	0.0879***	0.9916***	-0.1353***	-0.0569***	0.0896***	0.9916***
Fixed-line Telecommunications	-0.1558***	0.0096	0.1101***	0.9892***	-0.1541***	0.0107	0.1097***	0.9894***
Food and Drug Retailers	-0.2699***	-0.0352	0.1165***	0.9757***	-0.2905***	-0.0383*	0.1199***	0.9733***
Food Producers	-0.1656***	-0.0104	0.1254***	0.9914***	-0.1671***	-0.0104	0.1266***	0.9914***
Forestry And Paper	-2.1066	-0.2500	3.2722	0.2344	-2.0975	-0.2677	3.3217	0.2284
Gas, Water And Multi-Utilities	-0.1905**	-0.0240	0.0988***	0.9842***	-0.2241**	-0.0345	0.1034***	0.9801***
General Industrial	-0.2938***	-0.0465**	0.1504***	0.9753***	-0.2904***	-0.0442*	0.1509***	0.9758***
General Retailers	-0.1950***	-0.0035	0.1213***	0.9867***	-0.1985***	-0.0041	0.1222***	0.9863***
Healthcare Equipment and Services	-0.1052***	-0.0164	0.1123***	0.9951***	-0.1051***	-0.0163	0.1125***	0.9951***
Household Goods	-0.1532**	-0.0399***	0.0681***	0.9863***	-0.1452**	-0.0381***	0.0666***	0.9872***
Industrial Engineering	-0.4254**	-0.0392	0.1664***	0.9653***	-0.4311**	-0.0397	0.1655***	0.9646***
Industrial Transport	-7.8110***	-0.0288	-0.0005	-0.0028	-7.8287***	-0.0401	-0.0007	-0.0054
Leisure Goods	-0.0991***	-0.0086	0.2390***	1.0001***	-0.0994***	-0.0083	0.2397***	1.0001***

Table A6.3 continued A summary of non-financial industries' exposure to actual changes and unexpected changes in the foreign exchange rate JP¥/£for total sample period from January 1990 to December 2006- Estimated coefficients from the variance equation

	ACTUAL JP¥/£				UNEXPECTED JP¥/£			
INDUSTRY	α_0	α_1	α_2	φ	α_0	α_1	α_2	φ
Media	-0.0996***	-0.0100	0.2384***	1.0001***	-0.1001***	-0.0093	0.2397***	1.0000***
Mining	-0.2517***	-0.0061	0.1293***	0.9758***	-0.2623***	-0.0066	0.1322***	0.9746***
Mobile Telecommunications	-0.2867***	0.0410	0.1688***	0.9795***	-0.2908***	0.0411	0.1716***	0.9792***
Oil and Gas Producers	-0.1773**	-0.0028	0.1144***	0.9883***	-0.1748**	-0.0009	0.1140***	0.9886***
Oil Equipment And Services	-0.1726***	-0.0729**	0.2198***	0.9875***	-0.1802***	-0.0738**	0.2271***	0.9867***
Personal Goods	-0.3492***	-0.0070	0.2787***	0.9779***	-0.3622***	-0.0047	0.2861***	0.9767***
Pharmaceuticals and Biotechnology	-1.3002	-0.3298	-0.0231	0.0126	-1.0914	-0.2136	-0.0145	0.0051
Software and Computer Services	-0.0931***	0.0348**	0.1077***	0.9983***	-0.0942***	0.0348**	0.1088***	0.9983***
Support Services	-0.1449***	-0.0542***	0.0633***	0.9887***	-0.1490***	-0.0551***	0.0617***	0.9881***
Technical Hardware and Equipment	-0.1307***	-0.0285*	0.1428***	0.9954***	-0.1317***	-0.0282*	0.1438***	0.9954***
Tobacco	-0.1249***	-0.0482***	0.1001***	0.9925***	-0.1216***	-0.0442***	0.0953***	0.9925***
Travel and Leisure	-0.1617**	-0.0735***	0.0706***	0.9861***	-0.1602**	-0.0730***	0.0708***	0.9863***

Note: α_0 is the constant term in the variance equation, α_1 represents the coefficient for the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

Table A6.4 A summary of the ratio of negative innovation to positive innovations and half-life of persistence on the returns of UK non-financial industries using contemporaneous changes in the exchange rate and interest rate measures for the total period 01/01/90-31/1206

INDUSTRY	ACTUAL TWI		UNEXPECTED TWI		ACTIAL US$/$		UNEXPECTED US$/£		ACTIAL JP¥/£		UNEXPECTED JP¥/£	
	N.I/P.I	HL	N.I/P.I	HL	N.I/P.I	HL	N.I/P.I	HL	N.I/P.I	HL	N.I/P.I	HL
Aerospace and Defence	1.0319	60.0999	1.0325	62.1435	1.0292	61.4637	1.0298	63.7915	1.0323*	60.1632	1.0327*	62.6261
Automobiles and Auto Parts	1.1853*	35.9827	1.1815*	39.2789	1.1836*	38.5801	1.1811*	41.9175	1.1835	41.2629	1.1810	43.1073
Beverages	1.0330	9.6599	1.0290	9.4209	1.0411	9.4110	1.0359	9.0169	1.0327	10.2089	1.0316	10.0942
Chemicals	1.0896*	56.0016	1.0896*	49.2411	1.0927*	47.6911	1.0922*	43.7458	1.0909*	52.8775	1.0899*	47.6844
Construction And Materials	0.9641	25.4549	0.9632	23.3256	0.9603	24.4798	0.9614	22.2991	0.9608	24.7895	0.9584	22.2040
Electricity	1.0790	12.1858	1.0790	12.1496	1.0762	12.5192	1.0737	13.0298	1.0781	12.3575	1.0667	15.2331
Electronic And Electrical Equipment	1.1250*	86.7646	1.1241*	91.3513	1.1264*	89.0567	1.1254*	91.0972	1.1223*	82.3575	1.1206*	82.8339
Fixed-line Telecommunications	0.9813	66.5266	0.9798	66.4236	0.9815	65.7613	0.9804	65.5288	0.9809	64.3966	0.9789	65.5727
Food and Drug Retailers	1.0707	29.1414	1.0746	26.6615	1.0683	29.3245	1.0710	27.8402	1.0731	28.2189	1.0796*	25.6290
Food Producers	1.0201	82.5554	1.0200	81.5852	1.0223	80.9987	1.0219	79.5546	1.0211	81.1517	1.0209	80.4017
Forestry And Paper	1.7651	N.A	1.7247	N.A	1.7117	N.A	1.7072	N.A	1.6668	N.A	1.7309	N.A
Gas, Water And Multi-Utilities	1.0486	40.7619	1.0689	32.7380	1.0481	43.6758	1.0681	34.2128	1.0493	43.5254	1.0715	34.5434
General Industrial	1.0981*	27.0166	1.0933*	27.5284	1.0967*	28.6322	1.0913*	28.8655	1.0975*	27.7544	1.0925*	28.3835
General Retailers	1.0113	52.9635	1.0156	55.4078	1.0060	51.9854	1.0077	52.5768	1.0070	51.8435	1.0082	50.4141
Healthcare Equipment and Services	1.0338	140.5367	1.0345	140.3651	1.0352	142.1587	1.0347	140.9387	1.0334	142.2174	1.0332	142.5406
Household Goods	1.0831*	50.3769	1.0798*	54.0470	1.0834*	50.2325	1.0794*	54.2914	1.0832*	50.2991	1.0793*	53.9320
Industrial Engineering	1.0858	20.2044	1.0842	20.0010	1.0872	18.8590	1.0840	19.5505	1.0816	19.6337	1.0827	19.2373
Industrial Transport	1.0604*	N.A	1.1473*	N.A	1.1333*	N.A	1.0896	N.A	1.0594	N.A	1.0836	N.A
Leisure Goods	1.0177	N.A	1.0181	N.A	1.0143	N.A	1.0137	N.A	1.0174	N.A	1.0167	N.A
Media	1.0205	N.A	1.0204	N.A	1.0167	N.A	1.0164	N.A	1.0202	N.A	1.0188	N.A

Table A6.4 continued: A summary of the ratio of negative innovation to positive innovations and half-life of persistence on the returns of UK non-financial industries using contemporaneous changes in the exchange rate and interest rate measures for the total period 01/01/90-31/12/06

INDUSTRY	ACTUAL TWI		UNEXPECTED TWI		ACTIAL US$/$		UNEXPECTED US$/£		ACTIAL JP¥/£		UNEXPECTED JP¥/£	
	N.I/P.I	HL	N.I/P.I	HL	N.I/P.I	HL	N.I/P.I	HL	N.I/P.I	HL	N.I/P.I	HL
Mining	1.0075	26.6984	1.0098	24.7322	1.0104	27.6048	1.0114	26.1443	1.0123	28.3502	1.0132	26.9929
Mobile Telecommunications	0.9310	32.8124	0.9316	33.0730	0.9241	33.1311	0.9238	32.9766	0.9213	33.5951	0.9211	33.1230
Oil and Gas Producers	0.9987	64.2097	0.9973	65.6166	1.0050	61.8463	1.0048	62.0030	1.0057	59.0077	1.0018	60.5460
Oil Equipment And Services	1.1578*	50.8225	1.1576*	44.9385	1.1572*	53.6193	1.1540*	50.0597	1.1574*	55.3048	1.1595*	52.1400
Personal Goods	1.0082	28.8114	1.0034	26.3104	1.0029	27.7670	0.9958	25.1652	1.0141	31.0974	1.0095	29.4175
Pharmaceuticals and Biotechnology	1.8606	N.A	1.5438	N.A	1.9801	N.A	2.0246	N.A	1.9841	N.A	1.5433	N.A
Software and Computer Services	0.9325*	415.4585	0.9326*	405.7149	0.9326*	421.7893	0.9325*	426.2054	0.9326*	424.6363	0.9326*	418.2205
Support Services	1.1139*	62.3867	1.1149*	60.4712	1.1154*	58.8961	1.1157*	58.6540	1.1146*	61.0149	1.1167*	57.8564
Technical Hardware and Equipment	1.0590*	154.2355	1.0578*	154.6503	1.0597*	149.8801	1.0586*	150.5013	1.0587*	152.1944	1.0581*	150.5341
Tobacco	1.1020*	89.1260	1.0928*	89.2416	1.1097*	86.0911	1.0971*	87.9070	1.1014*	92.6055	1.0925*	92.1713
Travel and Leisure	1.1570*	50.9627	1.1564*	51.1763	1.1580*	49.7138	1.1576*	50.1588	1.1588*	49.4906	1.1576*	50.2917

Note: N.I/P.I represents the ratio of negative innovation to positive innovation but this s only relevant in instances where the asymmetric parameter is significant as denoted by *. HL is the half-life of the innovation and in columns with N.A, the GARCH parameter had been unstable and cannot be used in the calculation. Actual and unexpected represent the actual and unexpected changes in the exchange rate measures respectively. TWI is the bank of England trade weighted index, US$/£ is the US$ exchange rate against the £ while JP¥/£ is the Japanese Yen exchange rate against the £.

Table A6.5 A summary of non-financial industries exposure to actual and unexpected changes in the foreign exchange rate ECU/£ for the sample period before the Euro 01/01/90-31/12/98 - Estimated coefficients from the variance equation

	ACTUAL CHANGES IN ECU/£					UNEXPECTED CHANGES IN ECU/£			
INDUSTRY	α_0	α_1	α_2	α_2*	φ	α_0	α_1	α_2	φ
Aerospace and Defence	-0.0251	-0.0215	0.0936**		1.0039***	-0.0236	-0.0222	0.0925**	1.0039***
Automobiles and Auto Parts	-5.7997***	-0.3758	0.0731		0.1054	-5.756***	-0.3377	0.0616	0.1139*
Beverages	-2.2481***	0.1519**	0.3507***		0.7669***	-2.2852***	0.1505**	0.3599***	0.7632***
Chemicals	-0.6011**	-0.0772*	0.2267***		0.9466***	-0.6399**	-0.0785*	0.2373***	0.9427***
Construction And Materials	-9.4556***	-0.1856**	-0.0618		-0.1528*	-9.406***	-0.1709**	-0.0564	-0.1316
Electricity	-5.4581	-0.0411	0.1341		0.2336	-5.7615	-0.0295	0.1533	0.1920
Electronic And Electrical Equipment	-0.2498**	-0.0797**	0.1085**		0.9803***	-0.2368*	-0.0765**	0.1060**	0.9815***
Fixed-line Telecommunications	-2.516**	-0.0698	0.2338**		0.6905***	-2.6319**	-0.0713	0.2364**	0.6754***
Food and Drug Retailers	-0.3247*	-0.0561*	0.1061**		0.9674***	-0.3323**	-0.0580*	0.1061**	0.9663***
Food Producers	-3.7923	0.0157	0.0167		-0.3858	-0.2378**	0.0717***	0.0720***	0.9784***
Forestry And Paper	-5.4942***	0.0053	0.0021	-0.0039	0.1356	-5.0066	0.0181	0.0251	-0.3801
Gas, Water And Multi-Utilities	-12.9991***	0.0146	-0.1870		-0.7789***	-0.7394*	0.0668	-0.0051	0.8988***
General Industrial	-7.7417***	-0.0387	0.0209		-0.0053	-7.7692***	-0.0295	0.0153	-0.0069
General Retailers	-0.3712**	-0.0035	0.1019**		0.9637***	-0.3842**	-0.0058	0.0996*	0.9619***
Healthcare Equipment and Services	-9.7326***	-0.1266*	0.0570		-0.2255**	-9.6939***	-0.1239*	0.0519	-0.2190**
Household Goods	-0.6384*	-0.0968**	0.1277*		0.9293***	-0.6493*	-0.0999**	0.1249*	0.9275***
Industrial Engineering	-0.5844*	-0.0240	0.2000***		0.9503***	-0.6016*	-0.0159	0.2013***	0.9484***
Industrial Transport	-7.6922***	-0.1087	-0.0027		0.016	-7.9102***	-0.0976	-0.0027	-0.0084
Leisure Goods	-1.2923	-0.4699	1.9125		0.7198***	-1.2844	-0.4751	1.8610	0.7266***

Table A6.5 continued A summary of non-financial industries exposure to actual and unexpected changes in the foreign exchange rate ECU/£ for the sample period before the Euro 01/01/90-31/12/98 - Estimated coefficients from the variance equation

	ACTUAL CHANGES IN ECU/£					UNEXPECTED CHANGES IN ECU/£			
INDUSTRY	α_0	α_1	α_2	α_2*	φ	α_0	α_1	α_2	φ
Media	-1.3044	-0.4185	1.6827		0.7324***	-1.2792	-0.4437	1.7278	0.7361***
Mining	-0.0935**	-0.0924***	-0.0011		0.9859***	-0.0962*	-0.0887***	0.0085	0.9863***
Mobile Telecommunications	-0.6413*	0.0273	0.1935***		0.9372***	-0.6317*	0.0244	0.1911***	0.9382***
Oil and Gas Producers	-7.0582***	0.1437*	0.3636***		0.1235	-7.0728***	0.1502*	0.3649***	0.1218
Oil Equipment And Services	-4.4363	-0.2876	-0.0177		0.0136	-3.67	-0.3878	-0.0219	0.0130
Personal Goods	-1.5173***	0.0183	0.4167***		0.8547***	-1.522***	0.0208	0.4218***	0.8545***
Pharmaceuticals and Biotechnology	-0.3053	-0.2879	-0.0284		0.0063	-2.4141	-0.1048	-0.0141	0.0121
Software and Computer Services	-8.0308***	-0.1149	0.0449		-0.0662	-8.0129***	-0.1053	0.0426	-0.0647
Support Services	-0.0786	-0.0609***	0.0497*		0.9946***	-0.0649	-0.0611***	0.0375	0.9951***
Technical Hardware and Equipment	-7.6815***	0.0904***	0.0256		-0.0318	-7.6441***	0.0737***	0.0208	-0.0286
Tobacco	-0.3321**	-0.0046	0.1425***		0.9669***	-0.3438**	-0.0024	0.1436***	0.9654***
Travel and Leisure	-9.9703***	0.1048	0.6096***		-0.2289	-0.3124**	-0.1320***	0.0446	0.9638***

Note: α_0 is the constant term in the variance equation, α_1 represents the coefficient for the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. There is one instance where an AR(1)-EGARCH-M(1,1) could not be fitted due to lack of convergence. In this case, an AR(1)-EGARCH-M(2,1) was used instead, consequently, α_2* represents the coefficient for the second ARCH parameter in that model. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

Table A6.6 A summary of non-financial industries exposure to actual and unexpected changes in the foreign exchange rate EURO/£ for the sample period after the Euro 01/01/99-31/12/06 - Estimated coefficients from the variance equation

	ACTUAL CHANGES IN Euro/£					UNEXPECTED CHANGES IN Euro/£			
INDUSTRY	α_0	α_1	α_2	α_2^*	φ	α_0	α_1	α_2	φ
Aerospace and Defence	-12.6443***	0.0388	0.2252**		-0.7195***	-12.5857***	0.0449	0.2200**	-0.7119***
Automobiles and Auto Parts	-0.4487**	-0.1045**	0.1418**		0.9470***	-0.4525*	-0.1011**	0.1454**	0.9470***
Beverages	-0.7344*	-0.0323	0.2268***		0.9293***	-0.7202*	-0.0307	0.2243***	0.9308***
Chemicals	-7.7827***	0.0314	0.0004		-0.0044	-7.7940	0.0402***	0.0000	-0.0063
Construction And Materials	-4.4726*	0.0719	0.3246*		0.4598	-8.8065***	-0.0919	0.0101	-0.0981
Electricity	-0.0701	-0.0375	0.0698*		0.9979***	-0.0704	-0.0389	0.0692*	0.9977***
Electronic And Electrical Equipment	-7.4806***	0.1682**	0.0291		0.0251	-7.4738***	0.1694**	0.0304	0.0262
Fixed-line Telecommunications	-0.1783*	0.0136	0.1355***		0.9877***	-0.1779*	0.0134	0.1349***	0.9877***
Food and Drug Retailers	-0.0720***	-0.0543**	-0.0403		0.9875***	-0.0672***	-0.0558**	-0.0481**	0.9874***
Food Producers	0.0251***	-0.0538***	-0.0199***		1.0019***	0.0247***	-0.0482***	-0.0216***	1.0017***
Forestry And Paper	-7.0349	-0.3090	0.5385	1.1118	-0.6138***	0.4348	-1.6631	14.1702	0.6251***
Gas, Water And Multi-Utilities	-0.2040*	-0.0963**	0.1021*		0.9842***	-0.2002**	-0.0904**	0.1059**	0.9850***
General Industrial	-0.1149**	-0.0041	0.0551		0.9908***	-0.1105**	-0.0023	0.0519	0.9911***
General Retailers	-0.3045***	-0.0507	0.1611***		0.9772***	-0.2966***	-0.0555	0.1543***	0.9775***
Healthcare Equipment and Services	-0.2401**	-0.0610	0.1633***		0.9756***	-0.2351***	-0.1701**	0.2894**	0.9834***
Household Goods	-0.6028**	-0.0799***	-0.0260		0.9165***	-0.6066**	-0.0834***	-0.0227	0.9163***
Industrial Engineering	-0.0924***	-0.0427**	-0.0714**		0.9832***	-0.1193***	-0.0553***	-0.0712***	0.9800***
Industrial Transport	-8.0130***	0.1027*	0.0052		-0.0240	0.0304***	0.0902*	0.0062	-0.0271
Leisure Goods	-0.2085**	-0.0248	0.1947***		0.9825***	-0.1932**	-0.0218	0.1867***	0.9843***

Table A6.6 continued A summary of non-financial industries exposure to actual and unexpected changes in the foreign exchange rate EURO/£ for the sample period after the Euro 01/01/99-31/12/06 - Estimated coefficients from the variance equation

	ACTUAL CHANGES IN Euro/£					UNEXPECTED CHANGES IN Euro/£			
INDUSTRY	α_0	α_1	α_2	α_2*	φ	α_0	α_1	α_2	φ
Media	-0.2076**	-0.0242	0.1935***		0.9825***	-0.1939***	-0.0212	0.1859***	0.9841***
Mining	-0.0690**	0.0734***	-0.0339		0.9864***	-0.0523*	0.0643***	-0.0624	0.9856***
Mobile Telecommunications	-0.2033**	-0.0022	0.1377***		0.9878***	-0.2027***	-0.0023	0.1364***	0.9878***
Oil and Gas Producers	-0.0702	-0.0021	0.0535*		0.9968***	-0.0688	-0.0030	0.0509*	0.9967***
Oil Equipment And Services	-1.7050**	-0.2457***	-0.0102		0.7185***	-1.6514**	-0.2435***	-0.0149	0.7268***
Personal Goods	-0.7074*	0.0254	0.2345**		0.9242***	-0.6987*	0.0244	0.2325**	0.9253***
Pharmaceuticals and Biotechnology	3.0139	6.3973	89.2879		0.0414	-0.3318	0.9480	15.2008	0.0904
Software and Computer Services	-0.1424**	0.0338	0.1507***		0.9969***	-0.1418**	0.0331	0.1515***	0.9972***
Support Services	-0.1365***	-0.0552*	0.0204		0.9864***	-0.1143***	-0.0800***	-0.0083	0.9867***
Technical Hardware and Equipment	-0.2258***	-0.0426	0.1777***		0.9830***	-0.2204***	-0.0391	0.1752***	0.9836***
Tobacco	-0.0112	0.0031	-0.0445*		0.9947***	-0.0844**	-0.0195	0.0520	0.9945***
Travel and Leisure	-7.6280***	-0.2640***	-0.0751		-0.0102	-8.5947***	-0.2501***	-0.0389	-0.1331

Note: α_0 represents the constant term in the variance equation, α_1 is the coefficient for the asymmetric impact of past innovations on current volatility, α_2 denotes the ARCH parameter coefficient and φ is the GARCH parameter coefficient. In the model for the actual changes in the EURO/£, there is an instance where the AR(1)-EGARCH-M(1,1) could not be fitted as a result of lack of convergence, consequently, an AR(1)-EGARCH-M(2,1) was fitted instead. So, α_2* is the coefficient of the second ARCH parameter. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

Table A6.7 A summary of the ratio of negative innovation to positive innovations and half-life of persistence on the returns of UK non-financial industries for the 2 sub-periods 01/01/90-31/12/98 and 01/01/99-31/12/06 using contemporaneous changes in the exchange rate measures

	ACTUAL ECU/£		UNEXPECTED ECU/£		ACTUAL EURO/£		UNEXPECTED EURO	
INDUSTRY	N.I/P.I	HL	N.I/P.I	HL	N.I/P.I	HL	N.I/P.I	HL
Aerospace and Defence	1.0439	N.A	1.0454	N.A	0.9253	N.A	0.9141	N.A
Automobiles and Auto Parts	2.2039	0.3081	2.0197	0.3191*	1.2333*	12.7403*	1.2249*	12.7329*
Beverages	0.7361*	2.6117*	0.7382*	2.5653*	1.0666	9.4524*	1.0632	9.6647*
Chemicals	1.1675*	12.6305*	1.1704*	11.7603*	0.9391	N.A	0.9226*	N.A
Construction And Materials	1.4559*	N.A	1.4122*	N.A	0.8658	0.8922	1.2024	N.A
Electricity	1.0857	0.4767	1.0609	0.4200	1.0779	325.5335*	1.0809	305.1390*
Electronic And Electrical Equipment	1.1732*	34.8374*	1.1657*	37.2539*	0.7119*	0.1881	0.7101*	0.1904
Fixed-line Telecommunications	1.1501	1.8716*	1.1536	1.7666*	0.9731	55.9512*	0.9735	55.9100*
Food and Drug Retailers	1.1190*	20.9136*	1.1232*	20.2648*	1.1150*	55.2646*	1.1182*	54.7386*
Food Producers	0.9690	N.A	0.8661*	31.8122*	1.1137*	N.A	1.1013*	N.A
Forestry And Paper	0.9895	0.3469	0.9644	N.A	1.8945	N.A	N.A	1.4754*
Gas, Water And Multi-Utilities	0.9713	N.A	0.8747	6.4993*	1.2132*	43.5198*	1.1988*	45.9766*
General Industrial	1.0806	N.A	1.0608	N.A	1.0082	74.9704*	1.0046	77.4472*
General Retailers	1.0070	18.7462*	1.0117	17.8459*	1.1069	29.9987*	1.1176	30.4627*
Healthcare Equipment and Services	1.2900*	N.A	1.2830*	N.A	1.1299	28.1004*	1.4101*	41.4511*
Household Goods	1.2144*	9.4532*	1.2221*	9.2213*	1.1738*	7.9451*	1.1820*	7.9321*
Industrial Engineering	1.0492	13.5971*	1.0324	13.1053*	1.0892*	40.8205*	1.1172*	34.2698*
Industrial Transport	1.2439	0.1676	1.2163	N.A	0.8135*	N.A	0.8344*	N.A
Leisure Goods	2.7730	2.1082*	2.8100	2.1708*	1.0509	39.1659*	1.0445	43.7570*

Table A6.7 continued A summary of the ratio of negative innovation to positive innovations and half-life of persistence on the returns of UK non-financial industries for the 2 sub-periods 01/01/90-31/12/98 and 01/01/99-31/12/06 using contemporaneous changes in the exchange rate measures

	ACTUAL ECU/£		UNEXPECTED ECU/£		ACTUAL EURO/£		UNEXPECTED EURO	
INDUSTRY	N.I/P.I	HL	N.I/P.I	HL	N.I/P.I	HL	N.I/P.I	HL
Media	2.4394	2.2257*	2.5949	2.2627*	1.0497	39.3401*	1.0434	43.1645*
Mining	1.2038*	48.8119*	1.1947*	50.5332*	0.8630*	50.4512*	0.8790*	47.8145*
Mobile Telecommunications	0.9468	10.6870*	0.9523	10.8666*	1.0044	56.60811*	1.0046	56.5847*
Oil and Gas Producers	0.7486*	0.3314	0.7387*	0.3293	1.0042	216.0588*	1.0060	211.7545*
Oil Equipment And Services	1.8074	0.1613	2.2667	0.1595	1.6514*	2.0971*	1.6439*	2.1723*
Personal Goods	0.9641	4.4148*	0.9592	4.4100*	0.9505	8.7964*	0.9524	8.9266*
Pharmaceuticals and Biotechnology	1.8087	0.1368	1.2342	0.1569	-0.7296	0.2176	0.0267	0.2884
Software and Computer Services	1.2597	N.A	1.2355	N.A	0.9346	226.0239*	0.9359	243.8911*
Support Services	1.1298*	128.01370*	1.1300*	143.1024*	1.1170*	50.6455*	1.1741*	51.7102*
Technical Hardware and Equipment	0.8341*	N.A	0.8627*	N.A	1.0890	40.3181*	1.0814	41.7916*
Tobacco	1.0093	20.5924*	1.0048	19.6938*	0.9937	130.0174*	1.0398	125.6798*
Travel and Leisure	0.8103	N.A	1.3042*	18.8302*	1.7177*	N.A	1.6670*	N.A

Note: N.I/P.I stands for the ratio of negative innovation to positive innovation but this s only relevant in instances where the asymmetric parameter is significant as denoted by *. HL is the half-life of the innovation and in columns with N.A, the GARCH parameter had been unstable and cannot be used in the calculation. Actual and unexpected represent the actual and unexpected changes in the exchange rate measures respectively. ECU/£ is the ECU exchange rate against the £ while Euro/£ is the euro exchange rate against the £.

Table A6.8 A summary of non-financial industries' exposure to market risk and actual changes in the Trade weighted nominal exchange rate, 3 Month Treasury bill (TB) and 10 Year Government Bond (GB) before the euro and after the introduction of the euro: Estimated coefficients from the variance equation

INDUSTRY	α_0	α_1	α_2	α_2*	φ	EURDUM
Aerospace and Defence	-0.1523*	-0.0132	0.1036***		0.9891***	0.0011
Automobiles and Auto Parts	-0.3843**	-0.0876**	0.1977***		0.9640***	0.0307
Beverages	-1.6468***	0.0257	0.3008***		0.8356***	0.1293**
Chemicals	-0.4387***	-0.0654**	0.1453***		0.9600***	0.0308*
Construction And Materials	-8.9833***	-0.0899**	-0.0038	0.0050	-0.1056**	0.0258**
Electricity	-0.5079***	-0.0402	0.1650***		0.9458***	0.0064
Electronic And Electrical Equipment	-0.1520**	-0.0635***	0.0854***		0.9895***	0.0036
Fixed-line Telecommunications	-0.1631*	0.0091	0.1089***		0.9883***	0.0021
Food and Drug Retailers	-0.2337**	-0.0397**	0.0982***		0.9782***	-0.0088
Food Producers	-0.1687**	-0.0114	0.1234***		0.9910***	0.0003
Forestry And Paper	-2.0856	0.1528	4.5452		0.0833	1.4492***
Gas, Water And Multi-Utilities	-0.1771**	-0.0347	0.0810**		0.9838***	-0.0106
General Industrial	-0.3117***	-0.0483**	0.1519***		0.9735***	0.0045
General Retailers	-0.1740**	-0.0057	0.1188***		0.9890***	-0.0030
Healthcare Equipment and Services	-0.2408**	-0.0330	0.1184***		0.9786***	0.0325*
Household Goods	-0.3359**	-0.0653***	0.0547*		0.9623***	0.0231**
Industrial Engineering	-0.4414**	-0.0529*	0.1452***		0.9624***	0.0116
Industrial Transport	-0.446**	-0.0324	0.0668*		0.9507***	0.0261
Leisure Goods	-0.736***	-0.1807	0.7719		0.8968***	0.1944***

Table A6.8 continued A summary of non-financial industries' exposure to market risk and actual changes in the Trade weighted nominal exchange rate, 3 Month Treasury bill (TB) and 10 Year Government Bond (GB) before the euro and after the introduction of the euro: Estimated coefficients from the variance equation

INDUSTRY	α_0	α_1	α_2	α_2*	φ	EURDUM
Media	-0.7379***	-0.1833	0.7722		0.8964***	0.1953***
Mining	-0.4487***	-0.0338	0.1443***		0.9498***	0.0296*
Mobile Telecommunications	-0.3037***	0.0164	0.1707***		0.9768***	-0.0161
Oil and Gas Producers	-0.1636**	0.0009	0.1172***		0.9904***	-0.0020
Oil Equipment And Services	-2.0445***	-0.2198	0.7813		0.6887***	0.5080***
Personal Goods	-1.2685***	0.0290	0.3355***		0.8803***	0.2077***
Pharmaceuticals and Biotechnology	-2.6981	-0.2056	-0.0075	-0.0322	0.0231	0.0080
Software and Computer Services	-0.1312**	0.0370**	0.1155***		0.9944***	0.0075
Support Services	-0.0247	-0.0465***	0.0008***		0.9968***	-0.0085***
Technical Hardware and Equipment	-0.2089***	-0.0424**	0.1358***		0.9850***	0.0292
Tobacco	-0.1394***	-0.0329*	0.1140***		0.9917***	-0.0028
Travel and Leisure	-0.2067***	-0.1043***	0.0405*		0.9784***	0.0173***

Note: α_0 is the constant term, α_1 represents the coefficient for the asymmetric impact of past innovations on current volatility. α_2 is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. There is an instance where the AR(1)-EGARCH-M(1,1) could not be fitted as a result of lack of convergence, therefore an AR(1)-EGARCH-M(2,1) was fitted instead. Consequently, α_2* represents the coefficient of the second ARCH parameter. EURDUM is the coefficient of the euro dummy which examines the impact of the introduction of the euro on the volatility of industry returns. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

Table A6.9 A summary of non-financial industries' exposure to market risk and unexpected changes in the Trade weighted nominal exchange rate, 3 Month Treasury bill (TB) and 10 Year Government Bond (GB) before the euro and after the introduction of the euro: Estimated coefficients from the variance equation

INDUSTRY	α_0	α_1	α_2	φ	EURDUM
Aerospace and Defence	-0.1533*	-0.0154	0.1029***	0.9889***	0.0014
Automobiles and Auto Parts	-0.3664**	-0.0851**	0.1947***	0.9661***	0.0293
Beverages	-1.7028***	0.0288	0.3050***	0.8296***	0.1338**
Chemicals	-0.4609***	-0.0669**	0.1516***	0.9579***	0.0321*
Construction And Materials	-9.1436***	-0.0687	-0.0007	-0.1163**	0.0228
Electricity	-0.5176***	-0.0375	0.1675***	0.9445***	0.0061
Electronic And Electrical Equipment	-0.1430**	-0.0616***	0.0834***	0.9903***	0.0029
Fixed-line Telecommunications	-0.1644*	0.0099	0.1094***	0.9882***	0.0023
Food and Drug Retailers	-0.2391**	-0.0398*	0.0996***	0.9776***	-0.0093
Food Producers	-0.1703**	-0.0111	0.1241***	0.9909***	0.0004
Forestry And Paper	-3.0896	0.0532	2.5364	0.1094	1.411***
Gas, Water And Multi-Utilities	-0.2189**	-0.0367	0.0912***	0.9790***	-0.0125
General Industrial	-0.3029***	-0.0453*	0.1504***	0.9745***	0.0036
General Retailers	-0.1737**	-0.0067	0.1184***	0.9890***	-0.0029
Healthcare Equipment and Services	-0.2390**	-0.0311	0.1187***	0.9789***	0.0322
Household Goods	-0.2793**	-0.0567***	0.0564*	0.9696***	0.0175**
Industrial Engineering	-0.4406**	-0.0503	0.1467***	0.9626***	0.0115
Industrial Transport	-0.4392**	-0.0317	0.0708*	0.9519***	0.0247
Leisure Goods	-0.7578***	-0.1908	0.8105	0.8916***	0.2041***

Table A6.9 continued A summary of non-financial industries' exposure to market risk and unexpected changes in the Trade weighted nominal exchange rate, 3 Month Treasury bill (TB) and 10 Year Government Bond (GB) before the euro and after the introduction of the euro: Estimated coefficients from the variance equation

INDUSTRY	α_0	α_1	α_2	φ	EURDUM
Media	-0.7606***	-0.1881	0.7904	0.8917***	0.2035***
Mining	-0.4519***	-0.0331	0.1484***	0.9496***	0.0285*
Mobile Telecommunications	-0.3000***	0.0157	0.1690***	0.9771***	-0.0165
Oil and Gas Producers	-0.1639**	0.0015	0.1176***	0.9904***	-0.0021
Oil Equipment And Services	-2.0245***	-0.2227	0.7886	0.6921***	0.5033***
Personal Goods	-1.2627***	0.0276	0.3374***	0.8810***	0.2063***
Pharmaceuticals and Biotechnology	-2.5500	-0.1835	-0.0166	0.0126	0.0037
Software and Computer Services	-0.1323**	0.0373**	0.1168***	0.9944***	0.0075
Support Services	-0.0394*	-0.0471***	0.0139	0.9961***	-0.0094***
Technical Hardware and Equipment	-0.2081***	-0.0420**	0.1357***	0.9850***	0.0289
Tobacco	-0.1434***	-0.0335*	0.1134***	0.9911***	-0.0024
Travel and Leisure	-0.2055***	-0.1040***	0.0391	0.9784***	0.0170***

Note: α_0 represents the constant term, α_1 is the coefficient for the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. EURDUM stands for the coefficient of the euro dummy which examines the impact of the introduction of the euro on the volatility of industry returns. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

Table A6.10 A summary of non-financial industries' exposure to actual and unexpected changes in the US$/£ before the euro and after the introduction of the Euro: Estimated coefficients from the variance equation

	ACTUAL US$						UNEXPECTED US$				
INDUSTRY	α_0	α_1	α_2	α_2*	φ	EURDUM	α_0	α_1	α_2	φ	EURDUM
Aerospace and Defence	-0.1506*	-0.0119	0.1033***		0.9893***	0.0012	-0.1499*	-0.0139	0.1021***	0.9893***	0.0013
Automobiles and Auto Parts	-0.3671**	-0.0893**	0.1916***		0.9655***	0.0283	-0.3544**	-0.0870**	0.1875***	0.9670***	0.0278
Beverages	-1.6511***	0.0186	0.3032***		0.8352***	0.1305**	-1.7412***	0.0261	0.3128***	0.8257***	0.1378**
Chemicals	-0.4489***	-0.0654**	0.1478***		0.9591***	0.0319*	-0.4702***	-0.0670**	0.1537***	0.957***	0.0332*
Construction And Materials	-8.9580***	-0.0862*	-0.0031	0.0042	-0.1007**	0.0241*	-9.1272***	-0.0720	-0.0006	-0.1146**	0.0232
Electricity	-0.4943***	-0.0389	0.1611***		0.9473***	0.0055	-0.4751***	-0.0356	0.1582***	0.9496***	0.0049
Electronic And Electrical Equipment	-0.1495**	-0.0634***	0.0853***		0.9898***	0.0031	-0.1408**	-0.0617***	0.0834***	0.9906***	0.0023
Fixed-line Telecommunications	-0.1766**	0.0079	0.1120***		0.9868***	0.0034	-0.1802**	0.0092	0.1132***	0.9864***	0.0039
Food and Drug Retailers	-0.2272**	-0.0386**	0.0988***		0.9792***	-0.0084	-0.2296**	-0.0384*	0.0994***	0.9789***	-0.0089
Food Producers	-0.1685**	-0.0125	0.1244***		0.9911***	0.0003	-0.1712**	-0.0117	0.1252***	0.9909***	0.0004
Forestry And Paper	-2.0695	0.2222	4.6005		0.0815	1.4421***	-2.2981	0.1976	4.0481	0.0840	1.4382***
Gas, Water And Multi-Utilities	-0.1633**	-0.0369	0.0767**		0.9853***	-0.0096	-0.2051**	-0.0380	0.0874**	0.9805***	-0.0116
General Industrial	-0.2927***	-0.0470**	0.1484***		0.9756***	0.0036	-0.2882***	-0.0447*	0.148***	0.9762***	0.0028
General Retailers	-0.1784***	-0.0025	0.1190***		0.9884***	-0.0027	-0.1869***	-0.0031	0.1211***	0.9876***	-0.0025
Healthcare Equipment and Services	-0.2281**	-0.0333	0.1155***		0.98***	0.0304	-0.2251**	-0.0311	0.1154***	0.9804***	0.0297
Household Goods	-0.3334**	-0.0661***	0.0548*		0.9626***	0.0231**	-0.2765**	-0.0570***	0.0564*	0.97***	0.0173**
Industrial Engineering	-0.4723**	-0.0516	0.1536***		0.9596***	0.0110	-0.4584**	-0.0490	0.1516***	0.961***	0.0106
Industrial Transport	-0.4367**	-0.0337	0.065*		0.9517***	0.0255	-0.4336**	-0.0330	0.0697*	0.9525***	0.0242
Leisure Goods	-0.7336***	-0.1889	0.7802		0.8961***	0.1955***	-0.7246***	-0.1730	0.7359*	0.8999***	0.1901***

Table A6.10 continued A summary of non-financial industries' exposure to actual and unexpected changes in the US$/£ before the Euro and after the introduction of the Euro: Estimated coefficients from the variance equation

	ACTUAL US$						UNEXPECTED US$				
INDUSTRY	α_0	α_1	α_2	α_2*	φ	EURDUM	α_0	α_1	α_2	φ	EURDUM
Media	-0.7260***	-0.1851	0.7611		0.8980***	0.1924***	-0.7486***	-0.1893	0.7826	0.8938***	0.2006***
Mining	-0.4044***	-0.0318	0.1399***		0.9557***	0.0257*	-0.4314***	-0.0322	0.1466***	0.9524***	0.0268*
Mobile Telecommunications	-0.3066***	0.0169	0.1692***		0.9763***	-0.0161	-0.298***	0.0180	0.1669***	0.9772***	-0.0158
Oil and Gas Producers	-0.1663**	-0.0009	0.1155***		0.9899***	-0.0017	-0.1653**	-0.0017	0.1164***	0.9901***	-0.0018
Oil Equipment And Services	-2.0509***	-0.2108	0.7460		0.692***	0.5028***	-2.0315***	-0.2182	0.7696	0.6944***	0.5019***
Personal Goods	-1.2417***	0.0351	0.3310***		0.8826***	0.2038***	-1.2322***	0.0338	0.3332***	0.8835***	0.2017***
Pharmaceuticals and Biotechnology	-1.7245	-0.2325	-0.0053	-0.0338	0.0136	0.0050	-1.8941	-0.2401	-0.0200	0.0124	0.0036
Software and Computer Services	-0.1252**	0.0368**	0.1134***		0.995***	0.0070	-0.1281**	0.0370**	0.1151***	0.9948***	0.0072
Support Services	-0.0691*	-0.0522***	0.0396**		0.995***	-0.0080***	-0.0194*	-0.0504***	-0.0072	0.9967***	-0.0096***
Technical Hardware and Equipment	-0.2164***	-0.0420**	0.1417***		0.9844***	0 0297	-0.2171***	-0.0415**	0.1430***	0.9844***	0.0295
Tobacco	-0.1495***	-0.0357**	0.1179***		0.9907***	-0.0025	-0.1474***	-0.0343*	0.1153***	0.9907***	-0.0022
Travel and Leisure	-0.2024***	-0.0987***	0.051**		0.9799***	0.0148***	-0.2017***	-0.0978***	0.0506**	0.9799***	0.0145***

Note: α_0 represents the constant term, $\alpha 1$ is the coefficient for the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. There is a case in the actual changes of the US$/£ where the AR(1)-EGARCH-M(1,1) could not be fitted as a result of lack of convergence, therefore an AR(1)-EGARCH-M(2,1) was fitted instead. Consequently, α_2* represents the coefficient of the second ARCH parameter. EURDUM is the coefficient for the euro dummy which examines the impact of the introduction of the euro on the volatility of industry returns. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

Table A6.11 A summary of non-financial industries' exposure to actual and unexpected changes in the JP¥/£ before the euro and after the introduction of the euro: Estimated coefficients from the variance equation

	ACTUAL JP¥/£						UNEXPECTED JP¥/£				
INDUSTRY	α_0	α_1	α_2	α_2*	φ	EURDUM	α_0	α_1	α_2	φ	EURDUM
Aerospace and Defence	-0.1543*	-0.0130	0.1042***		0.9889***	0.0013	-0.1539*	-0.0145	0.1032***	0.9888***	0.0014
Automobiles and Auto Parts	-0.3972**	-0.0899**	0.2024***		0.9625***	0.0323	-0.3592**	-0.0858**	0.1964***	0.9670***	0.0289
Beverages	-1.7853***	0.0357	0.3035***		0.8198***	0.1421**	-1.8061***	0.0349	0.3045***	0.8174***	0.1431**
Chemicals	-0.442**	-0.0653**	0.1422***		0.9593***	0.0316*	-0.4512**	-0.0653**	0.1473***	0.9586***	0.0318*
Construction And Materials	-9.0159***	-0.0918***	-0.0011		-0.1108**	0.0273***	-9.0773***	-0.0735	-0.0008	-0.1093**	0.0244
Electricity	-0.4984***	-0.0389	0.1672***		0.9473***	0.0062	-0.4933***	-0.0361	0.1671***	0.9479***	0.0056
Electronic And Electrical Equipment	-0.1630**	-0.0618***	0.0901***		0.9886***	0.0044	-0.1616**	-0.0598***	0.0910***	0.9888***	0.0042
Fixed-line Telecommunications	-0.1683**	0.0098	0.1106***		0.9878***	0.0024	-0.1674**	0.0103	0.1110***	0.9879***	0.0023
Food and Drug Retailers	-0.2299**	-0.0384*	0.0961***		0.9784***	-0.0099	-0.2347**	-0.0390*	0.0965***	0.9778***	-0.0105
Food Producers	-0.1730**	-0.0095	0.1266***		0.9907***	0.0000	-0.1747**	-0.0091	0.1277***	0.9906***	0.0001
Forestry And Paper	-2.1118	0.1822	4.5491		0.0859	1.4548***	-3.2391	0.0634	2.3719	0.1113	1.4197***
Gas, Water And Multi-Utilities	-0.1729**	-0.0334	0.0794**		0.9841***	-0.0106	-0.2112**	-0.0341	0.0897***	0.9798***	-0.0124
General Industrial	-0.3012***	-0.0488**	0.1493***		0.9745***	0.0040	-0.2899***	-0.0453*	0.1475***	0.9759***	0.0030
General Retailers	-0.1784**	-0.0019	0.1187***		0.9884***	-0.0027	-0.1863***	-0.0015	0.1210***	0.9876***	-0.0025
Healthcare Equipment and Services	-0.2403**	-0.0324	0.1187***		0.9786***	0.0323*	-0.2373**	-0.0303	0.1191***	0.9791***	0.0319
Household Goods	-0.3233**	-0.0640***	0.0535*		0.9638***	0.0222**	-0.2863**	-0.0576***	0.0561*	0.9687***	0.0181**
Industrial Engineering	-0.4550**	-0.0496	0.1487***		0.9611***	0.0108	-0.4522**	-0.0487	0.1473***	0.9613***	0.0116
Industrial Transport	-0.4509**	-0.0322	0.0635*		0.9498***	0.0271	-0.4441**	-0.0313	0.0687*	0.9511***	0.0255
Leisure Goods	-0.7208***	-0.1837	0.7674		0.8992***	0.1909***	-0.7391***	-0.1980	0.8238	0.8940***	0.2009***

Table A6.11 continued A summary of non-financial industries' exposure to actual and unexpected changes in the JP¥/£ before the euro and after the introduction of the euro: Estimated coefficients from the variance equation

	ACTUAL JP¥/£						UNEXPECTED JP¥/£				
INDUSTRY	α_0	α_1	α_2	α_2*	φ	EURDUM	α_0	α_1	α_2	φ	EURDUM
Media	-0.6953***	-0.1748	0.7334		0.9047***	0.1818***	-0.7163***	-0.1844	0.7691	0.8998***	0.1903***
Mining	-0.4221***	-0.0366	0.1384***		0.9531***	0.0278*	-0.4221***	-0.0360	0.1419***	0.9533***	0.0267*
Mobile Telecommunications	-0.2973***	0.0208	0.1661***		0.9772***	-0.0156	-0.2894***	0.0199	0.1631***	0.9779***	-0.0157
Oil and Gas Producers	-0.1675**	-0.0014	0.1159***		0.9898***	-0.0019	-0.1709**	0.0005	0.1171***	0.9894***	-0.0015
Oil Equipment And Services	-2.0239***	-0.2265	0.7576		0.6938***	0.5014***	-1.9767***	-0.2344	0.7830	0.6996***	0.4936***
Personal Goods	-1.2374***	0.0287	0.3271***		0.8832***	0.2043***	-1.2319***	0.0288	0.3286***	0.8836***	0.2028***
Pharmaceuticals and Biotechnology	-1.897	-0.2014	-0.0047	-0.0260	0.0109	0.0040	-2.0726	-0.2363	-0.0199	0.0141	0.0038
Software and Computer Services	-0.1250**	0.0372**	0.1142***		0.9951***	0.0067	-0.1282**	0.0376**	0.1161***	0.9949***	0.0071
Support Services	-0.0192*	-0.0485***	-0.0106		0.9964***	-0.0086***	-0.0251**	-0.0493***	-0.0114	0.9956***	-0.0087***
Technical Hardware and Equipment	-0.2228***	-0.0439**	0.1447***		0.9839***	0.0309	-0.2228***	-0.0441**	0.1451***	0.9839***	0.0307
Tobacco	-0.1427***	-0.0342*	0.1167***		0.9915***	-0.0027	-0.1435***	-0.0334*	0.1163***	0.9914***	-0.0025
Travel and Leisure	-0.2069***	-0.1025***	0.0429*		0.9785***	0.0158***	-0.2043***	-0.1006***	0.0430*	0.9788***	0.0152***

Note: α_0 is the constant term, α_1 is the coefficient for the asymmetric impact of past innovations on current volatility, α_2 represents the ARCH parameter coefficient and φ is the GARCH parameter coefficient. There is a case in the actual changes of the JP¥/£ where the AR(1)-EGARCH-M(1,1) could not be fitted as a result of lack of convergence, therefore the AR(1)-EGARCH-M(2,1) was used instead. Consequently, α_2* represents the coefficient of the second ARCH parameter. EURDUM is the coefficient for the euro dummy which examines the impact of the introduction of the euro on the volatility of industry returns. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

A6.12 Summary of industries with change in volatility of their returns in the period after the euro

	TWI		US$/£		JP¥/£	
INDUSTRY	ACTUAL	UNEXP.	ACTUAL	UNEXP.	ACTUAL	UNEXP.
Beverages	0.1293	0.1338	0.1305	0.1378	0.1421	0.1431
Chemicals	0.0308	0.0321	0.0319	0.0332	0.0361	0.0318
Construction And Materials	0.0258	N.A	0.0241	N.A	0.0273	N.A
Forestry And Paper	1.4492	1.4110	1.4421	1.4382	1.4548	1.4197
Healthcare Equipment and Services	0.0325	N.A	N.A	N.A	0.0323	N.A
Household Goods	0.0231	0.0175	0.0231	0.0173	0.0222	0.0181
Leisure Goods	0.1944	0.2041	0.1955	0.1901	0.1909	0.2009
Media	0.1953	0.2035	0.1924	0.2006	0.1818	0.1903
Mining	0.0296	0.0285	0.0257	0.0268	0.0278	0.0267
Oil Equipment And Services	0.5080	0.5033	0.5028	0.5019	0.5014	0.4936
Personal Goods	0.2077	0.2063	0.2038	0.2017	0.2043	0.2028
Support Services	-0.0085	-0.0094	-0.008	-0.0096	-0.0086	-0.0087
Travel and Leisure	0.0173	0.0170	0.0148	0.0145	0.0158	0.0152

Note: TWI is the trade weighted nominal exchange rate, US$/£ is the US$ exchange rate to the pound and JP¥/£ is the JP¥ exchange rate to the pound. Actual and Unexp. represent actual and unexpected changes respectively. A positive figure indicates increase in volatility of returns whereas a negative figure implies a decrease in the volatility of returns. N.A applies to instances when the EURDUM is statistically insignificant.

Table A6.13 A summary of non-financial industries' exposure to lagged changes in the Trade weighted nominal exchange rate, short -term interest rate and long-term interest rate of the total sample period from January 1990 to December 2006- Estimated coefficients from the variance equation

	ACTUAL BOEGBPR			UNEXPECTED BOEGBPR		
INDUSTRY	α_1	α_2	φ	α_1	α_2	φ
Aerospace and Defence	-0.0248	0.0998***	0.9887***	-0.0234	0.1011***	0.9884***
Automobiles and Auto Parts	-0.0827***	0.1562***	0.9845***	-0.0829***	0.1568***	0.9842***
Beverages	-0.0090	0.2851***	0.9228***	-0.0104	0.2795***	0.9256***
Chemicals	-0.0453**	0.1300***	0.9831***	-0.0440**	0.1257***	0.9844***
Construction And Materials	0.0170	0.1352***	0.9663***	0.0188	0.1338***	0.9663***
Electricity	-0.0403	0.1819***	0.9406***	-0.0400	0.182***	0.9399***
Electronic And Electrical Equipment	-0.0620***	0.0801***	0.9926***	-0.0622***	0.077***	0.9928***
Fixed-line Telecommunications	0.0076	0.1119***	0.9891***	0.0078	0.1101***	0.9894***
Food and Drug Retailers	-0.0378*	0.1119***	0.9771***	-0.0365*	0.1111***	0.9776***
Food Producers	-0.0055	0.1286***	0.9911***	-0.0058	0.1287***	0.9911***
Forestry And Paper	-0.2714	3.2628	0.2359	-0.2896	3.2876	0.2329
Gas, Water And Multi-Utilities	-0.0193	0.0903***	0.9858***	-0.0229	0.0892***	0.9851***
General Industrial	-0.0398*	0.1549***	0.9771***	-0.0400*	0.1558***	0.9771***
General Retailers	-0.0052	0.1220***	0.9856***	-0.0050	0.1235***	0.9858***
Healthcare Equipment and Services	-0.0148	0.1125***	0.9953***	-0.0168	0.1126***	0.9952***
Household Goods	-0.0391***	0.0741***	0.9867***	-0.0368***	0.0725***	0.9878***
Industrial Engineering	-0.0405	0.1685***	0.9615***	-0.0399	0.1684***	0.9614***
Industrial Transport	-0.0322***	-0.0002	-0.0064	-0.0434***	-0.0006	-0.0107

Table A6.13 continued A summary of non-financial industries' exposure to lagged changes in the Trade weighted nominal exchange rate, short -term interest rate and long-term interest rate of the total sample period from January 1990 to December 2006- Estimated coefficients from the variance equation

	ACTUAL BOEGBPR			UNEXPECTED BOEGBPR		
INDUSTRY	α_1	α_2	φ	α_1	α_2	φ
Leisure Goods	-0.0112	0.2801***	1.0008***	-0.0099	0.2716***	1.0013***
Media	-0.0134	0.2870***	1.0007***	-0.0112	0.2725***	1.0011***
Mining	-0.0083	0.1293***	0.9755***	-0.0063	0.1249***	0.9767***
Mobile Telecommunications	0.0409	0.1704***	0.9788***	0.0404	0.1696***	0.9793***
Oil and Gas Producers	-0.0085	0.1152***	0.9877***	-0.0091	0.1154***	0.9877***
Oil Equipment And Services	-0.0834**	0.2449***	0.9833***	-0.0858**	0.2481***	0.9829***
Personal Goods	-0.0047	0.2903***	0.9755***	-0.0029	0.2868***	0.9763***
Pharmaceuticals and Biotechnology	-0.3070	-0.0171	0.0097	-0.2299	-0.0130	0.0059
Software and Computer Services	0.0322**	0.1094***	0.9981***	0.0323**	0.1091***	0.9981***
Support Services	-0.0569***	0.0558**	0.9889***	-0.0534***	0.0611***	0.9891***
Technical Hardware and Equipment	-0.0285*	0.1444***	0.9953***	-0.0278*	0.1445***	0.9953***
Tobacco	-0.0452***	0.1038***	0.9902***	-0.0444***	0.1022***	0.9901***
Travel and Leisure	-0.0723***	0.0725***	0.9858***	-0.07138***	0.0715***	0.9864***

Note: α_1 represents the coefficient for the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. ***,** and * denotes statistical significance at the 1%, 5% and 10% level

Table A6.14 A summary of non-financial industries' exposure to lagged changes in the US$/£ for the total sample period from January 1990 to December 2006- Estimated coefficients from the variance equation

	ACTUAL US$/£			UNEXPECTED US$/£		
INDUSTRY	α_1	α_2	φ	α_1	α_2	φ
Aerospace and Defence	-0.0241	0.0988***	0.9889***	-0.0223	0.1001***	0.9887***
Automobiles and Auto Parts	-0.0828***	0.1543***	0.9849***	-0.0826***	0.1537***	0.9848***
Beverages	-0.0117	0.2732***	0.9287***	-0.0131	0.2675***	0.9313***
Chemicals	-0.0453**	0.1268***	0.9845***	-0.0443**	0.1247***	0.9852***
Construction And Materials	0.0147	0.1331***	0.9668***	0.0165	0.1306***	0.9672***
Electricity	-0.0401	0.1801***	0.9403***	-0.0396	0.1802***	0.9398***
Electronic And Electrical Equipment	-0.0620***	0.0794***	0.9928***	-0.0620***	0.0771***	0.9928***
Fixed-line Telecommunications	0.0074	0.1106***	0.9893***	0.0075	0.1098***	0.9894***
Food and Drug Retailers	-0.0346	0.1112***	0.9771***	-0.0349	0.1098***	0.9775***
Food Producers	-0.0055	0.1284***	0.9911***	-0.0059	0.1288***	0.9911***
Forestry And Paper	-0.2666	3.3689	0.2264	-0.2891	3.3889	0.2214***
Gas, Water And Multi-Utilities	-0.0187	0.0884***	0.9863***	-0.0220	0.0881***	0.9856***
General Industrial	-0.0398*	0.1548***	0.9771***	-0.0400*	0.1549***	0.9769***
General Retailers	-0.0032	0.1236***	0.9857***	-0.0036	0.1249***	0.9858***
Healthcare Equipment and Services	-0.0131	0.1122***	0.9953***	-0.0143	0.1129***	0.9952***
Household Goods	-0.0378***	0.0709***	0.9871***	-0.0356***	0.0686***	0.9884***
Industrial Engineering	-0.0415	0.1656***	0.9632***	-0.0416	0.1681***	0.9619***
Industrial Transport	-0.0297	-0.0002	-0.0086	-0.0606***	-0.0005	-0.0127***
Leisure Goods	-0.0111	0.2644***	1.0011***	-0.0106	0.2619***	1.0011***

Table A6.14 A summary of non-financial industries' exposure to lagged changes in the US$/£ for the total sample period from January 1990 to December 2006- Estimated coefficients from the variance equation

	ACTUAL US$/£			UNEXPECTED US$/£		
INDUSTRY	α_1	α_2	φ	α_1	α_2	φ
Media	-0.0131	0.2674***	1.0008***	-0.0120	0.2624***	1.0011***
Mining	-0.0072	0.128***	0.9759***	-0.0056	0.1244***	0.9769***
Mobile Telecommunications	0.0410	0.1707***	0.9791***	0.0404	0.1717***	0.9789***
Oil and Gas Producers	-0.0076	0.1168***	0.9878***	-0.0079	0.1164***	0.9877***
Oil Equipment And Services	-0.0803**	0.2384***	0.9839***	-0.0800**	0.2381***	0.9843***
Personal Goods	-0.0056	0.2883***	0.9758***	-0.0032	0.2862***	0.9765***
Pharmaceuticals and Biotechnology	-0.3059	-0.0164	0.0093	-0.2350	-0.013	0.0056***
Software and Computer Services	0.0320**	0.1088***	0.9979***	0.0318**	0.1091***	0.9981***
Support Services	-0.0571***	0.0558***	0.9888***	-0.0534***	0.0591***	0.9893***
Technical Hardware and Equipment	-0.0281*	0.1443***	0.9953***	-0.0274	0.1441***	0.9953***
Tobacco	-0.0460***	0.0982***	0.9913***	-0.0465***	0.0978***	0.9908***
Travel and Leisure	-0.0717***	0.0722***	0.9858***	-0.0706***	0.0711***	0.9866***

Note: α_1 is the coefficient for the asymmetric impact of past innovations on current volatility, α_2 represents the ARCH parameter coefficient and φ is the GARCH parameter coefficient. ***,** and * denotes statistical significance at the 1%, 5% and 10% level

Table A6.15 A summary of non-financial industries' exposure to lagged changes in the JP¥/£ for the total sample period from January 1990 to December 2006- Estimated coefficients from the variance equation

	ACTUAL JP¥/£			UNEXPECTED JP¥/£		
INDUSTRY	α_1	α_2	φ	α_1	α_2	φ
Aerospace and Defence	-0.0234	0.1019***	0.9887***	-0.0219	0.1031***	0.9885***
Automobiles and Auto Parts	-0.0831***	0.1551***	0.9851***	-0.0830***	0.1546***	0.9851***
Beverages	-0.0118	0.2758***	0.9273***	-0.0113	0.2816***	0.9241***
Chemicals	-0.0452**	0.1222***	0.9852***	-0.0438**	0.1186***	0.9864***
Construction And Materials	0.0162	0.1364***	0.9657***	0.0170	0.1378***	0.9654***
Electricity	-0.0416	0.1793***	0.9404***	-0.0410	0.1786***	0.9403***
Electronic And Electrical Equipment	-0.0625***	0.0775***	0.9929***	-0.0623***	0.0767***	0.9928***
Fixed-line Telecommunications	0.0074	0.1102***	0.9892***	0.0077	0.1084***	0.9896***
Food and Drug Retailers	-0.0342	0.1104***	0.9775***	-0.0347	0.1092***	0.9778***
Food Producers	-0.0048	0.1281***	0.9914***	-0.0053	0.1274***	0.9916***
Forestry And Paper	-0.2443	3.1283	0.2316	-0.2701	3.2292	0.2259
Gas, Water And Multi-Utilities	-0.0180	0.0891***	0.9863***	-0.0224	0.0893***	0.9852***
General Industrial	-0.0396*	0.1547***	0.9767***	-0.0397*	0.1543***	0.9771***
General Retailers	-0.0023	0.1244***	0.9855***	-0.0025	0.1246***	0.9857***
Healthcare Equipment and Services	-0.0144	0.1121***	0.9953***	-0.0157	0.1122***	0.9952***
Household Goods	-0.0390***	0.0655***	0.9866***	-0.0371***	0.0645***	0.9874***
Industrial Engineering	-0.0396	0.1688***	0.9605***	-0.0379	0.1705***	0.9601***
Industrial Transport	-0.0357***	-0.0003	-0.0075	-0.0261***	-0.0006	-0.0074
Leisure Goods	-0.0043	0.2699***	1.0008***	-0.0043	0.2774***	1.0006***

Table A6.15 continued A summary of non-financial industries' exposure to lagged changes in the JP¥/£ for the total sample period from January 1990 to December 2006- Estimated coefficients from the variance equation

	ACTUAL JP¥/£			UNEXPECTED JP¥/£		
INDUSTRY	α_1	α_2	φ	α_1	α_2	φ
Media	-0.0059	0.2699***	1.0007***	-0.0058	0.2763***	1.0006***
Mining	-0.0075	0.1261***	0.9765***	-0.0059	0.1245***	0.9768***
Mobile Telecommunications	0.0409	0.1702***	0.9789***	0.0407	0.1698***	0.9791***
Oil and Gas Producers	-0.0091	0.1157***	0.9877***	-0.0094	0.1151***	0.9878***
Oil Equipment And Services	-0.0790**	0.2401***	0.9854***	-0.0817**	0.2444***	0.9844***
Personal Goods	-0.0037	0.2943***	0.9747***	-0.0017	0.2896***	0.9756***
Pharmaceuticals and Biotechnology	-0.2453	-0.0165	0.0082	-0.2360	-0.0168	0.0086
Software and Computer Services	0.0330**	0.1084***	0.9981***	0.0331**	0.1081***	0.9983***
Support Services	-0.0566***	0.0572***	0.9887***	-0.0529***	0.0603***	0.9893***
Technical Hardware and Equipment	-0.0284*	0.1447***	0.9953***	-0.0279*	0.1451***	0.9953***
Tobacco	-0.0438***	0.1031***	0.9904***	-0.0429**	0.1029***	0.9904***
Travel and Leisure	-0.0718***	0.0717***	0.9862***	-0.0712***	0.0711***	0.9865***

Note: α_1 represents the coefficient for the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. ***,** and * indicates statistical significance at the 1%, 5% and 10% level

Table A6.16 A summary of the ratio of negative innovation to positive innovations and half-life of persistence on the returns of UK non-financial industries using lagged changes in the exchange rate and interest rate measures for the total period 01/01/90-31/12/06

	ACTUAL TWI		UNEXPECTED TWI		ACTUAL US$/£		UNEXPECTED US$/£		ACTUAL JPY/£		UNEXPECTED JPY	
INDUSTRY	N.I/P.I	HL	N.I/P.I	HL	N.I/P.I	HL	N.I/P.I	HL	N.I/P.I	HL	N.I/P.I	HL
Aerospace and Defence	1.0509	61.1347	1.0480	59.4532	1.0494	62.0086	1.0457	60.9282	1.0478	60.8524	1.0448	59.7487
Automobiles and Auto Parts	1.1803*	44.3573	1.1807*	43.5226	1.1806*	45.5868	1.1801*	45.3174	1.1813*	45.9086	1.1811*	46.1257
Beverages	1.0182	8.6256	1.0211	8.9645	1.0236	9.3758	1.0265	9.7453	1.0239	9.1853	1.0228	8.7847
Chemicals	1.0950*	40.7376	1.0920*	44.1964	1.0950*	44.3630	1.0929*	46.4015	1.0947*	46.5122	1.0917*	50.5034
Construction And Materials	0.9665	20.2202	0.9632	20.2318	0.9711	20.5571	0.9676	20.7782	0.9681	19.8498	0.9665	19.6828
Electricity	1.0840	11.3139	1.0834	11.1998	1.0835	11.2571	1.0825	11.1544	1.0867	11.2715	1.0856	11.2578
Electronic And Electrical Equipment	1.1323*	93.8178	1.1327*	95.8433	1.1323*	95.6834	1.1324*	96.3667	1.1333*	97.3344	1.1330*	96.3263
Fixed-line Telecommunications	0.9849	63.3729	0.9846	65.0996	0.9854	64.4087	0.9852	65.2234	0.9854	64.0119	0.9847	66.6171
Food and Drug Retailers	1.0786*	29.9166	1.0759*	30.6294	1.0716	29.9655	1.0723	30.4409	1.0708	30.4628	1.0718	30.8665
Food Producers	1.0111	77.7980	1.0116	77.9569	1.0111	77.8774	1.0119	77.7012	1.0096	80.6849	1.0107	81.6919
Forestry And Paper	1.7451	0.4800	1.8152	0.4758	1.7268	0.4666	1.8133	0.4597	1.6466	0.4739	1.7402	0.4659
Gas, Water And Multi-Utilities	1.0394	48.4314	1.0468	46.0231	1.0381	50.2695	1.0451	47.8648	1.0366	50.2362	1.0459	46.6169
General Industrial	1.0830*	29.8691	1.0834*	29.9496	1.0830*	29.8086	1.0834*	29.6727	1.0825*	29.4418	1.0827*	29.9377
General Retailers	1.0104	47.6777	1.0100	48.6313	1.0064	48.1075	1.0072	48.3252	1.0046	47.3506	1.0051	48.2638
Healthcare Equipment and Services	1.0301	146.3820	1.0341	143.0135	1.0266	146.5686	1.0289	145.0890	1.0293	146.9746	1.0318	143.3106
Household Goods	1.0814*	51.7455	1.0765*	56.5520	1.0787*	53.3309	1.0739*	59.2629	1.0812*	51.4574	1.0772*	54.8044
Industrial Engineering	1.0845	17.6363	1.0831	17.6135	1.0867	18.5078	1.0868	17.8364	1.0824	17.2165	1.0787	17.0424
Industrial Transport	1.0666*	N.A	1.0909*	N.A	1.0613	N.A	1.1291*	N.A	1.0740*	N.A	1.0536*	N.A
Leisure Goods	1.0227	N.A	1.0200	N.A	1.0225	N.A	1.0214	N.A	1.0086	N.A	1.0086	N.A
Media	1.0272	N.A	1.0227	N.A	1.0265	N.A	1.0244	N.A	1.0119	N.A	1.0117	N.A

Table A6.16 continued A summary of the ratio of negative innovation to positive innovations and half-life of persistence on the returns of UK non-financial industries using lagged changes in the exchange rate and interest rate measures for the total period 01/01/90-31/12/06

	ACTUAL TWI		UNEXPECTED TWI		ACTUAL US$/£		UNEXPECTED US$/£		ACTUAL JP¥/£		UNEXPECTED JP¥	
INDUSTRY	N.I/P.I	HL	N.I/P.I	HL	N.I/P.I	HL	N.I/P.I	HL	N.I/P.I	HL	N.I/P.I	HL
Mining	1.0167	27.9842	1.0126	29.4443	1.0146	28.4276	1.0113	29.6923	1.0151	29.1414	1.0119	29.5021
Mobile Telecommunications	0.9214	32.4220	0.9223	33.0811	0.9211	32.6938	0.9223	32.5152	0.9213	32.5028	0.9217	32.7175
Oil and Gas Producers	1.0172	56.2177	1.0183	55.8053	1.0154	56.5193	1.0159	56.1762	1.0184	55.8690	1.0190	56.3380
Oil Equipment And Services	1.1822*	41.2230	1.1877*	40.3205	1.1747*	42.6490	1.1740*	43.8442	1.1716*	47.2588	1.1781*	44.1278
Personal Goods	1.0094	27.9726	1.0059	28.8482	1.0113	28.3348	1.0063	29.0851	1.0073	27.0253	1.0035	28.1098
Pharmaceuticals and Biotechnology	1.8859	0.1495	1.5972	0.1354	1.8812	0.1480	1.6145	0.1335	1.6502	0.1445	1.6177	0.1458
Software and Computer Services	0.9374*	355.1134	0.9373*	372.9151	0.9379*	336.2959	0.9382*	357.8689	0.9360*	366.0102	0.9358*	412.4867
Support Services	1.1208*	62.0479	1.1129*	63.4961	1.1211*	61.5133	1.1128*	64.4208	1.1201*	61.1401	1.1118*	64.4269
Technical Hardware and Equipment	1.0587*	147.3513	1.0572*	147.6035	1.0579*	148.5889	1.0564	148.2696	1.0586*	147.3827	1.0574*	147.2569
Tobacco	1.0947*	70.6066	1.0930*	69.6606	1.0965*	78.8697	1.0976*	74.6120	1.0916*	71.9536	1.0897*	71.4816
Travel and Leisure	1.1560*	48.5312	1.1537*	50.6343	1.1545*	48.4314	1.1520*	51.2031	1.1548*	49.8989	1.1534*	50.8150

Note: N.I/P.I is the ratio of negative innovation to positive innovation but this s only relevant in instances where the asymmetric parameter is significant as denoted by *. HL is the half-life of the innovation and in columns with N.A, the GARCH parameter had been unstable and cannot be used in the calculation. Actual and unexpected represent the actual and unexpected changes in the exchange rate measures respectively. TWI is the bank of England trade weighted index, US$/£ is the US$ exchange rate against the £ while JP¥/£ is the Japanese Yen exchange rate against the £.

Table A6.17 A summary of non-financial industries' exposure to lagged changes in the ECU/£ for the sample period from January 1990 to December 1998
Estimated coefficients from the variance equation

	ACTUAL ECU/£			UNEXPECTED ECU/£		
INDUSTRY	α_1	α_2	φ	α_1	α_2	φ
Aerospace and Defence	-0.0274	0.0938**	1.0026***	-0.0240	0.0926**	1.0033***
Automobiles and Auto Parts	-0.3232	0.0533	0.1196*	-0.1459**	0.3408***	0.9111***
Beverages	0.1299*	0.3706***	0.7632***	0.1303*	0.3698***	0.7637***
Chemicals	-0.0758	0.2427***	0.9353***	-0.0731	0.2469***	0.9353***
Construction And Materials	-0.1388*	-0.0345	-0.0586	-0.1569*	-0.0462	-0.1025
Electricity	-0.0048	0.1866*	0.2141	-0.0049	0.1855*	0.1988
Electronic And Electrical Equipment	-0.0883**	0.1038**	0.9809***	-0.0842**	0.1009**	0.9827***
Fixed-line Telecommunications	-0.0697	0.2208**	0.6744***	-0.0687	0.2181**	0.6869***
Food and Drug Retailers	-0.0612*	0.1115**	0.9685***	-0.0577*	0.1133**	0.9685***
Food Producers	0.0649**	0.0858***	0.9790***	0.0676**	0.0832***	0.9804***
Forestry And Paper	0.0192	0.0214	-0.4049	0.0051	0.0063	-0.3649
Gas, Water And Multi-Utilities	0.0237	-0.2118	0.1024	0.0148	-0.2381	0.1752
General Industrial	-0.0792	0.0460	-0.0009	-0.0591	0.0302	-0.0096
General Retailers	-0.0138	0.1076*	0.9504***	-0.0150	0.1102**	0.9517***
Healthcare Equipment and Services	-0.1225**	0.0477	-0.1576*	-0.1228*	0.0549	-0.1846*
Household Goods	-0.0770**	0.1221*	0.9528***	-0.0743**	0.1234**	0.9552***
Industrial Engineering	0.0322	0.4115***	0.7471***	0.0310	0.3918***	0.7748***
Industrial Transport	-0.0652	0.0001	0.1011	-0.0831	-0.0016	0.1089*
Leisure Goods	-0.5771	2.4507	0.7320***	-0.4534	1.9737	0.7447***

Table A6.17 continued A summary of non-financial industries' exposure to lagged changes in the ECU/£ for the sample period from January 1990 to December 1998- Estimated coefficients from the variance equation

	ACTUAL ECU/£			UNEXPECTED ECU/£		
INDUSTRY	α_1	α_2	φ	α_1	α_2	φ
Media	0.0453	0.4639***	0.0483	-0.4265	1.8646	0.7549***
Mining	0.2261***	0.3187**	-0.3267	0.2240**	0.3203**	-0.3259
Mobile Telecommunications	0.0354	0.1838***	0.9334***	0.0345	0.1835***	0.9346***
Oil and Gas Producers	0.1274	0.3454**	0.2889	0.1194	0.3364**	0.3212
Oil Equipment And Services	-0.4927	-0.0318	0.0064	-0.4533	-0.0302	0.0099
Personal Goods	0.0345	0.4083***	0.8550***	0.0369	0.4136***	0.8532***
Pharmaceuticals and Biotechnology	-0.4654	-0.0519	-0.0431	-0.4056	-0.0477	-0.0436
Software and Computer Services	-0.0692***	0.0179**	-0.0116	-0.1054**	0.0347**	-0.0286
Support Services	-0.0576***	-0.0235	0.9982***	-0.0559***	-0.0291	0.9977***
Technical Hardware and Equipment	-0.0901	-0.0172	-0.0105	-0.0831	-0.0177	-0.0038
Tobacco	-0.0142	0.1336***	0.9753***	-0.0117	0.1353***	0.9738***
Travel and Leisure	0.1269*	0.5290***	-0.3042*	0.1252*	0.5261***	-0.3114*

Note: α_1 represents the coefficient for the asymmetric impact of past innovations on current volatility. α_2 is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. ***,** and * indicates statistical significance at the 1%, 5% and 10% level

Table A6.18 A summary of non-financial industries' exposure to lagged changes in the Euro/£ for the sample period from January 1999 to December 2006
Estimated coefficients from the variance equation

	ACTUAL Euro/£			UNEXPECTED Euro/£		
INDUSTRY	α_1	α_2	φ	α_1	α_2	φ
Aerospace and Defence	0.0722	0.1546*	-0.6834***	0.0702	0.1568*	-0.6632***
Automobiles and Auto Parts	-0.0918**	0.1506**	0.9513***	-0.2461**	-0.0522	0.0336
Beverages	-0.0358	0.2317***	0.9261***	-0.0349	0.2254***	0.9285***
Chemicals	-0.0849***	-0.0209***	0.9311***	-0.0572	0.0016	0.0277
Construction And Materials	-0.0805	0.0077	-0.0617	-0.0798	0.0089	-0.0717
Electricity	-0.0432	0.0623*	0.9995***	-0.0467	0.0642*	0.9993***
Electronic And Electrical Equipment	0.1573**	0.0320	0.0007	0.1366*	0.0308	0.0255
Fixed-line Telecommunications	0.0086	0.1291***	0.9886***	0.0090	0.1279***	0.9886***
Food and Drug Retailers	-0.0588**	-0.0345	0.9879***	-0.0643**	-0.0253	0.9889***
Food Producers	-0.0488***	-0.0220***	1.0003***	-0.0454**	-0.0364*	0.9986***
Forestry And Paper	-0.6514	6.2667	0.6729***	-1.1505	10.4795	0.6318***
Gas, Water And Multi-Utilities	-0.0961***	0.0813*	0.9872***	-0.0998***	0.0896*	0.9856***
General Industrial	-0.0028	0.0619*	0.9911***	-0.0022	0.0615*	0.9911***
General Retailers	-0.0553	0.1498***	0.9788***	-0.0554	0.1500***	0.9789***
Healthcare Equipment and Services	-0.0677	0.1670***	0.9746***	-0.0632	0.1673***	0.9744***
Household Goods	-0.1919**	0.0682	0.2312	-0.1950**	0.0784	0.2457
Industrial Engineering	-0.0504	0.2953***	-0.6139***	-0.0548	0.2936***	-0.6048***
Industrial Transport	0.1399***	0.0100	-0.0351	0.0986**	0.0078	-0.0354
Leisure Goods	-0.0222	0.1839***	0.9842***	-0.0214	0.1825***	0.9844***

Table A6.18 continued A summary of non-financial industries' exposure to lagged changes in the Euro/£ for the sample period from January 1999 to December 2006- Estimated coefficients from the variance equation

	ACTUAL Euro/£			UNEXPECTED Euro/£		
INDUSTRY	α_1	α_2	φ	α_1	α_2	φ
Media	0.1806***	-0.0212	0.9847***	-0.0205	0.1816***	0.9843***
Mining	0.0633***	-0.0555***	0.9882***	0.0664***	-0.05158***	0.9895***
Mobile Telecommunications	0.0149	0.1393***	0.9866***	0.0157	0.1393***	0.9867***
Oil and Gas Producers	-0.0246	-0.0168	0.9991***	-0.0059	-0.0130***	1.0001***
Oil Equipment And Services	-0.2400**	0.0262	0.7292***	-0.2409**	0.0258	0.7248***
Personal Goods	0.0145	0.2110**	0.9374***	0.0158	0.2054**	0.9413***
Pharmaceuticals and Biotechnology	7.2807	118.1055	0.2239	7.7798	116.7891	0.2198
Software and Computer Services	0.0363*	0.1242***	0.9983***	0.0372*	0.1223***	0.9984***
Support Services	-0.0338	0.0588*	0.9875***	-0.0360	0.0553*	0.9881***
Technical Hardware and Equipment	-0.0344	0.1633***	0.9864***	-0.0360	0.1711***	0.9854***
Tobacco	-0.0038	-0.0403***	0.9943***	-0.0079	-0.0401***	0.9943***
Travel and Leisure	-0.0714***	0.0979*	0.9895***	-0.0690***	0.1032*	0.9893***

Note: α_1 represents the coefficient for the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. ***,** and * indicates statistical significance at the 1%, 5% and 10% level

Table A6.19: A summary of the ratio of negative innovation to positive innovations and half-life of persistence on the returns of UK non-financial industries for the 2 sub-periods 01/01/90- 31/12/98 and 01/01/99- 31/12/06

	ACTUAL ECU/£		UNEXPECTED ECU/£		ACTUAL Euro/£		UNEXPECTED Euro/£	
INDUSTRY	N.I/P.I	HL	N.I/P.I	HL	N.I/P.I	HL	N.I/P.I	HL
Aerospace and Defence	1.0563	N.A	1.0491	N.A	0.8654	N.A	0.8688	N.A
Automobiles and Auto Parts	1.9549	0.32644*	1.3417*	7.4477*	1.2023*	13.8923*	1.6528*	0.2044
Beverages	0.7700*	2.5655*	0.7693*	2.5714*	1.0742	9.0302*	1.0724	9.3473*
Chemicals	1.1641	10.3667*	1.1577	10.3697*	1.1856*	9.7023*	1.1213	0.1933
Construction And Materials	1.3225*	N.A	1.3723*	N.A	1.1751	N.A	1.1733	N.A
Electricity	1.0097	0.4497	1.0098	0.4291	1.0902	1458.9106*	1.0980	1013.0264*
Electronic And Electrical Equipment	1.1937*	36.0322*	1.1839*	39.7395*	0.7280*	0.0961	0.7596*	0.1889
Fixed-line Telecommunications	1.1497	1.7596*	1.1476	1.8459	0.9830	60.4871*	0.9821	60.2849*
Food and Drug Retailers	1.1305*	21.6842*	1.1225*	21.6695*	1.1251*	57.0990*	1.1376*	61.9469*
Food Producers	0.8780*	32.6843*	0.8732*	34.9359*	1.1027*	N.A	1.0952*	487.7851*
Forestry And Paper	0.9622	N.A	0.9899	N.A	4.7365	1.7496*	-14.2935	1.5093*
Gas, Water And Multi-Utilities	0.9538	0.3042	0.9709	0.3979	1.2127*	53.8683*	1.2219*	47.6677*
General Industrial	1.1721	N.A	1.1256	N.A	1.0056	76.8751*	1.0043	76.5837*
General Retailers	1.0280	13.6435*	1.0305	13.9987*	1.1171	32.2877*	1.1173	32.4934*
Healthcare Equipment and Services	1.2792*	N.A	1.2800*	N.A	1.1452	26.9143*	1.1350	26.6857*
Household Goods	1.1670*	14.3418*	1.1606*	15.1397*	1.4751*	0.4733	1.4845*	0.4938
Industrial Engineering	0.9376	2.3776*	0.9398	2.7168*	1.1061	N.A	1.1159	N.A
Industrial Transport	1.1395	0.3024*	1.1813	0.3126*	0.7545*	N.A	0.8204*	N.A
Leisure Goods	3.7296	2.2221*	2.6587	2.3519*	1.0455	43.4837*	1.0437	44.1420*
Media	0.9133	0.2288	2.4875	2.4662*	0.6939*	44.8558*	1.0418	43.8273*

Table A6.19 continued A summary of the ratio of negative innovation to positive innovations and half-life of persistence on the returns of UK non-financial industries for the 2 sub-periods 01/01/90- 31/12/98 and 01/01/99- 31/12/06

	ACTUAL ECU/£		UNEXPECTED ECU/£		ACTUAL Euro/£		UNEXPECTED Euro/£	
INDUSTRY	N.I/P.I	HL	N.I/P.I	HL	N.I/P.I	HL	N.I/P.I	HL
Mining	0.6311*	N.A	0.6339*	N.A	0.8809*	58.4887*	0.8753*	65.5726*
Mobile Telecommunications	0.9316	10.0636*	0.9333	10.2445*	0.9707	51.2452*	0.9691	51.8986*
Oil and Gas Producers	0.7740	0.5582	0.7866	0.6103	1.0504	718.6857*	1.0119	N.A
Oil Equipment And Services	2.9421	0.1372	2.6581	0.1500	1.6316*	2.1945*	1.6347*	2.1536*
Personal Goods	0.9333	4.4272*	0.9289	4.3649*	0.9715	10.7216*	0.9688	11.4600*
Pharmaceuticals and Biotechnology	2.7410	N.A	2.3647	N.A	-0.7585	0.4633	-0.7722	0.4575
Software and Computer Services	1.1488*	N.A	1.2358*	N.A	0.9298*	406.1912*	0.9281*	419.7425*
Support Services	1.1222*	387.3195*	1.1185*	304.7356*	1.0700	55.3137*	1.0746	57.5984*
Technical Hardware and Equipment	1.1981	N.A	1.1812	N.A	1.0712	50.5818*	1.0746	47.1870*
Tobacco	1.0287	27.7544*	1.0237	26.1018*	1.0077	120.9386*	1.0160	121.4501*
Travel and Leisure	0.7747*	N.A	0.7773*	N.A	1.1538*	65.9256*	1.1484*	64.5785*

Note: N.I/P.I represents the ratio of negative innovation to positive innovation but this s only relevant in instances where the asymmetric parameter is significant as denoted by *. HL is the half-life of the innovation and in columns with N.A, the GARCH parameter had been unstable and cannot be used in the calculation. Actual and unexpected represent the actual and unexpected changes in the exchange rate measures respectively. ECU/£ is the ECU exchange rate against the £ while Euro/£ is the euro exchange rate against the £.

Appendix 7 Summary of estimated parameter coefficients from the variance equations for concentrated and competitive industries

Table A7.1 A summary of non-financial concentrated and competitive industries' exposure to actual and unexpected changes in the trade weighted nominal exchange rate, short-term interest rate and long-term interest rate for the total sample period– Estimated coefficients from the variance equation

	ACTUAL BOEGBPR			UNEXPECTED BOEGBPR		
INDUSTRY COMPETITION	α_1	α_2	φ	α_1	α_2	φ
CONCENTRATED	-0.0128***	0.1173***	0.9928***	-0.0128***	0.1173***	0.9928***
COMPETITIVE	-0.0182***	0.1318***	0.9940***	-0.0185***	0.1322***	0.9940***
CONC AND COMP	-0.0151***	0.1230***	0.9934***	-0.0152***	0.1231***	0.9934***

Note: α_1 represents the coefficient for the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. *** indicates statistical significance at the 1% level.

Table A7.2 A summary of non-financial concentrated and competitive industries' exposure to actual and unexpected changes in the foreign exchange rate US$/£ of the total sample period from January 1990 to December 2006 – Estimated coefficients from the mean equation

	ACTUAL US$/£			UNEXPECTED US$/£		
INDUSTRY COMPETITION	α_1	α_2	φ	α_1	α_2	φ
CONCENTRATED	-0.0127***	0.1176***	0.9928***	-0.0127***	0.1175***	0.9928***
COMPETITIVE	-0.0180***	0.1322***	0.9939***	-0.0183***	0.1324***	0.9939***
CONC AND COMP	-0.0150***	0.1233***	0.9934***	-0.0151***	0.1233***	0.9934***

Note: α_1 is the coefficient for the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. *** indicates statistical significance at the 1% level.

Table A7.3 A summary of non-financial concentrated and competitive industries' exposure to actual and unexpected changes in the foreign exchange rate JP¥/£ of the total sample period from January 1990 to December 2006 – Estimated coefficients from the mean equation

	ACTUAL JP¥/£			UNEXPECTEDJP¥/£		
INDUSTRY COMPETITION	α_1	α_2	φ	α_1	α_2	φ
CONCENTRATED	-0.0128***	0.1172***	0.9928***	-0.0127***	0.1172***	0.9928***
COMPETITIVE	-0.0180***	0.1316***	0.9940***	-0.0187***	0.1316***	0.9940***
CONC AND COMP	-0.0151***	0.1228***	0.9935***	-0.0151***	0.1228***	0.9935***

Note: α_1 is the coefficient for the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. *** indicates statistical significance at the 1% level.

Table A7.4 A summary of the ratio of negative innovation to positive innovations and half-life of persistence on the returns of UK concentrated and competitive industries for the period 01/01/90 - 31/12/06 using contemporaneous changes in the exchange rate measures

	ACTUAL BOEGBPR		UNEXPECED BOEGBPR	
INDUSTRY COMPETITION	N.I/P.I	HL	N.I/P.I	HL
CONCENTRATED	1.0259	95.9235	1.0259	95.9235
COMPETITVE	1.0371	115.1776	1.0377	115.1776
CONC AND COMP	1.0307	104.6753	1.0309	104.6753
	ACTUAL US$/£		UNEXPECED US$/£	
INDUSTRY COMPETITION	N.I/P.I	HL	N.I/P.I	HL
CONCENTRATED	1.0257	95.9235	1.0257	95.9235
COMPETITVE	1.0367	113.2838	1.0373	113.2838
CONC AND COMP	1.0305	104.6753	1.0307	104.6753

Table A7.4 continued A summary of the ratio of negative innovation to positive innovations and half-life of persistence on the returns of UK concentrated and competitive industries for the period 01/01/90 - 31/12/06 using contemporaneous changes in the exchange rate measures

	ACTUAL JP¥/£		UNEXPECEDJP¥/£	
INDUSTRY COMPETITION	N.I/P.I	HL	N.I/P.I	HL
CONCENTRATED	1.0259	95.9235	1.0257	95.9235
COMPETITVE	1.0367	115.1776	1.0381	115.1776
CONC AND COMP	1.0307	106.2911	1.0307	106.2911

Note: N.I/P.I is the ratio of negative innovation to positive innovation. HL is the half-life of the innovation Actual and unexpected represent the actual and unexpected changes in the exchange rate measures respectively. BOEGBPR is the trade weighted nominal exchange rate, US$/£ is the US$ exchange rate against the £ while JP¥/£ is the JP¥ exchange rate against the £.

Table A7.5 A summary of non-financial concentrated and competitive industries' exposure to actual and unexpected changes in the foreign exchange rate ECU/£– Estimated coefficients from the variance equation

	ACTUAL ECU/£			UNEXPECTED ECU/£		
INDUSTRY COMPETITION	α_1	α_2	φ	α_1	α_2	φ
CONCENTRATED	-0.0461*	0.2949***	0.9451***	-0.0093	0.1363***	0.9836***
COMPETITIVE	-0.0147***	0.1340***	0.9846***	-0.0332***	0.1476***	0.9818***
CONC AND COMP	-0.0159***	0.1444***	0.9837***	-0.0163***	0.1444***	0.9837***

Note: α_1 is the coefficient for the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. *** indicates statistical significance at the 1% level.

Table A7.6 A summary of non-financial concentrated and competitive industries' exposure to actual and unexpected changes in the foreign exchange rate Euro/£ – Estimated coefficients from the variance equation

	ACTUAL Euro/£			UNEXPECTED Euro/£		
INDUSTRY COMPETITION	α_1	α_2	φ	α_1	α_2	φ
CONCENTRATED	-0.0414**	0.1165***	0.9799***	0.2550***	2.2299***	0.7193***
COMPETITIVE	-0.0127**	0.1495***	0.9931***	-0.0070***	0.0387***	0.0771***
CONC AND COMP	-0.0149***	0.1466***	0.9927***	-0.0149***	0.1464***	0.9927***

Note: α_1 is the coefficient for the asymmetric impact of past innovations on current volatility; $\alpha 2$ is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. *** indicates statistical significance at the 1% level.

Table A7.7 A summary of the ratio of negative innovation to positive innovations and half-life of persistence on the returns of UK concentrated and competitive industries for the contemporaneous changes in the ECU/£ and Euro/£

	ACTUAL ECU/£		UNEXPECTED ECU/£	
INDUSTRY COMPETITION	N.I/P.I	HL	N.I/P.I	HL
CONCENTRATED	1.0967*	12.2758	1.0188	41.9175
COMPETITVE	1.0298*	44.6621	1.0687*	37.7374
CONC AND COMP	1.0323*	42.1768	1.0331*	42.1768
	ACTUAL EURO/£		UNEXPECTED EURO/£	
INDUSTRY COMPETITION	N.I/P.I	HL	N.I/P.I	HL
CONCENTRATED	1.0864*	34.1372	0.5936*	2.1038
COMPETITVE	1.0257*	100.1091	1.0141*	0.2705
CONC AND COMP	1.0303*	94.6047	1.0303*	94.6047

Note: N.I/P.I is the ratio of negative innovation to positive innovation. HL is the half-life of the innovation Actual and unexpected represent the actual and unexpected changes in the exchange rate measures respectively. BOEGBPR is the trade weighted nominal exchange rate, US$/£ is the US$ exchange rate against the £ while JP¥/£ is the JP¥ exchange rate against the £.

Table A7.8 A summary of non-financial concentrated and competitive industries' exposure actual and unexpected changes in the trade weighted nominal exchange rate, short-term interest rate and long-term interest rate before and after the euro – Estimated coefficients from the variance equation

	ACTUAL BOEGBPR				UNEXPECTED BOEGBPR			
INDUSTRY COMPETITION	α_1	α_2	φ	EURDUM	α_1	α_2	φ	EURDUM
CONCENTRATION	-0.0128***	0.1175***	0.9927***	0.0003	-0.0129***	0.1175***	0.9926***	0.0003
COMPETITIVE	-0.0210***	0.1336***	0.9928***	0.0044*	-0.0213***	0.1339***	0.9928***	0.0044
CONC AND COMP	-0.0157***	0.1239***	0.9930***	0.0017	-0.0159***	0.1239***	0.9930***	0.0017

Note: α_1 is the coefficient for the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. EURDUM is the coefficient for the Euro dummy which examines the impact of the introduction of the Euro on the volatility of industry returns. *** and * indicates statistical significance at the 1% level and 10% level respectively.

Table A7.9 A summary of non-financial concentrated and competitive industries' exposure to actual changes and unexpected changes in the foreign exchange rate US$/£ before and after the euro – Estimated coefficients from the variance equation

	ACTUAL US$/£				UNEXPECTED US$/£			
INDUSTRY COMPETITION	α_1	α_2	φ	EURDUM	α_1	α_2	φ	EURDUM
CONCENTRATION	-0.0126***	0.1177***	0.9926***	0.0003	-0.0127***	0.1177***	0.9926***	0.0003
COMPETITIVE	-0.0208***	0.1338***	0.9928***	0.0043*	-0.0210***	0.1340***	0.9928***	0.0043*
CONC AND COMP	-0.0155***	0.1240***	0.9930***	0.0017	-0.0157***	0.1240***	0.9930***	0.0017

Note: α_1 represents the coefficient for the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. EURDUM is the coefficient for the Euro dummy which examines the impact of the introduction of the Euro on the volatility of industry returns. *** and * indicates statistical significance at the 1% level and 10% level respectively.

Table A7.10 A summary of non-financial concentrated and competitive industries' exposure to actual changes and unexpected changes in the foreign exchange rate JP¥/£ before and after the Euro – Estimated coefficients from the variance equation

	ACTUAL JP¥/£			
INDUSTRY COMPETITION	α_1	α_2	φ	EURDUM
CONCENTRATION	-0.0126***	0.1175***	0.9926***	0.0004
COMPETITIVE	-0.0208***	0.1330***	0.9928***	0.0044*
CONC AND COMP	-0.0156***	0.1235***	0.9930***	0.0017
	UNEXPECTED JP¥/£			
INDUSTRY COMPETITION	α_1	α_2	φ	EURDUM
CONCENTRATION	-0.0127***	0.1174***	0.9926***	0.0003
COMPETITIVE	-0.0210***	0.1332***	0.9928***	0.0043*
CONC AND COMP	-0.0158***	0.1234***	0.9930***	0.0017

Note: α_1 is the coefficient for the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. EURDUM is the coefficient for the Euro dummy which examines the impact of the introduction of the Euro on the volatility of industry returns. *** and * indicates statistical significance at the 1% level and 10% level respectively.

Table A7.11 A summary of non-financial concentrated and competitive industries' exposure to lagged changes in the trade weighted nominal exchange rate, short-term interest rate and long-term interest rate for the total sample period from January 1990 to December 2006 – Estimated coefficients from the variance equation

	ACTUAL BOEGBPR			UNEXPECTED BOEGBPR		
INDUSTRY COMPETITION	α_1	α_2	φ	α_1	α_2	φ
CONCENTRATION	-0.0126***	0.1173***	0.9928***	-0.0126***	0.1172***	0.9928***
COMPETITIVE	-0.0185***	0.1322***	0.9939***	-0.0185***	0.1320***	0.9939***
CONC AND COMP	-0.0152***	0.1230***	0.9934***	-0.0151***	0.1229***	0.9934***

Note: α_1 denotes the coefficient for the asymmetric impact of past innovations on current volatility, α_2 represents the ARCH parameter coefficient and φ is the GARCH parameter coefficient. *** indicates statistical significance at the 1% level.

Table A7.12 A summary of non-financial concentrated and competitive industries' exposure to lagged changes in the foreign exchange rate US$/£ of the total sample period from January 1990 to December 2006 – Estimated coefficients from the variance equation

	ACTUAL US$/£			UNEXPECTED US$/£		
INDUSTRY COMPETITION	α_1	α_2	φ	α_1	α_2	φ
CONCENTRATION	-0.0126***	0.1171***	0.9928***	-0.0126***	0.1117***	0.9928***
COMPETITIVE	-0.0185***	0.1318***	0.9940***	-0.0185***	0.1316***	0.9940***
CONC AND COMP	-0.0152***	0.1227***	0.9935***	-0.0151***	0.1226***	0.9935***

Note: α_1 is the coefficient for the asymmetric impact of past innovations on current volatility, α_2 represents the ARCH parameter coefficient and φ is the GARCH parameter coefficient. *** indicates statistical significance at the 1% level.

Table A7.13 A summary of non-financial concentrated and competitive industries' exposure to lagged changes in the foreign exchange rate JP¥/£ of the total sample period from January 1990 to December 2006 – Estimated coefficients from the variance equation

	ACTUAL JP¥/£			UNEXPECTED JP¥/£		
INDUSTRY COMPETITION	α_1	α_2	φ	α_1	α_2	φ
CONCENTRATION	-0.0126***	0.1173***	0.9928***	-0.0125***	0.1172***	0.9928***
COMPETITIVE	-0.0185***	0.1318***	0.9939***	-0.0184***	0.1317***	0.9939***
CONC AND COMP	-0.0152***	0.1229***	0.9934***	-0.0151***	0.1228***	0.9934***

Note: α_1 represents the coefficient for the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient while φ is the GARCH parameter coefficient. *** indicates statistical significance at the 1% level.

Table A7.14 A summary of non-financial concentrated and competitive industries' exposure to lagged changes in the foreign exchange rate ECU/£
Estimated coefficients from the variance equation

	ACTUAL ECU/£			UNEXPECTED ECU/£		
INDUSTRY COMPETITION	α_1	α_2	φ	α_1	α_2	φ
CONCENTRATION	-0.0459*	0.3032***	0.9419***	-0.0096	0.1361***	0.9837***
COMPETITIVE	-0.0151***	0.1344***	0.9845***	-0.0334***	0.1497***	0.9813***
CONC AND COMP	-0.0165***	0.1449***	0.9835***	-0.0166***	0.1448***	0.9836***

Note: α_1 represents the coefficient for the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient while φ is the GARCH parameter coefficient. *** indicates statistical significance at the 1% level.

Table A7.15 A summary of non-financial concentrated and competitive industries' exposure to lagged changes in the foreign exchange rate Euro/£
Estimated coefficients from the mean equation

	ACTUAL EURO/£			UNEXPECTED EURO/£		
INDUSTRY COMPETITION	α_1	α_2	φ	α_1	α_2	φ
CONCENTRATION	-0.0437**	0.1213***	0.9785***	0.1638***	2.3204***	0.7231***
COMPETITIVE	-0.0121**	0.1489***	0.9932***	0.1267***	2.1996***	0.7282***
CONC AND COMP	-0.0144***	0.1464***	0.9928***	-0.0143***	0.1459***	0.9928***

Note: α_1 is the coefficient for the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient while φ is the GARCH parameter coefficient. *** and ** represents statistical significance at the 1% and 5% level.

Table A7.16 continued A summary of the ratio of negative innovation to positive innovations and half-life of persistence on the returns of UK concentrated and competitive industries for the lagged changes in the TWI, US$/£, JP¥/£, ECU/£ and Euro/£

	ACTUAL JP¥/£		UNEXPECTED JP¥/£	
INDUSTRY COMPETITION	N.I/P.I	HL	N.I/P.I	HL
CONCENTRATED	1.0255	95.9235	1.0253	95.9235
COMPETITVE	1.0377	113.2838	1.0375	113.2838
CONC AND COMP	1.0309	104.6753	1.0307	104.6753
	ACTUALECU/£		UNEXPECTED ECU/£	
INDUSTRY COMPETITION	N.I/P.I	HL	N.I/P.I	HL
CONCENTRATED	1.0962	11.5802	1.0194*	42.1768
COMPETITVE	1.0307	44.3717	1.0691	36.7190
CONC AND COMP	1.0336	41.6614	1.0338	41.9175
	ACTUAL Euro/£		UNEXPECTED Euro/£	
INDUSTRY COMPETITION	N.I/P.I	HL	N.I/P.I	HL
CONCENTRATED	1.0914	31.8916	0.7185	2.1380
COMPETITVE	1.0245	101.5864	0.7751	2.1853
CONC AND COMP	1.0292	95.9235	1.0290	95.9235

Note: Note: N.I/P.I is the ratio of negative innovation to positive innovation. HL is the half-life of the innovation Actual and unexpected represent the actual and unexpected changes in the exchange rate measures respectively. BOEGBPR is the trade weighted nominal exchange rate, US$/£ is the US$ exchange rate against the £ while JP¥/£ is the JP¥ exchange rate against the £. Furthermore, ECU/£ is the ECU exchange rate against the pound whereas Euro/£ is the euro exchange rate against the pound. * indicates that the asymmetric coefficient was insignificant so the impact of positive and negative innovations on volatility is the same.

Appendix 8 Summary of estimated parameter coefficients from the variance equations for UK non-financial firms

Table A8.1 A summary of non-financial firms' exposure to actual and unexpected changes in the Trade weighted nominal exchange rate from January 1990 to December 2006-Parameter estimates from the variance equation

	A.BOEGBPR			U.BOEGBPR		
STATISTICS	α_1	α_2	φ	α_1	α_2	φ
Mean	-0.0817	1.3965	0.8274	-0.0731	1.3313	0.8277
Minimum	-7.7210	-0.5933	-0.7100	-2.9027	-0.1635	-0.7878
Median	-0.0579	0.4121	0.9703	-0.0580	0.4065	0.9712
Maximum	2.6880	39.2677	1.0237	2.8944	55.6440	1.0264
Standard deviation	0.7186	3.2660	0.2945	0.4792	3.4799	0.2944
Firms with significant exposure	48%	70%	94%	49%	69%	94%
Positive exposure coefficients	22%	98%	99%	21%	97%	99%
Significant coefficients at 1%	54%	69%	98%	52%	69%	98%
Significant coefficients at 5%	31%	19%	1%	29%	19%	2%
Significant coefficients at 10%	15%	12%	0%	19%	13%	0%

Note: BOEGBPR is the trade weighted exchange rate index. A. and U. represent the actual and unexpected changes respectively. α_1 represents the coefficient for the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. Furthermore, significant coefficients at the 1%, 5% and 10% signifies the percentage of firms with significant coefficients.

Table A8.2 A summary of non-financial firms' exposure to actual and unexpected changes in the US$/£ exchange rate from January 1990 to December 2006-Parameter estimates from the variance equation

	A.US$/£			U.US$/£		
STATISTICS	α_1	α_2	φ	α_1	α_2	φ
Mean	-0.1206	1.3952	0.8326	-0.0727	1.3535	0.8341
Minimum	-18.8849	-0.3874	-0.6665	-4.7268	-0.4531	-0.6744
Median	-0.0567	0.4371	0.9705	-0.0608	0.4800	0.9704
Maximum	2.4740	61.3069	1.0250	2.5695	57.8844	1.0241
Standard deviation	1.0783	3.7406	0.2863	0.4977	3.5173	0.2789
Firms with significant exposure	47%	69%	94%	49%	70%	95%
Positive exposure coefficients	19%	98%	99%	21%	97%	100%
Significant coefficients at 1%	54%	69%	98%	52%	71%	98%
Significant coefficients at 5%	28%	21%	1%	29%	19%	1%
Significant coefficients at 10%	19%	10%	1%	19%	11%	1%

Note: US$/£ is the US$ exchange rate. A. and U. represent the actual and unexpected changes respectively. α_1 is the coefficient for the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. Significant coefficients are at the 1%, 5% and 10% levels.

Table A8.3 A summary of non-financial firms' exposure to actual and unexpected changes in the JP¥/£ exchange rate from January 1990 to December 2006-Parameter estimates from the variance equation

	A.JP¥/£			U.JP¥/£		
STATISTICS	α_1	α_2	φ	α_1	α_2	φ
Mean	-0.0718	1.3692	0.8320	-0.0982	1.3027	0.8272
Minimum	-6.1530	-1.1134	-0.7209	-4.9156	-0.0584	-0.1494
Median	-0.0619	0.4138	0.9720	-0.0598	0.4096	0.9715
Maximum	3.8994	39.4382	1.0233	5.2296	25.1516	1.0232
Standard deviation	0.6344	3.1943	0.2911	0.6677	2.7146	0.2844
Firms with significant exposure	48%	69%	94%	47%	70%	93%
Positive exposure coefficients	20%	98%	99%	19%	98%	100%
Significant coefficients at 1%	56%	70%	99%	53%	70%	99%
Significant coefficients at 5%	24%	22%	1%	28%	21%	1%
Significant coefficients at 10%	20%	11%	1%	19%	9%	0%

Note: JP¥/£ is the JP¥ exchange rate. A. and U. signify the actual and unexpected changes respectively. α_1 is the coefficient for the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. Firms with significant exposure correspond to the percentage of firms with significant exposure coefficients in the total sample, while positive exposure coefficients represent the percentage of significant positive coefficients out of the significant coefficients. Furthermore, significant coefficients at the 1%, 5% and 10% signifies the percentage of firms with significant coefficients, out of the total significant coefficients, at the 1%, 5% and 10% level respectively.

Table A8.4 A summary of non-financial firms' exposure to actual and unexpected changes in the foreign exchange rate ECU/£ and Euro/£ - Parameter estimates from the variance equation

	A.ECU/£			U.ECU/£			A.EURO/£			U.EURO/£		
STATISTICS	α_1	α_2	φ	α_1	α_2	φ	α_1	α_2	φ	α_1	α_2	φ
Mean	-0.0829	2.4831	0.5567	0.0798	2.0532	0.5589	-0.1711	2.0807	0.5123	-0.0627	1.4958	0.5099
Minimum	-29.5964	-0.6692	-0.9600	-8.5690	-2.1188	-0.9418	-44.3937	-0.6716	-0.9289	-39.5003	-0.6516	-0.8842
Median	-0.0697	0.4025	0.7244	-0.0744	0.3448	0.7151	-0.0467	0.1892	0.7049	-0.0409	0.2067	0.6996
Maximum	14.7482	136.6485	1.0136	27.4926	63.8482	1.0095	26.8160	125.0747	1.0334	23.7570	101.8192	1.0331
Standard deviation	1.9657	9.2271	0.4318	2.0081	6.1899	0.4274	3.6394	9.7909	0.4899	3.3116	6.5401	0.4767
Firms with significant exposure	31%	42%	77%	31%	44%	77%	29%	50%	70%	26%	50%	67%
Positive exposure coefficients	19%	94%	96%	17%	98%	96%	12%	89%	93%	14%	91%	93%
Significant coefficients at 1%	52%	45%	95%	48%	45%	93%	47%	44%	91%	48%	48%	93%
Significant coefficients at 5%	28%	36%	3%	27%	30%	5%	30%	37%	6%	34%	34%	5%
Significant coefficients at 10%	19%	18%	2%	25%	25%	3%	23%	19%	2%	18%	19%	2%

Note: α_1 represents the coefficient for the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. A. and U. represent the actual and unexpected changes respectively. ECU/£ represents the exchange rate exposure coefficients of the ECU while Euro/£ represents the exchange rate exposure for the Euro. Firms with significant exposure signify the percentage of firms with significant exposure coefficients in the total sample whereas positive exposure coefficients are the percentage of significant positive coefficients out of the significant coefficients. Furthermore, significant coefficients are at the 1%, 5% and 10% level.

Table A8.5 A summary of non-financial firms' exposure to lagged actual and unexpected changes in the Trade weighted nominal exchange rate from January 1990 to December 2006-Parameter estimates from the variance equation

	A.BOEGBPR			U.BOEGBPR		
STATISTICS	α_1	α_2	φ	α_1	α_2	φ
Mean	-0.0535	1.4785	0.8168	-0.0600	1.5275	0.8306
Minimum	-8.1020	-0.6316	-0.7840	-7.0023	-0.1072	-0.6563
Median	-0.0595	0.4049	0.9689	-0.0638	0.4085	0.9730
Maximum	8.4546	39.2413	1.0251	16.8360	35.7947	1.0290
Standard deviation	0.7843	4.0044	0.3061	1.0902	3.7855	0.2851
Firms with significant exposure	46%	69%	93%	47%	68%	94%
Positive exposure coefficients	19%	97%	99%	19%	97%	100%
Significant coefficients at 1%	58%	69%	98%	56%	70%	99%
Significant coefficients at 5%	25%	20%	1%	28%	22%	1%
Significant coefficients at 10%	17%	11%	0%	16%	8%	0%

Note: BOEGBPR is the trade weighted exchange rate index. A. and U. are the actual and unexpected changes respectively. α_1 represents the coefficient for the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. Furthermore, significant coefficients at the 1%, 5% and 10% signifies the percentage of firms with significant coefficients.

Table A8.6 A summary of non-financial firms' exposure to lagged actual and unexpected changes in the US$/£ exchange rate from January 1990 to December 2006-Parameter estimates from the variance equation

	A.US$/£			U.US$/£		
STATISTICS	α_1	α_2	φ	α_1	α_2	φ
Mean	-0.0417	1.4469	0.8289	-0.0446	1.6192	0.8296
Minimum	-6.7777	-0.5267	-0.8121	-10.3439	-0.0559	-0.6446
Median	-0.0590	0.4040	0.9703	-0.0601	0.3793	0.9705
Maximum	12.5768	56.7296	1.0230	15.8196	53.7696	1.0232
Standard deviation	0.8854	4.0381	0.2888	1.1703	4.5319	0.2837
Firms with significant exposure	46%	69%	94%	45%	70%	94%
Positive exposure coefficients	17%	98%	99%	19%	98%	100%
Significant coefficients at 1%	54%	68%	99%	55%	67%	99%
Significant coefficients at 5%	25%	18%	1%	26%	21%	1%
Significant coefficients at 10%	20%	14%	0%	19%	12%	0%

Note: US$/£ is the US$ exchange rate. A. and U. denotes the actual and unexpected changes respectively. α_1 represents the coefficient for the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. Furthermore, significant coefficients at the 1%, 5% and 10% signifies the percentage of firms with significant coefficients.

Table A8.7 A summary of non-financial firms' exposure to lagged actual and unexpected changes in the JP¥/£ exchange rate from January 1990 to December 2006-Parameter estimates from the variance equation

	A.JP¥/£			U.JP¥/£		
STATISTICS	α_1	α_2	φ	α_1	α_2	φ
Mean	-0.0658	1.3010	0.8295	-0.0765	1.4700	0.8332
Minimum	-4.7529	-1.1236	-0.8082	-7.4743	-0.0616	-0.6439
Median	-0.0592	0.4158	0.9704	-0.0613	0.4039	0.9711
Maximum	2.6696	47.5648	1.0234	10.3537	42.7347	1.0254
Standard deviation	0.5251	3.0756	0.2920	0.8117	3.6740	0.2801
Firms with significant exposure	48%	70%	95%	46%	70%	94%
Positive exposure coefficients	20%	98%	99%	18%	98%	100%
Significant coefficients at 1%	55%	67%	98%	53%	70%	99%
Significant coefficients at 5%	27%	21%	1%	30%	19%	1%
Significant coefficients at 10%	19%	12%	1%	17%	11%	0%

Note: JP¥/£ is the JP¥. A. and U. represent the actual and unexpected changes respectively. α_1 represents the coefficient for the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. Furthermore, significant coefficients at the 1%, 5% and 10% signifies the percentage of firms with significant coefficients.

Table A8.8 A summary of non-financial firms' exposure to actual and unexpected changes in the foreign exchange rate ECU/£ and Euro/£ - Parameter estimates from the variance equation

	A.ECU/£			U.ECU/£			A.EURO/£			U.EURO/£		
STATISTICS	α_1	α_2	φ	α_1	α_2	φ	α_1	α_2	φ	α_1	α_2	φ
Mean	0.0313	2.5558	0.5669	-0.2232	3.4543	0.5586	-0.0959	1.7184	0.4996	-0.0853	1.5251	0.5162
Minimum	-13.0862	-0.7148	-0.9397	-72.3205	-0.2654	-0.9423	-43.7231	-1.2322	-0.9407	-41.2841	-0.4478	-0.8994
Median	-0.0683	0.4047	0.7536	-0.0740	0.4160	0.7275	-0.0512	0.1909	0.7062	-0.0425	0.1952	0.7250
Maximum	26.5338	176.2209	1.0168	25.8246	260.6931	1.0118	48.9808	98.4147	1.0111	20.9518	73.9787	1.0330
Standard deviation	2.1507	11.6552	0.4365	4.5882	15.0175	0.4373	4.1452	6.9821	0.5019	2.6061	6.8650	0.4930
Firms with significant exposure	31%	41%	78%	29%	42%	78%	29%	50%	71%	27%	50%	72%
Positive exposure coefficients	21%	95%	95%	19%	96%	94%	17%	90%	91%	12%	92%	92%
Significant coefficients at 1%	50%	45%	94%	52%	47%	95%	49%	50%	90%	47%	49%	92%
Significant coefficients at 5%	37%	37%	4%	29%	34%	4%	29%	31%	7%	32%	33%	6%
Significant coefficients at 10%	13%	18%	2%	19%	19%	2%	22%	19%	3%	21%	19%	2%

Note: α_1 is the coefficient denoting the asymmetric impact of past innovations on current volatility, α_2 is the ARCH parameter coefficient and φ is the GARCH parameter coefficient. A. and U. represent the actual and unexpected changes respectively. ECU/£ represents the exchange rate exposure coefficients of the ECU while Euro/£ represents the exchange rate exposure for the Euro. Firms with significant exposure signify the percentage of firms with significant exposure coefficients in the total sample whereas positive exposure coefficients are the percentage of significant positive coefficients out of the significant coefficients. Furthermore, significant coefficients are at the 1%, 5% and 10% level.

Appendix 9 Summary of risk-return, exchange rate and interest rate exposure of UK non-financial firms by industry grouping

Table A9.1 A summary of the direction of the risk-return coefficient and exchange rate exposure coefficients for non-financial firms returns by industry to actual and unexpected changes in the foreign exchange rates of the total sample period 01/01/90-31/12/06

		A. BOEGBPR				U. BOEGBPR				A. US$/£				U.US$/£				A.JP¥/£				U.JP¥/£			
		λ		TWI		λ		TWI		λ		US$/£		λ		US$/£		λ		JP¥/£		λ		JP¥/£	
INDUSTRY	N	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
Aerospace and Defence	8	0	0	1	0	0	0	2	0	0	0	1	1	0	1	1	1	0	1	1	1	1	0	1	1
Automobiles and Auto Parts	3	0	1	0	0	0	1	0	0	0	1	1	0	0	1	1		0	1	0	0	0	0	0	0
Beverages	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0
Chemicals	12	4	1	0	0	2	2	1	0	4	2	1	0	3	2	1	0	4	2	1	0	0	1	0	0
Construction And Materials	22	4	2	2	2	5	2	2	1	3	1	3	0	2	2	2	0	2	1	1	0	0	1	1	1
Electricity	3	1	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	1	0	0	0
Electronic And Electrical Eqpt	20	2	1	0	2	2	1	0	2	4	2	0	0	3	1	1	0	3	2	2	2	2	0	4	1
Fixed-line Telecommunications	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Food and Drug Retailers	5	0	1	2	0	0	1	2	0	0	1	2	0	0	1	2	0	0	1	1	0	0	0	1	0
Food Producers	15	3	1	3	2	3	2	2	1	2	2	1	2	3	2	1	2	2	2	2	2	2	1	2	1
Forestry And Paper	2	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	1	1	0
Gas, Water And Multi-Utilities	6	2	1	4	0	2	0	4	0	2	0	3	1	2	0	4	0	2	0	4	0	2	0	4	0
General Industrial	9	2	1	0	1	0	1	0	1	1	1	1	0	1	1	0	0	0	1	0	0	0	0	0	1
General Retailers	27	3	5	4	0	4	4	4	1	3	5	1	1	3	4	0	1	2	5	3	1	4	3	2	1
Healthcare Equipment and Services	10	1	3	0	0	1	2	0	0	1	2	1	0	1	2	1	0	1	4	0	1	1	2	0	0
Household Goods	19	4	2	0	3	3	3	0	3	5	2	0	1	5	3	0	1	3	3	0	2	2	2	1	2
Industrial Engineering	33	3	2	1	0	3	1	3	0	3	1	1	0	4	2	1	0	3	2	1	0	1	4	0	0

Table A9.1 continued A summary of the direction of the risk-return coefficient and exchange rate exposure coefficients for non-financial firms' returns by industry to actual and unexpected changes in the foreign exchange rates of the total sample period 01/01/90-31/12/06

		A. BOEGBPR				U. BOEGBPR				A. US$/£				U.US$/£				A.JP¥/£				U.JP¥/£			
		λ		TWI		λ		TWI		λ		US$/£		λ		US$/£		λ		JP¥/£		λ		JP¥/£	
INDUSTRY	N	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
Industrial Transport	9	3	1	0	1	3	1	0	1	4	0	0	0	4	0	0	0	4	0	1	0	4	0	1	0
Leisure Goods	6	0	3	0	1	0	3	0	0	1	1	1	0	0	2	1	0	1	1	0	0	1	2	0	0
Media	29	3	4	1	1	3	3	1	1	3	3	1	0	2	3	0	0	2	3	5	0	4	1	3	0
Mining	7	1	1	0	3	1	1	1	3	2	0	1	2	2	0	1	1	2	0	1	1	2	0	0	1
Mobile Telecommunications	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oil Equipment And Services	2	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0
Personal Goods	14	0	2	0	0	1	1	0	0	0	3	1	0	1	1	0	0	0	3	0	0	2	2	0	0
Pharmaceuticals and Biotechnology	7	2	3	1	1	1	4	0	0	3	2	0	0	1	4	1	0	1	3	1	1	2	1	0	1
Software and Computer Services	21	0	6	2	1	0	6	2	1	0	5	0	1	0	7	1	1	1	3	1	0	1	4	0	0
Support Services	62	13	4	5	3	13	3	6	3	12	3	4	2	13	2	6	2	11	5	3	4	12	4	3	4
Technical Hardware and Equipment	11	1	3	2	0	0	4	1	0	1	4	1	1	0	4	2	1	0	4	2	0	0	3	2	0
Tobacco	1	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	1
Travel and Leisure	23	4	2	2	0	5	1	5	0	6	1	3	0	3	2	1	0	5	1	1	0	4	2	2	0
TOTAL	402	57	55	33	24	54	52	39	21	61	47	31	14	56	52	30	13	50	54	34	19	49	39	31	18

The table presents the number of firms with significant positive or negative exchange rate exposure coefficient and risk parameter coefficient in each industry. N is the number of firms in the industry. (+) indicates number of firms with significant positive coefficients whereas (-) is the number of firms with significant negative coefficients at all levels of significance i.e. 1%, 5% and 10%. A. and U. represent the actual and unexpected changes respectively. λ is the risk-return trade-off parameter coefficient, BOEGBPR is the trade weighted nominal exchange rate, US$/£ is the US$ exchange rate exposure coefficient and JP¥/£ is the JP¥ exchange rate exposure coefficient and all show the number of firms. The total column shows the total number of firms with significant positive or negative coefficients and also the total number of firms in the sample.

Table A9.2 A summary of the direction of exposure for non-financial firms returns by industry to actual and unexpected changes in the interest rates of the total period 01/01/90 - 31/12/06

		A. UKTBTND		U. UKTBTND		A. UKMBRYD		U. UKMBRYD	
INDUSTRY	N	+	-	+	-	+	-	+	-
Aerospace and Defence	8	0	0	0	0	2	0	1	0
Automobiles and Auto Parts	3	0	0	0	0	2	1	2	0
Beverages	4	0	0	0	0	0	1	0	1
Chemicals	12	0	2	0	1	3	0	1	0
Construction And Materials	22	0	3	0	1	3	2	2	0
Electricity	3	0	0	0	0	0	0	0	0
Electronic And Electrical Equipment	20	0	2	0	2	5	0	4	0
Fixed-line Telecommunications	2	0	0	1	0	0	1	0	0
Food and Drug Retailers	5	0	0	0	0	0	1	0	1
Food Producers	15	0	0	1	0	0	5	0	6
Forestry And Paper	2	0	1	0	0	0	0	0	0
Gas, Water And Multi-Utilities	6	0	0	0	0	0	4	0	4
General Industrial	9	0	4	0	2	2	0	3	1
General Retailers	27	1	0	4	1	3	2	4	3
Healthcare Equipment and Services	10	1	1	0	0	0	0	0	0
Household Goods	19	1	2	1	2	0	1	1	2
Industrial Engineering	33	1	0	1	0	7	0	6	0
Industrial Transport	9	1	0	0	0	1	0	0	0
Leisure Goods	6	0	0	0	1	2	0	1	0
Media	29	0	2	0	2	7	0	6	1
Mining	7	0	1	1	0	3	0	3	0
Mobile Telecommunications	1	0	1	0	1	0	0	0	0
Oil and Gas Producers	9	0	0	0	0	1	1	1	2
Oil Equipment And Services	2	1	0	0	0	0	0	0	0
Personal Goods	14	0	2	0	2	0	1	0	0
Pharmaceuticals and Biotechnology	7	1	0	0	0	2	0	1	0
Software and Computer Services	21	0	2	0	2	4	0	3	0
Support Services	62	2	5	2	6	9	3	13	5
Technical Hardware and Equipment	11	1	1	1	0	1	0	1	0
Tobacco	1	0	0	0	0	0	1	0	1
Travel and Leisure	23	0	2	1	1	2	0	3	0
TOTAL	402	10	31	13	24	59	24	56	27

The table shows the number of firms with significant positive or negative interest rate exposure coefficient in each industry. N is the number of firms in the industry. (+) indicates number of firms with significant positive coefficients while (-) is the number of firms with significant negative coefficients. The levels of significance are 1%, 5% and 10% respectively. The A. and U. represents the actual and unexpected changes. UKTBTND denotes the 3 month Treasury bill and UKMBRYD is the 10 year Government bond.

Table A9.3 A summary of the direction of exposure for non-financial firms returns by industry to actual and unexpected changes in the ECU/£ and Euro/£

		A. ECU/£				U. ECU/£				A. Euro/£				U.Euro/£			
		λ		ECU/£		λ		ECU/£		λ		Euro/£		λ		Euro/£	
INDUSTRY	N	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
Aerospace and Defence	8	1	0	1	3	0	1	1	2	1	0	1	0	3	0	1	0
Automobiles and Auto Parts	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beverages	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemicals	12	4	2	2	1	3	2	1	1	1	0	1	0	1	0	1	0
Construction And Materials	22	4	0	1	4	5	1	2	2	1	2	0	1	1	3	1	0
Electricity	3	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Electronic And Electrical Equipment	20	4	2	0	1	4	1	0	1	4	0	1	2	4	0	1	4
Fixed-line Telecommunications	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Food and Drug Retailers	5	1	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0
Food Producers	15	3	2	2	1	2	1	2	1	3	0	1	1	4	1	1	1
Forestry And Paper	2	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
Gas, Water And Multi-Utilities	6	1	1	4	0	2	1	5	0	0	1	0	0	0	1	1	0
General Industrial	9	0	3	0	1	0	2	0	1	3	0	0	2	3	0	0	2
General Retailers	27	4	6	6	0	3	3	6	1	4	2	1	1	6	2	0	2
Healthcare Equipment and Services	10	0	4	0	1	2	2	0	0	0	0	0	2	0	2	0	2
Household Goods	19	3	3	0	1	2	3	0	2	4	1	0	1	5	2	0	1
Industrial Engineering	33	6	2	1	1	3	2	1	1	9	2	1	2	8	0	0	2
Industrial Transport	9	3	0	0	0	2	0	0	1	1	0	0	0	2	1	0	0
Leisure Goods	6	2	0	0	0	1	0	1	0	0	1	1	0	1	1	1	0
Media	29	1	6	0	2	4	4	1	3	6	4	0	2	6	3	0	2

Table A9.3 continued A summary of the direction of exposure for non-financial firms returns by industry to actual and unexpected changes in the ECU/£ and Euro/£

		A. ECU/£				U. ECU/£				A. Euro/£				U.Euro/£			
		λ		ECU/£		λ		ECU/£		λ		Euro/£		λ		Euro/£	
INDUSTRY	N	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
Mining	7	1	0	0	1	2	0	1	1	0	0	0	0	0	0	0	1
Mobile Telecommunications	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
Oil and Gas Producers	9	0	2	2	1	0	0	2	1	2	2	0	0	1	1	0	1
Oil Equipment And Services	2	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Personal Goods	14	1	0	0	0	3	0	2	0	0	1	0	0	0	1	1	0
Pharmaceuticals and Biotechnology	7	3	1	1	0	2	3	0	0	0	0	0	2	0	0	0	2
Software and Computer Services	21	2	3	3	0	3	4	2	1	1	4	1	0	1	2	2	0
Support Services	62	11	5	4	2	11	7	4	3	10	3	5	3	8	7	5	4
Technical Hardware and Equipment	11	4	1	1	0	3	2	1	0	1	1	2	0	2	1	1	1
Tobacco	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Travel and Leisure	23	8	2	4	0	6	2	4	0	4	0	1	0	4	1	1	0
TOTAL	402	71	45	34	21	65	42	39	22	56	25	16	19	60	29	17	25

The table shows the number of firms with significant positive or negative exchange rate exposure coefficient and risk parameter coefficient in each industry. N is the number of firms in the industry. (+) indicates number of firms with significant positive coefficients whereas (-) is the number of firms with significant negative coefficients at all levels of significance i.e. 1%, 5% and 10%. A. and U. represents the actual and unexpected changes respectively. λ is the risk-return trade-off parameter coefficient. ECU/£ represents the exchange rate exposure coefficients of the ECU while Euro/£ represents the exchange rate exposure for the Euro, and all show the number of firms with significant coefficients. The total column shows the total number of firms with significant positive or negative coefficients and also the total number of firms in the sample.

Appendix 10 Descriptive statistics and correlation coefficients of explanatory variables used as the determinants of exchange rate and interest rate exposure

Table A10.1: Descriptive statistics of the explanatory variables for the total sample period 1990-2006

Variables	Mean	Minimum	Median	Maximum	Std. Dev.
Size					
LOGASS	11.6415	5.7636	11.4571	17.8768	1.9856
Cost of external finance					
CFTA	-0.0007	-19.6899	0.0863	3.3557	1.0576
PAYOUT	0.6308	-23.7619	0.4661	137.0000	7.1717
QUICK	1.1279	0.1212	0.9135	20.4329	1.2478
Expected cost of financial distress					
ICBT	0.7810	-12.9548	0.0728	51.2895	4.2336
TANG	0.4208	-0.4138	0.4283	0.9387	0.1887
TOTDEBT	0.5193	-47.4248	0.4076	27.3185	3.3069
Growth opportunities					
MVBV	2.4329	-128.8888	1.9515	70.3853	8.4413
RDSA	0.0583	0.0000	0.0000	9.2129	0.5598
Degree of internationalisation					
FATA	0.1215	-0.1924	0.0391	5.8532	0.3253
FITI	0.2260	-5.0347	0.0310	19.1432	1.2082
FSTS	0.4278	0.0000	0.1804	37.2717	2.1507
Other motives					
PREFASS	0.0149	0.0000	0.0000	0.5217	0.0470

Notes: The table reports a summary of descriptive statistics of the total period 1990-2006 for the independent variables used in this study. The figure for size, denoted by LOGASS was in millions before log transformation. The variables are segregated into six groups, which are size, cost of external finance, expected cost of financial distress, growth opportunities, degree of internationalisation and other motives. Furthermore, these groups of firm specific variables, where significant, indicates that it has an influence on the firms' exposure to exchange rate and/or interest rate risk, and also offer an explanation on the firms' motives for engaging in hedging activities.

Table A10.2: Descriptive statistics of the explanatory variables for the sub-period 1990-1998

	Mean	Minimum	Median	Maximum	Std. Dev.
Size					
LOGASS	11.4113	7.0720	11.0292	18.0588	2.0272
Cost of external finance					
CFTA	0.0483	-6.4991	0.09390	0.4853	0.4087
PAYOUT	29.9853	0.0000	32.0067	71.9422	16.7811
QUICK	1.0089	0.0000	0.8783	9.4538	0.7658
Expected cost of financial distress					
ICBT	1.0094	-13.4274	0.0692	85.5304	6.6720
TANG	0.4063	-3.0635	0.4262	0.9848	0.2897
TOTDEBT	0.6249	-22.6663	0.3657	46.9637	3.7781
Growth opportunities					
MVBV	3.1102	-20.7300	1.9283	130.2511	8.7639
RDSA	0.0722	0.0000	0.0000	11.1210	0.7513
Degree of internationalisation					
FATA	0.0728	-0.3761	0.0000	1.0809	0.1458
FITI	0.1562	-3.9290	0.0000	9.4581	0.6416
FSTS	0.2554	0.0000	0.0856	14.7342	0.7727
Other motives					
PREFASS	0.0154	0.0000	0.0000	0.3614	0.0429

Notes: The Table reports a summary of descriptive statistics of the sub-period before the Euro 1990-1998 for the independent variables used in this study. The figure for size, represented by LOGASS was in millions before log transformation. The variables are grouped into 6 categories, based on factors that influence firms' hedging motives and at the same time provide a basis by which some of the optimal hedging theories can be tested.

Table A10.3: Descriptive statistics of the explanatory variables for the sub-period 1999-2006

	Mean	Minimum	Median	Maximum	Std. Dev.
Size					
LOGASS	12.1074	7.2711	11.8966	18.7000	2.0983
Cost of external finance					
CFTA	0.0782	-3.8057	0.0819	6.2858	0.4133
PAYOUT	28.5138	0.0000	29.4688	79.5000	19.2906
QUICK	1.2503	0.0813	0.9013	42.7475	2.3428
Expected cost of financial distress					
ICBT	0.5034	-27.2502	0.0510	59.6182	3.8413
TANG	0.4105	-1.6229	0.4141	1.0807	0.2364
TOTDEBT	0.3891	-10.06719	0.4076	15.5621	5.3045
Growth opportunities					
MVBV	1.6362	-276.4963	1.8313	21.2338	14.4585
RDSA	0.0407	0.0000	0.0000	7.0662	0.3633
Degree of internationalisation					
FATA	0.1761	-0.3701	0.0544	12.4381	0.6438
FITI	0.3055	-10.6868	0.0253	39.0793	23.4955
FSTS	0.6131	0.0000	0.2071	79.2024	4.4290
Other motives					
PREFASS	0.0209	0.0000	0.0000	1.3742	0.1032

Notes: The Table presents a summary of descriptive statistics of the sub-period after the Euro 1999-2006 for the independent variables used in this study. LOGASS which represents size, was in millions before the log transformation.

Table A10.4 Correlation coefficients of the explanatory variables used as determinants of exchange rate and interest rate exposure

	ICBT	QUICK	PAYOUT	LOGASS	MVBV	FSTS	FATA	FITI	CFTA	TANG	RDSA	PREFASS	TOTDEBT
ICBT	1.0000												
QUICK	0.0165	1.0000											
PAYOUT	-0.0019	-0.0021	1.0000										
LOGASS	-0.1023**	-0.1983***	-0.0009	1.0000									
MVBV	-0.0038	0.0028	0.0004	0.0647	1.0000								
FSTS	-0.0157	0.0781	-0.0069	-0.0300	-0.0097	1.0000							
FATA	-0.0448	0.0972*	0.0020	0.1175**	0.0126	0.0190	1.0000						
FITI	-0.0213	0.0462	-0.0104	0.0317	0.0206	0.0263	-0.0726	1.0000					
CFTA	0.0428	-0.0797	0.0082	0.0949*	-0.0656	-0.0081	0.0278	-0.0025	1.0000				
TANG	0.0665	0.2706***	0.0452	-0.2530***	0.0778	-0.0563	0.0521	-0.0275	-0.0038	1.0000			
RDSA	-0.0648	0.2911***	-0.0101	-0.0427	0.0270	-0.0004	-0.0281	-0.0051	-0.1577***	0.1028**	1.0000		
PREFTASS	-0.0734	-0.0110	-0.0279	-0.1202**	-0.3672***	0.0632	-0.0375	0.0161	-0.0483	-0.3336***	0.0788	1.0000	
TOTDEBT	-0.0232	-0.0337	-0.0002	0.0626	0.8930***	-0.0125	0.0129	0.0206	0.0027	-0.0263	-0.0121	-0.3251***	1.0000

Note: ICBT is the ratio of interest to profit before interest and tax, QUICK is defined as the ratio of current assets less inventory to current liabilities, PAYOUT is measured as the ratio of dividends per share to earnings per share, LOGASS is the natural log of total assets, MVBV is the ratio of the sum of market value of equity and book value of debt to total assets, FSTS is the ratio of foreign sales to total sales, FATA is the ratio of foreign assets to total assets, FITI is the ratio of foreign income to total income, CFTA is defined as cash flow to total assets where cash flow is measured as the operating income less interest expense, less cash dividends and less net taxes, TANG is the ratio of tangible assets to total assets, RDSA is ratio of research and development to total sales, PREFASS is the ratio of book value of preference capital to total assets and TOTDEBT is the ratio of long-term debt to total equity and reserves. *, **, *** represents significance at the 1%, 5% and 10% levels of significance.

Appendix 11 Summary of determinants for exchange rate and interest rate exposure of UK non-financial firms

Table A11.1 The determinants of exposure to actual changes in the foreign exchange rates of UK firms for the total sample period 01/01/90-31/12/06 (Exposure coefficients from the OLS model)

ERINDEX	ABS/RAW	MODEL	CFTA	PAYOUT	FATA	FITI	FSTS	ICBT	LOGASS	MVBV	PREFASS	QUICK	RDSA	TANG	TOTDEBT
BOEGBPR	RAW	1	-0.0166	-0.0011	-0.0050	-0.0185*	-0.0030	0.0044	-0.0311***	0.0057	-0.5645*	0.0044	-0.0019	-0.1357	-0.0182*
US$/£			-0.0119	0.0012	-0.0197	0.0078	-0.0030	-0.0005	-0.0119***	0.0042*	-0.6464***	0.0028	-0.0170	-0.0178	-0.0173***
JP¥/£			-0.0051	-0.0011	0.0437**	-0.0061	-0.0004	0.0008	-0.0067*	-0.0032*	0.0241	0.0038	-0.0117	-0.0204	0.0144***
BOEGBPR	ABS		-0.0156*	-0.0005	0.0186	-0.0050	-0.0048	0.0000	-0.0032	0.0024	-0.0774	0.0063	0.0078	-0.0021	-0.0048
US$/£			-0.0187***	0.0003	-0.0099	0.0088*	0.0006	-0.0003	-0.0029	-0.0002	0.0216	-0.0036	0.0078	-0.0237	0.0013
JP¥/£			-0.0009	0.0000	0.0245*	-0.0099***	0.0015	0.0000	-0.0030	0.0000	0.2054*	0.0001	0.0034	-0.0721**	0.0023
BOEGBPR	RAW	2	-0.0201	-0.0011	-0.0066	-0.0186*	-0.0028	0.0047	-0.0300***	-0.0007	-0.5185	0.0046	-0.0004	-0.0991	NA
US$/£			-0.0152**	0.0012	-0.0212	0.0077	-0.0028	-0.0002	-0.0108**	-0.0018*	-0.6028***	0.0030	-0.0156	0.0169	NA
JP¥/£			-0.0023	-0.0010	0.0450**	-0.0060	-0.0006	0.0006	-0.0076**	0.0018**	-0.0122	0.0037	-0.0129	-0.0493	NA
BOEGBPR	ABS		-0.0165*	-0.0005	0.0182	-0.0050	-0.0047	0.0001	-0.0028	0.0007	-0.0653	0.0064	0.0082	0.0076	NA
US$/£			-0.0185***	0.0003	-0.0098	0.0088*	0.0006	-0.0003	-0.0030	0.0003	0.0182	-0.0036	0.0077	-0.0264	NA
JP¥/£			-0.0005	0.0000	0.0247*	-0.0099***	0.0015	-0.0001	-0.0032	0.0008	0.1998*	0.0001	0.0032	-0.0766***	NA

Notes: The table presents the results for the determinants of exposure to the actual changes in the exchange rate measures (BOEGBPR, US$/£ and the JP¥/£) for the total period 01/01/90 – 31/12/06. RAW represents the raw exchange rate exposure coefficients whereas ABS represents the absolute exchange rate exposure coefficients. Model 1 has been estimated with leverage while in Model 2, leverage has not been included in the estimation. Furthermore, the exchange rate exposure coefficients have been estimated using the OLS model. The explanatory variables are CFTA which is the ratio of cash flow to total assets, PAYOUT is the ratio of dividends per share to earnings per share, FATA is the ratio of foreign assets to total assets, FITI is the ratio of foreign income to total income, FSTS is the ratio of foreign sales to total sales, ICBT is the ratio of interest to profit before interest and tax, LOGASS is the natural log of total assets, MVBV is the ratio of the sum of market value of equity and book value of debt to total assets, PREFASS is the ratio of book value of preference capital to total assets, QUICK is the ratio of current assets less inventory to current liabilities, RDSA is ratio of research and development to total sales, TANG is the ratio of tangible assets to total assets and TOTDEBT is the ratio of long-term debt to total equity and reserves. *, **, *** represents the significance at the 1%, 5% and 10% levels of significance.

Table A11.2 The determinants of exposure to unexpected changes in the foreign exchange rates of UK firms for the total sample period 01/01/90-31/12/06
(Exposure coefficients from the OLS model)

ERINDEX	ABS/RAW	MODEL	CFTA	PAYOUT	FATA	FITI	FSTS	ICBT	LOGASS	MVBV	PREFASS	QUICK	RDSA	TANG	TOTDEBT
BOEGBPR	RAW	1	-0.0001	0.0000	0.0001	-0.0002	0.0000	0.0000	-0.0003***	0.0001*	-0.0059	0.0001	0.0000	-0.0017*	-0.0002**
US$/£			-0.0037	0.0008	-0.0123	0.0057	-0.0018	-0.0004	-0.0075***	0.0030**	-0.3855***	0.0023	-0.0095	-0.0167	-0.0117***
JP¥/£			0.0000	0.0000	0.0002*	0.0000	0.0000	0.0000	-0.0000**	-0.0000*	0.0003	0.0000	-0.0001	-0.0001	0.0001***
BOEGBPR	ABS		-0.0001	0.0000	0.0002	-0.0001	0.0000	0.0000	0.0000	0.0000	-0.0009	0.0001	0.0001	-0.0002	-0.0001
US$/£			-0.0093***	0.0002	-0.0069	0.0060**	0.0001	-0.0005	-0.0019	0.0001	0.0276	-0.0009	0.0033	-0.0199	0.0005
JP¥/£			0.0000	0.0000	0.0001	-0.0001**	0.0000	0.0000	0.0000	0.0000	0.0013**	0.0000	0.0000	-0.0004**	0.0000
BOEGBPR	RAW	2	-0.0002	0.0000	0.0001	-0.0002	0.0000	0.0001	-0.0003***	0.0000	-0.0054	0.0001	0.0001	-0.0013	NA
US$/£			-0.0060	0.0008	-0.0133	0.0056	-0.0016	-0.0002	-0.0067**	-0.0011*	-0.3559***	0.0024	-0.0086	0.0069	NA
JP¥/£			0.0000	0.0000	0.0002*	0.0000	0.0000	0.0000	-0.0000***	0.0000**	0.0001	0.0000	-0.0001	-0.0003	NA
BOEGBPR	ABS		-0.0001	0.0000	0.0002	-0.0001	0.0000	0.0000	0.0000	0.0000	-0.0007	0.0001	0.0001	0.0000	NA
US$/£			-0.0092***	0.0002	-0.0069	0.0060**	0.0001	-0.0005	-0.0019	0.0003	0.0265	-0.0009	0.0033	-0.0208	NA
JP¥/£			0.0000	0.0000	0.0001	-0.0001**	0.0000	0.0000	0.0000	0.0000*	0.0012**	0.0000	0.0000	-0.0004***	NA

Notes: This table reports the results for the determinants of exposure to the unexpected changes in the exchange rate measures (BOEGBPR, US$/£ and the JP¥/£) for the total period 01/01/90 – 31/12/06. RAW represents the raw exchange rate exposure coefficients whereas ABS represents the absolute exchange rate exposure coefficients. Model 1 has been estimated with leverage while in Model 2, leverage has not been included in the estimation. The exchange rate exposure coefficient, which is the dependent variable in each model, has been estimated using the OLS methodology. The explanatory variables are represented by CFTA which is the ratio of cash flow to total assets, PAYOUT is the ratio of dividends per share to earnings per share, FATA is the ratio of foreign assets to total assets, FITI is the ratio of foreign income to total income, FSTS is the ratio of foreign sales to total sales, ICBT is the ratio of interest to profit before interest and tax, LOGASS is the natural log of total assets, MVBV is the ratio of the sum of market value of equity and book value of debt to total assets, PREFASS is the ratio of book value of preference capital to total assets, QUICK is the ratio of current assets less inventory to current liabilities, RDSA is ratio of research and development to total sales, TANG is the ratio of tangible assets to total assets and TOTDEBT is the ratio of long-term debt to total equity and reserves. *, **, *** represents the significance at the 1%, 5% and 10% levels of significance.

Table A11.3 The determinants of exposure to actual changes in the foreign exchange rates of UK firms for the total sample period 01/01/90-31/12/06 (Exposure coefficients from the GARCH model)

ERINDEX	ABS/RAW	MODEL	CFTA	PAYOUT	FATA	FITI	FSTS	ICBT	LOGASS	MVBV	PREFASS	QUICK	RDSA	TANG	TOTDEBT
BOEGBPR	RAW	1	0.0015	0.0007	-0.0258	-0.0092*	-0.0014	-0.0002	-0.0050	-0.0014	-0.2660	-0.0027	0.0003	-0.0104	-0.0009
US$/£			0.0011	0.0001	-0.0068	-0.0031	-0.0002	0.0000	-0.0034	-0.0011	-0.2560***	-0.0010	-0.0002	-0.0104	-0.0015
JP¥/£			0.0003	0.0003	-0.0076	-0.0067**	0.0003	-0.0006	-0.0013	-0.0015*	-0.1876**	-0.0002	-0.0003	0.0014	0.0029
BOEGBPR	ABS		0.0021	0.0003	0.0004	0.0003	-0.0008	-0.0002	0.0229***	0.0010	0.1231	0.0018	-0.0124	0.0460	-0.0011
US$/£			0.0008	-0.0004	0.0017	-0.0004	0.0000	0.0000	0.0126***	0.0000	0.0232	0.0014	-0.0062	-0.0019	0.0021
JP¥/£			0.0017	0.0001	-0.0011	-0.0006	0.0000	-0.0003	0.0082***	0.0009	0.0262	0.0001	-0.0049	-0.0089	-0.0033**
BOEGBPR	RAW	2	0.0013	0.0007	-0.0259	-0.0092*	-0.0014	-0.0002	-0.0049	-0.0017**	-0.2636	-0.0027	0.0003	-0.0085	NA
US$/£			0.0008	0.0001	-0.0070	-0.0031	-0.0002	0.0000	-0.0033	-0.0017***	-0.2522**	-0.0010	-0.0001	-0.0074	NA
JP¥/£			0.0009	0.0003	-0.0073	-0.0067**	0.0002	-0.0006	-0.0015	-0.0005	-0.1948**	-0.0002	-0.0006	-0.0044	NA
BOEGBPR	ABS		0.0019	0.0003	0.0003	0.0003	-0.0008	-0.0002	0.0230***	0.0006	0.1258	0.0018	-0.0123	0.0482*	NA
US$/£			0.0012	-0.0004	0.0019	-0.0004	0.0000	0.0000	0.0125***	0.0007**	0.0179	0.0013	-0.0064	-0.0061	NA
JP¥/£			0.0010	0.0001	-0.0014	-0.0006	0.0001	-0.0003	0.0084***	-0.0002	0.0345	0.0001	-0.0046	-0.0023	NA

Notes: The table presents the results for the determinants of exposure to the actual changes in the exchange rate measures (BOEGBPR, US$/£ and the JP¥/£) for the total period 01/01/90 – 31/12/06. RAW represents the raw exchange rate exposure coefficients whereas ABS represents the absolute exchange rate exposure coefficients. Model 1 has been estimated with leverage while in Model 2, leverage has not been included in the estimation. Furthermore, the exchange rate exposure coefficients have been estimated using the GARCH model. The explanatory variables are CFTA which is the ratio of cash flow to total assets, PAYOUT is the ratio of dividends per share to earnings per share, FATA is the ratio of foreign assets to total assets, FITI is the ratio of foreign income to total income, FSTS is the ratio of foreign sales to total sales, ICBT is the ratio of interest to profit before interest and tax, LOGASS is the natural log of total assets, MVBV is the ratio of the sum of market value of equity and book value of debt to total assets, PREFASS is the ratio of book value of preference capital to total assets, QUICK is the ratio of current assets less inventory to current liabilities, RDSA is ratio of research and development to total sales, TANG is the ratio of tangible assets to total assets and TOTDEBT is the ratio of long-term debt to total equity and reserves. *, **, *** represents the significance at the 1%, 5% and 10% levels of significance.

Table A11.4 The determinants of exposure to unexpected changes in the foreign exchange rates of UK firms for the total sample period 01/01/90-31/12/06 (Exposure coefficients from the GARCH model)

ERINDEX	ABS/RAW	MODEL	CFTA	PAYOUT	FATA	FITI	FSTS	ICBT	LOGASS	MVBV	PREFASS	QUICK	RDSA	TANG	TOTDEBT
BOEGBPR	RAW	1	0.0000	0.0000	-0.0002	-0.0001*	0.0000	0.0000	-0.0001*	0.0000	-0.0025	0.0000	0.0000	0.0000	0.0000
US$/£			0.0005	0.0004	-0.0038	-0.0018	-0.0002	0.0001	-0.0019	-0.0008	-0.1550***	-0.0005	0.0001	-0.0104	-0.0008
JP¥/£			0.0000	0.0000	0.0000	-0.0000*	0.0000	0.0000	0.0000	-0.0000**	-0.0009**	0.0000	0.0000	0.0001	0.0000**
BOEGBPR	ABS		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002***	0.0000	0.0007	0.0000	-0.0001	0.0004	0.0000
US$/£			0.0005	0.0001	0.0008	-0.0002	0.0000	0.0000	0.0077***	0.0000	0.0199	0.0011	-0.0039	-0.0009	0.0008
JP¥/£			0.0000	0.0000	0.0000	-0.0000*	0.0000	0.0000	0.0000***	0.0000**	-0.0001	0.0000	0.0000	-0.0001*	-0.0000***
BOEGBPR	RAW	2	0.0000	0.0000	-0.0002	-0.0001*	0.0000	0.0000	-0.0001*	-0.0000**	-0.0025	0.0000	0.0000	0.0000	NA
US$/£			0.0003	0.0004	-0.0039	-0.0018	-0.0001	0.0001	-0.0019	-0.0011***	-0.1530***	-0.0005	0.0001	-0.0088	NA
JP¥/£			0.0000	0.0000	0.0000	-0.0000*	0.0000	0.0000	0.0000	0.0000	-0.0010**	0.0000	0.0000	0.0000	NA
BOEGBPR	ABS		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003***	0.0000	0.0008	0.0000	-0 0001	0.0005	NA
US$/£			0.0007	0.0001	0.0009	-0.0002	0.0000	0.0000	0.0077***	0.0003	0.0178	0.0011	-0.0040	-0 0026	NA
JP¥/£			0.0000	0.0000	0.0000	-0.0000*	0.0000	0.0000	0.0000***	0.0000	-0.0001	0.0000	0 0000	-0.0001	NA

Notes: This table reports the results for the determinants of exposure to the unexpected changes in the exchange rate measures (BOEGBPR, US$/£ and the JP¥/£) for the total period 01/01/90 – 31/12/06. RAW represents the raw exchange rate exposure coefficients whereas ABS represents the absolute exchange rate exposure coefficients. Model 1 has been estimated with leverage while in Model 2, leverage has not been included in the estimation. The exchange rate exposure coefficient, which is the dependent variable in each model, has been estimated using the GARCH methodology. The explanatory variables are represented by CFTA which is the ratio of cash flow to total assets, PAYOUT is the ratio of dividends per share to earnings per share, FATA is the ratio of foreign assets to total assets, FITI is the ratio of foreign income to total income, FSTS is the ratio of foreign sales to total sales, ICBT is the ratio of interest to profit before interest and tax, LOGASS is the natural log of total assets, MVBV is the ratio of the sum of market value of equity and book value of debt to total assets, PREFASS is the ratio of book value of preference capital to total assets, QUICK is the ratio of current assets less inventory to current liabilities, RDSA is ratio of research and development to total sales, TANG is the ratio of tangible assets to total assets and TOTDEBT is the ratio of long-term debt to total equity and reserves. *, **, *** represents the significance at the 1%, 5% and 10% levels of significance.

Table A11.5 The determinants of exposure to actual changes in the short-term interest rates of UK firms for the total sample period 01/01/90-31/12/06 (Exposure coefficients from the OLS model)

ERINDEX	ABS/RAW	MODEL	CFTA	PAYOUT	FATA	FITI	FSTS	ICBT	LOGASS	MVBV	PREFASS	QUICK	RDSA	TANG	TOTDEBT
BOEGBPR	RAW	1	0.0208***	-0.0018**	0.0014	0.0030	0.0063**	0.0003	-0.0005	0.0002	0.0220	-0.0045	-0.0064	-0.0279	-0.0046
US$/£			0.0208***	-0.0019**	0.0028	0.0011	0.0064**	0.0006	-0.0014	0.0002	0.0438	-0.0045	-0.0050	-0.0350	-0.0042
JP¥/£			0.0200***	-0.0018**	-0.0021	0.0022	0.0061**	0.0005	-0.0020	0.0008	-0.0161	-0.0045	-0.0057	-0.0352	-0.0068
BOEGBPR	ABS		-0.0176***	0.0015**	-0.0059	-0.0008	0.0012	-0.0020*	-0.0090***	-0.0002	-0.0327	0.0032	0.0102	-0.0639**	-0.0020
US$/£			-0.0178***	0.0017***	-0.0103	-0.0012	0.0016	-0.0019*	-0.0086***	-0.0003	-0.0529	0.0026	0.0114	-0.0549**	-0.0020
JP¥/£			-0.0167***	0.0015**	-0.0055	-0.0002	0.0013	-0.0019*	-0.0085***	-0.0010	-0.0156	0.0023	0.0130	-0.0552**	0.0004
BOEGBPR	RAW	2	0.0199***	-0.0018**	0.0009	0.0030	0.0063**	0.0004	-0.0002	-0.0014*	0.0336	-0.0045	-0.0060	-0.0186	NA
US$/£			0.0199***	-0.0019**	0.0024	0.0011	0.0064**	0.0007	-0.0011	-0.0012	0.0545	-0.0044	-0.0046	-0.0265	NA
JP¥/£			0.0187***	-0.0018**	-0.0027	0.0022	0.0062**	0.0006	-0.0016	-0.0015*	0.0011	-0.0044	-0.0051	-0.0215	NA
BOEGBPR	ABS		-0.0180***	0.0015**	-0.0061	-0.0008	0.0012	-0.0019*	-0.0089***	-0.0009*	-0.0277	0.0032	0.0104	-0.0600**	NA
US$/£			-0.0181***	0.0017***	-0.0105	-0.0012	0.0017	-0.0019*	-0.0085***	-0.0010*	-0.0477	0.0026	0.0115	-0.0508*	NA
JP¥/£			-0.0166***	0.0015**	-0.0055	-0.0002	0.0013	-0.0020*	-0.0086***	-0.0009	-0.0167	0.0023	0.0129	-0.0561**	NA

Notes: The table reports the results for the determinants of exposure to the actual changes in the short-term interest rate measures for the total period 01/01/90 – 31/12/06. RAW represents the raw exchange rate exposure coefficients whereas ABS represents the absolute exchange rate exposure coefficients. Model 1 has been estimated with leverage while in Model 2, leverage has not been included in the estimation. Furthermore, the exchange rate exposure coefficients have been estimated using the OLS model. The explanatory variables are CFTA which is the ratio of cash flow to total assets, PAYOUT is the ratio of dividends per share to earnings per share, FATA is the ratio of foreign assets to total assets, FITI is the ratio of foreign income to total income, FSTS is the ratio of foreign sales to total sales, ICBT is the ratio of interest to profit before interest and tax, LOGASS is the natural log of total assets, MVBV is the ratio of the sum of market value of equity and book value of debt to total assets, PREFASS is the ratio of book value of preference capital to total assets, QUICK is the ratio of current assets less inventory to current liabilities, RDSA is ratio of research and development to total sales, TANG is the ratio of tangible assets to total assets and TOTDEBT is the ratio of long-term debt to total equity and reserves. *, **, *** represents the significance at the 1%, 5% and 10% levels of significance.

Table A11.6 The determinants of exposure to unexpected changes in the short-term interest rates of UK firms for the total sample period 01/01/90-31/12/06
(Exposure coefficients from the OLS model)

ERINDEX	ABS/RAW	MODEL	CFTA	PAYOUT	FATA	FITI	FSTS	ICBT	LOGASS	MVBV	PREFASS	QUICK	RDSA	TANG	TOTDEBT
BOEGBPR	RAW	1	0.0196***	-0.0017**	-0.0001	0.0012	0.0063**	0.0000	-0.0026	-0.0003	0.0929	-0.0036	-0.0124	-0.0322	-0.0033
US$/£			0.0194***	-0.0019**	0.0017	-0.0004	0.0063**	0.0003	-0.0035	-0.0003	0.1058	-0.0036	-0.0112	-0.0389	-0.0031
JP¥/£			0.0192***	-0.0018**	-0.0015	0.0005	0.0061**	0.0002	-0.0040	0.0002	0.0603	-0.0035	-0.0117	-0.0398	-0.0050
BOEGBPR	ABS		-0.0158***	0.0014**	-0.0096	-0.0018	0.0025	-0.0021**	-0.0079***	-0.0002	-0.0200	0.0013	0.0176**	-0.0401	-0.0027
US$/£			-0.0156***	0.0016***	-0.0142	-0.0016	0.0027	-0.0021**	-0.0083***	-0.0001	-0.0183	0.0011	0.0186**	-0.0410	-0.0031
JP¥/£			-0.0149***	0.0014**	-0.0113	-0.0014	0.0023	-0 0020**	-0.0082***	-0.0006	-0.0097	0.0010	0.0199**	-0.0437	-0.0014
BOEGBPR	RAW	2	0.0190***	-0.0017**	-0.0003	0.0012	0.0063**	0.0001	-0.0024	-0.0015*	0.1012	-0.0036	-0.0122	-0.0256	NA
US$/£			0.0189***	-0.0019**	0.0015	-0.0004	0.0063**	0.0003	-0.0033	-0.0014*	0.1135	-0.0036	-0.0109	-0.0327	NA
JP¥/£			0.0182***	-0.0018**	-0.0019	0.0004	0.0062**	0.0003	-0.0036	-0.0016*	0.0730	-0 0034	-0.0113	-0.0297	NA
BOEGBPR	ABS		-0.0163***	0.0014**	-0.0098	-0.0018	0.0025	-0.0020**	-0.0078***	-0.0012**	-0.0133	0.0014	0.0178**	-0.0347	NA
US$/£			-0.0161***	0.0016***	-0.0145	-0.0016	0.0027	-0.0020*	-0.0081***	-0.0012**	-0.0106	0.0011	0.0189**	-0.0348	NA
JP¥/£			-0.0152***	0.0014**	-0.0114	-0.0014	0.0024	-0.0020**	-0.0081***	-0.0011*	-0.0062	0.0010	0.0200**	-0.0409	NA

Notes: The table presents the results for the determinants of exposure to the unexpected changes in the short-term interest rate measures for the total period 01/01/90 – 31/12/06. RAW represents the raw exchange rate exposure coefficients whereas ABS represents the absolute exchange rate exposure coefficients. Model 1 has been estimated with leverage while in Model 2, leverage has not been included in the estimation. Furthermore, the exchange rate exposure coefficients have been estimated using the OLS model. The explanatory variables are CFTA which is the ratio of cash flow to total assets, PAYOUT is the ratio of dividends per share to earnings per share, FATA is the ratio of foreign assets to total assets, FITI is the ratio of foreign income to total income, FSTS is the ratio of foreign sales to total sales, ICBT is the ratio of interest to profit before interest and tax, LOGASS is the natural log of total assets, MVBV is the ratio of the sum of market value of equity and book value of debt to total assets, PREFASS is the ratio of book value of preference capital to total assets, QUICK is the ratio of current assets less inventory to current liabilities, RDSA is ratio of research and development to total sales, TANG is the ratio of tangible assets to total assets and TOTDEBT is the ratio of long-term debt to total equity and reserves. *, **, *** represents the significance at the 1%, 5% and 10% levels of significance.

Table A11.7 The determinants of exposure to actual changes in the short-term interest rates of UK firms for the total sample period 01/01/90-31/12/06 (Exposure coefficients from the GARCH model)

ERINDEX	ABS/RAW	MODEL	CFTA	PAYOUT	FATA	FITI	FSTS	ICBT	LOGASS	MVBV	PREFASS	QUICK	RDSA	TANG	TOTDEBT
BOEGBPR	RAW	1	0.0001	-0.0007*	0.0092	0.0012	-0.0002	0.0005	-0.0012	-0.0012	0.0326	0.0010	0.0019	0.0036	0.0021
US$/£			0.0019	-0.0007*	0.0079	0.0007	-0.0002	0.0005	-0.0012	-0.0011	0.0464	0.0007	0.0025	0.0031	0.0020
JP¥/£			-0.0005	-0.0007*	0.0096	0.0018	-0.0003	0.0006	-0.0017	-0.0012	0.0539	0.0009	0.0014	0.0051	0.0020
BOEGBPR	ABS		0.0001	0.0006**	0.0009	0.0004	-0.0001	-0.0005	0.0058***	-0.0004	0.0756	-0.0008	-0.0045	0.0111	0.0007
US$/£			-0.0017	0.0007**	-0.0004	-0.0003	-0.0001	-0.0005	0.0059***	-0.0004	0.0771	-0.0010	-0.0047	0.0058	0.0006
JP¥/£			0.0008	0.0006**	0.0022	0.0010	0.0000	-0.0005	0.0056***	-0.0003	0.0499	-0.0005	-0.0043	0.0092	0.0002
BOEGBPR	RAW	2	0.0005	-0.0007*	0.0093	0.0012	-0.0002	0.0005	-0.0013	-0.0005	0.0272	0.0010	0.0018	-0.0007	NA
US$/£			0.0023	-0.0007*	0.0080	0.0007	-0.0003	0.0005	-0.0013	-0.0004	0.0413	0.0006	0.0023	-0.0010	NA
JP¥/£			-0.0002	-0.0007*	0.0098	0.0018	-0.0003	0.0005	-0.0018	-0.0005	0.0489	0.0009	0.0012	0.0011	NA
BOEGBPR	ABS		0.0003	0.0006**	0.0009	0.0004	-0.0001	-0.0005	0.0058***	-0.0001	0.0739	-0.0008	-0.0046	0.0098	NA
US$/£			-0.0016	0.0007**	-0.0003	-0.0003	-0.0001	-0.0005	0.0059***	-0.0001	0.0755	-0.0010	-0.0048	0.0046	NA
JP¥/£			0.0008	0.0006**	0.0022	0.0010	0.0000	-0.0006	0.0056***	-0.0003	0.0494	-0.0005	-0.0043	0.0088	NA

Notes: This table shows the results for the determinants of exposure to the actual changes in the short-term interest rate measures for the total period 01/01/90 – 31/12/06. RAW represents the raw exchange rate exposure coefficients whereas ABS represents the absolute exchange rate exposure coefficients. Model 1 has been estimated with leverage while in Model 2, leverage has not been included in the estimation. Furthermore, the exchange rate exposure coefficients have been estimated using the GARCH model. The explanatory variables are CFTA which is the ratio of cash flow to total assets, PAYOUT is the ratio of dividends per share to earnings per share, FATA is the ratio of foreign assets to total assets, FITI is the ratio of foreign income to total income, FSTS is the ratio of foreign sales to total sales, ICBT is the ratio of interest to profit before interest and tax, LOGASS is the natural log of total assets, MVBV is the ratio of the sum of market value of equity and book value of debt to total assets, PREFASS is the ratio of book value of preference capital to total assets, QUICK is the ratio of current assets less inventory to current liabilities, RDSA is ratio of research and development to total sales, TANG is the ratio of tangible assets to total assets and TOTDEBT is the ratio of long-term debt to total equity and reserves. *, **, *** represents the significance at the 1%, 5% and 10% levels of significance.

Table A11.8 The determinants of exposure to unexpected changes in the short-term interest rates of UK firms for the total sample period 01/01/90-31/12/06 (Exposure coefficients from the GARCH model)

ERINDEX	ABS/RAW	MODEL	CFTA	PAYOUT	FATA	FITI	FSTS	ICBT	LOGASS	MVBV	PREFASS	QUICK	RDSA	TANG	TOTDEBT
BOEGBPR	RAW	1	0.0003	-0.0007*	0.0118	0.0028	-0.0005	0.0006	-0.0010	-0.0013	0.0715	0.0009	0.0010	0.0045	0.0025
US$/£			0.0036	-0.0007*	0.0081	0.0006	-0.0005	0.0006	-0.0008	-0.0013	0.0861	0.0004	0.0021	0.0025	0.0026
JP¥/£			0.0000	-0.0006	0.0100	0.0022	-0.0005	0.0006	-0.0013	-0.0013	0.0536	0.0001	0.0015	0.0008	0.0022
BOEGBPR	ABS		-0.0002	0.0006**	0.0035	0.0022	0.0001	-0.0003	0.0064***	-0.0006	0.0517	-0.0009	-0.0042	0.0153	0.0010
US$/£			-0.0032	0.0006**	0.0001	0.0000	0.0001	-0.0004	0.0067***	-0.0004	0.0576	-0.0010	-0.0047	0.0083	0.0008
JP¥/£			0.0004	0.0006**	0.0009	0.0012	0.0001	-0.0005	0.0061***	-0.0004	0.0475	-0.0010	-0.0039	0.0066	0.0005
BOEGBPR	RAW	2	0.0008	-0.0007*	0.0120	0.0028	-0.0005	0.0006	-0.0012	-0.0004	0.0651	0.0009	0.0008	-0.0007	NA
US$/£			0.0041	-0.0007*	0.0083	0.0006	-0.0005	0 0006	-0.0010	-0.0004	0.0796	0.0004	0.0019	-0.0027	NA
JP¥/£			0.0004	-0.0006	0.0102	0.0022	-0.0006	0.0006	-0.0015	-0.0005	0.0479	0.0001	0.0013	-0.0037	NA
BOEGBPR	ABS		0.0000	0.0006**	0.0036	0.0022	0.0001	-0.0003	0.0063***	-0.0002	0.0492	-0.0009	-0.0043	0.0134	NA
US$/£			-0.0031	0.0006**	0.0002	0.0000	0.0001	-0.0004	0.0066***	-0.0001	0.0556	-0.0011	-0.0047	0.0067	NA
JP¥/£			0.0005	0.0006**	0.0010	0.0012	0.0001	-0.0005	0.0061***	-0.0002	0.0463	-0.0010	-0.0039	0.0057	NA

Notes: The table displays the results for the determinants of exposure to the unexpected changes in the short-term interest rate measures for the total period 01/01/90 – 31/12/06. RAW represents the raw exchange rate exposure coefficients whereas ABS represents the absolute exchange rate exposure coefficients. Model 1 has been estimated with leverage while in Model 2, leverage has not been included in the estimation. Furthermore, the exchange rate exposure coefficients have been estimated using the GARCH model. The explanatory variables are CFTA which is the ratio of cash flow to total assets, PAYOUT is the ratio of dividends per share to earnings per share, FATA is the ratio of foreign assets to total assets, FITI is the ratio of foreign income to total income, FSTS is the ratio of foreign sales to total sales, ICBT is the ratio of interest to profit before interest and tax, LOGASS is the natural log of total assets, MVBV is the ratio of the sum of market value of equity and book value of debt to total assets, PREFASS is the ratio of book value of preference capital to total assets, QUICK is the ratio of current assets less inventory to current liabilities, RDSA is ratio of research and development to total sales, TANG is the ratio of tangible assets to total assets and TOTDEBT is the ratio of long-term debt to total equity and reserves. *, **, *** represents the significance at the 1%, 5% and 10% levels of significance.

Table A11.9 The determinants of exposure to actual changes in the long-term interest rates of UK firms for the total sample period 01/01/90-31/12/06 (Exposure coefficients from the OLS model)

ERINDEX	ABS/RAW	MODEL	CFTA	PAYOUT	FATA	FITI	FSTS	ICBT	LOGASS	MVBV	PREFASS	QUICK	RDSA	TANG	TOTDEBT
BOEGBPR	RAW	1	0.0107	-0.0008	-0.0090	0.0084	0.0008	0.0005	0.0009	0.0014	-0.3437**	-0.0009	0.0123	-0.0769*	-0.0046
US$/£			0.0105	-0.0008	-0.0093	0.0084	0.0007	0.0006	0.0006	0.0015	-0.3538**	-0.0008	0.0121	-0.0775*	-0.0048
JP¥/£			0.0107	-0.0008	-0.0089	0.0083	0.0008	0.0006	0.0008	0.0014	-0.3453**	-0.0008	0.0123	-0.0773*	-0.0046
BOEGBPR	ABS		-0.0026	-0.0011*	0.0182	0.0022	-0.0001	-0.0002	0.0016	0.0023*	0.0907	0.0064	-0.0072	-0.0873***	-0.0041
US$/£			-0.0022	-0.0011*	0.0178	0.0023	0.0000	-0.0002	0.0013	0.0023*	0.0887	0.0063	-0.0073	-0.0864***	-0.0043
JP¥/£			-0.0026	-0.0011*	0.0178	0.0022	-0.0001	-0.0002	0.0015	0.0023*	0.0904	0.0064	-0.0072	-0.0869***	-0.0041
BOEGBPR	RAW	2	0.0099	-0.0008	-0.0094	0.0083	0.0009	0.0006	0.0012	-0.0002	-0.3322*	-0.0008	0.0127	-0.0677	NA
US$/£			0.0096	-0.0008	-0.0097	0.0084	0.0008	0.0006	0.0009	-0.0002	-0.3416**	-0.0008	0.0125	-0.0678	NA
JP¥/£			0.0098	-0.0008	-0.0093	0.0083	0.0009	0.0006	0.0011	-0.0002	-0.3337**	-0.0008	0.0126	-0.0681	NA
BOEGBPR	ABS		-0.0034	-0.0011*	0.0178	0.0022	0.0000	-0.0001	0.0018	0.0008	0.1010	0.0065	-0.0069	-0.079***	NA
US$/£			-0.0031	-0.0011*	0.0175	0.0023	0.0000	-0.0001	0.0016	0.0008	0.0995	0.0063	-0.0070	-0.0777***	NA
JP¥/£			-0.0033	-0.0011*	0.0175	0.0022	0.0000	-0.0001	0.0018	0.0008	0.1008	0.0064	-0.0069	-0.0786***	NA

Notes: This table reports the results for the determinants of exposure to the actual changes in the long-term interest rate measures for the total period 01/01/90 – 31/12/06. RAW represents the raw exchange rate exposure coefficients whereas ABS represents the absolute exchange rate exposure coefficients. Model 1 has been estimated with leverage while in Model 2, leverage has not been included in the estimation. Furthermore, the exchange rate exposure coefficients have been estimated using the OLS model. The explanatory variables are CFTA which is the ratio of cash flow to total assets, PAYOUT is the ratio of dividends per share to earnings per share, FATA is the ratio of foreign assets to total assets, FITI is the ratio of foreign income to total income, FSTS is the ratio of foreign sales to total sales, ICBT is the ratio of interest to profit before interest and tax, LOGASS is the natural log of total assets, MVBV is the ratio of the sum of market value of equity and book value of debt to total assets, PREFASS is the ratio of book value of preference capital to total assets, QUICK is the ratio of current assets less inventory to current liabilities, RDSA is ratio of research and development to total sales, TANG is the ratio of tangible assets to total assets and TOTDEBT is the ratio of long-term debt to total equity and reserves. *, **, *** represents the significance at the 1%, 5% and 10% levels of significance

Table A11.10 The determinants of exposure to unexpected changes in the long-term interest rates of UK firms for the total sample period 01/01/90-31/12/06 (Exposure coefficients from the OLS model)

ERINDEX	ABS/RAW	MODEL	CFTA	PAYOUT	FATA	FITI	FSTS	ICBT	LOGASS	MVBV	PREFASS	QUICK	RDSA	TANG	TOTDEBT
BOEGBPR	RAW	1	0.0019*	-0.0001	-0.0004	0.0012	0.0002	0.0001	-0.0005	0.0004	-0.0598**	-0.0001	0.0030	-0.0166**	-0.0011
US$/£			0.0019*	-0.0001	-0.0005	0.0012	0.0002	0.0001	-0.0005	0.0004	-0.0609**	-0.0001	0.0030	-0.0164**	-0.0011
JP¥/£			0.0019*	-0.0001	-0.0005	0.0012	0.0002	0.0001	-0.0005	0.0004	-0.0589**	-0.0002	0.0030	-0.0163**	-0.0011
BOEGBPR	ABS		-0.0004	-0.0002*	0.0021	0.0003	-0.0001	-0.0001	0.0003	0.0004**	0.0028	0.0010*	-0.0003	-0.0136***	-0.0008
US$/£			-0.0004	-0.0002*	0.0022	0.0003	-0.0002	-0.0001	0.0003	0.0004**	0.0029	0.0010	-0.0004	-0.0136***	-0.0008*
JP¥/£			-0.0005	-0.0002*	0.0023	0.0003	-0.0002	-0.0001	0.0004	0.0004**	0.0029	0.0010*	-0.0003	-0.0137***	-0.0008
BOEGBPR	RAW	2	0.0017*	-0.0001	-0.0005	0.0012	0.0002	0.0001	-0.0004	0.0000	-0.0570**	-0.0001	0.0031	-0.0144**	NA
US$/£			0.0017*	-0.0001	-0.0006	0.0012	0.0002	0.0001	-0.0004	0.0000	-0.0581**	-0.0001	0.0030	-0.0142**	NA
JP¥/£			0.0017*	-0.0001	-0.0005	0.0012	0.0002	0.0001	-0.0004	0.0000	-0.0562**	-0.0001	0.0031	-0.0142**	NA
BOEGBPR	ABS		-0.0006	-0.0002*	0.0020	0.0003	-0.0001	-0.0001	0.0004	0.0001	0.0048	0.0010*	-0.0003	-0.012***	NA
US$/£			-0.0006	-0.0002*	0.0022	0.0003	-0.0001	-0.0001	0.0004	0.0001	0.0049	0.0010*	-0.0003	-0.012***	NA
JP¥/£			-0.0006	-0.0002*	0.0022	0.0003	-0.0001	-0.0001	0.0004	0.0001	0.0049	0.0011*	-0.0003	-0.0121***	NA

Notes: The table presents the results for the determinants of exposure to the unexpected changes in the long-term interest rate measures for the total period 01/01/90 – 31/12/06. RAW represents the raw exchange rate exposure coefficients whereas ABS represents the absolute exchange rate exposure coefficients. Model 1 has been estimated with leverage while in Model 2, leverage has not been included in the estimation. Furthermore, the exchange rate exposure coefficients have been estimated using the OLS model. The explanatory variables are CFTA which is the ratio of cash flow to total assets, PAYOUT is the ratio of dividends per share to earnings per share, FATA is the ratio of foreign assets to total assets, FITI is the ratio of foreign income to total income, FSTS is the ratio of foreign sales to total sales, ICBT is the ratio of interest to profit before interest and tax, LOGASS is the natural log of total assets, MVBV is the ratio of the sum of market value of equity and book value of debt to total assets, PREFASS is the ratio of book value of preference capital to total assets, QUICK is the ratio of current assets less inventory to current liabilities, RDSA is ratio of research and development to total sales, TANG is the ratio of tangible assets to total assets and TOTDEBT is the ratio of long-term debt to total equity and reserves. *, **, *** represents the significance at the 1%, 5% and 10% levels of significance

Table A11.11 The determinants of exposure to actual changes in the long-term interest rates of UK firms for the total sample period 01/01/90-31/12/06 (Exposure coefficients from the GARCH model)

ERINDEX	ABS/RAW	MODEL	CFTA	PAYOUT	FATA	FITI	FSTS	ICBT	LOGASS	MVBV	PREFASS	QUICK	RDSA	TANG	TOTDEBT
BOEGBPR	RAW	1	0.0019	-0.0006	0.0129	0.0025	0.0009	0.0000	-0.0008	0.0016	-0.1366	0.0011	0.0004	-0.0478**	-0.0049*
US$/£			0.0020	-0.0006	0.0137	0.0026	0.0009	0.0001	-0.001	0.0016	-0.1553*	0.0008	0.0005	-0.0484**	-0.0052**
JP¥/£			0.0018	-0.0005	0.0156	0.0036	0.0009	0.0000	-0.001	0.0014	-0.1278	0.0013	-0.0001	-0.0463*	-0.0040
BOEGBPR	ABS		0.0028	0.0001	-0.0002	0.0010	0.0002	-0.0003	0.0119***	0.0032***	-0.0271	0.0008	-0.0053	-0.0140	-0.0071***
US$/£			0.0029	0.0001	0.0007	0.0009	0.0003	-0.0002	0.0119***	0.0033***	-0.0431	0.0006	-0.0052	-0.0173	-0.0076***
JP¥/£			0.0027	0.0001	0.0021	0.0019	0.0003	-0.0002	0.0119***	0.0028***	-0.0063	0.0009	-0.0056	-0.0133	-0.0060***
BOEGBPR	RAW	2	0.0010	-0.0006	0.0125	0.0025	0.0009	0.0001	-0.0005	-0.0001	-0.1243	0.0011	0.0008	-0.0380	NA
US$/£			0.0011	-0.0006	0.0133	0.0026	0.0010	0.0002	-0.0007	-0.0002	-0.1423	0.0009	0.0009	-0.0380*	NA
JP¥/£			0.0010	-0.0005	0.0153	0.0036	0.0009	0.0001	-0.0007	0.0000	-0.1177	0.0014	0.0002	-0.0382*	NA
BOEGBPR	ABS		0.0014	0.0001	-0.0008	0.0010	0.0003	-0.0002	0.0124***	0.0007*	-0.0091	0.0009	-0.0047	0.0003	NA
US$/£			0.0014	0.0001	0.0000	0.0009	0.0004	-0.0001	0.0124***	0.0006*	-0.0241	0.0007	-0.0045	-0.0021	NA
JP¥/£			0.0016	0.0001	0.0016	0.0018	0.0003	-0.0001	0.0122***	0.0007*	0.0089	0.0010	-0.0051	-0.0013	NA

Notes: The table displays the results for the determinants of exposure to the actual changes in the long-term interest rate measures for the total period 01/01/90 – 31/12/06. RAW represents the raw exchange rate exposure coefficients whereas ABS represents the absolute exchange rate exposure coefficients. Model 1 has been estimated with leverage while in Model 2, leverage has not been included in the estimation. Furthermore, the exchange rate exposure coefficients have been estimated using the GARCH model. The explanatory variables are CFTA which is the ratio of cash flow to total assets, PAYOUT is the ratio of dividends per share to earnings per share, FATA is the ratio of foreign assets to total assets, FITI is the ratio of foreign income to total income, FSTS is the ratio of foreign sales to total sales, ICBT is the ratio of interest to profit before interest and tax, LOGASS is the natural log of total assets, MVBV is the ratio of the sum of market value of equity and book value of debt to total assets, PREFASS is the ratio of book value of preference capital to total assets, QUICK is the ratio of current assets less inventory to current liabilities, RDSA is ratio of research and development to total sales, TANG is the ratio of tangible assets to total assets and TOTDEBT is the ratio of long-term debt to total equity and reserves.
*, **, *** represents the significance at the 1%, 5% and 10% levels of significance

Table A11.12 The determinants of exposure to unexpected changes in the long-term interest rates of UK firms for the total sample period 01/01/90-31/12/06 (Exposure coefficients from the GARCH model)

ERINDEX	ABS/RAW	MODEL	CFTA	PAYOUT	FATA	FITI	FSTS	ICBT	LOGASS	MVBV	PREFASS	QUICK	RDSA	TANG	TOTDEBT
BOEGBPR	RAW	1	0.0003	0.0000	0.0017	0.0002	0.0001	0.0000	-0.0004	0.0003*	-0.0185	0.0001	0.0001	-0.0081**	-0.0008**
US$/£			0.0003	0.0000	0.0020	0.0003	0.0001	0.0000	-0.0004	0.0003*	-0.0203	0.0001	0.0001	-0.0086**	-0.0008**
JP¥/£			0.0003	-0.0001	0.0018	0.0002	0.0002	0.0000	-0.0004	0.0003*	-0.0170	0.0001	0.0001	-0.0080**	-0.0007*
BOEGBPR	ABS		0.0004	0.0000	-0.0002	0.0001	0.0000	-0.0001	0.0019***	0.0004***	-0.0003	0.0001	-0.0008	0.0001	-0.0009***
US$/£			0.0003	0.0000	-0.0002	0.0001	0.0000	-0.0001	0.0019***	0.0004***	-0.0013	0.0001	-0.0008	-0.0003	-0.0008***
JP¥/£			0.0004	0.0000	-0.0002	0.0001	0.0001	0.0000	0.0019***	0.0004***	0.0015	0.0001	-0.0008	-0.0008	-0.0009***
BOEGBPR	RAW	2	0.0001	0.0000	0.0016	0.0001	0.0001	0.0000	-0.0004	0.0000	-0.0166	0.0002	0.0002	-0.0066*	NA
US$/£			0.0001	0.0000	0.0019	0.0003	0.0001	0.0000	-0.0004	0.0000	-0.0184	0.0001	0.0002	-0.0070**	NA
JP¥/£			0.0002	-0.0001	0.0017	0.0002	0.0002	0.0000	-0.0004	0.0000	-0.0152	0.0001	0.0002	-0.0066*	NA
BOEGBPR	ABS		0.0002	0.0000	-0.0003	0.0001	0.0001	-0.0001	0.0019***	0.0001	0.0019	0.0001	-0.0008	0.0019	NA
US$/£			0.0002	0.0000	-0.0003	0.0001	0.0001	0.0000	0.0019***	0.0001	0.0009	0.0001	-0.0007	0.0014	NA
JP¥/£			0.0002	0.0000	-0.0003	0.0001	0.0001	0.0000	0.002***	0.0001*	0.0036	0.0001	-0.0008	0.0009	NA

Notes: The table shows the results for the determinants of exposure to the unexpected changes in the long-term interest rate measures for the total period 01/01/90 – 31/12/06. RAW represents the raw exchange rate exposure coefficients whereas ABS represents the absolute exchange rate exposure coefficients. Model 1 has been estimated with leverage while in Model 2, leverage has not been included in the estimation. Furthermore, the exchange rate exposure coefficients have been estimated using the GARCH model. The explanatory variables are CFTA which is the ratio of cash flow to total assets, PAYOUT is the ratio of dividends per share to earnings per share, FATA is the ratio of foreign assets to total assets, FITI is the ratio of foreign income to total income, FSTS is the ratio of foreign sales to total sales, ICBT is the ratio of interest to profit before interest and tax, LOGASS is the natural log of total assets, MVBV is the ratio of the sum of market value of equity and book value of debt to total assets, PREFASS is the ratio of book value of preference capital to total assets, QUICK is the ratio of current assets less inventory to current liabilities, RDSA is ratio of research and development to total sales, TANG is the ratio of tangible assets to total assets and TOTDEBT is the ratio of long-term debt to total equity and reserves. *, **, *** represents the significance at the 1%, 5% and 10% levels of significance.

Table A11.13 The determinants of exposure to actual and unexpected changes in the ECU/£ exchange rate of UK firms for the sub-period before the Euro 01/01/90-31/12/98 (Exposure coefficients from the OLS and GARCH model)

METHOD	MEASURE	ABS/RAW	MODEL	CFTA	PAYOUT	FATA	FITI	FSTS	ICBT	LOGASS	MVBV	PREFASS	QUICK	RDSA	TANG	TOTDEBT
OLS	ACTUAL	RAW	1	0.0313	-0.0014	-0.2676**	-0.0387	0.0219	0.0018	-0.0341***	-0.0024	-0.1529	0.0013	-0.0046	-0.0876	0.0070
		ABS		-0.0029	-0.0029***	-0.1004	0.0088	0.0110	-0.0001	-0.0066	0.0020	0.1890	0.0376*	-0.0487**	-0.0135	0.0002
		RAW	2	0.0348	-0.0014	-0.2518*	-0.0397	0.0219	0.0018	-0.0343***	-0.0001	-0.1615	-0.0014	-0.0037	-0.0870	NA
		ABS		-0.0028	-0.0029***	-0.0999	0.0088	0.0110	-0.0001	-0.0066	0.0020	0.1887	0.0375*	-0.0487**	-0.0134	NA
	UNEXP	RAW	1	0.0308	-0.0011	-0.2233**	-0.0225	0.0145	0.0013	-0.0244***	-0.0015	-0.0972	0.0069	-0.0032	-0.0555	0.0046
		ABS		-0.0069	-0.0020***	-0.0896	0.0057	0.0052	-0.0003	-0.0032	0.0014	0.1391	0.0365**	-0.0414***	-0.0152	0.0002
		RAW	2	0.0331	-0.0011	-0.2129**	-0.0231	0.0145	0.0012	-0.0245***	0.0000	-0.1028	0.0051	-0.0027	-0.0552	NA
		ABS		-0.0068	-0.0020***	-0.0891	0.0056	0.0052	-0.0003	-0.0032	0.0014	0.1389	0.0364**	-0.0414***	-0.0152	NA
GARCH	ACTUAL	RAW	1	0.0362	-0.0006	-0.1439**	0.0011	-0.0143	0.0000	-0.0042	-0.0012	0.0106	0.0239	-0.0170	-0.0294	0.0029
		ABS		0.0363*	-0.0009**	0.0718	-0.0089	-0.0144*	-0.0005	0.0238***	0.0006	0.0942	0.0364***	-0.0273**	-0.0493*	-0.0019
		RAW	2	0.0376	-0.0006	-0.1373**	0.0007	-0.0143	0.0000	-0.0043	-0.0002	0.0070	0.0228	-0.0166	-0.0291	NA
		ABS		0.0353*	-0.0009**	0.0676	-0.0086	-0.0144*	-0.0005	0.0238***	-0.0001	0.0964	0.0371***	-0.0275**	-0.0494*	NA
	UNEXP	RAW	1	0.0275	-0.0006	-0.1177**	-0.0008	-0.0073	0.0000	-0.0037	-0.0011	0.1309	0.0140	-0.0108	-0.0102	0.0021
		ABS		0.0274*	-0.0007**	0.0555	-0.0062	-0.0074	-0.0004	0.0185***	0.0008	0.1836	0.0252***	-0.0200**	-0.0263	-0.0023
		RAW	2	0.0286	-0.0006	-0.113**	-0.0011	-0.0073	0.0000	-0.0038	-0.0004	0.1283	0.0132	-0.0106	-0.0100	NA
		ABS		0.0262*	-0.0007**	0.0503	-0.0058	-0.0074	-0.0004	0.0186***	0.0000	0.1865	0.0261***	-0.0203**	-0.0265	NA

Notes: The table presents the results for the determinants of exposure to the actual and unexpected changes in the ECU/£ for the period before the Euro represented by 01/01/90 – 31/12/98. Method denotes the type of model that has been used to derive the exchange rate exposure coefficients. Actual is the actual changes in the ECU/£ whereas Unexp stands for the unexpected changes. RAW represents the raw exchange rate exposure coefficients whereas ABS represents the absolute exchange rate exposure coefficients. Model 1 has been estimated with leverage while in Model 2, leverage has not been included in the estimation. Furthermore, the exchange rate exposure coefficients have been estimated using the OLS model. The explanatory variables are CFTA which is the ratio of cash flow to total assets, PAYOUT is the ratio of dividends per share to earnings per share, FATA is the ratio of foreign assets to total assets, FITI is the ratio of foreign income to total income, FSTS is the ratio of foreign sales to total sales, ICBT is the ratio of interest to profit before interest and tax, LOGASS is the natural log of total assets, MVBV is the ratio of the sum of market value of equity and book value of debt to total assets. PREFASS is the ratio of book value of preference capital to total assets. QUICK is the ratio of current assets less inventory to current liabilities. RDSA is ratio of research and development to total sales, TANG is the ratio of tangible assets to total assets and TOTDEBT is the ratio of long-term debt to total equity and reserves. *, **, *** represents the significance at the 1%, 5% and 10% levels of significance.

Table A11.14 The determinants of exposure to the actual and unexpected changes in the short-term interest rate exposure of UK firms for the sub-period before the Euro 01/01/90-31/12/98 (Exposure coefficients from the OLS and GARCH model)

METHOD	MEASURE	ABS/RAW	MODEL	CFTA	PAYOUT	FATA	FITI	FSTS	ICBT	LOGASS	MVBV	PREFASS	QUICK	RDSA	TANG	TOTDEBT
OLS	ACTUAL	RAW	1	00858***	-00007*	00840	-00030	00111	00010	00038	00000	-01403	-00261**	00166	00087	00012
		ABS		-00502***	-00005*	-00453	-00026	00029	-00008	-00050*	00010	01619	00130	-00026	-00388*	-00043**
		RAW	2	00864***	-00007*	00866	-00032	00111	00010	00037	00004	-01417	-00266**	00167	00088	NA
		ABS		-00524***	-00005*	-00550	-00020	00029	-00008	-00049*	-00005	01671	00147*	-00032	-00392*	NA
	UNEXP	RAW	1	00943***	-00008*	01182**	-00053	00059	00008	00003	-00004	-00673	-00247**	00150	-00043	00017
		ABS		-0056***	-00005*	-00527	00002	00003	-00007	-00024	00012	01728	00125	-00008	-00203	-00030
		RAW	2	00952***	-00008*	01221**	-00055	00059	00008	00003	00002	-00694	-00254**	00152	-00042	NA
		ABS		-00575***	-00005*	-00595	00006	00003	-00007	-00023	00001	01765	00136	-00012	-00206	NA
GARCH	ACTUAL	RAW	1	00032	00000	00429	00036	00001	00003	-00024	-00003	00449	00022	00008	-00045	00012
		ABS		00133*	-00003*	00491**	-00058	-00023	-00003	00089***	-00003	01393**	00115***	-00085**	-00159	00005
		RAW	2	00038	00000	00457*	00035	00001	00003	-00025	00001	00434	00017	00010	-00044	NA
		ABS		00135*	-00003*	00503***	-00059	-00023	-00003	00089***	-00002	01387**	00113***	-00084**	-00158	NA
	UNEXP	RAW	1	00111	00000	00625**	00040	-00030	00003	-00022	-00007	01098	00030	00014	-00070	00020
		ABS		00046	-00002	00418**	-00058	00007	-00002	00093**	-00003	00500	00112**	-00094**	-00136	00007
		RAW	2	00121	00000	00670**	00037	-00030	00003	-00022	00000	01073	00022	00017	-00068	NA
		ABS		00049	-00002	00434**	-00059	00007	-00002	00093**	00000	00492	00109**	-00093**	-00136	NA

Notes: The table presents the results for the determinants of exposure to the actual and unexpected changes in the short-term interest for the period before the Euro represented by 01/01/90 – 31/12/98. Method refers to the type of model that has been used to derive the exchange rate exposure coefficients. Actual is the actual changes in the ECU/£ whereas Unexp stands for the unexpected changes. RAW represents the raw exchange rate exposure coefficients whereas ABS represents the absolute exchange rate exposure coefficients. Model 1 has been estimated with leverage while in Model 2, leverage has not been included in the estimation. Furthermore, the exchange rate exposure coefficients have been estimated using the OLS model. The explanatory variables are CFTA which is the ratio of cash flow to total assets, PAYOUT is the ratio of dividends per share to earnings per share, FATA is the ratio of foreign assets to total assets, FITI is the ratio of foreign income to total income, FSTS is the ratio of foreign sales to total sales, ICBT is the ratio of interest to profit before interest and tax, LOGASS is the natural log of total assets, MVBV is the ratio of the sum of market value of equity and book value of debt to total assets, PREFASS is the ratio of book value of preference capital to total assets, QUICK is the ratio of current assets less inventory to current liabilities, RDSA is ratio of research and development to total sales, TANG is the ratio of tangible assets to total assets and TOTDEBT is the ratio of long-term debt to total equity and reserves. *, **, *** represents the significance at the 1%, 5% and 10% levels of significance

Table A11.15 The determinants of exposure to the actual and unexpected changes in the long-term interest rate exposure of UK firms for the sub-period before the Euro 01/01/90-31/12/98 (Exposure coefficients from the OLS and GARCH model)

METHOD	MEASURE	ABS/RAW	MODEL	CFTA	PAYOUT	FATA	FITI	FSTS	ICBT	LOGASS	MVBV	PREFASS	QUICK	RDSA	TANG	TOTDEBT
OLS	ACTUAL	RAW	1	0.0412*	0.0005	0.0404	-0.0096	0.0246**	-0.0004	-0.0085*	-0.0004	-0.5548**	0.0258*	0.0002	-0.1397***	0.0019
		ABS		0.0127	-0.0017***	0.0367	-0.0098	0.0089	-0.0006	0.0013	0.0006	0.1685	0.0072	-0.0080	-0.0277	-0.0019
		RAW	2	0.0421*	0.0005	0.0446	-0.0099	0.0246**	-0.0004	-0.0086*	0.0002	-0.5571**	0.0251*	0.0004	-0.1395***	0.0000
		ABS		0.0117	-0.0017***	0.0323	-0.0096	0.0089	-0.0006	0.0013	0.0000	0.1709	0.0079	-0.0082	-0.0279	0.0000
	UNEXP	RAW	1	0.0066**	0.0000	0.0043	-0.0013	0.0034**	0.0000	-0.0014**	0.0000	-0.0787***	0.0032*	0.0004	-0.0195***	0.0003
		ABS		0.0025	-0.0002***	0.0007	-0.0012	0.0015	-0.0001	0.0000	0.0001	0.0164	0.0013	-0.0011	-0.0046	-0.0001
		RAW	2	0.0068**	0.0000	0.0050	-0.0014	0.0034**	0.0000	-0.0014**	0.0001	-0.0791***	0.0031*	0.0004	-0.0195***	0.0000
		ABS		0.0025	-0.0002***	0.0005	-0.0012	0.0015	-0.0001	0.0000	0.0001	0.0165	0.0014	-0.0011	-0.0046	0.0000
GARCH	ACTUAL	RAW	1	0.0169	0.0002	0.0546	0.0038	-0.0063	-0.0002	-0.0029	0.0009	-0.0811	0.0045	-0.0005	-0.0470**	-0.0006
		ABS		0.0139	-0.0002	0.0001	0.0016	0.0028	-0.0005	0.0124***	0.0003	0.1012	0.0136**	-0.0104*	-0.0176	-0.0012
		RAW	2	0.0166	0.0002	0.0531	0.0039	-0.0063	-0.0002	-0.0029	0.0006	-0.0804	0.0047	-0.0006	-0.0470**	0.0000
		ABS		0.0133	-0.0002	-0.0027	0.0017	0.0028	-0.0005	0.0124***	-0.0002	0.1027	0.0141**	-0.0105*	-0.0177	0.0000
	UNEXP	RAW	1	0.0026	0.0000	0.0042	0.0003	-0.0002	0.0000	-0.0007**	0.0001	-0.0157	0.0002	0.0003	-0.0071***	-0.0001
		ABS		0.0012	0.0000	0.0000	-0.0001	-0.0001	-0.0001	0.0016***	0.0000	0.0096	0.0015**	-0.0013*	-0.0016	-0.0001
		RAW	2	0.0025	0.0000	0.0040	0.0003	-0.0002	0.0000	-0.0007**	0.0001	-0.0156	0.0002	0.0002	-0.0071***	0.0000
		ABS		0.0011	0.0000	-0.0003	-0.0001	-0.0001	-0.0001	0.0016***	0.0000	0.0098	0.0015**	-0.0013*	-0.0016	0.0000

Notes: The table presents the results for the determinants of exposure to the actual and unexpected changes in the long-term interest for the period before the Euro represented by 01/01/90 – 31/12/98. Method denotes the type of model that has been used to derive the exchange rate exposure coefficients. Actual is the actual changes in the ECU/£ whereas Unexp stands for the unexpected changes. RAW represents the raw exchange rate exposure coefficients whereas ABS represents the absolute exchange rate exposure coefficients. Model 1 has been estimated with leverage while in Model 2, leverage has not been included in the estimation. Furthermore, the exchange rate exposure coefficients have been estimated using the OLS model. The explanatory variables are CFTA which is the ratio of cash flow to total assets, PAYOUT is the ratio of dividends per share to earnings per share, FATA is the ratio of foreign assets to total assets, FITI is the ratio of foreign income to total income, FSTS is the ratio of foreign sales to total sales, ICBT is the ratio of interest to profit before interest and tax, LOGASS is the natural log of total assets, MVBV is the ratio of the sum of market value of equity and book value of debt to total assets. PREFASS is the ratio of book value of preference capital to total assets. QUICK is the ratio of current assets less inventory to current liabilities, RDSA is ratio of research and development to total sales, TANG is the ratio of tangible assets to total assets and TOTDEBT is the ratio of long-term debt to total equity and reserves. *, **, *** represents the significance at the 1%, 5% and 10% levels of significance

Table A11.16 The determinants of exposure to actual and unexpected changes in the Euro/£ exchange rate of UK firms for the sub-period after the Euro 01/01/99 - 31/12/06 (Exposure coefficients from the OLS and GARCH model)

METHOD	MEASURE	ABS/RAW	MODEL	CFTA	PAYOUT	FATA	FITI	FSTS	ICBT	LOGASS	MVBV	PREFASS	QUICK	RDSA	TANG	TOTDEBT
OLS	ACTUAL	RAW	1	0 0441	-0 0012	0 0053	-0 0149**	-0 0076*	0 0089*	-0 0244**	0 0092*	0 2547	0 0027	0 0172	-0 1561	-0 0274*
		ABS		0 0168	-0 0019***	0 0116	0 0067	-0 0012	-0 0024	-0 0134**	0 0080**	0 2881*	0 0018	-0 0285	-0 1227*	-0 0219**
		RAW	2	0 0429	-0 0009	0 0073	-0 0147*	-0 0070*	0 0088*	-0 0235**	-0 0006	0 3412	0 0030	0 0258	-0 0996	NA
		ABS		0 0158	-0 0017**	0 0133	0 0068	-0 0007	-0 0024	-0 0127**	0 0002	0 3571**	0 0020	-0 0216	-0 0777	NA
	UNEXP	RAW	1	0 0276	-0 0004	-0 0036	-0 0092*	-0 0053**	0 0071**	-0 0118**	0 0049	0 0847	0 0034	0 0155	-0 1344**	-0 0146
		ABS		0 0039	-0 0011***	-0 0029	0 0043	0 0007	-0 0020	-0 0075*	0 0036	0 1691*	0 0008	-0 0219	-0 0510	-0 0091
		RAW	2	0 0270	-0 0003	-0 0025	-0 0091*	-0 0050**	0 0071**	-0 0113*	-0 0003	0 1307	0 0035	0 0201	-0 1043*	NA
		ABS		0 0035	-0 0010**	-0 0022	0 0043	0 0008	-0 0020	-0 0072*	0 0004	0 1977**	0 0009	-0 0190	-0 0323	NA
GARCH	ACTUAL	RAW	1	-0 0042	-0 0010	-0 0070	-0 0003	-0 0022	0 0059**	-0 0060	0 0071**	-0 0418	-0 0002	0 0563*	-0 0642	-0 0225**
		ABS		-0 0072	-0 0016***	-0 0085	-0 0020	-0 0011	0 0018	0 0150***	0 0067***	-0 0045	0 0015	0 0375*	-0 0096	-0 0201***
		RAW	2	-0 0051	-0 0007	-0 0054	-0 0002	-0 0018	0 0058**	-0 0052	-0 0009	0 0290	0 0001	0 0633**	-0 0179	NA
		ABS		-0 0081	-0 0014***	-0 0070	-0 0019	-0 0007	0 0017	0 0157***	-0 0005	0 0589	0 0017	0 0438**	0 0318	NA
	UNEXP	RAW	1	-0 0115	-0 0003	-0 0038	-0 0005	-0 0006	0 0037**	-0 0034	0 0027	-0 0680	-0 0006	0 0347*	-0 0566	-0 0095*
		ABS		-0 0053	-0 0009***	-0 0052	-0 0015	-0 0011	-0 0001	0 0102***	0 0028*	-0 0318	0 0002	0 0210	-0 0051	-0 0087**
		RAW	2	-0 0119	-0 0002	-0 0031	-0 0005	-0 0005	0 0036**	-0 0031	-0 0006	-0 0382	-0 0005	0 0377**	-0 0372	NA
		ABS		-0 0057	-0 0008***	-0 0046	-0 0015	-0 0009	-0 0001	0 0105***	-0 0003	-0 0046	0 0003	0 0237*	0 0127	NA

Notes: The table presents the results for the determinants of exposure to the actual and unexpected changes in the Euro/£ for the period before the Euro represented by 01/01/99 – 31/12/06. Method denotes the type of model that has been used to derive the exchange rate exposure coefficients. Actual is the actual changes in the ECU/£ whereas Unexp stands for the unexpected changes. RAW represents the raw exchange rate exposure coefficients whereas ABS represents the absolute exchange rate exposure coefficients. Model 1 has been estimated with leverage while in Model 2, leverage has not been included in the estimation. Furthermore, the exchange rate exposure coefficients have been estimated using the OLS model. The explanatory variables are CFTA which is the ratio of cash flow to total assets, PAYOUT is the ratio of dividends per share to earnings per share, FATA is the ratio of foreign assets to total assets, FITI is the ratio of foreign income to total income, FSTS is the ratio of foreign sales to total sales, ICBT is the ratio of interest to profit before interest and tax, LOGASS is the natural log of total assets, MVBV is the ratio of the sum of market value of equity and book value of debt to total assets, PREFASS is the ratio of book value of preference capital to total assets, QUICK is the ratio of current assets less inventory to current liabilities, RDSA is ratio of research and development to total sales, TANG is the ratio of tangible assets to total assets and TOTDEBT is the ratio of long-term debt to total equity and reserves. *, **, *** represents the significance at the 1%, 5% and 10% levels of significance

Table A11.17 The determinants of exposure to the actual and unexpected changes in the short-term interest rate exposure of UK firms for the sub-period after the Euro 01/01/99-31/12/06 (Exposure coefficients from the OLS and GARCH model)

METHOD	MEASURE	ABS/RAW	MODEL	CFTA	PAYOUT	FATA	FITI	FSTS	ICBT	LOGASS	MVBV	PREFASS	QUICK	RDSA	TANG	TOTDEBT
OLS	ACTUAL	RAW	1	00291	-00008	-00444**	00024	00025	-00042	-00165**	00019	01006	-00009	-00314	-00895	-00068
		ABS		-00070	-0002***	00240*	-00008	00001	00013	-00169***	-00007	02091*	-00028	-00024	-01011**	00030
		RAW	2	00288	-00008	-00439**	00024	00027	-00043	-00163**	-00005	01219	-00008	-00292	-00756	NA
		ABS		-00069	-00021***	00238*	-00008	00000	00013	-0017***	00004	01997*	-00029	-00033	-01073**	NA
	UNEXP	RAW	1	00404	-00007	-00442**	-00017	00049	-00057	-00165**	00044	00538	-00038	-00377	-01084	-00143
		ABS		-00184	-00019***	00116	-00040	00024	00026	-00202***	-00016	01963	-00014	00114	-01070**	00039
		RAW	2	00398	-00006	-00431*	-00016	00052	-00058	-0016**	-00007	00987	-00037	-00332	-00790	NA
		ABS		-00182	-0002***	00113	-00041	00023	00026	-00203***	-00002	01840	-00015	00101	-01150**	NA
GARCH	ACTUAL	RAW	1	00044	-00006	-00039	00036	-00002	-00042**	00067	-00014	01313	00007	-00204	00593	00027
		ABS		-00086	-00012***	-00118	-00045*	-00013	00060***	0013***	00043**	00156	-00027	00097	00063	-00124***
		RAW	2	00045	-00007	-00041	00036	-00002	-00042**	00066	-00005	01227	00007	-00213	00537	NA
		ABS		-00091	-00011***	-00109	-00045*	-00011	00059***	00134***	-00001	00547	-00026	00136	00318	NA
	UNEXP	RAW	1	-00157	-00007	-00046	00026	-00003	-00038*	00078*	-00001	01893*	-00001	-00324	00777*	-00013
		ABS		00016	-00013***	-00110	-00030	-00012	00039***	00143***	00036**	00301	-00030	00222	00198	-00112**
		RAW	2	-00158	-00007	-00045	00026	-00003	-00038*	00079*	-00005	01933*	-00001	-00320	00803*	NA
		ABS		00012	-00012***	-00102	-00029	-00010	00038***	00147***	-00004	00654	-00029	00257*	00428	NA

Notes: The table presents the results for the determinants of exposure to the actual and unexpected changes in the short-term interest for the period after the euro Method stands for the type of model that has been used to derive the exchange rate exposure coefficients. Actual is the actual changes in the ECU/£ whereas Unexp stands for the unexpected changes. RAW represents the raw exchange rate exposure coefficients whereas ABS represents the absolute exchange rate exposure coefficients. Furthermore, the exchange rate exposure coefficients have been estimated using the OLS model. The explanatory variables are CFTA which is the ratio of cash flow to total assets, PAYOUT is the ratio of dividends per share to earnings per share, FATA is the ratio of foreign assets to total assets, FITI is the ratio of foreign income to total income, FSTS is the ratio of foreign sales to total sales, ICBT is the ratio of interest to profit before interest and tax, LOGASS is the natural log of total assets, MVBV is the ratio of the sum of market value of equity and book value of debt to total assets, PREFASS is the ratio of book value of preference capital to total assets, QUICK is the ratio of current assets less inventory to current liabilities, RDSA is ratio of research and development to total sales, TANG is the ratio of tangible assets to total assets and TOTDEBT is the ratio of long-term debt to total equity and reserves. *, **, *** represents the significance at the 1%, 5% and 10% levels of significance

Table A11.18 The determinants of exposure to the actual and unexpected changes in the long-term interest rate exposure of UK firms for the sub-period after the Euro 01/01/99-31/12/06 (Exposure coefficients from the OLS and GARCH model)

METHOD	MEASURE	ABS/RAW	MODEL	CFTA	PAYOUT	FATA	FITI	FSTS	ICBT	LOGASS	MVBV	PREFASS	QUICK	RDSA	TANG	TOTDEBT
OLS	ACTUAL	RAW	1	-0.0014	-0.0003	-0.0204	0.0052	-0.0015	-0.0025	0.0155***	-0.0023	-0.1356	-0.0003	-0.0263	0.0806*	0.0040
		ABS		-0.0311**	-0.0007**	0.0150*	0.0006	0.0018	-0.0022	-0.0020	-0.0013	0.2417***	0.0002	-0.0007	-0.0539*	0.0047
		RAW	2	-0.0012	-0.0003	-0.0207*	0.0052	-0.0016	-0.0025	0.0154***	-0.0008	-0.1483	-0.0004	-0.0275	0.0723	NA
		ABS		-0.0309**	-0.0008**	0.0147*	0.0006	0.0017	-0.0022	-0.0022	0.0003	0.2268***	0.0001	-0.0022	-0.0636**	NA
	UNEXP	RAW	1	-0.0050	-0.0001	-0.0050*	0.0011	-0.0004	-0.0005	0.0028***	-0.0005	-0.0146	0.0001	-0.0059	0.0167*	0.0009
		ABS		-0.0022	-0.0002**	0.0037**	0.0001	0.0004*	-0.0005*	-0.0003	-0.0003	0.0522***	-0.0001	-0.0004	-0.0086	0.0010
		RAW	2	-0.0049	-0.0001	-0.0051**	0.0011	-0.0004	-0.0005	0.0028***	-0.0001	-0.0176	0.0001	-0.0062	0.0148	NA
		ABS		-0.0021	-0.0002***	0.0036**	0.0001	0.0004*	-0.0005*	-0.0003	0.0001	0.0490***	-0.0001	-0.0007	-0.0107*	NA
GARCH	ACTUAL	RAW	1	-0.0080	-0.0002	0.0026	0.0003	-0.0002	-0.0007	0.0042	0.0006	0.0271	-0.0003	-0.0165	0.0277	-0.0022
		ABS		-0.0025	-0.0005***	-0.0046	-0.0006	-0.0009	-0.0013	0.0074***	0.0025**	-0.0787*	-0.0008	0.0021	-0.0135	-0.0071**
		RAW	2	-0.0081	-0.0001	0.0028	0.0003	-0.0002	-0.0007	0.0042	-0.0002	0.0339	-0.0003	-0.0159	0.0322	NA
		ABS		-0.0028	-0.0004**	-0.0041	-0.0006	-0.0007	-0.0013	0.0077***	0.0000	-0.0562	-0.0007	0.0044	0.0012	NA
	UNEXP	RAW	1	-0.0020	0.0000	0.0001	0.0000	-0.0001	-0.0003	0.0008	0.0002	0.0110	0.0000	-0.0031	0.0074	-0.0005
		ABS		-0.0005	-0.0001***	-0.0011	-0.0002	-0.0002	-0.0003	0.0019***	0.0005**	-0.0106	-0.0002	-0.0002	-0.0011	-0.0013**
		RAW	2	-0.0020	0.0000	0.0002	0.0000	-0.0001	-0.0003	0.0008	0.0000	0.0128	0.0000	-0.0029	0.0085	NA
		ABS		-0.0005	-0.0001***	-0.0010	-0.0002	-0.0001	-0.0003	0.0019***	0.0000	-0.0064	-0.0002	0.0002	0.0017	NA

Notes: The table presents the results for the determinants of exposure to the actual and unexpected changes in the long-term interest for the period after the Euro denoted by 01/01/99 – 31/12/06. Method refers to the type of model that has been used to derive the exchange rate exposure coefficients. Actual is the actual changes in the ECU/£ whereas Unexp stands for the unexpected changes. RAW represents the raw exchange rate exposure coefficients whereas ABS represents the absolute exchange rate exposure coefficients. Model 1 has been estimated with leverage while in Model 2, leverage has not been included in the estimation. Furthermore, the exchange rate exposure coefficients have been estimated using the OLS model. The explanatory variables are CFTA which is the ratio of cash flow to total assets, PAYOUT is the ratio of dividends per share to earnings per share, FATA is the ratio of foreign assets to total assets, FITI is the ratio of foreign income to total income, FSTS is the ratio of foreign sales to total sales, ICBT is the ratio of interest to profit before interest and tax. LOGASS is the natural log of total assets, MVBV is the ratio of the sum of market value of equity and book value of debt to total assets, PREFASS is the ratio of book value of preference capital to total assets, QUICK is the ratio of current assets less inventory to current liabilities, RDSA is ratio of research and development to total sales, TANG is the ratio of tangible assets to total assets and TOTDEBT is the ratio of long-term debt to total equity and reserves. *, **, *** represents the significance at the 1%, 5% and 10% levels of significance.

Appendix 12 Summary of exchange rate and interest rate exposure of UK non-financial industries using the OLS model

Table A12.1 A summary of non-financial industries' exposure to actual and unexpected changes in the Trade weighted nominal exchange rate, short -term interest rate and long-term interest rate of the total sample period from January 1990 to December 2006

	BOEGBPR		UKTBTND		UKMBRYD	
INDUSTRY	ACTUAL	UNEXP.	ACTUAL	UNEXP.	ACTUAL	UNEXP.
Aerospace and Defence	0.0357	0.0005	0.0025	0.0204	0.0845*	0.0124*
Automobiles and Auto Parts	-0.0279	-0.0003	0.0387	0.0609	0.1655***	0.0243***
Beverages	0.0997	0.0011	-0.0611*	-0.0538	-0.0164	-0.0029
Chemicals	0.0267	0.0002	-0.0094	0.0272	0.0920**	0.0099**
Construction And Materials	0.0707	0.0008	-0.0695**	-0.0485	0.0640**	0.0088**
Electricity	0.2088*	0.0029**	-0.0715	-0.0803	-0.0917	-0.0067
Electronic And Electrical Equipment	-0.0789	-0.0008	-0.0542	-0.0540	0.0958***	0.0127***
Fixed-line Telecommunications	0.1082	0.0016	0.0618	0.0671	0.0707	0.0120
Food and Drug Retailers	0.2522**	0.0024**	0.0327	0.0352	-0.0368	-0.0106*
Food Producers	-0.1476	-0.0015	0.0284	0.0265	-0.0608*	-0.0107**
Forestry And Paper	0.3642*	0.0042**	-0.1544	-0.1144	0.0698	0.0094
Gas, Water And Multi-Utilities	0.3502***	0.0036***	-0.0873*	-0.1292**	-0.1948***	-0.0336***
General Industrial	-0.1086	-0.0013	0.0089	0.0263	0.0551	0.0059
General Retailers	0.0099	0.0000	-0.0193	0.0123	-0.0166	-0.0036
Healthcare Equipment and Services	-0.1427	-0.0014	0.0785	0.0780	-0.1362*	-0.0094
Household Goods	-0.0906	-0.0010	-0.1216***	-0.0917*	0.0035	-0.0009
Industrial Engineering	-0.0396	-0.0004	-0.0073	0.0130	0.0179	0.0019

Table A12.1 continued: A summary of non-financial industries' exposure to actual and unexpected changes in the Trade weighted nominal exchange rate, short -term interest rate and long-term interest rate of the total sample period from January 1990 to December 2006

	BOEGBPR		UKTBTND		UKMBRYD	
INDUSTRY	ACTUAL	UNEXP.	ACTUAL	UNEXP.	ACTUAL	UNEXP.
Industrial Transport	0.0053	0.0002	-0.0511	-0.0437	0.1015***	0.0147***
Leisure Goods	0.2237	0.0022	-0.1300	-0.0996	0.1055	0.0203
Media	0.2253	0.0022	-0.1299	-0.1003	0.1086	0.0208
Mining	-0.3324**	-0.0034**	-0.0246	0.0046	0.1586**	0.0240**
Mobile Telecommunications	0.1448	0.0016*	-0.0227	-0.0100	0.0085	-0.0001
Oil and Gas Producers	-0.2918***	-0.0027**	0.0070	0.0081	0.0618	0.0119
Oil Equipment And Services	0.2639	0.0031	-0.0533	-0.0373	0.0948	0.0140
Personal Goods	0.0635	0.0009	0.0000	0.0134	0.0522	0.0075
Pharmaceuticals and Biotechnology	0.4978***	0.0052***	-0.2383***	-0.2601***	0.0195	-0.0001
Software and Computer Services	0.1538	0.0019	-0.0686	-0.0484	0.1679**	0.0280***
Support Services	-0.0195	-0.0002	-0.0045	0.0130	0.0106	-0.0007
Technical Hardware and Equipment	0.4130*	0.0048**	0.0423	0.0409	0.2065**	0.0362***
Tobacco	-0.3151*	-0.0034*	0.0062	-0.0141	-0.1762***	-0.0277***
Travel and Leisure	0.0265	0.0002	-0.0516	-0.0488	-0.0070	-0.0030

Note: Actual is the model for actual changes whereas Unexp. is the model for unexpected changes. BOEGBPR refers to the Trade-weighted nominal exchange rate exposure coefficient while UKTBTND and UKMBRYD are the exposure coefficients for the 3 Month TB and 10 Year GB respectively. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

Table A12.2 A summary of non-financial industries' exposure to actual and unexpected changes in foreign exchange rates US$/£ and the JP¥/£ of the total sample period from January 1990 to December 2006

	US$/£		JP¥/£	
INDUSTRY	ACTUAL	UNEXP.	ACTUAL	UNEXP.
Aerospace and Defence	0.0523	0.0330	-0.0314	-0.0001
Automobiles and Auto Parts	0.1119	0.0555	0.0201	0.0002
Beverages	0.0291	0.0130	0.0496	0.0002
Chemicals	0.0252	0.0067	-0.0081	0.0000
Construction And Materials	-0.0197	-0.0054	0.0273	0.0002
Electricity	0.0316	0.0385	0.0488	0.0001
Electronic And Electrical Equipment	0.0564	0.0350	-0.0549	-0.0003
Fixed-line Telecommunications	0.1461	0.0836	0.0290	0.0001
Food and Drug Retailers	0.1951***	0.1134***	0.0608	0.0003
Food Producers	-0.0779	-0.0447	0.0051	0.0000
Forestry And Paper	-0.0802	-0.0585	0.0843	0.0004
Gas, Water And Multi-Utilities	0.1564*	0.0988*	0.1458**	0.0008***
General Industrial	0.0064	-0.0099	0.0010	0.0000
General Retailers	-0.0344	-0.0264	0.0193	0.0002
Healthcare Equipment and Services	0.0588	0.0420	-0.1651*	-0.0006
Household Goods	-0.0596	-0.0445	-0.0599	-0.0003
Industrial Engineering	-0.0218	-0.0133	0.0272	0.0001
Industrial Transport	0.0132	0.0102	0.0284	0.0001
Leisure Goods	0.4339***	0.2369***	0.2255	0.0012*
Media	0.4315***	0.2363***	0.2274	0.0012*
Mining	-0.0843	-0.0503	-0.0273	-0.0002
Mobile Telecommunications	0.0225	0.0068	0.0184	0.0001
Oil and Gas Producers	-0.2205***	-0.1270***	-0.1439**	-0.0007**
Oil Equipment And Services	0.0478	0.0458	0.1471*	0.0007**
Personal Goods	-0.0373	-0.0297	0.0371	0.0002
Pharmaceuticals and Biotechnology	0.2351**	0.1173**	0.1154	0.0006
Software and Computer Services	0.0476	0.0305	0.0407	0.0004
Support Services	0.0052	-0.0009	-0.0136	-0.0001
Technical Hardware and Equipment	0.1828	0.1160	0.0296	0.0002
Tobacco	-0.1600*	-0.0978*	-0.1266	-0.0007
Travel and Leisure	0.0346	0.0194	0.0186	0.0001

Note: The US$/£ column refers to the US$ exchange rate exposure coefficient and the JP¥/£ column is the JP¥ exchange rate exposure coefficient. Actual refers to actual changes whereas Unexp. is the unexpected changes. ***,** and * signifies statistical significance at the 1%, 5% and 10% level respectively.

Table A12.3 A summary of non-financial industries' exposure to actual and unexpected changes in foreign exchange rates: ECU/£ for January 1990 to December 1998 and Euro/£ for the period January 1999 to December 2006

	ECU/£		EURO/£	
INDUSTRY	ACTUAL	UNEXP.	ACTUAL	UNEXP.
Aerospace and Defence	-0.0610	-0.0491	0.1854	0.0907
Automobiles and Auto Parts	-0.1230	-0.1222	-0.1118	-0.1120
Beverages	0.0767	0.0420	0.0317	0.0307
Chemicals	0.0708	0.0542	0.0615	0.0091
Construction And Materials	0.0855	0.0551	0.1182	0.0344
Electricity	0.1668	0.1320	0.0837	0.0917
Electronic And Electrical Equipment	-0.1540	-0.1337*	-0.0489	-0.0419
Fixed-line Telecommunications	-0.1235	-0.0794	-0.0129	-0.0253
Food and Drug Retailers	0.1792	0.1181	0.0111	0.0476
Food Producers	-0.0519	-0.0344	-0.2455**	-0.1408*
Forestry And Paper	0.5582**	0.3795*	0.5143	0.2614
Gas, Water And Multi-Utilities	0.3523**	0.2728**	-0.0681	0.0114
General Industrial	-0.1288	-0.1057	-0.1630	-0.1328
General Retailers	0.1158	0.0777	-0.1016	-0.0885
Healthcare Equipment and Services	-0.0633	0.0016	-0.2089	-0.1666
Household Goods	-0.1371	-0.0907	0.0126	-0.0065
Industrial Engineering	-0.0046	-0.0158	-0.0357	-0.0469
Industrial Transport	-0.0273	-0.0293	-0.0429	-0.0688
Leisure Goods	-0.0020	-0.0164	-0.1583	-0.3802
Media	0.0001	-0.0148	-0.1573	-0.3784
Mining	-0.3749***	-0.2897***	-0.3469*	-0.2646**
Mobile Telecommunications	0.0873	0.0785	0.1694*	0.0799
Oil and Gas Producers	-0.1254	-0.0760	-0.1023	-0.0569
Oil Equipment And Services	0.2692	0.1872	0.1868	0.1251
Personal Goods	0.1538*	0.1168*	0.1016	0.0835
Pharmaceuticals and Biotechnology	0.5197**	0.3889**	0.1837	0.1155
Software and Computer Services	0.0344	0.0099	0.2398	0.0733
Support Services	0.0127	-0.0067	0.0096	-0.0251
Technical Hardware and Equipment	-0.0446	-0.0423	0.5876*	0.2545
Tobacco	-0.4238*	-0.3250*	-0.2452	-0.0999
Travel and Leisure	0.0421	0.0074	-0.0917	-0.0625

Note: ECU/£ represents the exchange rate exposure coefficients of the ECU while Euro/£ represents the exchange rate exposure for the Euro. ***,** and * signifies statistical significance at the 1%, 5% and 10% level

Table A12.4 A summary of non-financial industries' exposure to market risk and actual changes in the Trade weighted nominal exchange rate, 3 Month Treasury bill (TB) and 10 Year Government Bond (GB) before the Euro and after the introduction of the Euro

INDUSTRY	FTSEALLSH	FTSEDUM	ERINDEX	ERDUM	UKTBTND	TBTNDUM	UKMBRYD	BRYDUM
Aerospace and Defence	0.4451***	0.2125**	-0.1164	0.3815	0.0297	-0.1014	0.0535	-0.0134
Automobiles and Auto Parts	0.5092***	0.2055**	-0.0930	0.1645	0.0124	0.0933	0.1404**	-0.0162
Beverages	0.4645***	-0.2607***	0.0824	0.0400	-0.0963***	0.1383**	0.0463	-0.0430
Chemicals	0.6431***	-0.2086**	0.0416	-0.0389	-0.0291	0.0785	0.1374***	-0.0238
Construction And Materials	0.4562***	-0.1275	0.0823	-0.0199	-0.0363	-0.1228	0.0987***	-0.0291
Electricity	0.6002***	-0.0929	0.1082	0.2424	-0.0884	0.0709	-0.0716	-0.0165
Electronic And Electrical Equipment	0.6855***	-0.0398	-0.1236	0.1066	-0.0725**	0.0721	0.1053***	-0.0085
Fixed-line Telecommunications	1.2163***	0.3362**	-0.1211	0.5603*	0.0769	-0.0536	-0.0008	0.0236
Food and Drug Retailers	0.6958***	-0.4028***	0.3347**	-0.2587	-0.0218	0.2250	-0.0486	0.1501*
Food Producers	0.6835***	-0.2790***	-0.0811	-0.1568	0.0216	0.0275	0.0108	-0.0509
Forestry And Paper	0.2770**	0.0653	0.3515	0.0421	-0.2201*	0.2383	0.0968	-0.0706
Gas, Water And Multi-Utilities	0.4967***	-0.2195*	0.4766***	-0.4093*	-0.1210***	0.1540	-0.3384***	0.3520***
General Industrial	0.8497***	-0.0999	-0.1108	-0.0028	0.0140	-0.0136	0.0594	0.0213
General Retailers	0.8047***	-0.0408	0.0664	-0.1361	0.0110	-0.1141	-0.0139	0.0095
Healthcare Equipment and Services	0.4960***	0.3974**	-0.0569	-0.0968	-0.0071	0.2672	0.0229	-0.4197**
Household Goods	0.8773***	-0.2710***	-0.2130	0.2764	-0.1253**	0.0336	0.0213	0.0397
Industrial Engineering	0.5713***	-0.2180***	-0.0290	-0.0177	-0.0119	0.0195	0.0826**	-0.0591
Industrial Transport	0.6992***	-0.3076***	-0.0011	0.0287	-0.0576	0.0287	0.1958***	-0.0904
Leisure Goods	0.5316***	0.4943*	0.1995	0.1032	-0.1950**	0.2146	0.1046	-0.1462

Table A12.4 continued: A summary of non-financial industries' exposure to actual changes in the Trade weighted nominal exchange rate, short -term interest rate and long-term interest rate of the total sample period from January 1990 to December 2006

INDUSTRY	FTSEALLSH	FTSEDUM	ERINDEX	ERDUM	UKTBTND	TBTNDUM	UKMBRYD	BRYDUM
Media	0.5346***	0.5020*	0.2031	0.0971	-0.1957**	0.2180	0.1039	-0.1410
Mining	0.8170***	-0.0376	-0.4421***	0.2572	0.0803	-0.3774*	0.1181	0.0803
Mobile Telecommunications	0.7388***	-0.2318***	0.0999	0.0815	-0.0723*	0.2001*	0.0182	0.0495
Oil and Gas Producers	0.8336***	0.0657	-0.2876**	-0.0088	-0.0701	0.2820	0.0725	-0.0380
Oil Equipment And Services	0.5354***	0.1051	0.1204	0.3554	0.0202	-0.2685	0.0636	0.0184
Personal Goods	0.3397***	-0.0806	0.0758	-0.0169	-0.0429	0.1560	0.1075**	-0.0811
Pharmaceuticals and Biotechnology	0.4710***	-0.1190	0.5568**	-0.2044	-0.3821***	0.5488***	-0.0335	0.1456
Software and Computer Services	0.8112***	0.7342***	0.0295	0.2982	-0.1256**	0.1987	0.0177	0.0648
Support Services	0.7008***	-0.0629	-0.0010	-0.0567	-0.0074	0.0147	0.0018	0.0370
Technical Hardware and Equipment	0.8448***	1.0635***	-0.0432	1.1416**	0.0360	0.0096	0.0416	-0.0266
Tobacco	0.9354***	-0.7737***	-0.4086**	0.2002	0.0042	0.0414	-0.0622	0.0060
Travel and Leisure	0.8795***	-0.2509**	0.0144	0.0164	-0.0550	0.0236	0.0224	0.0176

Note: FTSEALLSH refers to the market risk before the Euro, FTSEDUM is the change in market risk following the introduction of the Euro, ERINDEX is the Trade-weighted nominal exchange rate exposure coefficient before the Euro and ERDUM is the change in exposure after the Euro. UKTBTND and UKMBRYD are the exposure coefficients for the 3 Month TB and 10 Year GB before the euro while TBTNDUM and BRYDUM are changes in the exposure after the Euro for the TB and GB respectively. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

Table A12.5 A summary of non-financial industries' exposure to unexpected changes in the Trade weighted nominal exchange rate, 3 Month Treasury bill (TB) and 10 Year Government Bond (GB) before the Euro and after the introduction of the Euro

INDUSTRY	ER INDEX	ERDUM	UKTBTND	TBTNDUM	UKMBRYD	BRYDUM
Aerospace and Defence	-0.0014	0.0041	0.0400	-0.0673	0.0046	0.0045
Automobiles and Auto Parts	-0.0013	0.0020	0.0117	0.1809	0.0159*	0.0087
Beverages	0.0010	0.0001	-0.0984***	0.1654*	0.0053	-0.0038
Chemicals	0.0002	-0.0003	0.0037	0.0915	0.0121**	0.0107
Construction And Materials	0.0011	-0.0006	-0.0343	-0.0493	0.0113**	0.0034
Electricity	0.0027	0.0009	-0.0904	0.0341	0.0027	-0.0197
Electronic And Electrical Equipment	-0.0015	0.0012	-0.0726**	0.0731	0.0107***	0.0092
Fixed-line Telecommunications	-0.0013	0.0062**	0.1048**	-0.1325	0.0006	0.0041
Food and Drug Retailers	0.0034*	-0.0028	-0.0287	0.2439*	-0.0081	0.0289**
Food Producers	-0.0008	-0.0016	0.0240	0.0091	-0.0013	-0.0065
Forestry And Paper	0.0040	0.0003	-0.1731	0.2133	0.0066	0.0027
Gas, Water And Multi-Utilities	0.0055***	-0.0047*	-0.1545***	0.1032	-0.0405***	0.0460**
General Industrial	-0.0016	0.0005	0.0147	0.0482	0.0048	0.0118
General Retailers	0.0007	-0.0015	0.0313	-0.0696	-0.0033	0.0031
Healthcare Equipment and Services	0.0001	-0.0019	-0.0136	0.2950	0.0079	-0.0906***
Household Goods	-0.0025	0.0029	-0.1189***	0.1116	0.0023	0.0121
Industrial Engineering	-0.0003	-0.0003	0.0018	0.0429	0.0085*	-0.0029
Industrial Transport	0.0002	-0.0001	-0.0673	0.0906	0.0232***	-0.0005
Leisure Goods	0.0017	0.0014	-0.2017**	0.3563	0.0157	-0.0284
Media	0.0017	0.0014	-0.2029**	0.3581	0.0157	-0.0276

Table A12.5 continued: A summary of non-financial industries' exposure to unexpected changes in the Trade weighted nominal exchange rate, 3 Month Treasury bill (TB) and 10 Year Government Bond (GB) before the Euro and after the introduction of the Euro

INDUSTRY	ER INDEX	ERDUM	UKTBTND	TBTNDUM	UKMBRYD	BRYDUM
Mining	-0.0046***	0.0024	0.0916	-0.3025	0.0160	0.0299
Mobile Telecommunications	0.0013	0.0006	-0.0666	0.2128**	0.0038	0.0083
Oil and Gas Producers	-0.0027*	-0.0002	-0.0815	0.3238*	0.0111	-0.0015
Oil Equipment And Services	0.0020	0.0022	0.0189	-0.1996	0.0081	0.0096
Personal Goods	0.0011	-0.0007	-0.0334	0.1700	0.0102*	-0.0014
Pharmaceuticals and Biotechnology	0.0059**	-0.0024	-0.4094***	0.5502***	-0.0046	0.0285
Software and Computer Services	0.0004	0.0031	-0.1001	0.1837	0.0051	0.0107
Support Services	-0.0001	-0.0005	0.0047	0.0337	-0.0023	0.0108
Technical Hardware and Equipment	-0.0006	0.0117**	0.0513	-0.0374	0.0053	0.0018
Tobacco	-0.0044*	0.0021	-0.0384	0.1036	-0.0066	-0.0024
Travel and Leisure	-0.0001	0.0003	-0.0598	0.0476	0.0007	0.0095

Note: The changes in the market risk are not presented because they are similar to those reported in table 4.7 where actual changes in exchange rates (TWI) and interest rates were used. ERINDEX represents the Trade-weighted nominal exchange rate exposure coefficient before the Euro while ERDUM stands for the change in exposure after the Euro. UKTBTND and UKMBRYD are the exposure coefficients for the 3 Month TB and 10 Year GB before the euro while TBTNDUM and BRYDUM denotes changes in the exposure after the Euro for the TB and GB respectively***,** and * connotes statistical significance at the 1%, 5% and 10% level.

Table A12.6 A summary of non-financial industries' exposure to actual and unexpected changes in the US$/£ and the JP¥/£ before the Euro and after the introduction of the Euro

	ACTUAL US$		UNEXP. US$		ACTUAL JP¥		UNEXP. JP¥	
INDUSTRY	ER INDEX	ERDUM	ER INDEX	ERDUM	ER INDEX	ERDUM	ER INDEX	ERDUM
Aerospace and Defence	-0.0374	0.2275	-0.0191	0.1277	-0.0973	0.1535	-0.0004	0.0006
Automobiles and Auto Parts	-0.0352	0.3844**	-0.0363	0.2368**	0.0201	0.0018	0.0002	0.0000
Beverages	0.0595	-0.0517	0.0343	-0.0370	0.0438	0.0491	0.0001	0.0004
Chemicals	-0.0080	0.1180	-0.0146	0.0732	0.0409	-0.1073	0.0002	-0.0005
Construction And Materials	0.0112	-0.0683	0.0103	-0.0336	0.0731	-0.1230	0.0003*	-0.0006
Electricity	0.0136	0.0625	0.0391	0.0125	-0.0540	0.2855*	-0.0003	0.0013*
Electronic And Electrical Equipment	-0.0261	0.2350**	-0.0128	0.1349**	-0.0156	-0.0927	-0.0001	-0.0006
Fixed-line Telecommunications	-0.0718	0.5676**	-0.0452	0.3314**	-0.0406	0.1616	-0.0002	0.0009
Food and Drug Retailers	0.2923***	-0.2274	0.1647***	-0.1136	0.0843	-0.0279	0.0003	0.0001
Food Producers	-0.0622	-0.0087	-0.0355	-0.0031	-0.0190	0.0845	-0.0001	0.0004
Forestry And Paper	-0.0610	-0.0629	-0.0709	0.0257	0.1954	-0.2626	0.0008	-0.0012
Gas, Water And Multi-Utilities	0.2685***	-0.2997*	0.1727***	-0.1937*	0.1868**	-0.1050	0.0010**	-0.0006
General Industrial	-0.0113	0.0606	-0.0216	0.0386	-0.0071	0.0244	-0.0001	0.0002
General Retailers	-0.0243	-0.0231	-0.0238	-0.0054	0.0390	-0.0626	0.0002	-0.0001
Healthcare Equipment and Services	-0.0221	0.1874	-0.0076	0.1175	-0.0157	-0.3606	0.0000	-0.0017
Household Goods	-0.1110	0.1754	-0.0690	0.0896	-0.1034	0.1309	-0.0005	0.0007
Industrial Engineering	-0.0574	0.1273	-0.0325	0.0708	0.0385	-0.0101	0.0002	0.0000
Industrial Transport	-0.0095	0.1048	-0.0011	0.0570	0.0781*	-0.1023	0.0003*	-0.0004
Leisure Goods	0.2286*	0.5165	0.1268	0.2706	0.1235	0.2789	0.0008	0.0015

Table A12.6 continued: A summary of non-financial industries' exposure to actual and unexpected changes in the US$/£ and the JP¥/£ before the Euro and after the introduction of the Euro

	ACTUAL US$		UNEXP. US$		ACTUAL JP¥		UNEXP. JP¥	
INDUSTRY	ER INDEX	ERDUM	ER INDEX	ERDUM	ER INDEX	ERDUM	ER INDEX	ERDUM
Media	0.2309*	0.5023	0.1289	0.2625	0.1315	0.2626	0.0008	0.0014
Mining	-0.2620**	0.4999**	-0.1488*	0.2744**	-0.1056	0.1646	-0.0006	0.0010
Mobile Telecommunications	0.0342	-0.0067	0.0153	-0.0054	0.0257	0.0123	0.0002	0.0000
Oil and Gas Producers	-0.2429***	0.0513	-0.1399***	0.0297	-0.0853	-0.1282	-0.0005	-0.0007
Oil Equipment And Services	-0.0506	0.2635	0.0086	0.0948	0.0511	0.2226	0.0003	0.0013
Personal Goods	-0.0454	0.0324	-0.0245	-0.0090	0.0716**	-0.0630	0.0003*	-0.0004
Pharmaceuticals and Biotechnology	0.1934	0.1200	0.0987	0.0557	0.1737*	-0.0994	0.0009	-0.0005
Software and Computer Services	-0.0520	0.1839	-0.0365	0.1250	0.0833	-0.1327	0.0006	-0.0008
Support Services	-0.0054	0.0359	-0.0079	0.0224	0.0265	-0.1032	0.0001	-0.0005
Technical Hardware and Equipment	-0.0347	0.4822	-0.0316	0.3258*	0.0657	-0.1407	0.0003	-0.0006
Tobacco	-0.1253	-0.0014	-0.0658	-0.0238	-0.1971	0.2311	-0.0010*	0.0015
Travel and Leisure	-0.0074	0.1470	-0.0052	0.0874	-0.0308	0.1452	-0.0001	0.0008

Note: The ERINDEX represents the exchange rate exposure coefficient for actual and unexpected US$/£ and the JP¥/£ before the introduction of the Euro. ERDUM refers to the change in the exposure (US$ or JP¥) after the introduction of the Euro. Actual refers to the actual changes whereas Unexp. denotes the unexpected changes. ***,** and * denotes statistical significance at the 1%, 5% and 10% level.

Table A12.7 A summary of non-financial industries' exposure to lagged changes in the Trade weighted nominal exchange rate, short -term interest rate and long-term interest rate of the total sample period from January 1990 to December 2006

	BOEGBPR		UKTBTND		UKMBRYD	
INDUSTRY	ACTUAL	UNEXP.	ACTUAL	UNEXP.	ACTUAL	UNEXP.
Aerospace and Defence	-0.1502	-0.0018*	0.0557	0.0761	-0.0182	-0.0011
Automobiles and Auto Parts	-0.0193	-0.0002	0.0378	0.0728	0.0428	0.0014
Beverages	-0.0244	-0.0002	0.0167	0.0356	0.0386	0.0035
Chemicals	-0.2383**	-0.0027***	0.0635	0.0956**	0.0353	0.0008
Construction And Materials	-0.0936	-0.0010	-0.0353	-0.0097	0.0102	-0.0002
Electricity	-0.0268	-0.0003	0.0401	0.0675	-0.0367	-0.0015
Electronic And Electrical Equipment	-0.1085	-0.0012	0.0742*	0.0924**	-0.0136	-0.0050
Fixed-line Telecommunications	-0.0174	-0.0001	0.0128	-0.0008	0.0315	0.0062
Food and Drug Retailers	0.0964	0.0009	0.1417**	0.1482**	-0.0700	-0.0077
Food Producers	-0.0150	-0.0002	0.0172	0.0198	-0.0022	-0.0005
Forestry And Paper	-0.2762	-0.0030	0.1101	0.1585**	0.0338	-0.0034
Gas, Water And Multi-Utilities	0.1232	0.0015	0.0305	0.0200	-0.0641	-0.0112*
General Industrial	0.0384	0.0003	0.0652	0.0987*	0.0088	0.0012
General Retailers	-0.0342	-0.0007	-0.0655*	-0.0427	0.0126	-0.0001
Healthcare Equipment and Services	0.0343	0.0006	-0.1019*	-0.1205*	0.1207	0.0164
Household Goods	-0.2629*	-0.0029**	-0.0212	0.0029	-0.1009***	-0.0130**
Industrial Engineering	-0.1154	-0.0011	0.0392	0.0669**	0.0389	0.0025
Industrial Transport	-0.1051	-0.0010	0.0536	0.0653	0.0009	-0.0028
Leisure Goods	-0.3816	-0.0040	-0.0348	-0.0530	0.1320	0.0110

Table A12.7 continued: A summary of non-financial industries' exposure to lagged changes in the actual and unexpected changes in the Trade weighted nominal exchange rate, short -term interest rate and long-term interest rate of the total sample period from January 1990 to December 2006

	BOEGBPR		UKTBTND		UKMBRYD	
INDUSTRY	ACTUAL	UNEXP.	ACTUAL	UNEXP.	ACTUAL	UNEXP.
Media	-0.3762	-0.0039	-0.0342	-0.0535	0.1291	0.0105
Mining	0.0582	0.0005	-0.1397	-0.1004	-0.0466	-0.0033
Mobile Telecommunications	-0.0550	-0.0006	0.0263	0.0325	0.0074	-0.0011
Oil and Gas Producers	-0.1365	-0.0015	0.0159	0.0189	0.0558	0.0075
Oil Equipment And Services	-0.0850	-0.0009	0.1202	0.1340	0.0304	0.0003
Personal Goods	-0.0861	-0.0009	-0.0181	0.0116	-0.0053	-0.0024
Pharmaceuticals and Biotechnology	-0.3089*	-0.0031*	-0.1091	-0.1250	-0.0731	-0.0133
Software and Computer Services	-0.0046	-0.0001	-0.0972	-0.0973	-0.0726	-0.0101
Support Services	-0.0701	-0.0008	0.0085	0.0332	0.0222	-0.0004
Technical Hardware and Equipment	-0.1542	-0.0014	0.2240**	0.2495**	-0.0872	-0.0104
Tobacco	-0.1182	-0.0013	-0.0029	0.0027	-0.0184	-0.0020
Travel and Leisure	-0.0585	-0.0005	0.0094	0.0183	-0.0274	-0.0073

Note: This table provides a summary of the effects of lagged changes on actual (unexpected) Bank of England Nominal Trade Weighted Index (BOEGBPR), short-term interest rate (UKTBTND) and the long-term interest rate (UKMBRYD). Unexp represents the unexpected changes.***,** and * connotes statistical significance at the 1%, 5% and 10% level.

Table A12.8 A summary of non-financial industries' exposure to lagged changes in the foreign exchange rates US$/£ and the JP¥/£

	US$/£		JP¥/£	
INDUSTRY	ACTUAL	UNEXP.	ACTUAL	UNEXP.
Aerospace and Defence	-0.0911	-0.0615*	-0.0008	-0.0001
Automobiles and Auto Parts	0.0101	0.0055	0.0105	-0.0001
Beverages	-0.0122	-0.0081	0.0201	0.0002
Chemicals	-0.0967*	-0.0603*	-0.0875**	-0.0004**
Construction And Materials	-0.0813**	-0.0549**	0.0130	0.0001
Electricity	-0.0188	-0.0240	0.1225	0.0008
Electronic And Electrical Equipment	-0.0430	-0.0214	-0.0453	-0.0002
Fixed-line Telecommunications	0.0591	0.0438	-0.0182	-0.0001
Food and Drug Retailers	-0.0237	-0.0187	-0.0181	-0.0001
Food Producers	-0.0207	-0.0157	-0.0338	-0.0002
Forestry And Paper	-0.0525	-0.0153	-0.0238	-0.0001
Gas, Water And Multi-Utilities	0.1066	0.0661	0.0681	0.0004
General Industrial	0.0152	0.0085	0.0715	0.0004
General Retailers	-0.0566	-0.0384	0.0017	0.0000
Healthcare Equipment and Services	-0.1065	-0.0581	0.0682	0.0003
Household Goods	-0.1501	-0.0936	-0.0313	-0.0002
Industrial Engineering	-0.1094**	-0.0688**	-0.0549*	-0.0003*
Industrial Transport	-0.0492	-0.0282	-0.0697*	-0.0003*
Leisure Goods	-0.2190	-0.1218	-0.2514*	-0.0012*
Media	-0.2159	-0.1204	-0.2445	-0.0011*
Mining	-0.0306	0.0016	-0.0368	-0.0002
Mobile Telecommunications	-0.0434	-0.0235	-0.0491	-0.0003
Oil and Gas Producers	-0.0512	-0.0259	0.0271	0.0002
Oil Equipment And Services	-0.2251**	-0.1139**	0.0038	0.0000
Personal Goods	-0.0561	-0.0261	-0.0262	-0.0001
Pharmaceuticals and Biotechnology	-0.1088	-0.0641	-0.2141**	-0.0010***
Software and Computer Services	0.0718	0.0459	0.0200	-0.0001
Support Services	-0.0776*	-0.0407*	-0.0732**	-0.0004**
Technical Hardware and Equipment	-0.0380	-0.0170	-0.0927	-0.0005
Tobacco	-0.0822	-0.0551	-0.0499	-0.0004
Travel and Leisure	-0.0838	-0.0476	0.0098	0.0000

This table presents a summary of the lagged changes in the actual and unexpected changes in the US$/£ and JP¥/£. Unexp. stands for the unexpected changes. .***,** and * represents statistical significance at the 1%, 5% and 10% level respectively.

Table A12.9 A summary of non-financial industries' exposure to lagged changes in foreign exchange rates: ECU/£ and Euro/£

	ECU/£		EURO/£	
INDUSTRY	ACTUAL	UNEXP.	ACTUAL	UNEXP.
Aerospace and Defence	-0.0150	-0.0103	-0.2041	-0.1599**
Automobiles and Auto Parts	-0.0564	-0.0805	-0.0620	-0.0969
Beverages	0.0163	-0.0006	-0.0563	-0.0165
Chemicals	-0.2162*	-0.1871*	-0.2086*	-0.1880**
Construction And Materials	0.0373	0.0070	-0.1192	-0.1192*
Electricity	0.0151	0.0082	-0.1477	-0.0872
Electronic And Electrical Equipment	-0.0302	-0.0364	-0.1962*	-0.1476*
Fixed-line Telecommunications	0.2972**	0.2311**	-0.2087	-0.1470
Food and Drug Retailers	0.1487	0.1308	0.1892	0.1420
Food Producers	0.0291	0.0254	-0.0429	0.0053
Forestry And Paper	0.0217	-0.0139	-0.6106***	-0.4351***
Gas. Water And Multi-Utilities	0.0335	0.0355	0.1078	0.1203
General Industrial	-0.0178	-0.0175	-0.1173	-0.1024
General Retailers	0.0128	0.1054	0.0233	-0.0108
Healthcare Equipment and Services	-0.0540	-0.0236	0.1033	0.0295
Household Goods	-0.3496**	-0.2785**	-0.0438	-0.0541
Industrial Engineering	-0.0453	-0.0508	-0.0734	-0.0622
Industrial Transport	-0.0337	-0.0432	-0.0882	-0.1100
Leisure Goods	-0.0167	-0.0445	-0.7032	-0.6565*
Media	-0.0202	-0.0468	-0.6960	-0.6511*
Mining	0.2122	0.1125	-0.0156	-0.0549
Mobile Telecommunications	0.0158	-0.0009	-0.0014	-0.0362
Oil and Gas Producers	-0.2638**	-0.2217**	-0.1343	-0.1174
Oil Equipment And Services	0.1116	0.0563	0.0714	0.0116
Personal Goods	0.0217	0.0051	-0.1619	-0.0916
Pharmaceuticals and Biotechnology	-0.4060	-0.3356	-0.1380	-0.0822
Software and Computer Services	0.2415	0.1721	-0.2506	-0.2149
Support Services	0.0552	0.0283	-0.1274	-0.1110**
Technical Hardware and Equipment	0.1459	0.1192	-0.1769	-0.2633
Tobacco	-0.3433	-0.2737	0.2223	0.2067
Travel and Leisure	0.0251	0.0022	-0.1665	-0.1162

This table presents a summary of the lagged changes in actual (unexpected) ECU/£ for the period 01/01/90-31/12/98 and Euro/£ for the period 01/01/99-31/12/06. .***,** and * represents statistical significance at the 1%, 5% and 10% level respectively.

Table A12.10 A summary of non-financial concentrated and competitive industries' exposure to actual and unexpected changes in the trade weighted nominal exchange rate, short -term interest rate and long-term interest rate of the total sample period from January 1990 to December 2006

		BOEGBPR		UKTBTND		UKMBRYD	
INDUSTRYCOMPETITION	COMPETITION DUMMY	ACTUAL	UNEXP.	ACTUAL	UNEXP.	ACTUAL	UNEXP.
CONCENTRATED		0.0636*	0.0007**	-0.0309*	-0.0234	0.0144	0.0022
COMPETITIVE		0.0616	0.0007*	-0.0446**	-0.0286	0.0670***	0.0102***
CONC AND COMP	NOT SIGNIFICANT (NEGATIVE)	0.0628**	0.0007***	-0.0362***	-0.0254*	0.0347***	0.0053***

Note: The table presents the results of actual and unexpected changes in the TWI, long-term and short-term interest rates. ***,** and * denotes statistical significance at the 1%, 5% and 10% level. The industry dummy coefficient is insignificant indicating that there the change in the returns of concentrated and competitive industries are same after taking into consideration the influences of changes in exchange rates and interest rates. Unexp represents unexpected changes.

Table A12.11 A summary of non-financial concentrated and competitive industries' exposure to actual and unexpected changes in foreign exchange rates US$/£ and the JP¥/£ of the total sample period from January 1990 to December 2006

		US$/£		JP¥/£	
INDUSTRY COMPETITION	COMPETITION DUMMY	ACTUAL	UNEXP.	ACTUAL	UNEXP.
CONCENTRATED		0.0489**	0.0264**	0.0236	0.0001
COMPETITIVE		0.0499**	0.0272*	0.0273	0.0001***
CONC AND COMP	NOT SIGNIFICANT (NEGATIVE)	0.0493***	0.0267***	0.0250*	0.0001**

Note: The table presents the results of the actual and unexpected changes in the US$/£ and the JP¥/£. Unexp stands for unexpected changes. ***,** and * indicates statistical significance at the 1%, 5% and 10% level respectively. The competition dummy is not significant at any level of confidence.

Table A12.12 A summary of non-financial concentrated and competitive industries' exposure to actual and unexpected changes in foreign exchange rates ECU/£ and the EURO/£

		ECU/£		EURO/£	
INDUSTRY COMPETITION	COMPETITION DUMMY	ACTUAL	UNEXP.	ACTUAL	UNEXP.
CONCENTRATED		-0.0091	0.0293	0.0417	-0.0256
COMPETITIVE		0.0339	-0.0055	0.0070	-0.0253
CONC AND COMP	NOT SIGNIFICANT (POSITIVE)	0.0284	0.0158	0.0115	-0.0255

Note: The period for the ECU/£ is 01/01/90-31/12/98 while that of the Euro/£ is 01/01/99 – 31/12/06. All the exchange rate exposure coefficients are statistically insignificant.

Table A12.13 A summary of concentrated and competitive non-financial industries' exposure to market risk and actual changes in the Trade weighted nominal exchange rate, 3 Month Treasury bill (TB) and 10 Year Government Bond (GB) before the Euro and after the introduction of the Euro

INDUSTRY COMPETITION	FTSEALLSH	FTSEDUM	BOEGBPR	GBPRDUM	UKTBTND	TBTNDUM	UKMBRYD	BRYDUM
CONCENTRATED	0.6442***	-0.0444	0.0344	0.0659	-0.0549***	0.0929**	0.0205	0.0004
COMPETITIVE	0.6837***	0.0751	0.0051	0.1431*	-0.0569***	0.0448	0.0654***	-0.0223
CONC AND COMP	0.6595***	0.0018	0.0231	0.0958*	-0.0557***	0.0742**	0.0378**	-0.0083

Note: The competition dummy coefficient is negative but insignificant. ***,** and * denotes statistical significance at the 1%, 5% and 10% level respectively.

Table A12.14 A summary of concentrated and competitive non-financial industries' exposure to unexpected changes in the Trade weighted nominal exchange rate, 3 Month Treasury bill (TB) and 10 Year Government Bond (GB) before the Euro and after the introduction of the Euro

INDUSTRY COMPETITION	BOEGBPR	GBPRDUM	UKTBTND	TBTNDUM	UKMBRYD	BRYDUM
CONCENTRATED	0.0005	0.0005	-0.0550***	0.1173**	0.0028	0.0021
COMPETITIVE	0.0000	0.0014	-0.0500***	0.0796	0.0073***	0.0024
CONC AND COMP	0.0003	0.0008	-0.0531***	0.1027***	0.0045**	0.0022

Note: The competition dummy coefficient is negative and insignificant. ***,** and * represents statistical significance at the 1%, 5% and 10% level respectively.

Table A12.15 A summary of concentrated and competitive non-financial industries' exposure to actual and unexpected changes in the US$/£ and the JP¥/£ before the Euro and after the introduction of the Euro

	ACTUAL US$		UNEXP. US$		ACTUAL JP¥		UNEXP. JP¥	
INDUSTRY COMPETITION	ER INDEX	ERDUM	ER INDEX	ERDUM	ER INDEX	ERDUM	ER INDEX	ERDUM
CONCENTRATED	0.0053	0.1263***	0.0029	0.0690**	0.0170	0.0305	0.0001	0.0002
COMPETITIVE	-0.0109	0.1612***	-0.0088	0.0938***	0.0381	-0.0243	0.0002*	-0.0001
CONC AND COMP	-0.0010	0.1398***	-0.0017	0.0786***	0.0252	0.0093	0.0001*	0.0001

Note: The coefficient for the competition dummy is negative but insignificant for the actual and unexpected changes models.

Table A12.16 A summary of non-financial concentrated and competitive industries' exposure to lagged changes in the Trade weighted nominal exchange rate, short -term interest rate and long-term interest rate

	BOEGBPR		UKTBTND		UKMBRYD	
INDUSTRY COMPETITION	ACTUAL	UNEXP.	ACTUAL	UNEXP.	ACTUAL	UNEXP.
CONCENTRATED	-0.0790**	-0.0008**	0.0192	0.0306*	0.0108	0.0001
COMPETITIVE	-0.1224***	-0.0013***	0.0115	0.0281	-0.0076	-0.0032
CONC AND COMP	-0.0958***	-0.0010***	0.0162	0.0296**	0.0037	-0.0011

Note: The industry competition coefficient is negative but statistically insignificant.

Table A12.17 A summary of non-financial concentrated and competitive industries' exposure to lagged changes in the US$/£ and the JP¥/£

	US$/£		JP¥/£	
INDUSTRY COMPETITION	ACTUAL	UNEXP.	ACTUAL	UNEXP.
CONCENTRATED	-0.0505***	-0.0285**	-0.0206	-0.0001
COMPETITIVE	-0.0733***	-0.0426***	-0.0494**	-0.0002***
CONC AND COMP	-0.0593***	-0.0339***	-0.0317**	-0.0001**

Note: The industry competition coefficient is negative and insignificant.

Table A12.18 A summary of non-financial concentrated and competitive industries' exposure to lagged changes in the ECU/£ and the EURO/£

	ECU/£		EURO/£	
INDUSTRY COMPETITION	ACTUAL	UNEXP.	ACTUAL	UNEXP.
CONCENTRATED	-0.0538	-0.0309	-0.1101*	-0.0517
COMPETITIVE	0.0314	-0.0027	-0.1185**	-0.0231
CONC AND COMP	-0.0094	-0.0202	-0.1300***	-0.1174***

Note: Industry competition coefficient is insignificant, but negative for actual changes and positive for unexpected changes.

Appendix 13 Summary of exchange rate and interest rate exposure of UK non-financial firms using the OLS model

Table A13.1 A summary of non-financial firms' exposure to actual and unexpected changes in foreign exchange rate and interest rate of the total sample period 01/01/90 - 31/12/06

	BOEGBPR		US$/£		JP¥/£		UKTBTND		UKMBRYD	
STATISTICS	ACTUAL	UNEXP.	ACTUAL	UNEXP.	ACTUAL	UNEXP.	ACTUAL	UNEXP.	ACTUAL	UNEXP.
Mean	0.0474	0.0006	0.0270	0.0156	0.0252	0.0002	-0.0250	-0.0081	0.0436	0.0065
Minimum	-0.9290	-0.0108	-0.5856	-0.3518	-0.6189	-0.0031	-0.4820	-0.4577	-0.5179	-0.0784
Median	0.0553	0.0006	0.0281	0.0161	0.0243	0.0001	-0.0147	0.0014	0.0508	0.0064
Maximum	0.9595	0.0104	0.7179	0.4277	0.7879	0.0047	0.5032	0.5707	0.5330	0.0745
Standard deviation	0.2724	0.0029	0.1611	0.0987	0.1315	0.0007	0.1242	0.1281	0.1341	0.0208
Firms with significant exposure	18%	18%	12%	14%	15%	15%	12%	10%	26%	30%
Positive exposure coefficients	65%	66%	66%	61%	62%	62%	31%	35%	76%	71%
Significant coefficients at 1%	18%	18%	22%	21%	8%	8%	16%	13%	28%	34%
Significant coefficients at 5%	43%	48%	42%	39%	35%	38%	39%	45%	33%	34%
Significant coefficients at 10%	39%	34%	36%	39%	57%	53%	45%	43$	39%	31%

Note: This table outlines the statistics of the estimated exchange rate and interest rate exposure coefficients of 402 non-financial UK firms. Actual represents the model for actual changes whereas Unexp. is the model for the unexpected changes in the exchange rate and interest rate measure. BOEGBPR refers to the Trade-weighted nominal exchange rate exposure coefficient, US$/£ refers to the US$/£ exchange rate exposure coefficient, JP¥/£ is the JP¥ exchange rate exposure coefficient while UKTBTND and UKMBRYD are the exposure coefficients for the 3 Month Treasury bill and 10 Year Government bond respectively. Firms with significant exposure signify the percentage of firms with significant exposure coefficients in the total sample whereas positive exposure coefficients are the percentage of significant positive coefficients out of the significant coefficients. Furthermore, significant coefficients at the 1%, 5% and 10% represents the percentage of firms with significant coefficients, out of all the total significant coefficients, at the 1%, 5% and 10% level.

Table A13.2 A summary of the direction of exposure for non-financial firms returns by industry to actual and unexpected changes in the foreign exchange rates of the total sample period 01/01/90-31/12/06

		ACTUAL BOEGBPR		UNEXP. BOEGBPR		ACTUAL US$/£		UNEXP. US$/£		ACTUAL JP¥/£		UNEXP. JP¥/£	
INDUSTRY	NO OF FIRMS	+	-	+	-	+	-	+	-	+	-	+	-
Aerospace and Defence	8	2	0	2	0	2	0	2	0	1	1	1	1
Automobiles and Auto Parts	3	0	0	0	0	1	0	0	0	0	0	0	0
Beverages	4	1	0	1	0	0	0	0	0	1	0	0	0
Chemicals	12	0	0	0	0	0	1	0	1	1	0	1	0
Construction And Materials	22	2	1	2	1	0	2	1	3	3	1	3	2
Electricity	3	0	0	0	0	1	0	1	0	1	0	1	0
Electronic And Electrical Equipment	20	2	2	2	1	1	1	1	0	2	2	2	2
Fixed line Telecommunications	2	0	0	0	0	1	0	0	0	0	0	0	0
Food and Drug Retailers	5	2	0	2	0	2	1	2	0	1	0	0	0
Food Producers	15	1	1	0	1	2	2	2	2	1	1	2	1
Forestry And Paper	2	0	0	0	0	0	0	0	1	0	0	0	0
Gas, Water And Multi-Utilities	6	4	0	4	0	2	0	2	0	3	0	4	0
General Industrial	9	0	0	0	0	0	0	0	0	0	0	0	0
General Retailers	27	2	1	2	1	1	1	1	2	1	2	1	1
Healthcare Equipment and Services	10	0	2	0	2	0	1	0	2	0	1	0	1
Household Goods	19	0	2	2	2	1	1	0	1	1	2	1	2
Industrial Engineering	33	2	4	2	3	2	0	2	0	3	0	3	0
Industrial Transport	9	1	0	1	0	2	0	1	0	1	0	1	0
Leisure Goods	6	1	0	1	0	3	0	3	0	2	0	2	0
Media	29	8	1	6	1	0	0	1	0	3	1	3	1

TableA13.2 continued: A summary of the direction of exposure for non-financial firms' returns by industry to actual and unexpected changes in foreign exchange rates of the total sample period 01/01/90 - 31/12/06

		ACTUAL BOEGBPR		UNEXP.BOEGBPR		ACTUAL US$/£		UNEXP.US$/£		ACTUAL JP¥/£		UNEXP.JP¥/£	
INDUSTRY	NO OF FIRMS	+	-	+	-	+	-	+	-	+	-	+	-
Mining	7	0	4	0	4	1	2	1	2	0	2	0	3
Mobile Telecommunications	1	0	0	0	0	0	0	0	0	0	0	0	0
Oil and Gas Producers	9	0	2	0	2	1	2	1	2	1	2	1	2
Oil Equipment And Services	2	1	0	1	1	0	0	0	0	1	0	1	0
Personal Goods	14	1	0	1	0	1	0	2	0	0	1	0	1
Pharmaceuticals and Biotechnology	7	3	0	3	0	1	0	1	0	0	1	0	1
Software and Computer Services	21	6	0	7	0	1	0	2	0	2	0	2	0
Support Services	62	5	5	5	4	2	2	3	4	5	6	5	5
Technical Hardware and Equipment	11	3	0	3	0	4	0	4	1	1	0	1	0
Tobacco	1	0	1	0	1	0	1	0	1	0	0	0	0
Travel and Leisure	23	1	0	1	1	1	0	1	0	2	0	2	0
TOTAL	402	48	26	48	25	33	17	34	22	37	23	37	23

The table reports the number of firms with significant positive or negative exchange rate exposure coefficient in each industry. No of firms is the number of firms in the industry. (+) indicates number of firms with significant positive coefficients whereas (-) is the number of firms with significant negative coefficients at all levels of significance i.e. 1%, 5% and 10% . Actual and Unexp. denote actual and unexpected changes respectively. Then BOEGBPR is the trade weighted nominal exchange rate, US$/£ is the US$ exchange rate exposure coefficient and JP¥/£ is the JP¥ exchange rate exposure coefficient and all show the number of firms. The total column shows the total number of firms with significant positive or negative coefficients and also the total number of firms in the sample.

Table A13.3 A summary of the direction of exposure for non-financial firms returns by industry to actual and unexpected changes in the interest rates of the total period 01/01/90 - 31/12/06

		ACTUAL UKTBTND		UNEXP. UKTBTND		ACTUAL UKMBRYD		UNEXP. UKMBRYD	
INDUSTRY	NO OF FIRMS	+	-	+	-	+	-	+	-
Aerospace and Defence	8	0	0	0	0	5	0	4	0
Automobiles and Auto Parts	3	0	0	0	0	1	0	1	0
Beverages	4	0	1	0	1	0	2	0	2
Chemicals	12	0	0	0	0	2	0	3	0
Construction And Materials	22	1	2	1	1	3	1	4	1
Electricity	3	0	0	0	0	0	1	0	1
Electronic And Electrical Equipment	20	1	2	0	2	5	0	5	1
Fixed-line Telecommunications	2	0	0	0	0	0	0	0	0
Food and Drug Retailers	5	1	0	1	0	0	0	0	1
Food Producers	15	1	0	1	0	1	3	1	5
Forestry And Paper	2	0	1	0	0	1	0	0	0
Gas. Water And Multi-Utilities	6	2	2	1	2	5	0	1	4
General Industrial	9	0	2	0	1	2	0	3	0
General Retailers	27	2	1	1	1	3	2	4	3
Healthcare Equipment and Services	10	0	0	0	0	0	0	0	0
Household Goods	19	0	5	0	2	1	0	1	1
Industrial Engineering	33	1	4	0	3	10	2	9	2
Industrial Transport	9	1	0	1	0	3	1	3	0
Leisure Goods	6	1	0	2	0	2	0	2	0
Media	29	0	1	1	1	12	2	10	2

Table A13.3 continued: A summary of the direction of exposure for non-financial firms' returns by industry to actual and unexpected changes in the interest rates of the total period 01/01/90 - 31/12/06

		ACTUAL UKTBTND		UNEXP. UKTBTND		ACTUAL UKMBRYD		UNEXP. UKMBRYD	
INDUSTRY	NO OF FIRMS	+	-	+	-	+	-	+	-
Mining	7	0	0	0	0	4	1	4	1
Mobile Telecommunications	1	0	0	0	0	0	0	0	0
Oil and Gas Producers	9	0	1	0	1	0	1	1	1
Oil Equipment And Services	2	0	0	0	0	0	0	0	0
Personal Goods	14	1	2	1	3	1	0	3	0
Pharmaceuticals and Biotechnology	7	0	3	0	3	0	0	0	0
Software and Computer Services	21	1	1	1	1	5	2	5	2
Support Services	62	1	5	1	4	8	3	11	4
Technical Hardware and Equipment	11	1	0	1	0	3	0	3	0
Tobacco	1	0	0	0	0	0	1	0	1
Travel and Leisure	23	0	1	1	0	3	3	6	3
TOTAL	402	15	34	14	26	80	25	84	35

The table presents the number of firms with significant positive or negative interest rate exposure coefficient in each industry. No of firms is the number of firms in the industry. (+) indicates number of firms with significant positive coefficients while (-) is the number of firms with significant negative coefficients. The levels of significance are 1%, 5% and 10% respectively. Actual and Unexp. column indicate actual and unexpected changes. UKTBTND denotes the 3 month Treasury bill and UKMBRYD is the 10 year Government bond.

Table A13.4 A summary of non-financial firms' exposure to actual and unexpected changes in the foreign exchange rate ECU/£ and Euro/£

STATISTICS	ECU/£		EURO/£	
	ACTUAL	UNEXP.	ACTUAL	UNEXP.
Mean	0.0781	0.0512	0.0203	-0.0201
Minimum	-1.2909	-1.1145	-1.2657	-0.7797
Median	0.0661	0.0447	-0.0094	-0.0335
Maximum	1.3999	0.9879	1.4366	0.8243
Standard deviation	0.3378	0.2517	0.3542	0.2225
Firms with significant exposure	16%	17%	14%	13%
Positive exposure coefficients	65%	69%	53%	32%
Significant coefficients at 1%	23%	15%	19%	19%
Significant coefficients at 5%	39%	40%	28%	38%
Significant coefficients at 10%	38%	46%	53%	43%

Note: The levels of significance are at 1%, 5% and 10% respectively. ECU/£ represents the exchange rate exposure coefficients of the ECU while Euro/£ represents the exchange rate exposure for the Euro. Actual and Unexp. represents the actual and unexpected changes respectively.

Table A13.5 A summary of the direction of exposure for non-financial firms returns by industry to actual and unexpected changes in the ECU/£ and EURO/£

	ACTUAL ECU/£			UNEXP. ECU/£			ACTUAL EURO/£			UNEXP. EURO/£		
INDUSTRY	+/-	+	-	+/-	+	-	+/-	+	-	+/-	+	-
Aerospace and Defence	1	0	1	1	0	1	1	1	0	1	1	0
Automobiles and Auto Parts	0	0	0	0	0	0	0	0	0	0	0	0
Beverages	0	0	0	0	0	0	0	0	0	0	0	0
Chemicals	2	1	1	2	1	1	3	2	1	3	2	1
Construction And Materials	4	3	1	4	3	1	4	2	2	4	2	2
Electricity	0	0	0	0	0	0	0	0	0	0	0	0
Electronic And Electrical Equipment	4	1	3	4	1	3	5	3	2	3	1	2
Fixed-line Telecommunications	0	0	0	0	0	0	0	0	0	0	0	0
Food and Drug Retailers	1	1	0	1	1	0	0	0	0	0	0	0
Food Producers	5	3	2	5	3	2	2	0	2	1	0	1
Forestry And Paper	0	0	0	0	0	0	0	0	0	0	0	0
Gas, Water And Multi-Utilities	3	3	0	3	3	0	0	0	0	0	0	0
General Industrial	0	0	0	0	0	0	0	0	0	0	0	0
General Retailers	4	4	0	3	3	0	2	1	1	1	0	1
Healthcare Equipment and Services	1	0	1	1	0	1	3	1	2	2	0	2
Household Goods	1	0	1	1	0	1	1	1	0	1	1	0
Industrial Engineering	4	2	2	4	2	2	4	1	3	4	1	3
Industrial Transport	0	0	0	1	0	1	2	1	1	1	0	1
Leisure Goods	1	1	0	1	1	0	1	1	0	0	0	0
Media	5	5	0	5	5	0	6	4	2	4	1	3
Mining	4	0	4	5	1	4	1	0	1	2	0	2

Table A13.5 continued: A summary of the direction of exposure for non-financial firms returns by industry to actual and unexpected changes in the ECU/£ and EURO/£

	ACTUAL ECU/£			UNEXP. ECU/£			ACTUAL EURO/£			UNEXP. EURO/£		
INDUSTRY	+/-	+	-	+/-	+	-	+/-	+	-	+/-	+	-
Mobile Telecommunications	1	1	0	1	1	0	0	0	0	0	0	0
Oil and Gas Producers	2	1	1	2	1	1	1	1	0	2	1	1
Oil Equipment And Services	0	0	0	0	0	0	0	0	0	0	0	0
Personal Goods	1	1	0	5	5	0	0	0	0	1	0	1
Pharmaceuticals and Biotechnology	1	1	0	1	1	0	0	0	0	0	0	0
Software and Computer Services	6	4	2	5	4	1	2	2	0	3	2	1
Support Services	9	6	3	7	6	1	12	5	7	13	3	10
Technical Hardware and Equipment	1	1	0	1	1	0	5	3	2	4	1	3
Tobacco	1	0	1	1	0	1	0	0	0	0	0	0
Travel and Leisure	4	4	0	4	4	0	3	2	1	3	1	2
TOTAL	66	43	23	68	47	21	58	31	27	53	17	36

Note: +/- represents number of firms with significant positive or negative coefficient. + is number of firms with significant positive coefficient whereas - is the number of firms with significant negative coefficients. Levels of significant are at the 1%, 5% and 10% level. Actual and Unexp. stand for actual and unexpected changes respectively.

Table A13.6 A summary of UK non-financial firms' exposure to market risk before the Euro and after the introduction of the Euro

STATISTICS	FTSEALLSH (+)	FTSEDUM (+)	FTSEALLSH (-)	FTSEDUM (-)
Mean	0.5757	-0.0167	-0.0492	0.1679
Minimum	0.0014	-1.2302	-0.0933	-0.4080
Median	0.5246	-0.0255	-0.0501	0.2288
Maximum	1.9601	1.3812	-0.0102	0.5008
Standard deviation	0.3330	0.3940	0.0322	0.3446
Number of firms	396	+178 (-218)	6	+4 (-2)
Firms with significant exposure	87%	38%	17%	17%
Positive exposure coefficients	100%	39%	0%	100%
Negative exposure coefficients	0%	61%	100%	0%
Significant coefficients at 1%	82%	40%	100%	100%
Significant coefficients at 5%	13%	35%	0%	0%
Significant coefficients at 10%	5%	25%	0%	0%

Note: FTSEALLSH is the market risk before the Euro, FTSEDUM is the change in market risk following the introduction of the Euro. + denotes positive coefficient whereas (-) indicates a negative coefficient. Number of firms is the total number of firms in the sample. Firms with significant exposure represent firms with significant coefficients. Positive exposure coefficients and negative exposure coefficients stands for firms with significant positive or negative coefficients respectively. Levels of significance are at the 1%, 5% and 10% level and indicate the percentage of firms with significant coefficients at each level.

Table A13.7 A summary of non-financial firms' exposure to actual and unexpected changes in the Trade weighted nominal exchange rate before and after the introduction of the Euro

	ACTUAL BOEGBPR				UNEXPECTED BOEGBPR			
STATISTICS	ERINDEX (+)	ERDUM (+)	ERINDEX (-)	ERDUM (-)	ERINDEX (+)	ERDUM (+)	ERINDEX (-)	ERDUM (-)
Mean	0.2495	-0.2075	-0.2471	0.2764	0.0028	-0.0023	-0.0028	0.0030
Minimum	0.0003	-1.5232	-1.4471	-1.0729	0.0000	-0.0167	-0.0163	-0.0078
Median	0.2039	-0.2369	-0.1928	0.1934	0.0166	0.0121	-0.0020	0.0019
Maximum	1.2178	1.5631	-0.0008	2.0850	0.0144	0.0149	-0.0001	0.0210
Standard deviation	0.2230	0.4647	0.2390	0.4940	0.0025	0.0047	0.0028	0.0051
Number of firms	245	+73 (-172)	157	+119 (-38)	244	+71 (-173)	158	+119 (-39)
Firms with significant exposure	18%	14%	16%	12%	18%	15%	15%	13%
Positive exposure coefficients	100%	20%	0%	84%	100%	14%	0%	95%
Negative exposure coefficients	0%	80%	100%	16%	0%	86%	100%	5%
Significant coefficients at 1%	26%	9%	28%	16%	27%	5%	29%	14%
Significant coefficients at 5%	37%	51%	48%	21%	27%	46%	54%	33%
Significant coefficients at 10%	37%	40%	24%	63%	46%	49%	17%	52%

Note: The table reports the exposure to changes in the Trade weighted nominal exchange rate (BOEGBPR) in the period before and after the Euro. ERINDEX represents the Trade-weighted nominal exchange rate exposure coefficient before the Euro and ERDUM is the change in exposure after the Euro. + refers to positive coefficients whereas (-) corresponds to negative coefficients. The number of firms is the total number of firms in the sample. Firms with significant exposure refer to firms with significant coefficients. Positive exposure coefficients and negative exposure coefficients are firms with significant positive or negative coefficients respectively. The levels of significance are at the 1%, 5% and 10% level and indicate the percentage of firms with significant coefficients at each level.

Table A13.8 A summary of non-financial firms' exposure to actual and unexpected changes in the in the US$/£ exchange rate before and after the introduction of the Euro

	ACTUAL US$/£				UNEXPECTED US$/£			
STATISTICS	ERINDEX (+)	ERDUM (+)	ERINDEX (-)	ERDUM (-)	ERINDEX (+)	ERDUM (+)	ERINDEX (-)	ERDUM (-)
Mean	0.1382	-0.0627	-0.1429	0.2361	0.0794	-0.0318	-0.0912	0.1453
Minimum	0.0006	-1.5455	-1.0176	-0.6994	0.0001	-0.8499	-0.6055	-0.2968
Median	0.0980	-0.0832	-0.0954	0.1780	0.0564	-0.0408	-0.0613	0.1019
Maximum	0.8069	0.9108	-0.0001	1.8422	0.4614	0.5908	-0.0001	1.1422
Standard deviation	0.1279	0.3162	0.1538	0.3388	0.0769	0.1849	0.0978	0.2077
Number of firms	198	+75 (-123)	204	+165 (-39)	202	+80 (-122)	200	+159 (-41)
Firms with significant exposure	12%	9%	12%	17%	12%	11%	12%	18%
Positive exposure coefficients	100%	35%	0%	91%	100%	41%	0%	100%
Negative exposure coefficients	0%	65%	100%	9%	0%	59%	100%	0%
Significant coefficients at 1%	30%	12%	21%	6%	29%	14%	17%	6%
Significant coefficients at 5%	30%	35%	46%	50%	29%	18%	58%	57%
Significant coefficients at 10%	39%	53%	33%	44%	42%	68%	25%	37%

Note: ERINDEX represents the exchange rate exposure coefficient for actual and unexpected changes in the US$/£ before the introduction of the Euro while ERDUM refers to the change in the US$/£ exposure after the introduction of the Euro. + represents the positive coefficients whereas (-) corresponds to the negative coefficients. The number of firms is the total number of firms in that sample. Firms with significant exposure denote firms with significant coefficients. Positive exposure coefficients and negative exposure coefficients represent firms with significant positive or negative coefficients respectively. The levels of significance are at the 1%, 5% and 10% levels and indicate the percentage of firms with significant coefficients at each level.

Table A13.9 A summary of non-financial firms' exposure actual and unexpected changes in the JP¥/£ exchange rate before and after the introduction of the Euro

	ACTUAL JP¥/£				UNEXPECTED JP¥/£			
STATISTICS	ERINDEX (+)	ERDUM (+)	ERINDEX (-)	ERDUM (-)	ERINDEX (+)	ERDUM (+)	ERINDEX (-)	ERDUM (-)
Mean	0.1467	-0.1864	-0.1093	0.1297	0.0007	-0.0009	-0.0006	0.0007
Minimum	0.0007	-1.1595	-0.6096	-0.4891	0.0000	-0.0056	-0.0035	-0.0027
Median	0.1125	-0.1565	-0.0763	0.0920	0.0006	-0.0007	-0.0004	0.0005
Maximum	1.1070	0.5681	-0.0005	1.0078	0.0063	0.0050	-0.0001	0.0052
Standard deviation	0.1319	0.2697	0.1124	0.2645	0.0007	0.0014	0.0006	0.0014
Number of firms	263	+54 (-209)	139	+90 (-49)	274	+73 (-201)	128	+90 (-38)
Firms with significant exposure	18%	15%	13%	10%	17%	14%	16%	12%
Positive exposure coefficients	100%	5%	0%	79%	100%	8%	0%	87%
Negative exposure coefficients	0%	95%	100%	21%	0%	92%	100%	13%
Significant coefficients at 1%	17%	13%	11%	14%	15%	11%	15%	20%
Significant coefficients at 5%	45%	49%	56%	29%	43%	47%	35%	47%
Significant coefficients at 10%	38%	38%	33%	57%	43%	42%	50%	33%

Note: ERINDEX represents the exchange rate exposure coefficient for actual and unexpected changes in the JP¥/£ before the introduction of the Euro while ERDUM refers to the change in the JP¥/£ exposure after the introduction of the Euro. + represents the positive coefficients whereas (-) corresponds to the negative coefficients. The number of firms is the total number of firms in that sample. Firms with significant exposure denote firms with significant coefficients. Positive exposure coefficients and negative exposure coefficients represent firms with significant positive or negative coefficients respectively. The levels of significance are at the 1%, 5% and 10% levels and indicate the percentage of firms with significant coefficients at each level.

Table A13.10 A summary of non-financial firms' exposure actual and unexpected changes in the short-term interest rate (3 Month Treasury bill) before and after the introduction of the Euro

	ACTUAL UKTBTND				UNEXPECTED UKTBTND			
STATISTICS	UKTBTND (+)	TBTNDUM (+)	UKTBTND (-)	TBTNDUM (-)	UKTBTND (+)	TBTNDUM (+)	UKTBTND (-)	TBTNDUM (-)
Mean	0.0807	-0.0788	-0.1126	0.1467	0.0853	-0.0492	-0.1108	0.1734
Minimum	0.0009	-0.7638	-0.6286	-0.8540	0.0001	-0.8565	-0.6339	-0.8668
Median	0.0606	-0.0702	-0.0821	0.1185	0.0626	-0.0145	-0.0817	0.1435
Maximum	0.6094	1.2032	-0.0013	1.1328	0.6872	1.1569	-0.0010	1.0591
Standard deviation	0.0872	0.2972	0.1061	0.2722	0.0918	0.2834	0.1054	0.2904
Number of firms	145	+54 (-91)	257	+193 (-64)	165	+77 (-88)	237	+182 (-55)
Firms with significant exposure	6%	15%	19%	15%	7%	13%	19%	18%
Positive exposure coefficients	100%	59%	0%	89%	100%	43%	0%	93%
Negative exposure coefficients	0%	41%	100%	11%	0%	57%	100%	7%
Significant coefficients at 1%	13%	5%	29%	13%	18%	5%	25%	19%
Significant coefficients at 5%	13%	59%	44%	50%	27%	52%	43%	43%
Significant coefficients at 10%	75%	36%	27%	37%	55%	43%	32%	38%

Note: UKTBTND is the exposure coefficients to the 3 Month Treasury bill before the euro while TBTNDUM denotes changes in the exposure after the Euro. + corresponds to the positive coefficients whereas (-) represents the negative coefficients. The number of firms is the total number of firms in the sample. The firms with significant exposure correspond to firms with significant coefficients. Positive exposure coefficients and negative exposure coefficients represent firms with significant positive or negative coefficients respectively. The levels of significance are at the 1%, 5% and 10% levels and indicate the percentage of firms with significant coefficients at each level.

Table A13.11 A summary of non-financial firms' exposure actual and unexpected changes in the 10 Year Government Bond (GB) before and after the introduction of the Euro

	ACTUAL UKMBRYD				UNEXPECTED UKMBRYD			
STATISTICS	UKMBRYD (+)	BRYDUM (+)	UKMBRYD (-)	BRYDUM (-)	UKMBRYD (+)	BRYDUM (+)	UKMBRYD (-)	BRYDUM (-)
Mean	0.1363	-0.0816	-0.1208	0.1252	0.0170	-0.0045	-0.0134	0.0166
Minimum	0.0006	-0.5982	-0.7576	-0.7766	0.0001	-0.1131	-0.1188	-0.1643
Median	0.1118	-0.0688	-0.0769	0.0937	0.0141	-0.0032	-0.0081	0.0165
Maximum	0.5791	0.4156	-0.0001	0.9061	0.0861	0.0903	-0.0001	0.1405
Standard deviation	0.1100	0.1754	0.1295	0.2140	0.0132	0.0331	0.0161	0.0386
Number of firms	274	+89 (-185)	128	+99 (-29)	257	+120 (-137)	145	+103 (-42)
Firms with significant exposure	23%	8%	13%	17%	24%	7%	15%	19%
Positive exposure coefficients	100%	0%	0%	100%	100%	37%	0%	89%
Negative exposure coefficients	0%	100%	100%	0%	0%	63%	100%	11%
Significant coefficients at 1%	27%	4%	41%	23%	25%	5%	36%	4%
Significant coefficients at 5%	44%	48%	35%	32%	33%	37%	9%	44%
Significant coefficients at 10%	30%	48%	24%	45%	43%	58%	55%	52%

Note: UKMBRYD is the exposure coefficients to the 10 Year GB before the euro while BRYDUM represents the changes in the exposure after the Euro. + denotes the positive coefficients whereas (-) stands for the negative coefficients. The number of firms is the total number of firms in the sample. The firms with significant exposure refer to firms with significant coefficients. Positive exposure coefficients and negative exposure coefficients corresponds to firms with significant positive or negative coefficients respectively. The levels of significance are at the 1%, 5% and 10% levels and indicate the percentage of firms with significant coefficients at each level.

Table A13.12 A summary of non-financial industries' exposure to lagged changes in the trade weighted nominal exchange rate, US$/£ exchange rate, JP¥/£ exchange rate, short -term interest rate and long-term interest rate of the total sample period from January 1990 to December 2006

	BOEGBPR		US$/£		JP¥/£		UKTBTND		UKMBRYD	
STATISTICS	ACTUAL	UNEXP.	ACTUAL	UNEXP.	ACTUAL	UNEXP.	ACTUAL	UNEXP.	ACTUAL	UNEXP.
Mean	-0.0991	-0.0011	-0.0645	-0.0374	-0.0353	-0.0002	0.0124	0.0308	0.0168	0.0002
Minimum	-1.0916	-0.0125	-1.0177	-0.6169	-0.8978	-0.0047	-0.7285	-0.7535	-0.3085	-0.0644
Median	-0.0851	-0.0010	-0.0603	-0.0367	-0.0309	-0.0001	0.0146	0.0306	0.0179	0.0001
Maximum	1.2777	0.0129	0.4391	0.2340	0.4648	0.0027	0.5326	0.5869	0.3982	0.0599
Standard deviation	0.2635	0.0028	0.1639	0.0981	0.1429	0.0007	0.1360	0.1417	0.1029	0.0149
Firms with significant exposure	16%	17%	14%	14%	12%	13%	16%	16%	13%	11%
Positive exposure coefficients	11%	13%	15%	14%	18%	27%	64%	77%	54%	44%
Significant coefficients at 1%	11%	9%	9%	11%	8%	10%	6%	9%	6%	16%
Significant coefficients at 5%	40%	38%	42%	37%	33%	38%	45%	54%	31%	36%
Significant coefficients at 10%	49%	53%	49%	53%	59%	52%	48%	37%	63%	49%

Note: This table provides a summary of the descriptive statistics and effects of lagged changes on the actual and unexpected changes in the Bank of England Nominal Trade Weighted Index (BOEGBPR), US$/£, JP¥/£,short-term interest rate (UKTBTND) and the long-term interest rate (UKMBRYD). Unexp represents the unexpected changes. Firms with significant exposure refer to firms with significant coefficients out of the total sample of 402 firms. Positive exposure coefficients correspond to firms with significant positive coefficients. The levels of significance are at the 1%, 5% and 10% levels and indicate the percentage of firms with significant coefficients at each level.

Table A13.13 A summary of non-financial firms' exposure to lagged changes in foreign exchange rates: ECU/£ and Euro/£

	ECU/£		EURO/£	
STATISTICS	ACTUAL	UNEXP.	ACTUAL	UNEXP.
Mean	0.0181	-0.0038	-0.1452	-0.1279
Minimum	-1.3038	-0.9684	-1.4723	-1.1062
Median	0.0303	0.0095	-0.1489	-0.1207
Maximum	1.2741	0.9656	1.1284	0.6706
Standard deviation	0.3234	0.2478	0.3168	0.2129
Firms with significant exposure	11%	10%	15%	20%
Positive exposure coefficients	49%	38%	17%	9%
Significant coefficients at 1%	14%	18%	13%	19%
Significant coefficients at 5%	35%	35%	35%	41%
Significant coefficients at 10%	51%	48%	52%	40%

The table presents a summary of the lagged changes in actual (unexpected) ECU/£ for the period 01/01/90-31/12/98 and Euro/£ for the period 01/01/99-31/12/06. Actual and Unexp represents the actual and unexpected changes respectively. Firms with significant exposure refer to firms with significant coefficients out of the total sample of 402 firms. Positive exposure coefficients correspond to firms with significant positive coefficients. The levels of significance are at the 1%, 5% and 10% levels and indicate the percentage of firms with significant coefficients at each level.

Bibliography

Adedeji, A. and Baker, R. (2002) Why firms in the UK use interest rate derivatives, *Managerial Finance*, Vol. 28 No.11, pp.53-74.

Adler, M. and Dumas, B. (1984) Exposure to currency risk: Definition and measurement, Financial Management, pp. 41-50.

Aggarwal, R. (1981) Exchange rates and stock prices: A study of the US capital markets under the floating exchange rates, *Akron Business and Economic Review*, Vol.12, pp.7-12.

Akatsuka, K. and Leggate, H. (2001) Perceptions of foreign exchange risk in the shipping industry, *Journal of Maritime Policy and Management*, Vol. 28, pp. 235-49.

Al-Abadi, M. and Sabbagh, O. (2006) Interest rate sensitivity, market risk, inflation and bank stock returns, *Journal of Accounting, Business and Management*, Vol.13, pp.25-38.

Al-Shboul, M. and Alison, S. (2009) The effects of the use of corporate derivatives on the foreign exchange rate exposure, *Journal of Accounting, Business and Management*, Vol.16 No.1, pp.72-92.

Al-Zoubi, H. and Kh.Al-Zu'bi, B. (2007) Market efficiency, time varying volatility and the asymmetric effect in the Amman stock exchange, *Managerial Finance*, Vol.33 No.7, pp.490-99.

AlDiab, T., Zoubi, P. and Thornton, P. (1994), The effects of changes in the dollar foreign exchange rate on stock returns of multinational corporations, *Journal of Applied Research*, Vol.10, pp.142-47.

Alexander, C. (1999) Risk management and analysis, Vol.1: Measuring and modelling financial risk, John Wiley and Sons, New York.

Allayannis, G., Brown, G. and Klapper, L. (2003) Capital structure and financial risk: Evidence from foreign debt use in East Asia, *Journal of Finance*, Vol.58, pp.273-96.

Allayannis, G. and Ihrig, J. (2001) Markups and exposure, *Review of Financial Studies*, Vol.14 No.3, pp.805-35.

Allayannis, G. and Ofek, E. (1996) Exchange rate exposure, hedging and the use of foreign currency derivatives, Working Paper, Stern School of Business, New York University.

Allayanis, G. and Ofek, E. (2001) Exchange rate exposure, hedging and the use of foreign currency derivatives, *Journal of International Money and Finance,* Vol.20, pp. 273-96.

Allayannis, G. and Weston, J. (2001) The use of foreign currency derivatives and firm market value, *The Review of Financial Studies*, Vol. 14 No.1, pp.243-76.

Andrews, A. (2005) Interest rates: To hedge or not to hedge, *Accountancy Ireland*, Vol.37 No.5, pp.14-16.

Arnold, G. (2005) Corporate financial management, 3rd edition, Pearson Education, Harlow.

Artis, M. (1989) The call of a common currency, in Britton, S. and Artis, M. (eds), Europe without currency barriers, Socila Marketing Foundation, No.3.

Artis, M. and Taylor, D. (1994) The stabilising effects of the ERM on exchange rates and interest rates, *IMF Staff Papers*, Vol.41, pp.123-48.

Atindéhou, R. and Gueyie, J. (2001) Canadian chartered banks' stock returns and exchange rate risk *Management Decision*, Vol.39 No.4, pp.285-295.

Bae, S. (1990) Interest rate changes and common stock returns of financial institutions: revisited, *The Journal of Financial Research*, Vol.13 No 1, pp. 71-90.

Baillie, R. and DeGennaro, R. (1990) Stock returns and volatility, *Journal of Financial and Quantitative Analysis*, Vol.25, pp.203-14.

Bailly, N., Browne, D., Hicks, E. and Skerrat, L. (2003) UK corporate use of derivatives *The European Journal of Finance*, Vol. 9, pp.169-93.

Bank of England (2005) Explanatory note: The Bank of England's new sterling exchange rate index (ERI) [Online] Available: http://www.bankofengland.co.uk/publications/news/2005/eriexplanatorynote050408.pdf [Accessed 9th September, 2007]

Bank of England (2007) Changes in bank rate, minimum lending rate, minimum band 1 dealing rate, repo rate and official bank rate [Online] Available: http://213.225.136.206/statistics/rates/baserate.pdf [Accessed 9th September, 2007].

Bansal, R. and Lundblad, C. (2002) Market efficiency, fundamental values and asset returns in global equity markets, *Journal of Econometrics*, Vol. 109, pp.195-237.

Barrett, C. and Turongpun, W. (1999) The firm level effects of the European monetary unification, *Managerial Finance*, Vol.25 No.11, pp.35-42.

Bartov, E. and Bodnar, G. (1994) Firm valuation earnings expectations and the exchange exposure rate exposure effect, *The Journal of Finance*, Vol.44, pp. 1755-85.

Bartov, E. and Bodnar, G. (1995) Foreign currency translation reporting and the exchange rate exposure effect, *Journal of International Financial Management and Accounting*, Vol.6 No.2, pp.93-114.

Bartov, E., Bodnar, G. and Kaul, A. (1996) Exchange rate variability and the riskiness of US multinational firms: Evidence from the breakdown of the Bretton Woods system, *Journal of Financial Economics*, Vol. 42, pp.105-32.

Bartram, S. (2002) The interest rate exposure of non-financial corporations, *European Finance Review*, Vol.6, pp.101-25.

Bartram, S. (2004) Linear and non-linear foreign exchange rate exposures of German non-financial corporation's, *Journal of International Monetary Finance*, Vol.23, pp.673-99.

Bartram, S., Brown, G. and Fehle, F. (2004) International evidence on financial derivatives, *Working Paper*, University of Lancaster

Bartram, S., Dufey, G. and Frenkel, M. (2005) A primer on the exposure of non-financial corporations to foreign exchange rate risk, *Journal of Multinational Financial Management*, Vol.15, pp.394-413.

Bartram, S. and Karolyi, A. (2006) The impact of the introduction of the Euro on foreign exchange rate risk exposures, *Journal of Empirical Finance*, Vol.13, pp.519-49.

Belongia, M. and Santoni, G. (1987) Interest rate risk, market value and hedging financial portfolios, *The Journal of Financial Research*, Vol. 10 No. 1, pp.47 - 55.

Belsley, D., Kuh, E. and Welsch, R. (1980) Regression diagnostics: Identifying influential data and sources of collinearity, John Wiley, New York.

Berkman, H. and Bradbury, M. (1996), Empirical evidence on the corporate use of derivatives, *Financial Management*, Vol. 25, pp. 5-13.

Black, F. (1976) Studies in stock price volatility changes, Proceedings of the 1976 Business Meeting of Business and Economic Statistics Section, *American Statistical Association*, pp.177-81.

Block, S. and Gallagher, T. (1986) The use of interest rate futures and options by corporate financial managers, *Financial Management*, Vol.15 No.3, pp.73-78.

Bodnar, G., Dumas, B. and Marston, R. (2002) Pass-through and exposure, *Journal of Finance*, Vol. 57 No.1, pp. 199-231.

Bodnar, G. and Gebhardt, G. (1999) Derivatives usage in risk management by US and German non-financial firms: A comparative study, *Journal of International Financial Management and Accounting*, Vol.10 No.3, pp.153-87.

Bodnar, G. and Gentry, W. (1993) Exchange rate exposure and industry characteristics: evidence from Canada, Japan and the U.S.A, *Journal of International Money and Finance*, Vol.12, pp. 29-45.

Bodnar, G., Hayt, G. and Marston, R. (1998) 1998 Wharton survey of financial risk management by US non-financial firms, *Financial Management*, Vol. 27 No.4, pp.70-91.

Bodnar, G., Jong, A. and Macrae, V. (2003) The impact of institutional differences on derivatives usage: a comparative study of US and Dutch firms, *European Financial Management*, Vol. 9, pp.271-97.

Bodnar, G. and Wong, F. (2003) Estimating exchange rate exposures: Issues in model structure, *Financial Management*, pp.35-67.

Bollerslev, T. (1986) Generalised autoregressive conditional Heteroskedasticity, *Journal of Econometrics*, Vol. 31, pp. 307-27.

Bollerslev, T. (1987) A conditional Heteroscedastic time series model for speculative prices and rates of return, *Review of Economics and Statistics*,Vol.69, pp.542-47.

Bollerslev, T., Chou, R. and Kroner, K. (1992) ARCH modelling in finance, *Journal of Econometrics*, Vol. 52, pp.5-59.

Booth, J. and Officer, D. (1985) Expectations interest rates and commercial bank stocks, *The Journal of Financial Research*, Vol. 8, pp.51-58.

Booth, L. and Rotenberg, W. (1990) Assessing foreign exchange exposure: Theory and application using Canadian firms, *Journal of International Financial Management and Accounting*, Vol.2, pp.1-12.

Borokhovich, K., Brunarski, K., Crutchley, C. And Simkins, B. (2004) Board composition and corporate use of interest rate derivatives, *The Journal of Financial Research*, Vol. 28 No. 2, pp. 199-216.

Bradley, K. and Moles, P. (2001) The effects of exchange rate movements on non-financial UK firms, *International Business Review*, Vol.10, pp.51-69.

Bree, W., Glosten, L. and Jagannathan, R. (1989) Economic significance of predictable variations in stock index returns, *Journal of Finance*, Vol.44, pp.1177-89.

Brewer, E., Carson, J., Elyasiani, E., Mansur, I. And Scott, W. (2007) Interest rate risk and equity values of life insurance companies: A GARCH-M model, *The Journal of Risk and Insurance*, Vol.74 No.2, pp.401-23.

Bris, A., Koskinen,Y. and Nilsson, M. (2004) The Euro and corporate valuations, *Working Paper*, Stockholm School of Economics, No. 2006-21, pp.1-54.

Bris, A., Koskinen,Y. and Nilsson, M. (2006) The real effects of the Euro: Evidence from corporate investments, *Review of Finance*, Vol.10, pp.1-37.

Buckley, A. (2000) Multinational Finance. (4th ed.) Pearson Education Limited, Essex.

Buckley, A. (2004) Multinational Finance. (5th ed.) Pearson Education Limited, Essex.

Campa, J. and Goldberg, L. (1995) Investment in manufacturing, exchange rates and external exposure, *Journal of International Economics*, Vol.38, pp.297-320.

Campbell, J. (1987) Stock returns and the term structure, *Journal of Financial Economics*, Vol.18, pp.373-99.

Campbell, J. and Hentschel, L. (1993) No news is good news: An asymmetric model of changing volatility in stock returns, *Journal of Financial Economics*, Vol. 31, pp.281-318

Capstaff, J., Marshall, A. and Hutton, J. (2007) The introduction of the Euro and derivative use of French firms, *Journal of International Financial Management and Accounting*, Vol.18, pp.1-17.

Carson, J., Elyasiani, E. and Mansur, I. (2008) Market risk, interest rate risk and interdependencies in insurer stock returns: A system GARCH model, *The Journal of Risk and Insurance*, Vol.75 No.4, pp.873-91.

Ceglowski, J. (1989), Dollar depreciation and U.S industry performance, *Journal of International Money and Finance*, Vol.8, pp.233-51.

Chan, K., Karolyi, A. and Stulz, R.(1992) Global financial markets and the risk premium on US equity, *Journal of Financial Economics*, Vol.32, pp.137-69.

Chance, D. and Lane, W. (1980), A re-examination of interest rate sensitivity in the common stocks of financial institutions, *Journal of Financial Research*, Vol.3, pp.49-56.

Chang, Y. (2002) The pricing of foreign exchange risk around the Asian financial crisis: Evidence form Taiwan's stock market, *Journal of Multinational Financial Management*, Vol.12, pp.223-38.

Chen, C and Chan, A. (1989), Interest rate sensitivity and stock returns of financial institutions, *Financial Review*, Vol. 24, pp.457-73.

Chiang, Y. and Lin, H. (2005) The use of foreign currency derivatives and foreign denominated debts to reduce exposure to exchange rate fluctuations, *International Journal of Management*, Vol.22 No. 4, pp. 598-604.

Chiao, C. And Hung, K.(2000) Exchange rate exposure of Taiwanese exporting firms, *Review of Pacific Basin Financial Markets and Policies*, Vol.3 No.2, pp.201-33.

Choi, J. and Elyasiani, E. (1997) Derivative exposure and the interest rate and exchange rate risks of US banks, *Journal of Financial Services Research*, Vol.12, pp.267-86.

Choi, J., Elyasiani, E. and Kopecky, K. (1992) The sensitivity of bank stock returns to market, interest and exchange rate risks, *Journal of Banking and Finance*, Vol. 16, pp.983-1004.

Choi, J. and Kim, Y. (2003) The Asian exposure of US firms: operational and risk management strategies, *Pacific Basin Finance Journal*, Vol. 11, pp.121-38.

Choi, J. and Prasad, M. (1995) Exchange risk sensitivity and its determinants: A firm and industry analysis of U.S multinationals, *Financial Management*, Vol.24, pp.77-88.

Choudhry, T. (1996) Stock market volatility and the crash of 1987: evidence from six emerging markets, *Journal of International Money and Finance*, Vol.15, pp.969-81.

Chow, E. and Chen, H. (1998) The determinants of foreign exchange rate exposure: Evidence on Japanese firms, *Pacific Basin Finance Journal*, Vol.6, pp.153-74.

Chow, E., Lee, W. and Solt, M. (1997a) The economic exposure of US multinational firms, *Journal of Financial Research*, Vol. 20, pp.191-210.

Chow, E., Lee, W. and Solt, M. (1997b), The exchange rate risk exposure of asset returns. *Journal of Business*, Vol. 70 No.1, pp.105-123.

Clark, E. and Judge, A. (2008) The determinants of foreign currency hedging: Does foreign currency debt induce a bias? *European Financial Management*, Vol.14 No.3, pp.445-69.

Consensus Economics (2006) Real interest rate forecasts [Online] Available: http://www.consensuseconomics.com/Forecast_Surveys/Real_Interest_Rate_Forecasts.htm [Accessed 23rd August, 2007].

Daly, K. (2008) Financial volatility: Issues and measuring techniques, *Physica A*, Vol.387, pp.2377-93.

Davidson, J. (2000) Econometric theory, Oxford, Blackwell Publishers.

Davies, D., Eckberg, C. and Marshall, A. (2006) The determinants of Norwegian exporters' foreign exchange risk management, *The European Journal of Finance*, Vol.12 No.3, pp.217-240.

Dhanani, A., Fifield, S., Helliar, C. and Stevenson, L. (2008) The management of interest rate risk: Evidence from UK companies, *Journal of Applied Accounting Research*, Vol.9 No. 1, pp.52-70.

Diebold, F and Nerlove, M. (1989) The dynamics of exchange rate volatility: A multivariate latent factor ARCH model, *Journal of Applied Econometrics*, Vol.4, pp.1-21.

Dinenis, E. and Staikouras, S. (1998) Interest rate changes and common stock returns of financial institutions: Evidence from the UK, *The European Journal of Finance*, Vol. 4, pp.113-27.

Doidge, C., Griffin, J. and Williamson, R. (2006) Measuring the economic importance of exchange rate exposure, *Journal of Empirical Finance*, Vol. 13, pp 550-76.

Dolde, W. (1995), Hedging leverage and primitive risk, *Journal of Financial Engineering*, Vol. 4, pp. 187-216.

Dominguez, K. and Tesar, L. (2001) A re-examination of exchange rate exposure, *American Economic Review*, Vol.91, pp. 396-99.

Dominguez, K. and Tesar, L. (2006) Exchange rate exposure, *Journal of International Economics*, Vol.68, pp.188-218

Donnelly, R. and Sheehy, E. (1996), The share price reaction of U.K exporters to exchange rates movements: an empirical study, *The Journal of International Business Studies*, Vol.27, pp.157-65.

Doukas, J., Hall, P. And Lang, H. (1999) The pricing of currency risk in Japan, *Journal of Banking and Finance*, Vol. 23 No. 1, pp.1-20.

Doukas, J., Hall, P. And Lang, H. (2003) Exchange rate exposure at the firm and industry level, *Financial Markets, Institutions and Instruments*, Vol.12 No.5, pp.291-347.

Eilidh, C. and Marshall, A. (2001) The impact of the introduction of the Euro on foreign exchange risk management in UK multinational companies, *European Financial Management*, Vol.7 No.3, pp.419-34.

Eiteman, D., Stonehill, A. and Moffett, M. (2001) *Multinational Business Finance* (9th ed.), Addison-Wesley, London.

El-Masry, A. (2004) Foreign exchange rate exposure and its determinants: Firm and industry level analysis, *Thesis*, Manchester Business School, University of Manchester.

El-Masry, A. (2005a) Does foreign exchange matter? Some evidence from UK non-financial companies, *Journal of International Business and Economics*, Vol. 4 No. 1, pp.20-41.

El-Masry, A. (2005b) On the determinants of exchange rate exposure of UK industries, Journal of International Finance and Economics, Vol. 1 No.1, pp.9-31.

El-Masry, A. (2006a) Exchange rate exposure of UK non-financial companies: Industry level analysis, *Managerial Finance*, Vol. 32 No. 2, pp.115-36.

El-Masry, A. (2006b) Derivative use and risk management practices by UK non-financial companies, *Managerial Finance*, Vol. 32 No. 2, pp.137-59.

El-Masry, A., Abdel-Salam, O. and Alatraby, A. (2007) The exchange rate exposure of UK non-financial companies, *Managerial Finance*, Vol.33 No.9, pp.620-41.

El-Masry, A., Olugbode, M. and Pointon, J. (forthcoming) The exposure of shipping firms' stock returns to financial risks and oil prices: A global perspective, Maritime Policy and Management.

Elyasiani, E. and Mansur, I. (1998) Sensitivity of the bank stock returns distribution to changes in the level and volatility of interest rate: A GARCH-M model, *Journal of Banking and Finance*, Vol.22. pp.535-63.

Engle, R. (1982a) Modelling the persistence of conditional variances, *Econometric Reviews*, Vol.50, pp.81-7.

Engle, R. (1982b) Autoregressive Conditional Heteroskedasticity with Estimates of the Variance of U.K. Inflation, *Econometrica*, 50, 987-1008.

Engle, R., Lilien, D. and Robins, R. (1987) Estimating time-varying risk premia in the term structure: The ARCH-M model, *Econometrica*, Vol.5, pp.391-407.

European Central Bank (2007) Convergence criteria, [Online] Available: http://www.ecb.int/ecb/orga/escb/html/convergence-criteria.en.html#longterm [Accessed 6th August, 2007].

European Central Bank (2009) Map of Euro area 1999-2009 [Online] Available: http://www.ecb.europa.eu/euro/intro/html/map.en.html [Accessed 31st March, 2010].

Faff, R. and Marshall, A. (2005) International evidence on the determinants of foreign exchange rate exposure of multinational corporations, *Journal of Business Studies*, Vol.36, pp. 539-58.

Fang, H. and Loo, J. (1994), Dollar value and stock returns, *International Review of Economics and Finance*, Vol. 3, pp.221-31.

Fang, W., Lai, Y. and Thompson, H. (2007) Exchange rates, exchange risk and Asian export revenue, *International Review of Economics and Finance*, Vol.16, pp.237-54.

Fang, W. and Thompson, H. (2004) Exchange rate risk and export revenue in Taiwan, *Pacific Economic Review*, Vol.9 No.2, pp.117-29.

Faseruk, A. and Mishra, D. (2008) An examination of US dollar risk management by Canadian non-financial firms, *Management Research News*, Vol.31 No.8, pp.570-82.

Faulkender, M. (2005) Hedging or market timing? Selecting the interest rate exposure of corporate debt, *The Journal of Finance*, Vol. 9. No.2, pp.931-62.

Ferrer, R., González, C. and Soto, G. (2010) Linear and non-linear interest rate exposure in Spain, *Managerial Finance*, Vol.36 No. 5, pp431- 51.

Flannery, M. (1983) Interest rates and bank profitability: Additional evidence. *Journal of Money, Credit and Banking*, Vol. 15, pp.435-445.

Flannery, M. and James, C. (1984) the effect of interest rate changes on the common stock returns of financial institutions, *Journal of Finance*, Vol. 39, pp.1141-54.

Floros, C. (2008) Modelling volatility using GARCH models: Evidence from Egypt and Israel, *Middle Eastern Finance and Economics*, Vol.2, pp.31-41.

Flood, E. and Lessard, D. (1986) On the measurement of operating exposure to exchange rates: A conceptual approach, *Financial Management*, Vol.13, pp.25-37.

Fraser, S. and Pantzalis, C. (2004) Foreign exchange rate exposure of US multinational corporations: A firm-specific approach, *Journal of Multinational Financial Management*, Vol. 14, pp.261-81.

French, K., Schwert, G. And Stambaugh, R. (1987) Expected stock returns and volatility, *Journal of Financial Economics*, Vol.19, pp.3-29.

Frenkel, J. and Goldstein, M. (1997) Monetary policy in an emerging European Economic and Monetary Union, *International Finance Contemporary Issues*, pp.187-98.

Friberg, R. and Nydahl, S. (1999) Openness and the exchange rate exposure of national stock markets - A note, *International Journal of Finance and Economics*, Vol.4 No.1, pp.55-62.

Frisch, H. (2003) The euro and its consequences: What makes a currency strong? *Atlantic Economic Journal*, Vol.31 No.1, pp.15-31.

Froot, K., Scharfstein, D. and Stein, J. (1993) Risk Management: Coordinating corporate investment and financing policies, *Journal of Finance*, Vol. 48, pp.1624-58.

Galati, G. and Tsatsaronis, K. (2003) The impact of the Euro on Europe's financial markets, *Financial Markets, Institutions and Instruments*, Vol. 12 No.3, pp. 165-221.

Gay, G. and Nam, J. (1998) The underinvestment problem and corporate derivatives use, *Financial Management*, Vol. 52, pp. 53-69.

Geczy, C., Minton, B. and Schrand, C. (1997) Why firms use currency derivatives, *Journal of Finance*, Vol.52, pp. 1323-54.

Giliberto, M. (1985) Interest rate sensitivity in the common stocks of financial intermediaries: A methodological note, *Journal of Financial and Quantitative Analysis*, Vol.20, pp.123-6.

Glaum, M., Brunner, M. and Himmel, M. (2000) The DAX and the dollar: The economic exchange rate exposure of German Corporations, *Journal of International Business Studies*, Vol.31, pp.715-24.

Glen, A. (2005) *Corporate financial management* (3rd ed.), Essex, Pearson Education Limited.

Glosten, L., Jagannathan, R. and Runkle, D. (1993) On the relationship between the expected value and the volatility on the nominal excess returns on stocks, *Journal of Finance*, Vol.48, pp.1779-801.

González, C., Ferrer, R. and Soto, G. (2006) Linear and non-linear interest rate exposure of Spanish firms, *Working Paper*, University of Valencia.

Graham, J. and Rogers, D. (2002) Do firms' hedge in response to tax incentives? *Journal of Finance*, Vol. 57 No. 2, pp. 815-839.

Grant, K. and Marshall, A. (1997) Large UK companies and derivatives, *European Financial Management*, Vol.3 No.2, pp.191-208.

Griffin, J. and Karolyi, A. (1998) Another look at the role of the industrial structure of markets for international diversification strategies, *Journal of Financial Economics*, Vol.50, pp.351-73.

Griffin, J. and Stultz, R. (2001) International competition and exchange rate shocks: a cross country industry analysis of stock returns, *Review of Financial Studies*, Vol.14, pp.215-41.

Gros, D. (2000) Public debt in the Euro area and the UMTS windfall [Online] Available: http://www.europarl.europa.eu/comparl/econ/pdf/emu/speeches/20000912/gros/default_en.pdf [Accessed 23rd August 2007]

Guay, W. and Kothari, S. (2003) How much do firms hedge with derivatives ?, *Journal of Financial Economics*, Vol.70, pp.423-461.

Hagelin, N. (2003) Why firms hedge with currency derivatives: An examination of transaction and translation exposure, *Applied Financial Economics*, Vol.13, pp.55-69.

Hagelin, N. and Pramborg, B. (2004) Hedging foreign exchange exposure: Risk reduction from transaction and translation hedging, *Journal of International Financial Management and Accounting*, Vol.15 No.1, pp.1-20.

Hahm, J. (2004) Interest rate and exchange rate exposure of banking institutions in pre-crisis Korea, *Applied Economics*, Vol. 36 No. 13, pp.1409-19.

Hakkarainen, A., Kasanen, E. and Puttonen, V. (1997) Interest rate risk management in major Finnish firms, *European Financial Management*, Vol. 3, pp. 255-268.

Harrington, S. (1983) The relationship between risk and return: Evidence for life insurance stocks, Journal *of Risk and Insurance*, Vol. 50 No.4, pp. 587-610.

Harris, J., Marr, M. and Spivey, M. (1991) Exchange rate movements and the stock returns of US commercial banks, *Journal of Business Research*, Vol. 22, pp.233-42.

Haugen, R., Stroyny, A. and Wichern, D. (1978) Rate regulation, capital structure and the sharing of interest rate risk in the electric utility industry, *Journal of Finance*, Vol. 33 No. 3, pp.707-21.

Hauser, S. and Levy, A. (1991) Effect of exchange rate and interest rate risk on international fixed-income portfolios, *Journal of Economics and Business*, Vol.43, pp. 375-88.

Haushalter, G. (2000), Financing policy, basis risk and corporate hedging: Evidence from oil and gas producers, *Journal of Finance*, Vol. 55 No.1, pp. 107-152.

He, J. and Ng, L. (1998) The foreign exchange exposure of Japanese multinational corporations, *Journal of Finance*, Vol. 53, pp.733-53.

Helliar, C., Dhanani, A., Fifield, S. and Stevenson, L. (2005) Interest rate risk management: An investigation into the management of interest rate risk in large UK companies, CIMA, Oxford.

Hill, C., Griffiths, W. and Lim.G. (2008) Principles of Econometrics, 3rd Edition, John Wiley & Sons, New Jersey.

Howton, S. and Perfect, S. (1998) Currency and interest rate derivatives use in US firms *Financial Management*, Vol.27 No.4, pp.111-21.

Hsin, C., Shiah-Hou, S. and Chang, F. (2007) Stock return exposure to exchange rate risk: A perspective from delayed reactions and hedging effects, *Journal of Multinational Financial Management*, Vol. 17, pp.384-400.

Hu, M., Jiang, C. and Tsoukalas, C. (2004) The volatility impact of the European monetary system on member and non-member currencies, *Applied Financial Economics*, Vol. 14, pp.313-25.

Hunter, J. and Isachenova, N. (2006) Aggregate economy risk and company failure: An examination of UK quoted firms in the early 1990s, *Journal of Policy Modelling*, Vol. 28, pp.911-19.

Hyde, S. (2007) The response of industry stock returns to market, exchange rate and interest rate risks, *Managerial Finance*, Vol.33 No.9, pp.693-709.

Ihrig, J. (2001) Exchange rate exposure of multinationals: Focusing on exchange rate issues, *Working Paper*, International Finance Discussion Papers.

Ihrig, J. and Prior, D. (2005) The effect of exchange rate fluctuations on multinationals' returns, *Journal of Multinational Financial Management*, Vol.15, pp.273-286.

Iorio, A. and Faff, R. (2000) An analysis of asymmetry in foreign currency exposure of the Australian equities market, *Journal of Multinational Financial Management*, Vol.10, pp.133-159.

Jayasinghe, P. And Tsui, A. (2008) Exchange rate exposure of sectoral returns and volatilities: Evidence from Japanese industrial sectors, *Japan and World Economy*, Vol.20, pp.639-60.

Jensen, G., Johnson, R. and Bauman, W. (1997) Federal Reserve monetary policy and industry stock returns, *Journal of Business, Finance and Accounting*, Vol.24 No.5, pp.629-44.

Jesswein, K., Kwok, C. and Folks, W. (1995) Corporate use of innovative foreign exchange risk management products, *The Columbia Journal of World Business*, pp.71-80.

Joehnk, M. and Nielsen, J. (1976) The effect of interest rates on utility shares, *Review of Business and Economic Research*, Vol.12 No.1, pp.35-43.

Joehnk, M. and Petty, W. (1980) The interest rate sensitivity of common stock prices, *The Journal of Portfolio Management* Vol. 6 No.2, pp.19-25.

Jong, A., Ligterink, J. and Macrae, V. (2006) A firm specific analysis of the exchange rate exposure of Dutch firms, *Journal of International Financial Management and Accounting*, Vol. 17, pp.1-28.

Jorion, P. (1990) The exchange rate exposure of US multinationals, *Journal of Business*, Vol.63, pp.331-45.

Jorion, P. (1991) The pricing of exchange rate risk in the stock market, *Journal of Financial and Quantitative Analysis*, Vol. 26, pp.363-76.

Joseph, N. (2002), Modelling the impacts of interest rate and exchange rate changes on UK stock returns, *Derivatives Use, Trading and Regulation*, Vol.7, pp. 306-23.

Joseph, N. (2003a) Predicting returns in US financial sector indices, *International Journal of Forecasting*, Vol.19, pp.351-367.

Joseph, N. (2003b) Using monthly returns to model conditional Heteroskedasticity, *Applied Economics*, Vol.35, pp.791-801.

Joseph, N. and Vezos, P. (2006) The sensitivity of US banks' stock returns to interest rate and exchange rate changes, *Managerial Finance*, Vol.32 No. 2, pp.182-99.

Judge, A. (2006a) The determinants of foreign currency hedging by UK non-financial firms, *Multinational Finance Journal*, Vol. 10 No.1/2, pp.1-41.

Judge, A. (2006b) Why and how UK firms hedge, *European Financial Management*, Vol.12 No.3, pp.407-41.

Kane, E. and Unal, H. (1988) Change in the market assessment of deposit institution riskiness, *Journal of Financial Services Research*, Vol. 1, pp. 207-29.

Kaufold, H. and Smirlock, M. (1986), Managing corporate exchange and interest rate exposure, *Financial Management*, pp.64 - 72.

Khoo, A. (1994) Estimation of foreign exchange exposure: An application to mining companies in Australia, *Journal of International Money and Finance*, Vol.13, pp.342-63.

Kim, S., Mathur, I. And Nam, J. (2006) Is operational hedge a substitute for or a complement to financial hedging? *Journal of Corporate Finance*, Vol.12, pp.834-53.

Koch, T. and Saporoschenko, A. (2001) The effect of market returns, interest rates and exchange rates on the stock returns of Japanese horizontal keiretsu financial firms, *Journal of Multination Financial Management*, Vol.11, pp.165-182.

Korkeamäki, T. (2007) The effects of the Euro on interest rate sensitivity, *Working Paper*, Hanken School of Economics.

Koulakiotis, A., Papasyriopoulos, N. and Molyneux, P. (2006) More evidence on the relationship between stock price returns and volatility: A note, *International Research Journal of Finance and Economics*, Vol.1, pp.22-8.

Koutmos, G. and Knif, J. (2002) Time variation and asymmetry in systematic risk: Evidence from the Finnish stock exchange, *Journal of Multinational Financial Management,*Vol.12, pp.261-271.

Koutmos, G. and Martin, A. (2003) Asymmetric exchange rate exposure: Theory and evidence, *Journal of International Money and Finance*, Vol.22, pp.365-383.

Koutmos, G. and Martin, A. (2007) Modelling time variation and asymmetry in foreign exchange rate exposure, *Journal of Multinational Financial Management*, Vol.17, pp.61-74.

Koutmos, G., Negakis, C. and Theodossiou, P. (1993) Stochastic behaviour of the Athens stock exchange, Applied Financial Economics, Vol.3, pp.119-126.

Koutmos, G. and Saidi, R. (1995) The leverage effect in individual stocks and the debt to equity ratio, *Journal of Business Finance and Accounting*, Vol.22, pp.1063-1075.

Krishnamoorthy, A. (2001), The impact of industrial structure and the exchange rate exposure of industry portfolio returns, *Global Finance Journal*, Vol.12, pp.285-97.

Lamoureux, C. and Lastrapes, W. (1990) Heteroskedasticity in stock return data: Volume versus GARCH effects, *The Journal of Finance*, Vol.45, pp.221-9.

Léon, N. (2008) An empirical study of the relation between stock market returns and volatility in the BRVM, *International Research Journal of Finance and Economics*, Vol.14, pp.8-14.

Li, Q., Yang, J., Hsiao, C. and Chang, Y. (2005) The relationship between stock returns and volatility in international stock markets, *Journal of Empirical Finance*, Vol.12, pp.650-65.

Liow, K. and Huang, Q. (2006) Interest rate risk and time-varying excess returns for Asian property stocks, Journal of Property Investment and Finance, Vol.23 No.3, pp.188-210.

Liu, J. (2004) Macroeconomic determinants of corporate failures: Evidence from the UK, *Applied Economics*, Vol.36, pp. 939-45.

Lloyd, W. and Shick, R. (1977) A test of Stone's two-index model of returns, *Journal of Financial and Quantitative Analysis*, Vol.12, pp.363-76.

Lobo, B. (2000), The asymmetric effects of interest rate changes on stock prices, *The Financial Review*, Vol.35, pp.125-44.

Loudon, G. (1993a) Foreign exchange exposure and the pricing of currency risk in equity returns: Some Australian evidence, *Pacific-Basin Finance Journal*, Vol.1 pp. 335-54.

Loudon, G. (1993b) The foreign exchange operating exposure of Australian stocks, *Accounting and Finance*, Vol. 33 No.1, pp.19-32.

Loudon, G. (2004) Financial risk exposures in the airline industry: Evidence from Australia and New Zealand, *Australian Journal of Management*, Vol.29 No.2, pp.295-316.

LSE (2007) Following indices [online] http://www.londonstockexchange.com/en-gb/pricesnews/education/experiencedinvestors/makingsenseofdata/followingindices.htm [Accessed 15th June 2007].

Luehrman, T. (1991) Exchange rate changes and the distribution of industry value, *Journal of International Business Studies*, Vol.22, pp.619-649.

Lynge, M. and Zumwalt, K. (1980) An empirical study of the interest rate sensitivity of commercial bank returns: A multi-index approach, *Journal of Financial and Quantitative Analysis*, Vol.15, No.3, pp. 731-42.

Madura, J. (2000) International Financial Management, South Western College Publishing, London.

Madura, J. And Zarruk, E. (1995) Bank exposure to interest rate risk: A global perspective, *The Journal of Financial Research*, Vol.18 No.1, pp.1-13.

Magnus, F. And Fosu, O. (2006) Modelling and forecasting volatility of returns on the Ghana stock exchange using GARCH models, *American Journal of Applied Sciences*, Vol.3 No.10, pp.2042-48.

Mallin, C., Ow-Yong. and Reynolds, M. (2001) Derivatives usage in UK non-financial listed companies, *The European Journal of Finance*, Vol. 7, pp.63-91.

Mark, N. (1999) Real and nominal exchange rates in the long run: An empirical investigation, Journal of International Economics, Vol.28, pp.115-36.

Marston, R. (2001) The effects of industry structure on economic exposure, *Journal of International Money and Finance*, Vol. 20, pp. 149-64.

Martin, A. and Mauer, L. (2005) A note on common methods used to estimate foreign exchange exposure, *International Financial Markets, Institution and Money*, Vol.15, pp.125- 40.

Mayers, D. and Smith, C. (1987) Corporate insurance and the underinvestment problem, *Journal of Risk and Insurance*, Vol. 54, pp.45-54.

McKinnon, R. (1963) Optimum currency areas, *American Economic Review*, Vol.53, pp.717-25.

McKinnon, R. (1963) Optimum currency areas, *American Economic Review*, Vol.53, pp.717-25.

Meen, G. (2003) The UK housing market and the Euro, *Consumer Policy Review*, Vol.13 No.6, pp.194-8.

Mian, S. (1996) Evidence of corporate hedging policy, *Journal of Financial and Qualitative Analysis*, Vol.31 No. 3, pp.419-39.

Miller, K. and Reuer,J. (1998), Firm strategy and economic exposure to foreign exchange rate movements, *Journal of International Business Studies*,Vol.29, pp.493-513.

Morana, C. and Beltratti, A. (2000) The effects of the introduction of the euro on the volatility of European stock markets, *Journal of Banking and Finance*, Vol.26, pp. 2047-64.

Moskowitz, T. and Grinblatt, M. (1999) Do industries explain momentum?, *Journal of Finance*, Vol. 54, pp.1249-90.

Mulhearn, C., Vane, H. And Eden, J. (2001) Economics for business, Palgrave: Basingstoke

Muller, A. and Verschoor, W. (2006a) Asymmetric foreign exchange rate risk exposure: Evidence from US multinational firms, *Journal of Empirical Finance*, Vol.13, pp.495-518.

Muller, A. and Verschoor, W. (2006b) European foreign exchange risk exposure, *European Financial Management*, Vol.12 No. 2, pp. 195-220.

Muller, A. and Verschoor, W. (2007) Asian foreign exchange risk exposure, *Journal of the Japanese and International Economies*, Vol.21, pp. 16-37.

Murtagh, J. and Bessler, W. (2003) Interest rate and exchange rate risk in financial and non-financial industries: An international study, *Working Paper*, Rensselaer Polytechnic Institute, New York.

Nance , D., Smith, C. and Smithson, C. (1993) On the determinants of corporate hedging, *Journal of Finance*, Vol.48, pp.391-405.

Neale, B. and McElroy, T. (2004) Business finance: A value based approach, Prentice Hall, London.

Nellis, J. and Parker, D. (2002) Principles of Business Economics, Pearson Education Limited, Essex.

Nelson, D. (1991) Conditional Heteroskedasticity in asset returns: A new approach, *Econometrica*, Vol.59, pp.347-70.

Nelson, D. and Cao, C. (1992) Inequality constraints in the univariate GARCH model, *Journal of Business and Economics Statistics*, Vol.10, pp.229-35.

Nguyen, H. and Faff, R. (2002) On the determinants of derivative usage by Australian companies, *Australian Journal of Management*, Vol.27, pp.1-24.

Nguyen, H. and Faff, R. (2003) Can the use of foreign currency derivative explain variations in foreign exchange exposure? Evidence from Australian companies, *Journal of Multinational Financial Management*, Vol.13 No.13, pp.193-215.

Nguyen, H. and Faff, R. (2006) Foreign debt and financial hedging: Evidence from Australia, *International Review of Economics and Finance*, Vol.15, pp.184-201.

Nguyen, H., Faff, R. and Marshall, A. (2007) Exchange rate exposure, foreign currency derivatives and the introduction of the Euro: French evidence, *International Review of Economics and Finance*, Vol.16, pp. 563-77.

Nydahl, S. (1999) Exchange rate exposure, foreign involvement and currency hedging of firms. Some Swedish evidence, *European Financial Management*, Vol.5, pp. 241-57.

Oertmann, P., Rendu, C. and Zimmermann, H. (2000) Interest rate risk of European financial corporations, *European Financial Management*, Vol.6, pp.459-78.

Pagano, M. and Thadden, E. (2004) The European bond markets under EMU, *CEPR Discussion Papers*, No.4779.

Pierre, E. (1998) Estimating EGARCH-M models: Science or art? *The Quarterly Review of Economics and Finance*, Vol.38 No.2, pp.167-80.

Pilbeam, K. (1998) International Finance (2nd ed.) Macmillan, New York.

Pope, P. and Marshal, A. (1991) Foreign exchange and interest rate exposure: A survey of UK reporting practice, *Financial Reporting* 1990/1991, The Institute of Chartered Accountants.

Pramborg, B. (2005) Foreign exchange risk management by Swedish and Korean non-financial firms: A comparative survey *Pacific Basin Finance Journal*, Vol. 13, pp.343-66.

Prasad, A. and Rajan, M. (1995), The role of exchange and interest risk in equity valuation: A comparative study of international stock markets, *Journal of Economics and Business*, Vol. 47, pp.457-72.

Prevost, A., Rose, L. and Miller, G. (2000) Derivatives usage and financial risk management in large and small economics, A comparative analysis, *Journal of Business Finance and Accounting*, Vol.27 No.5-6, pp.733-59.

Priestley, R. and Ødegaard,B. (2007) Linear and non-linear exchange rate exposure, *Journal of International Money and Finance*, Vol.13, pp.1016-1037.

Rajan, R. and Zingales, L. (2003) Banks and markets: The changing character of European finance, *NBER Working Paper*, No.4779.

Rees, W. and Unni, S. (2005) Exchange rate exposure among European firms: Evidence from France, Germany and the UK, *Accounting and Finance*, Vol.45, pp.479-79.

Ryan, S. and Worthington, A. (2004) Market, interest rate and foreign exchange rate risk in Australian banking: A GARCH-M approach, *International Journal of Applied Business and Economic Research*, Vol.2 No.2, pp.81-103.

Saatcioglu, C., Korap, L. and Volkan, A. (2007) Information content of exchange rate volatility, *International Business and Economics Research Journal*, Vol.6 No.4, pp.9-14.

Schiozer, R. and Saito, R. (2009) The determinants of currency risk management in Latin American non-financial firms, *Emerging Markets Finance and Trade*, Vol.45 No.1, pp.49-71.

Schwert, W. (1990) Stock volatility and the crash of 87, *The Review of Financial Studies*, Vol.3, pp.77-102.

Scott, W. and Peterson, R. (1986) Interest rate risk and equity values of hedges and unhedged financial intermediaries, *The Journal of Financial Research*, Vol. 9, pp.325-9.

Seiyeol, O. and Hyonsok, L. (2004) Foreign exchange exposures and asymmetries of exchange rate: Korean economy is highly vulnerable to exchange rate variations, *Journal of Financial Management and Analysis*, Vol. 17 No.1, pp.8 -21.

Sfakianakis, M. (2002) A behavioural analysis of interest rates in Euro area, *Managerial Finance*, Vol.28 No.5, pp.1-19.

Shin, H. and Soenen, L. (1999) Exposure to currency risk by US multinational corporations, *Journal of Multinational Financial Management*, Vol. 9, pp.195-207.

Shu, P. and Chen, H. (2003), The determinants of derivatives use: evidence form non-financial firms in Taiwan, *Review of Pacific Basin Financial Markets and Policies*, Vol. 6 No.4, pp.473-500.

Simpson, M. and Dania, A. (2006) Selectively hedging the Euro, *Journal of Multinational Financial Management*, Vol.16, pp.27-42.

Smith, C. and Stulz, R. (1985) The determinants of firms' hedging policies, *Journal of Financial and Qualitative Analysis*, pp.391-40.

Solnik, B. (1984) Stock prices and monetary variables: The international evidence, *Financial Analysts Journal*, pp.69-73.

Staikouras, S. (2006) Testing the stabilisation hypothesis in the UK short-term interest rates: Evidence from a GARCH-X model, *The Quarterly Review of Economics and Finance*, Vol.46, pp.169-189.

Stevenson, S. (2002) The sensitivity of European bank stocks to German interest rate changes, *Multinational Finance Journal*, Vol. 6 No. 6, pp.223-49.

Strong, N. (1992) Modelling abnormal returns: A review article, *Journal of Business Accounting and Finance*, Vol.19, pp.533-553.

Sweeney, R. and Warga, A. (1986) The pricing of interest risk: Evidence from the stock market, *Journal of Finance*, Vol. 41, pp. 393-410.

Tai, C. (2000) Time varying market, interest rate and exchange rate risk premia in the US commercial bank stock returns, *Journal of Multinational Financial Management*, Vol. 10, pp.397-420.

Tai, C. (2005) Asymmetric currency exposure of US bank stock returns, *Journal of Multinational Financial Management*, Vol.15, pp.455-472.

Taing, S. and Worthington, A. (2005) Return relationship among European equity sectors: A comparative analysis across selected sectors in small and large economies, *Journal of Applied Economics*, Vol. 8 No.2, pp.371-388.

Theodossiou, P. and Lee, U. (1995) Relationship between volatility and unexpected returns across international stock markets, *Journal of Business Accounting and Finance*, Vol.22, pp.289-300.

Thorbecke, W. (1997) On stock market returns and monetary policy, *Journal of Finance*, Vol.52, pp.635-54.

Times Online (2006) Charting the relationship between interest rates and exchange rates [Online] Available: http://business.timesonline.co.uk [Assessed16th May, 2007].

Tufano, P. (1996) Who manages risk? An empirical examination of risk management practices in the gold mining industry, *Journal of Finance*, Vol. 51, pp.1017-1137.

Vardar, G., Aksoy, G. and Can, E. (2008) Effects of interest rate and exchange rate on volatility and return of sector price indices at Istanbul stock exchange, *European Journal of Economics, Finance and Administrative Sciences*, Vol.11, pp.26-35.

Verschoor, W. and Muller, A. (2007) The Asian crisis exchange risk exposure of US multinationals, *Managerial Finance*, Vol.33, No.9, pp710-40.

Visvanathan, G. (1998) Who uses interest rate swaps? A cross-sectional analysis, *Journal of Accounting, Auditing and Finance*, Vol. 13, pp.173-200.

Welsh, J. (1999) Enter the Euro World, *World Trade*, pp.34-38.

Wetmore, J. and Brick, J. (1994) Commercial bank risk: Market, interest rate and foreign exchange, *The Journal of Financial Research*, Vol.17 No. 4, pp.585-96.

Williamson, R. (2001) Exchange rate exposure and competition: Evidence from the automotive industry, *Journal of Financial Economics*, Vol. 59, pp. 441-75.

Worthington, I., Britton, C. and Rees, A. (2001) Economics for business: Blending theory and practice, Pearson Education Limited, Essex.

Yong, H., Faff, R. and Chalmers, K. (2009) Derivative activities and Asia-Pacific banks' interest rate and exchange rate exposures, *International Finance Markets, Institution and Money*, Vol. 19, pp.16-32.