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THE PERFORMANCE OF ISLAMIC BANKS VS. CONVENTIONAL BANKS: THE CASE OF MENA REGION

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THE PERFORMANCE OF ISLAMIC BANKS VS. CONVENTIONAL BANKS: THE CASE OF MENA REGION

by

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Dedication

An Achievement is best enjoyed when it is shared with those who are close to one's heart.
I would like to dedicate this work to my late father, Muhammed, and hope that he will be looking down at me with a satisfied eye. Equally, I dedicate it to my mother, Swasan El shewy. I pray to Allah to bestow his blessings on you always.
Rabab, Amany, Nada, and Mohamed... This is yours as much as it is mine.
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Mohamed… no comment… you know.

Author's Declaration

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Graduate Committee.

Work submitted for this research degree at the Plymouth University has not formed part of any other degree either at Plymouth University or at another establishment

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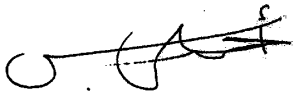
Signed: 

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Abstract

This study aimed to compare the financial performance of Islamic banks and conventional bank in the MENA region. This was undertaken through examining the influence of bank specific factors (represented by bank size, capital risk, loan intensity, financial leverage, credit risk, operating ratio and Z-score) and macroeconomic factors (represented by gross domestic product (GDP) and inflation) on banks' financial performance (captured by return on assets (ROA) and return on equity (ROE)). The underlying aim is to demonstrate that the difference in operational models of banks has an effect on financial performance.

The study analysed data obtained from Bankscope and Worldbank Databank for 108 banks comprising 35 Islamic banks and 73 conventional banks from 15 countries (Algeria, Bahrain, Egypt, Jordan, Iran, Iraq, Kuwait, Libya, Morocco, Oman, Saudi Arabia, Tunisia, Qatar, Yemen, United Arab of Emirates) for the period 2004-2014. Thus, the study examines the financial performance of the two banking types for the periods before, during, and after the 2007/2008 global financial crisis. A deductive quantitative data analysis approach from a positivist epistemological perspective was employed using two research techniques: multivariate linear regression and non-linear artificial neural network model.

The study has found that there are significant financial performance differences that exist between Islamic banks and conventional banks in the MENA region based on the financial variables examined. In respect to the impact of the 2008 financial crisis on the banking types in the MENA region, the study suggests that the conventional banks were affected relatively more than Islamic banks. Further, the study has revealed that credit risk and Z-score are key determinants of banks' financial performance in the MENA region. This suggests that effective credit and bankruptcy risk management could positively influence banks' performance. An increased investment in fixed assets, however, affects mainly conventional banks than Islamic banks. Similarly, the influence of bank size applies more to conventional banks than Islamic banks in the MENA region. When comparing the results obtained using the artificial neural network to those obtained using the multiple regression analysis, the study found that overall, the explanatory power obtained using the artificial neutral network was relatively higher.

With a focus on the GCC countries, the study reveals that Islamic banks suffered relatively more than conventional banks from the 2008 global financial crisis, contrary to the results for

the MENA region as a whole. Further, in addition to credit risk and Z-score, the study results suggest that increased bank capitalisation (capital risk) has a positive effect on banking performance in the GCC countries. However, increased financial leverage and operating ratio significantly affected conventional banks, and not Islamic banks, in the GCC countries. Contrary to the MENA region, bank size in the GCC countries impacts Islamic banks more than conventional banks. The changes in GDP, on the other hand, was found to matter more in the GCC countries (than non-GCC countries) whilst inflation affects conventional banks only in MENA countries. Increase in loan intensity, however, was not found to significantly influence the banks' performance.

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Abbreviations and Acronyms

AfDB	-	African Development Bank
ANN	-	Artificial Neural Networks
CBK	-	Central Bank of Kuwait
DEA	-	Data Envelopment Analysis
FDI	-	Foreign direct investment
Gharar	-	Excessive uncertainty
GCC	-	Gulf Cooperation Council
GDP	-	Gross Domestic Product
GFC	-	Global financial crisis
Halal	-	Lawful or permissible
IAIB	-	International Association of Islamic Banks (IAIB)
IMF	-	International Monetary Fund
IFSB	-	Islamic Financial Services Board
MENA	-	Middle East and North African countries
OECD	-	Organisation for Economic Co-operation and Development
OIC	-	Organisation of the Islamic Conference
OPEC	-	Organization of the Petroleum Exporting Countries
Riba	-	Interest or usury (literally ‘increase’)
Shariah		Islamic (divine) jurisprudence
SPSS	-	Statistical Package for the Social Sciences
TOPSIS	-	Technique for Order of Preference by Similarity to Ideal Solution
UNCTAD	-	United Nations Conference on Trade and Development
WGI	-	World Governance Indicators
WTO	-	World Trade Organisation

Chapter One: Introduction

1.1 Aim of chapter

This chapter is aimed at introducing the research project. The chapter begins with a discussion of the underlying motivation to undertake this research (in section 1.2) on performance comparison between Islamic banks (IBs) and conventional banks (CBs) in the Middle East and North Africa (MENA) region before, during and after the 2008 global financial crisis (GFC). An overview of the MENA region is provided (in section 1.3) before outlining the research aims, objectives and research questions (in sections 1.4 and 1.5). This is followed by a summary of the methodological approach adopted, the contribution of this study and how this thesis is organised.

1.2 The research motivation

Several aspects have motivated the undertaking of this study on the comparative performance of Islamic banks and conventional banks in the MENA region. Firstly, several sources appear to suggest that many Islamic banks suffered much lower losses and were more stable during the crisis than many conventional banks (Al-Hamzani, 2008; Ahmed, 2010; International Monetary Fund, 2010; Hassan et al., 2019; Parashar & Venkatesh, 2010; Zeitun, 2012). If this is the case, then there is the potential for conventional banking system to develop strategies based on the strengths of the Islamic banking system in order to apply them to their operational procedures. This could allow conventional banks to have much more stable and sustainable strategies for dealing with potential financial crises in the future.

The chance that there will be a further financial crisis in the future comparable to what was seen in 2007/2008 is practically a certainty (Harrison, 1999; Economist, 2018). However, the ability to predict such as crisis is still questionable (Inman, 2017) and so is the ability to withstand it. Harrison (1999) in his writings, did not only predict the 2008 banking crisis but proffered a hypothesis of an 18-year economic cycle of boom and bust, which he links directly to land values and rents. This idea of the 18-year cycle is supported by Downey (2009), with the creation of a relative illustration of this cycle for the past century. It is claimed that the risk of future financial collapse is significant unless lessons are learned from the 2008 crisis. The next

financial crisis is predicted to occur by some commenters in the year 2020 (Fortune, 2018; The Guardian, 2018).

On this basis, Islamic banking may have much to offer in mitigating against the inherent risk factors. It is by nature more risk-averse (Khediri et al., 2015; Prenzlin, 2009), and many of the Sharia laws, intrinsic in the Islamic banking sector, prevent certain behavioural patterns which are believed to have been significant contributory factors in the 2008 banking crisis (Ahmed 2010; Alexakis et al., 2018; Karkal, 2010; Hasan, 2009; Srairi, 2013).

It is also possible that, given Islamic banking's prediction towards slower, modest but sustainable growth and profitability (Zeitun, 2012), such wild swings from boom to bust may be mitigated, at least in part. Once these comparative strengths and weaknesses are known and a template for sustainable banking is developed using what could be considered as the best of both worlds; it could then be possible to apply these findings to the present banking structure in MENA countries. It could also be possible to adapt the findings from this study in order to develop or enhance national banking policies in the MENA countries. Thus, by understanding the relative differences in the banking models and the factors which influence performance, future national banking policies could be developed that enable banks to structure their operations and focus on key performance aspects. In this way, banks could become more efficient and also effective in insulating both themselves and their investors against the effects of any future global banking crises.

The motivation to undertake this research has also emanated from the observed growth in Islamic finance worldwide. Interestingly, the total Islamic finance assets is projected to reach US$3.8 trillion by 2022 (The National, 2017). Islamic banking has impressively recorded annual average growth of 7% from 2012 to 2016 in the total Islamic finance assets (The National, 2017). This shows that the presence and importance of Islamic banking will continue in future. The motivation in this respect is therefore, to understand what makes the Islamic banking model significantly different from the conventional banking model in order to achieve such growth.

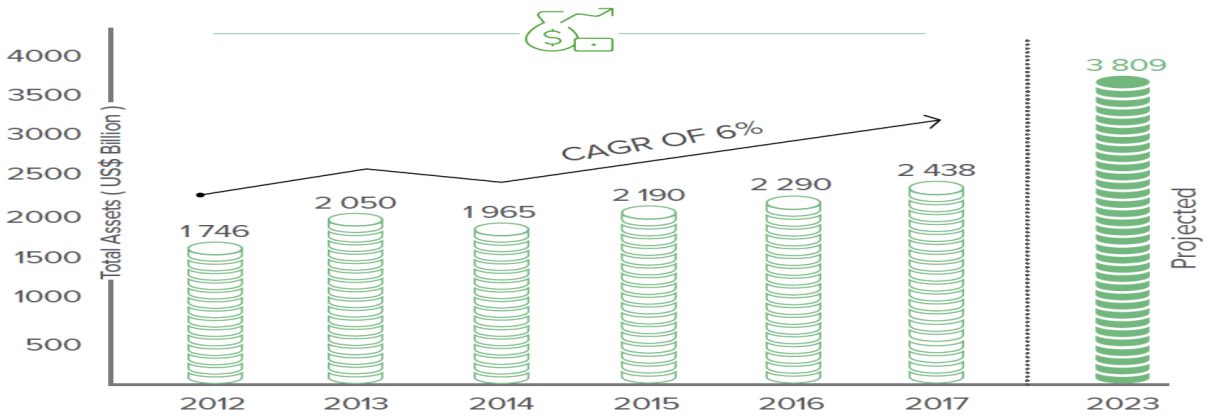
The interest in Islamic finance research has also grown following the researcher's informal interactions with banking professionals from both the Islamic banks and conventional banks. Such interactions have revealed the growing consumer interests in the Islamic banking

products. Interestingly, Islamic banking products continue to grow, and some conventional banks are starting to offer some of the Islamic banking products. Thus, the Islamic banking products have offered conventional banks opportunities to diversify their financial products and services (PWC, 2018). In the UK, the Bank of England recognised this Islamic finance movement and established a Sharia compliant facility in 2017 to serve as a deposit facility for UK Islamic banks to hold central bank assets as part of their liquid assets buffer (Bank of England, 2017).

Given these aspects, among others, its motivating to understand the difference in the two banking models. With an interest on performance, the motivation is to compare the financial performance of the Islamic banks and conventional banks, not only during the 2008 global financial crisis, but before, during and after so that a better picture can be captured. In order to do this, the MENA region where Islamic banking is most pronounced has been chosen.

1.3 The study in context

The MENA region comprises the highest number of Islamic banks (Bourkhis and Nabi, 2013; Caporale et al., 2017) with the banking sector playing a major role in the developmental agendas of the economies (Ali, 2012). Importantly, Islamic banking in the region is a growing business as it satisfies the financial needs of the people in congruent to their social and religious values (Ali, 2012; Caporale et al., 2017). The Islamic banking assets have recorded exponential growth over the last few years. The total Islamic finance assets is projected to reach US$3.8 trillion by 2022 after recording annual average growth of 7% to reach US$2.29 trillion in 2016 from 1.746 trillion in 2012 (The National, 2017). Figure 1 shows the growth in global Islamic finance assets from 2012 to 2017 and the projected 2023 figures.



Source: IFSB, 2018

Figure 1: Growth in global Islamic finance assets

In terms of distribution, the MENA region, which comprises also the GCC countries accounts for over 72% of the global Islamic finance assets (IFSB, 2018). The 72% is comprised of 42% for the GCC countries only and the remaining 30% of the non-GCC countries within the MENA region. Table 1 below shows the global distribution of Islamic finance assets.

Table 1: Distribution of global Islamic finance assets by sector and region (US$ billion)

Table 1.1.1 Breakdown of IFSI by Sector and by Region (USD billion, 2016*)

Region	Islamic Banking	*Ṣukūk* Outstanding	Islamic Funds Assets	*Takāful* Contributions	Total
Asia	218.6	182.7	19.8	4.4	425.5
GCC	650.8	115.2	23.4	11.7	801.1
MENA (ex-GCC)	540.5	16.6	0.2	8.4	565.7
Africa (ex-North Africa)	26.6	1.9	1.5	0.6	30.6
Others	56.9	2.1	11.2	--	70.2
Total	1,493.40	318.5	56.1	25.1	1,893.10

** Data for ṣukūk outstanding and Islamic funds is for full-year 2016; data for Islamic banking is for the six months ended June 2016 (1H2016); data for takāful is as at end-2015.*

Source: Islamic Financial Services Board (IFSB) Secretariat Workings

Source: IFSB, 2018

Several factors are contributing to this growth. Among these factors include the increases in oil prices which lead to more surplus funds available in the region (The National, 2017). Further, governments in the region have embarked on regulatory reforms which have strengthened the banking industry (Ali, 2012). There is more public confidence in the Islamic banks following successful performance over the years, including during the 2007/2008 global financial crisis (Ali, 2012; Al-Musali & Ismail, 2014; Beck et al., 2013; Caporale et al., 2017). In addition, there has been a growing demand for Islamic system which is associated with Islamic finance

in the region (Ali, 2012), arising from population growth. As such, the banking sector has had to develop to meet this demand.

Another contributory factor to the exponential growth of Islamic banking in the region arises from some foreign hostile government policies in countries such as the USA following the wake of September 11, 2001 terrorist incident which reduced the incentive to invest in foreign countries (Ali, 2012). This resulted in more funds being available within the region coupled with rising oil prices resulting in higher investable (petrodollar) surplus (Ali, 2012; Olson & Zoubi, 2011). Further, in many GCC countries, the real estate market boomed resulting in more demand for funds (Ali, 2012; Almasah Capital, 2011). The construction sector in the GCC countries had emerged as an attractive investment opportunity for global investors in the period 2003 to 2008 with government also intensifying investment in the sector as part of its diversification efforts from hydrocarbons (Almasah Capital, 2011). This had a positive impact on the financial sector and Islamic banking in the region. Growth of Islamic banking has, however, slowed from the historic highs since the global financial crisis (The National, 2017). The Islamic banking sector is forecasted to grow at an average annual rate of 5% in 2018 and 2019 compared to as high as 15% average annual rates in the past 10 years (The National, 2017). This is reflective of the tougher economic conditions following relatively unstable and low oil price.

The next section outlines the research aim and objectives.

1.4 The research aim and objectives

This study aims to enhance knowledge and understanding on the comparative financial performance of Islamic banks and conventional bank before, during and after the 2008 global financial crisis in the MENA region. This contributes to knowledge about the nature of Islamic banks and how this affects their financial performance. In order to achieve this aim, the research:

(a) analyses the fundamental differences between conventional banks and Islamic banks.
(b) assesses the impact of the 2008 global financial crisis on the performance of conventional banks and Islamic banks.
(c) evaluates the financial performance of Islamic banks and conventional before and after the 2008 global financial crisis.

(d) identifies the most significant factors that affect the financial performance of conventional banks and Islamic banks.
(e) compares the relative strength of the artificial neural network model to the multiple linear regression model in data analysis.

1.5 Research questions and proposed hypotheses

The research questions of this study have been developed in order to address the research objectives above. The key question being addressed is: 'what is the relative financial performance of the Islamic banks to the conventional banks before, during and the after the 2007/2008 financial crisis in the MENA countries?'

In order to formulate a comprehensive answer to this question, several resultant questions are considered which assist in the development of hypotheses that contribute to addressing the research aim. The resultant questions include:

(a) Are there significant financial performance differences between conventional banks and Islamic banks in the MENA countries?
(b) How was the financial performance of both Islamic and conventional banks before and after the 2008 global financial crisis?
(c) How did the 2008 global financial crisis affect the performance of conventional banks and Islamic banks in the MENA countries?
(d) Are the determinants of bank performance the same for Islamic banks and conventional banks in the MENA countries?
(e) Does the artificial neural network (ANN) improve the explanatory power of the significant difference between Islamic banks and conventional banks?

These questions are used to develop the following hypotheses:

H1: There are no significant financial performance differences between the Islamic banks and conventional banks in the MENA countries.
H2: There are no significant differences between the Islamic banks and conventional banks for the financial variables before and after the financial crisis.

H3: The 2008 global financial crisis had a similar negative effect on the performance of both the conventional banks and Islamic banks in the MENA countries.

H4: The determinants of bank performance for Islamic banks and conventional banks are the same in the MENA countries.

H5: The artificial neural network (ANN) does not improve the explanatory power of the significant difference between Islamic banks and conventional banks.

The next section briefly outlines the methodological approach chosen in order to address the research aim and objectives.

1.6 Methodological approach

In order to address the research objectives, this study adopts a positivist epistemological approach employing a deductive quantitative data analysis. Based on the research aim, a positivist epistemological perspective is adopted to aid prediction and explanation of causal relationships, which also assumes a priori causal relationship between observable phenomena (Saunders et al., 2012). This causal relationship is assumed between bank specific characteristics (which include bank size, capital risk, loan intensity, financial leverage, credit risk, operating ratio, Z-score) and macroeconomic developmental indicators (which include GDP and inflation) with the banks' financial performance. Several studies have highlighted this causal relationship between the bank specific characteristics with banks' financial performance (Abedifar et al., 2013; Abid et al., 2018; Beck et al., 2013; Caporale et al., 2017; Micco et al., 2007). Similarly, external macroeconomic factors (such as inflation rate, GDP, money supply growth rate) have been identified as determinants of financial performance in many studies (Athanasoglou et al., 2008; Bikker & Hu, 2002; Caporale et al., 2017). The data on banks' specific characteristics (i.e. bank size, capital risk, loan intensity, financial leverage, credit risk, operating ratio, Z-score) was obtained from Bankscope database whilst data on the macroeconomic indicators (i.e. GDP and inflation) was obtained from the World Bank database. Thus, the study uses secondary data in order to compare the financial performance of Islamic banks and conventional banks in the MENA region.

The study, in order to investigate the comparative financial performance of Islamic banks and conventional banks in the MENA region, analysed data obtained from 108 banks comprising 35 Islamic banks (32.4% of the total sample) and 73 conventional banks (67.6% of the total

sample). The 108 banks are from 15 countries: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates, Algeria, Egypt, Iran, Iraq, Libya, Morocco, Jordan, Tunisia, and Yemen. The data obtained was for the periods 2004 to 2014 in order to capture the periods, before, during and after the 2008 global financial crisis for a broader comparative analysis of the financial performance of the two banking types.

The analysis of the financial variables of the banking models in the MENA countries was further segregated into the GCC (and non-GCC) countries only. This provided an additional opportunity to gain an understanding of the difference in financial performance of the two banking models in the GCC countries as compared to non-GCC countries in the region. This additional perspective is important given the nature of GCC countries which account for 42% of the 72% in the share of the total global Islamic finance assets of the MENA regions (The National, 2017).

The quantitative analysis of data involved statistical models. In particular, the multivariate linear regression and artificial neural network (ANN) techniques are used to analyse the data collected. Thus, the study uses both linear regression model and non-linear statistical techniques. This gives an opportunity to also compare the results obtained from the two research techniques.

1.7 Contribution of the study

This study makes some contributions in three main ways. The first contribution is to the growing literature on Islamic finance, particularly to the literature that compares financial performance of Islamic banks to conventional banks (Bilal & Amin, 2015; Caporale et al., 2017; Demirguc-Kunt & Huizinga, 1999; Micco et al., 2007; Samad & Hassan, 2006; Van Horen, 2007). The contribution in this respect is that the study goes beyond one country analysis as compared to other studies that focus on one country (Al-Qudah & Jaradat, 2013; Ramlan & Adnan, 2016; Wasiuzzaman & Tarmizi, 2010) and also beyond the GCC countries (Khediri et al., 2015; Olson & Zoubi, 2008; Smaoui & Salah, 2012; Srairi, 2010) to cover 15 countries in the MENA region. As such, the study makes an empirical contribution through giving a broader perspective to the comparative study of financial performance of Islamic banks and conventional banks.

Further, the study makes an empirical contribution to the literature by covering a longer period of 10 years from 2004 to 2014. This period includes the period of financial instability of the 2008 global financial crisis as compared to other studies (Abedifar et al., 2013; Beck et al., 2013; Srairi, 2010) that concentrated on the pre-2008 global financial crisis period only or post-financial crisis period only. Thus, this study on the other hand, covers the periods, before, during and after the 2008 global financial crisis giving a much broader, and arguably richer, perspective that facilitates the understanding of financial performance of the two banking models.

In making a comparison between Islamic banks and conventional banks' financial performance, this study contributes to the crescent literature on Islamic finance giving more insight on how the "compliance to the Sharia's principles may affect financial performance" (Wanke et al., 2016, p. 486). Therefore, this goes beyond the financial performance of the banking models to question the ideological foundations of the business operations. For instance, if Islamic banks are more profitable and where less affected by global financial instability, could this imply that more equality and fairness (social responsibility) should be promoted in the financial dealings of society? Or are ethical, moral and social considerations in financial operations key to sustainable growth? This study, therefore, has ideological contributions to thinking about social inequality and injustice in financial operations.

In addition, the results obtained from this study contribute to the body of knowledge from prior studies that have revealed mixed results on the comparative financial performance of Islamic banks to conventional banks. For instance, Ramlan & Adnan (2016) found that Islamic banks are more profitable than conventional banks whilst El Massah & Al-Sayed (2015) showed that conventional banks are more solvent, liquid and profitable and less risky than Islamic banks. Similarly, Hassan et al. (2019) found that Islamic banks are better than conventional banks in managing risks. Belanes & Hassiki (2012), on the other hand, did not find any significant differences between conventional banks and Islamic banks. This shows that the body of knowledge on performance comparison is still unclear.

The second aspect of the contribution of this study is regarding the methodological approach applied. This study makes a methodological contribution in using two research methods: multivariate linear regression and artificial neural network approach. As such, the study uses both linear and non-linear models in evaluating the comparative financial performance of

Islamic banks and conventional banks. The usage of non-linear (forecasting) models, the artificial neutral network in particular, has rarely been used in evaluating banks' financial performance. Wanke et al. (2016) for instance, applied the ANN approach in evaluating the efficiency of 16 Islamic banks in Malaysia over the period 2009 to 2013. Similarly, Baker & Tahir (2009) used multiple linear regression and artificial neural network in evaluating the performance of 13 banks over the period 2001 to 2006. The benefit of using the artificial neutral network approach is that it improves the research results. This is supported by several studies that have compared the performance of artificial neural network approach to other traditional (linear) statistical techniques and shown that the artificial neural networks performed better than the linear statistical techniques (Arulsudar et al., 2005; Baker & Tahir, 2009; Delen et al., 2005; Leshno & Spector, 1996; Nghiep & Al, 2001). This is because using multiple linear regression models often produced low coefficient of determination, or R^2 values (Baker & Tahir, 2009). Thus, through employing this research method, this study makes a methodological contribution in advancing the usage of non-linear models.

The third aspect relates to the potential practical and policy implications of the results from this study. In this study, some key aspects that affect bank performance are considered. These include bank specific characteristics and macroeconomic variables. The bank specific factors include bank size, financial leverage, operating leverage, loan intensity, credit risk, capital risk and financial stability (Z-score). The macroeconomic variables include the gross domestic product and inflation. An understanding of the significance of these variables on bank performance is enlightening and could lead to policy implications. For instance, the impact of loan intensity on bank performance would be suggestive of the need for banks to consider the overall proportion of loans issued compared to the bank's total assets. Similarly, appropriate policies on credit risk and capitalisation could be drawn based on the results obtained on these factors' influence on firm performance.

1.8 Outline of the thesis

This chapter was aimed at introducing the research project. It outlined the motivation of undertaking the research, the research objectives and research questions. The research hypothesis to be tested in order to address the research objectives were also stipulated. A contextual overview of the MENA region was discussed followed by a summary of the methodological approach adopted in investigating the comparative performance of the Islamic

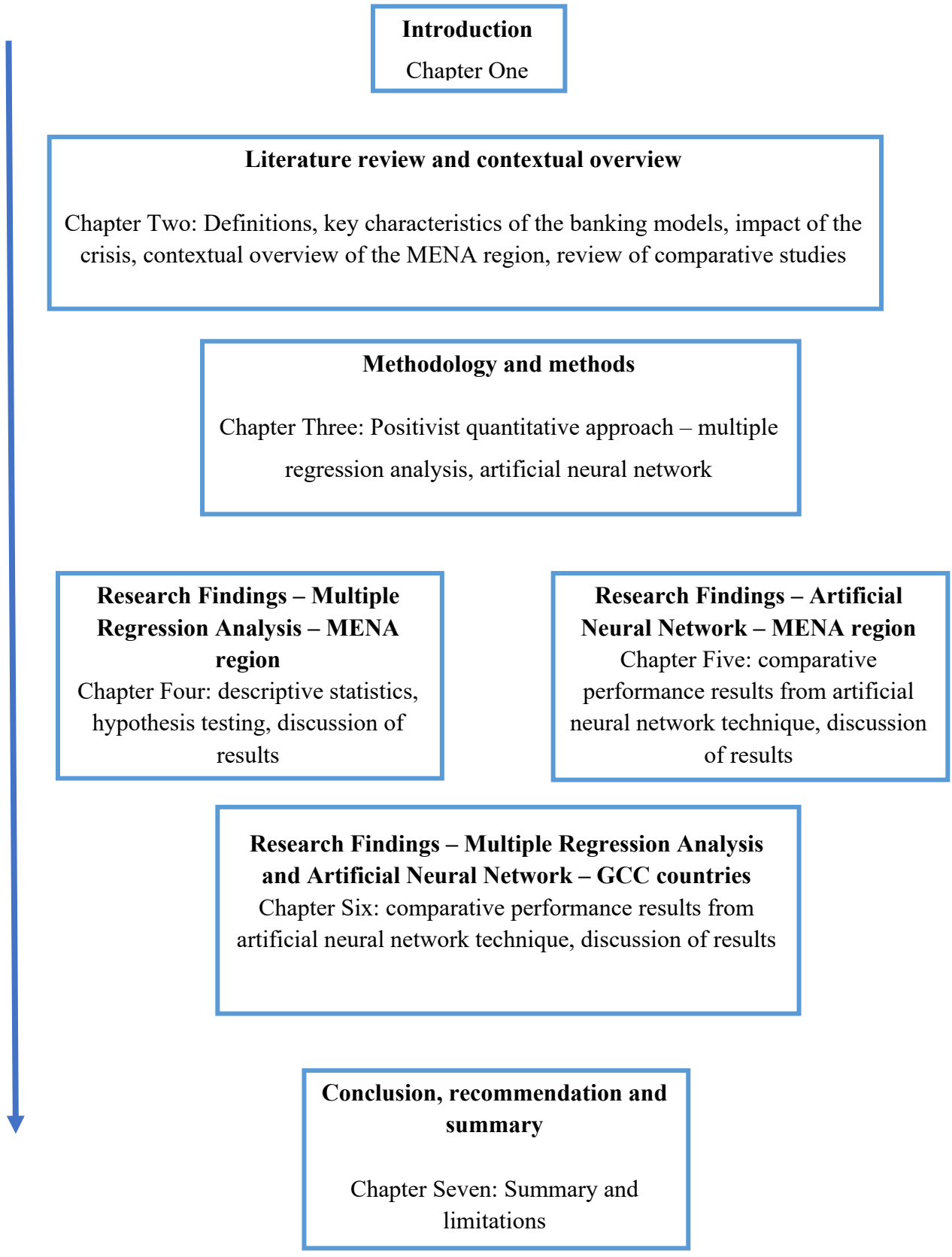
banks and conventional banks. The contributions of the study were then highlighting. The rest of the thesis is organised as follows. Chapter 2 gives a review of the literature. This discusses in detail the differences between Islamic banks and conventional banks and highlights the fundamental principles of the Islamic banking model. The review of the literature also delves into prior studies that have investigated the comparative financial performance of the two banking models, with a particular focus on the MENA region. This is important in order to highlight the contribution of this research project to the extant literature through identifying the existing gaps.

Chapter 3 outlines the methodological approach that underpins this study. The chapter highlights the study's philosophical standpoint and presents the research approach, research strategies and the research methods. The chapter identifies and justifies this research as a quantitative positivist study, which takes a case study approach by focussing on the MENA countries. In this respect, the data collection method and the statistical methods employed to analyse the data are discussed. The chapter discusses in detail the artificial neural network technique utilised to statistically analyse the data. The research validity and also limitations are then highlighted.

Chapter 4, 5 and 6 present the results of the project. Chapter 4 details the descriptive statistics and the interpretations therefore for the Islamic banks and conventional banks in the MENA region. The statistical results are then linked to the developed hypothesis in order to highlight how these have been answered. Chapter 5 details the results of the artificial neural network statistical technique employed for the MENA region. The interpretation of these results with a comparison with prior studies is also presented. This also highlights the similarities and also differences with previous studies and thus the contribution of this study. Chapter six delves deeper by focussing on the GCC countries only. Thus, the multiple linear regression analysis results and the artificial neural network results for the Islamic banks and conventional banks in the GCC countries are presented and discussed. This is important in order to show how the results for the banks in the GCC countries are comparable to the non-GCC countries.

Chapter 7 summarises the key findings with respect to the research objectives. The chapter then highlighted the key contributions of the research to existing debate and then makes suggestions for future research after presenting the research limitations. Figure 2 below gives a diagrammatic presentation of the thesis.

Figure 2: Diagrammatic presentation of the thesis



Chapter Two: Literature review

2.1 Aim of chapter

This chapter reviews the literature on Islamic banking in order to highlight the key differences in the operating models between Islamic banks and conventional banks. The chapter also reviews studies that have compared the performance of Islamic banks to conventional banks. This includes studies that have examined the impact of the 2008 global financial crisis on the banking types. The aim is to build a sufficient context to understand Islamic banking model so that a comparison can then be undertaken, and the contribution of this study highlighted.

2.2 Defining Islamic banks and conventional banks

Despite the global growth in Islamic banking (see also section 1.3), no universal definition seems to encapsulate this banking model (Zarrouk et al., 2016). Thus, Warde (2000, p. 5) argued that "no definition of Islamic finance is entirely satisfactory. To every general criterion - a financial institution owned by Muslims, catering to Muslims, supervised by a Shari'a Board, belonging to the International Association of Islamic Banks (IAIB), etc" would be classified as an Islamic bank. This essentially means that any financial institution organised on the basic elements of Islam is an Islamic bank. The difficulty in defining Islamic banking partly arises from the different interpretations of the Sharia. In this respect, DiVanna (2008, p. 1) observed that:

> "finding a single definition of Islamic banking and finance is difficult to come by, due to numerous interpretations. To most Western bankers and some Muslims, the general definition of what constitutes Islamic banking appears ambiguous, differing slightly in each country, becoming less clear as one gets closer to the details of financial instruments and transactions"

Nonetheless, a formal definition has been provided by the Organisation of the Islamic Conference (OIC) which define an Islamic bank as "a financial institution whose statutes, rules and procedures expressly state its commitment to the principles of Islamic Sharia and to the banning of the receipt and payment of interest on any of its operations" (stated in Ali & Sarkar, 1995, p. 20). Similarly, the International Association of Islamic Banks define it as a "bank which implements a new banking concept in that it adheres strictly to the rulings of Islamic Sharia in the fields of finance and other dealings" (stated in Mudawi, 1984, p. 2). In simple

terms, Islamic banks are those banks that comply to the Sharia law. Islamic finance, thus, means financial business that is not contradictory to the principles of Sharia. The specific Sharia law which regulates the relationship among human beings and addresses all aspects which are trade related or involve economic activities is the Islamic commercial law, *fiqh al-mu'amalat*. In general, two sources of Sharia law can be identified: primary sources (these are taken directly from the holy Quran and Sunnah) and secondary sources (which is made up of interpretations (*Ijtihad*)) (Wasiuzzaman & Tarmizi, 2010).

Given the definition of an Islamic bank as that which provides financial services that meet the requirements of the Sharia or Islamic law, by default, a conventional bank is any non-Islamic bank. This is the operational definition adopted in this study. The next section discusses some key similarities and differences between Islamic banks and conventional banks.

2.3 Comparison of Islamic banking to conventional banking

Islamic banking and conventional banking have both similarities and differences. Chong & Liu (2009) highlight that Islamic banks are similar to conventional banks except for the four principles that they follow according to Sharia law. These are with regard to the prohibition of uncertainty (*Gharar*), the prohibition of interest (*Riba*), money is not a commodity and the prevalence of justice (Caporale et al., 2017). The underlying feature of Islamic banking is the promotion of risk sharing, co-operation, mutual assistance, and the sharing of profits (losses) between the investors and the users of funds (Wanke et al., 2016). As such, a key feature of the Islamic banking model is that its nature and structure promote social responsibility (Warde, 2000). The driving aim for Islamic banking is the provision of socio-economic benefits to the wider society rather than the primacy of profit maximisation (Wasiuzzaman & Tarmizi, 2010). The argument is that the foundations of the Islamic banking model is the promotion of equality and fairness in the financial dealings of society. This results from the attachment of the financial dealings to Sharia principles that emphasize ethical, moral and social aspects (Wanke et al., 2016). In this regard, the International Association of Islamic Banks (IAIB) states that:

> "The Islamic bank takes into prime consideration the social implications that may be brought about by any decision or action taken by the bank. Profitability - despite its importance and priority - is not therefore the sole criterion or the prime element in evaluating the performance of Islamic banks, since they have to match both between the material and the social objectives that would serve the interests of the community as a whole and help achieve their role in the sphere of social mutual guarantee. Social goals

> are understood to form an inseparable element of the Islamic banking system that cannot be dispensed with or neglected."

Thus, one of the significant differences between Islamic banks and conventional banks relates to this focus on the equality and fairness in financial dealings. Conventional banking system, on the other hand, has the primary objective of profit maximization (Abedifar et al., 2013; Cerovic et al., 2017). The difference is on their relative emphasis of profit.

Nonetheless, profitability is an important aspect in both conventional banking and Islamic banking systems (Zarrouk et al., 2016). Shareholders/Investors and managers (directors) are particularly interested in profitability as both Islamic banks and conventional banks are profitable institutions. As such, the evaluation of profits is important in both banking types. Profitability enhances a bank's performance and stability (Zarrouk et al., 2016) and can also act as a signal to both investors and depositors (Cerovic et al., 2017). To depositors, for instance, profitability and stability concerns influence the decisions of whether to keep or withdraw their funds.

Put simply, Islamic banks, despite their prioritisation of ethical and social objectives are not charitable organisations but have to offer returns to their shareholders and depositors (Warde, 2000). Islamic banks also have to compete (whether direct or indirect) with conventional banks, investing in product innovation and technology (Haseeb, 2018). However, whilst profit is important to Islamic banks, this is not their primary goal as compared to conventional banks (Wanke et al., 2016). Further, being Sharia based organizations, they are expected to achieve only a reasonable rate of return (Haron & Azmi, 2009). Determining the reasonable rate of return, however, is subjective and depends on interpretations (Haron & Azmi, 2009; Wanke et al., 2016; Warde, 2000).

Further, besides profitability, both Islamic banks and conventional banks share the underlying objective of a financial institution, which is the provision of an efficient system of money management, as well as the facilitation of finance for business (Cerovic et al., 2017). The acceptance of deposits and the provision of financing to individuals and businesses remains the fundamental role of a financial institution. The difference, however, lies in the approach to how this is done.

Both conventional banks and Islamic banks, therefore, accept deposits and use these deposits to provide funding to individuals and businesses. The difference, however, is that in conventional banking, frequently referred to as *retail banking*, the banks pay a rate of interest to depositors, and charges a rate of interest to debtors (Abedifar et al., 2013). The payment of interest on credit deposits and the charging of interest on debt (be it in the form of an overdraft, loan, credit card account or other debt arrangement) is fundamental in the conventional (or western) banking style (Cerovic et al., 2017). Put into perspective, the assets of conventional banks are traditionally derived from the savings and other deposits of savers and deposit account customers (Chong & Liu, 2009). These customers deposit money for two key reasons. Firstly, to receive interest on their savings and, in the case of deposit or checking account customers, to hold their money in a safe place and manage it, taking advantage of the bank's facilities in terms of electronic payments such as standing orders and direct debits, cheque amenities and similar money management tools (Haydon & Hicks 1966). Obaidullah (2005) argues that because these deposits cost the bank nothing to receive but provide them with the funds necessary to profit from lending and investing them, banks compete for these funds by providing individual customers with so-called free services or services priced at less than it would otherwise cost the bank to provide them. These services include preparation of banker's drafts, safekeeping of funds, accounting and the provision of traveler's checks. However, such benefits are effectively interest payments to the depositors and, as such, would be prohibited in a Sharia-compliant bank (Obaidullah, 2005; Wanke et al., 2016).

Further, the investment capital is generated via deposits placed with the bank either for investment purposes, safekeeping, or a combination, by savers (Abedifar et al., 2013). These savings are used to invest in debt finance in the form of conventional and consumer loans and mortgages. In the early part of the 21st century, immediately prior to the global banking crisis of 2008, some conventional banks frequently extended their investment capital by borrowing from other conventional banks, using these debt funds as equity to invest. This involved considering the debts owed to the bank in the form of loans, mortgages and similar agreements as assets owned by the bank in order to use them as collateral on the banks' own borrowing (Diaw, 2015; Downey 2009; Smolo & Mirakhor, 2010). This practice was inherently riskier than the traditional deposit asset equity, as this opened up the banks that undertook this practice to the variations of the conventional interest rates charged on these loans, as well as the fundamental risk of assuming that funds not presently held by the bank were assets – assuming that no defaults would occur (Wasiuzzaman & Gunasegavan, 2013).

Essentially, conventional banks make their profits from a range of sources, which include returns on investments, interest charged on borrowing and the banking fees that they charge their customers (either in the form of penalties for unauthorized borrowing or late payment, or as monthly or annual fees for services, such as credit cards or premium bank accounts), as well as the sale of additional products such as insurance and foreign currency exchange (Bessis, 2015). They also charge a range of fees to businesses for standard banking services such as processing customer payments, depositing cheques and cash, and providing coins to use as change or floats. They also make significant profits from *arrangement fees* on products such as loans and mortgages, and similar levies (Johansen, 2010).

In addition, conventional banks use credit scoring systems to help assess the risk involved in loaning money, either to a business or an individual customer (Bessis, 2015; Fiordelisi et al., 2011). They frequently use credit reference agencies, which are private sector companies regulated and licensed by their respective nations to hold a variety of data on the financial background and credit history of both individuals and companies. This data is analysed electronically to devise a *score* to determine how significant the risk of default is perceived to be on the proposed loan (Santomero 1997). This assists the bank in making a judgment on whether it believes that the amount of the loan is suitable for the applicant's current circumstances, and whether it perceives the proposed finance as affordable for the applicant prior to making a decision. Such decisions had previously been made manually by a bank manager or lending officer, but are now taken using a computerized process, frequently without any human involvement (Karkal 2010).

The most fundamental difference between the conventional banks and Islamic banks revolves around the payment and levying of interest. On the surface, this would raise the question of how an Islamic banking system could possibly be conventionally sustainable. This is based on the fact that traditional forms of conventional or retail banking rely on interest as their primary source of revenue, with a conventional bank profiting from the differential between the level of interest it pays for deposits and other sources of funds, and the level of interest it charges on its lending activities (Bessis, 2015; Freixas & Rochet, 2008). This is because, while different rates of interest are used for different activities or products (for example, savers would normally expect better rates of interest in exchange for tying their money in to a longer deposit period, using instruments such as term deposits or bonds, and borrowers would expect to pay a lower percentage rate of interest on large secured loans than they would on small unsecured loans or

credit card balances), a lower rate of interest is always paid to savers than is charged to borrowers (Bessis, 2015; Karkal, 2010; Mishkin, 2007).

As highlighted already, one of the basic principles of Islamic banking is the prohibition of *riba* (usury or interest) (Obaidullah, 2005; Zarrouk et al., 2016; Wanke et al., 2016). Before the 1980s, some contradictions in the interpretation existed among the different Muslim schools of thought where *riba* was used to define usury only (Hasan, 1994). However, it is now an accepted definition of all forms of interest by the majority of scholars (Warde, 2000). In particular, the Islamic scriptures, which are the basis of this banking system, taken from the Qu'ran as a primary source of Sharia, are explicit in their forbidding of the charging of interest:

> "O believers, devour not usury, doubled and redoubled, and fear you God; haply so you will prosper" (Qur'an 3:130)
>
> "God has permitted trafficking (buy and sell), and forbidden usury (Riba/interrest)" (Qur'an 2:275)

The central concept in Islamic banking and finance, as with many aspects of Islamic society, culture and legislation, is justice. In this instance, justice is achieved predominantly through the risk sharing, co-operation and mutual assistance (Haron & Azmi, 2009; Wanke et al., 2016; Warde, 2000). These aspects are reflected in the principle of profit/loss sharing which forms a cornerstone of Islamic banking (Abedifar et al., 2013; Warde, 2000). Thus, in terms of the methods by which Islamic banks generate revenue, deposits are made by investors and then invested in a manner similar to a conventional investment bank. Those who have deposited their savings then share the profits or losses resulting from the investment. While outright speculation is not permitted within Sharia law, this type of co-operative venture capitalism is seen as enabling enterprise and, as such, is permissible (Prenzlin, 2009). The principle of profit/loss sharing, thus, underlie Islamic banking operations. The principle of profit/loss sharing, Warde (2000, p. 153) argues:

> "is at once the most "authentic" form of Islamic finance since it replicates transactions that were common in the early days of Islam, the one that is most consistent with the value system and the moral economy of Islam and the most "modern" one. Thus, it is believed that Islamic banks are supposed to offer instruments consistent with the religious beliefs and cultural characteristics of Muslim societies."

As such, *Riba,* the prohibition of interest, essentially provides the theoretical concept to the Islamic banking system which is based on profit/loss sharing (Abedifar et al., 2013; Cerovic et

al., 2017). Further, concepts of *mudaraba* (Trustee Financing) and musharakah (equity participation) are all forms of profit/loss sharing (Farooq & Zaheer, 2015; Zarrouk et al., 2016).

A good example of a product that applies to both Islamic banks and conventional banks is mortgages. This is prime example of one of the most common lending scenarios within contemporary retail banking practice from a consumer perspective. In such an instance, the risks are shared between the bank and the borrower in Islamic banking. This frequently happens under a diminishing Musharakah, or partnership contract (Farooq & Zaheer, 2015). The applicant and the bank form an effective partnership, with the bank providing the bulk of the equity and the borrower a percentage which in a conventional banking scenario would be classed as a deposit. The borrower then buys out the bank's share of the partnership over a pre-defined period, through profits made on rental income for the property, although the borrower is usually the rental customer. In most cases, the borrower is effectively paying rent to him or herself, and then paying a proportion of that rent back to the bank in accordance with the bank's percentage capital share of the partnership at the time (Hassan et al., 2017; Khediri et al., 2015).

The bank (and therefore the depositors who have entrusted their money to the bank, who are effectively partners of the bank in the purchase of the house) makes revenue/gains through the profit from the rent, which is usually effectively paid by the borrower, as they normally live in the home they are purchasing through the bank (Farooq & Zaheer, 2015). Should the borrower default on either the agreed rent or the principal partnership agreement itself, then the bank may elect to provide the borrower with an interest-free loan to enable him or her to continue making the agreed payments on the understanding that they will pay in full when they are able to do so (Prenzlin, 2009; Zarrouk et al., 2016). This does not mean that Islamic banks do not assess credit risk. In fact, they are usually more risk-averse than many conventional banks when making lending decisions (Khediri et al., 2015; Miah & Uddin, 2017; Prenzlin, 2009).

Prenzlin (2009) simplified the definition of Islamic banking by calling it essentially as a system of banking without interest. This reflects Siddiqi's (1963) *Banking Without Interest* paper that elaborated on an interest free economy. Siddiqi (1963) defined the first model of an interest-free economy. It is one of the few models that comprehensively outline the micro and macroeconomic functioning of a system of economics based on profit and loss sharing (PLS) in place of interest within the institutional framework of a market economy. Within this model, the market economy is comprised of private entrepreneurs and private PLS banks and has no

public sector/government interference into and planning of the capital formation and allocation (Iqbal & Llewellyn, 2002).

Several Islamic countries have adopted a dual banking system (comprising both Islamic banks and conventional banks). In the Gulf Cooperation Council (GCC) region, for example, member countries enjoy a free market economy where customers are free to select from a range of banks – both Islamic and conventional (Alexakis et al., 2018; El Massah & Al-Sayed, 2015). This has provided the ideal environment for the development of numerous innovative Sharia-compliant products, which are designed to compete with the products on offer in conventional banks in the region (Ali, 2012). These range from equity funds to bonds and insurance, as well as daily transaction services such as debit cards, internet, and telephone banking (Iqbal & Molyneux 2016).

To further understand the key differences between Islamic banks and conventional banks, some ideological foundations underlying each banking system need to be explored particularly that no banking system would exist in an ideological vacuum (Kniss, 1988). This is because "any economic system requires a set of rules, an ideology to justify them, and a conscience in the individual which makes him strive to carry them out" (Robinson, 2017, p. 13). An economic system is basically the sum total of devices (or institutions and patterns of behavior) which influence economic choices through their interactions.

2.4 Comparing Islamic and conventional economics

Conventional banking and Islamic banking systems have slightly different ideological foundations. In general, the conventional banking model is tailored according to capitalistic ideology in which rate of interest is a significant factor (Bessis, 2015; Mishkin, 2007). In capitalism, there is greater social inequality through excessive accumulation of wealth (Muller, 2013). The basic economic problem that confronts the economic man in a capitalist economic system is the relative scarcity of resources available to satisfy the endless wants (Muller, 2013). In this economic system, the economic man is "a self-seeking individualist and who will maximise ruthlessly to get what he wants" (Robbin, 1989, p. 96). As such, social inequality and injustice continue to grow in capitalist societies as individuals pursue the most efficient means to an end, whatever it takes. As such, the economic man in this economic ideology is largely devoid of ethical values with the self-seeking motive.

The effects of a self-seeking economic man, largely devoid of ethical considerations, has been evidenced historically (Stevenson, 1982). For instance, capitalism has historically led to negative elements and exploitative practices such as child labour, long working hours and other forms of worker exploitation, and even the slave trade (Robbins, 1989; Stevenson, 1982); the more contemporary negative elements of capitalism have become more visible in recent times. These include market instabilities, short-selling, the boom and bust economic cycle, unemployment and perceived inequities (Akhtar & Jahromi, 2017; Claessens & Van Horen, 2015; Posner 2009).

The pervasiveness of capitalism is recognisable. In practice, all modern systems (excluding the few remaining totalitarian states) involve elements of capitalism and socialism to varying degrees, in what is known as *social market economies* (Posner 2009). These are a form of economic liberalism characterized by fair competition in private industry, the maintenance of low levels of unemployment, good working conditions and social welfare for all, alongside substantial public services (Muller, 2013). All of these are provided through government intervention.

Contrary to conventional banking model anchored in capitalist ideology, the ideological orientation of the Islamic economic system is anchored in a divine source (*Allah*) outside the society itself as revealed in the Holy Book (*Quran*) and the *Sunnah* (traditions of the Prophet Muhammad (Chapra, 1992). The Sharia (the foundation of Islamic law) is derived from these two sources. As compared to capitalist ideology that is essentially derived from within the society and thus subject to changes in time or space, the exogenous nature of Sharia means that the principles espoused in it are not subject to change. Instead, the economic principles are applicable to all Muslim societies at any time and at any stage of economic development (Warde, 2000).

Thus, the ideological foundation of the Islamic economic system is distinct from conventional philosophies, although it has often been referred to as *socially responsible capitalism* (Sairally 2007). Whilst communism and capitalism in their pure forms are absolutes, Sharia finance is upheld by Obaidullah (2005) as a *middle way* – an option without extremes, where the individual choice and freedom of capitalism are tempered with moral regulations which prevent the more exploitative elements of capitalism without recourse to legislation, whilst providing

the impetus to succeed not seen with socialist regimes. As such, Islamic economics can be differentiated from capitalism in its resistance to excessive accumulation of wealth but also distinct from socialism (which is based on the principle of "from each according to his ability, to each accord to his need" (Marx, 1970, p. 763) in its protection of the rights to own property and control production (Chapra, 1992). The key guiding principle in the Islamic system of economics is *Falah,* which describes a state of both happiness and prosperity both in this life and thereafter. Sharia finance accepts the capitalist principles of supply and demand, and also acknowledges the right of the individual to own personal property and to make a profit, but these rights are tempered with certain conditions.

These conditions are governed by ensuring that the business dealings of the individual are in agreement with Islamic law, such as ensuring that the individual is not involved in businesses which trade in products and services contradictory to Islam (such as alcoholic drinks, pornography, tobacco, pork products or armaments). They are also linked to the core Islamic belief that mankind has sufficient resources to fulfil his needs, and therefore it can only be through either a lack of effort or through greed that everyone will not have enough (Bessis, 2015; Khan, 2008).

In response to the global financial crisis, Khan (2010) argued that the crisis demonstrated the need for a system of or similar to a Sharia compliant system of global economics. Khan (2010) argument centres around the concept that the market itself is the place best suited to generate and maintain a financial system to suit its own needs. Kham provides the example of retail and wholesale businesses which provide their customers with non-interest-bearing finance in the form of accounts. Further, Kham proffers the concept of the *forward sale*, or *Bai' Salam*, as a model of a non-speculative economic instrument.

A forward sale, also known as a forward contract or just a forward is a purchase/sale agreement where the price is set at the time of the agreement, but the effective sale is postponed to a specified point in the future (Hull, 2006). As applied to Islamic economic practices, a purchaser would effectively promise to buy a commodity at an agreed point in the future, paying a price normally under the market value for the goods with the money changing hands at the time of the agreement, but the actual sale taking place at the time of delivery. In such a way, a grain merchant could agree to buy a farmer's stock of grain once it is ready at a time before it is grown. A farmer could then use the money paid for the *forward sale* to purchase seed and pay

wages to grow the grain. The sale would then complete when the grain is delivered, and the merchant could then make their profit by selling the grain to a third party, such as a mill. This type of agreement is covered by *Bay al-salam,* or a *Salam contract.* The purpose behind the forward contract is that it removes the requirement for two key economic instruments which are forbidden under Sharia law: the payment of interest and market speculation, as the payment for the goods in a forward sale is fixed at the time of the agreement, and no credit is granted, as no formal sale takes place until the goods are delivered (Khan, 2008).

The overriding feature of the Islamic economic system is that it has ethical practice as its cornerstone (Obaidullah, 2005; Wanke et al., 2016). The Sharia system seeks to fulfil the purpose of a system of economics from the point of view of facilitating the transfer of funds from points of savings surplus to points of savings deficit within the economy, whilst avoiding the use of economic instruments which are contrary to the Islamic faith. In this respect, an Islamic bank faces not only the technical constraints generally imposed on banks but also the legal and ethical constraints provided by the Sharia.

2.5 The development of the principles of Islamic finance

The development of Islamic finance has been a long process, taking many hundreds of years to get to where it is today. As with all processes by which people interact, it has developed in accordance with the needs of the people involved and the societies and civilizations in which it takes place (Islahi, 2018). Of all the world religions, Islam is the only one of whose laws require a specific banking and financial system. While some other religions have comparable ethical standards, including Christianity and Judaism, their religious laws do not prescribe a specific financial system (Utama, 2019). Historically, however, this was not always the case. *Usury* was forbidden by law in many countries in the past. During the middle ages, Catholic *Canon* law banned the charging of interest, but this only applied to Catholics. While the *Torah* (the Jewish holy book) also forbids the charging of interest, this is interpreted as a rule for transactions carried out between Jews, leaving Jewish people free to lend money to others outside their faith. This interpretation provided Jewish money lenders with the ability to effectively create their own market in Catholic countries (Algaoud & Lewis, 2001), famously becoming Western society's moneylenders.

The Western style of conventional banking in the form in which it is recognized today was a product of the Industrial Revolution. This, combined with the publication of Smith's (1976) *A Wealth of Nations* (as cited in Kohn, 1999), was the impetus for the creation of a formal system of banking and financial services. Prior to this point, basic and local financial services were provided by merchants, goldsmiths, and the aforementioned moneylenders.

The birth of Islam was the life of the Prophet Mohammad from 570 to 632AD. After the Prophet's death in 632AD, the leadership of the Muslim people passed to Abu Bakr, referred to as the first of the four *rightly guided* Caliphs. Over the course of the following five hundred years, Islam continued to expand and spread through the sub-Saharan African region, across and Asia Minor, and across the Mediterranean to Southern Spain (Hallaq, 1997). Islam, as a *World Power,* reached its peak around the ninth century AD and continued until around the thirteenth century. During this time, Islam represented:

> "The greatest military power on earth – its armies were at the same time invading Europe and Africa, India and China. It was the foremost economic power in the world [and] it had achieved the highest level so far in human history in the arts and sciences of civilizations" (Lewis, 2002, p. 6).

According to Runciman (1965), from around the mid-1500s, the Islamic civilization's learning and development began to be overtaken by that of the West. The fall of Constantinople to the Turks in 1453 led to the departure of many Byzantine scholars, most of whom relocated to Rome or other European cities. The same author reports that, armed with all the learning of ancient Greece from their own libraries, these Byzantines would become the catalyst for a European rebirth of learning which eventually led to the Renaissance. He also argues that, the fall of Constantinople was not the sole reason for the decline of the Islamic civilization, but rather a *last straw* in a series of events over a period of time. The invasion of the Crusaders, and particularly the Mongols into Islamic territories from the 11th to the 13th centuries, were key turning points in the course of Islamic civilization, also. When the Mongols invaded, they destroyed scores of Muslim libraries, hospitals, observatories and universities, until they reached and sacked Baghdad, which was at the time the Abbasid capital (Hodgson, 1977).

International conflicts and resultant displacement notwithstanding, science and learning were already in decline in Iraq, Al-Andalus (modern-day Spain) and the Maghreb (North-West Africa – including present-day Tunisia, Morocco, Libya, Algeria, and Mauritania) by the late 1300s, as conflicts between Sunni and Shi'a Muslims took precedence over ongoing education

(Khaldun, 1967). At the time of the decline of knowledge and innovation, the Islamic World also entered into a period of economic decline. This was fostered by a range of economic problems which would not be out of place in today's economic world - corruption, greed, spiralling taxation, oppression, and nepotism (Khaldun, 1967). Many observers from the Muslim World took an active interest in the developments of the European renaissance, principally in innovations in weaponry, new shipbuilding techniques and advances in medicine and medical practice. Despite this interest, they were unable to neither realize the socioeconomic reforms nor appreciate the elements responsible for the renaissance period, which prevented the Islamic World from replicating this period of development and advancement.

In addition to these external factors, the Islamic leaders of the day also had their part to play in the demise of their own civilization; through the suppression of the freedom of their scholars to learn, to innovate and to pursue new ideas and advancements; considering such things to be a threat to their power and dominance. With the stagnation of learning and civil development, came the overall decline of the Islamic World as it lost its economic, technological and military supremacy in favour of the West. The Islamic World entered into a long and slow decline over the following few centuries, which culminated in the breaking up and division of the Ottoman Empire at the end of World War 1 (Khaldun, 1967).

As with all World religions, Muslims are governed by a series of religious laws. As indicated above, Islamic law is known as *Sharia,* which is translated literally as *the path that leads to the spring*, or figuratively *a clear path to be followed and observed*. Islamic law has a variety of sources, which can be categorized (in order of provenance or priority) as *primary* and *secondary sources*, and *minor* or *subsidiary techniques* (Wasiuzzaman & Tarmizi, 2010).

The most important source of Sharia by far is the Holy Quran (which means *The Recitation*), which is the Muslim Holy Book - a collection of revelations to the Prophet Mohammad. Approximately 500 rules or decrees are contained in the Quran, of which 20 concern economic matters (Warde, 2000). Further, as stated in section 2.4, in addition to the Quran, the *Sunna* or *Hadith* are also considered to be primary sources of Islamic law. Secondary sources include the *Ijama*, *Qvias* and *Ijtihad* (Siddiqi, 1983; Warde, 2000; Wasiuzzaman & Tarmizi, 2010).

The first of the secondary sources is *Ijama.* This means *consensus* which, in this context describes the informed consensus of the community of scholars. The application of consensus is designed not for application in fundamental matters of faith, as these are already agreed, but for decisions on the application of Sharia in contemporary scenarios. This is of particular relevance concerning finance, as there is no reference to suitable models of Islamic banking in either the Quran or in the Hadith, the primary sources of Sharia. For this reason, the development of the Islamic system of banking has mainly been developed through the consensus of modern Muslim scholars at both national and international levels.

The second of the secondary sources is *Qyias*, or analogical deduction. This is where scholars use analogies from existing law to make judgments. The third of the secondary sources is *Ijtihad,* which is individual interpretation. This is where individuals use their own reason and judgment to decide whether a particular course of action is in line with the spirit of the Holy Quran and the Hadith.

Finally, there are the subsidiary techniques, or minor sources:

- *Istihsan* - juristic preference. This refers to the exceptions that can be made to an otherwise strict or literal legal judgment. *Istihsan* can be applied to any method and does not provide a single or definite response.
- *Istihlah*- public interest. This means *seeking the good*, in literal terms (Ramadan, 2004) or taking public interest into consideration.
- *Urf* – custom. This refers to the recognition of customary practice (within reason). This is not accepted by all schools of thought and would only be used in practice in the absence of a more prestigious alternative, such as scripture.
- *Darura* – necessity. This is a method of creating exceptions to the law in times or situations of absolute necessity. This is the mechanism by which an individual is permitted to carry out an action which would normally be against Sharia, such as eating a forbidden foodstuff such as pork, or to carry out an otherwise impermissible action if it is the only way to preserve the individual's life at the time. It would be for the individual to decide what would constitute a legitimate case of *Darura*.

The Quran and the *Sunna* can be considered as Sharia in its most narrow sense. They are perceived to be the word and the will of God and, as such, to be both infallible and immutable (Siddiqi, 1983). However, given the sheer length of time since these writings came into being,

there are many contemporary issues which require judgement on which ancient law cannot be used, simply because the situation to which they refer did not exist at the time the law was prescribed. In addition, both texts have elements of their phrasing which are open to interpretation. It is in these circumstances that secondary sources of law are used. Further, Al-Shafii (1997) suggested that human reason should be considered to be the final judge on matters not directly governed by the Quran. Thus, Al-Shafii (1997) advanced two secondary sources of law: *Ijma*, or consensus, and *Qyias*, or analogy. In concent with the primary sources of the Quran and Sunna, these form the four-principals of *Fiqh* or the *Fundamentals of Jurisprudence*. From very early in Islamic history, Muslims established the basis of a financial system without interest in order to manage resources to facilitate the financing of conventional activities and the fulfilment of consumers' needs (El-Masry et al., 2015). The original pre-Industrial Revolution method of financing business transactions was generally based on profit and loss sharing. Versions of mudarabah (a passive partnership agreement) and musharakah (an active partnership agreement) were used, in addition to deferred trading and qaradhasana (a basic form of interest-free loan) to finance both business transactions and the purchases of end users (El-Masry et al., 2015; Wasiuzzaman & Tarmizi, 2010).

The system was very successful over the course of Islamic civilization. These systems changed very little throughout several centuries. The initial Islamic financing models of mudarabah and musharakah proved sufficient to facilitate the needs of the entire Islamic civilization, from the financing of agriculture and manufacturing to long-distance trade agreements (Warde, 2000).

After the decline of the Muslim civilization, as discussed previously, Western institutions replaced most of the existing Islamic arrangements, including the Islamic systems of rudimentary financial services provision (Chapra, 1992). Given the point in history where Muslim civilization collapsed, it was the Western systems of financial management, which were in place at the time of the Industrial Revolution that closed this gap. They became the face of the financial services as they changed irrevocably to service the growing trade and the swiftly developing industrial economies formed by the advances in technology and innovation of the age.

After the Industrial Revolution, global economic development continued from the point it was established, namely using the Western systems created during the period of rapid industrial development (Siddiqi, 1983). Despite this, there remained numerous independent Muslim

states. The revival of Islam after the Second World War refocused the Muslim World on its desire to reinstate most of its lost institutions, of which an effective Sharia-compliant financial system was a key priority.

2.6 The development of modern Islamic banking

While the foundation for a Sharia-compliant system of finance had been laid centuries ago, the turning point for the establishment of a modern comprehensive system of Islamic finance and, more specifically, Islamic banking, came in the 1960s (Iqbal & Molyneux, 2016). One of the first attempts to introduce Islamic financial system was in Pakistan in the late 1950s through the establishment of a local bank in a rural setting, initiated by religious landlords who deposited funds without interest to be utilised by small landowners (Wilson, 1983). However, the bank collapsed mainly due to the inability to recruit bank staff and also a shortage of funds as deposits were too small to cover the credit demands (Wilson, 1983).

The first successful Islamic bank was launched in Egypt in 1963 by Dr Ahmad El Najjar, a leading Egyptian economist (Iqbal & Molyneux, 2016). The bank, *MitGhamr Savings Bank,* became the first Islamic bank. The bank operated through a system of profit sharing, providing savers with an incentive to deposit funds without resorting to the payment of interest. This institution was modelled on *Sparkessen* (or *Savings Bank*) in Germany, which used profit-sharing techniques in order to finance small, rural conventional enterprises. By the end of 1976 the bank had expanded to include 9 branches throughout Egypt. These banks neither paid interest on savings nor charged interest on debts. Their business activities were generally limited to market sectors where they had direct investments, or where they had entered into partnerships with depositors. For this reason, these early institutions were operating more as investment institutions than as conventional or retail banks. In 1971, *Nasir Social Bank* became the first *high street* bank in Egypt which operated according to Islamic financial principles. However, the institution's charter made no reference to Sharia principles.

The concept of an Islamic bank was then rationalized in the early 1970s, when the First International Conference on Islamic Economics, organized by King Abdul Aziz University in Makkah, Saudi Arabia, was held. The first bank explicitly based on Sharia principles was established soon after this conference by the Organization of Islamic countries (OIC) in 1974, known as the Islamic Development Bank (IDB) (Khediri et al., 2015). The bank's primary role

was with intergovernmental activities and provided the funds for development projects within OIC member countries. The business model for the bank was based on profit sharing financial assistance for projects, with profits generated through charging fees for financial services.

Shortly after this, the first domestic Islamic Bank, the Dubai Islamic Bank (DIB), was launched in the UAE (Iqbal & Molyneux, 2016). This was swiftly followed by the establishment of the Islamic Development Bank (IDB) in Jeddah, Saudi Arabia (Khediri et al., 2015). The formation of these institutions coincided with the rise in the price of oil which was a key feature of the Middle Eastern economy in the 1970s; which led to the accumulation of oil revenues in several oil-rich Muslim countries, chiefly Saudi Arabia, the UAE, and Kuwait, among others. This oil revenue, or *petro-dollars*, as it came to be known, provided a powerful incentive to create suitable investment opportunities for Muslims wishing to make money from investments, but also wishing to comply with Sharia (Wasiuzzaman & Tarmizi, 2010). The sudden wealth of a significant group of Muslims provided the incentive to take what was at the time merely the conceptual entity that was interest-free or Islamic banking, and turn it into a viable business model or, at the very least, a sufficiently powerful business case to warrant further market research and development (Khediri et al., 2015).

After the initial pioneering work, many private and semi-private conventional Islamic banks were formed in Egypt, Sudan, Kuwait, Bahrain, and other Islamic countries. It was at this point that Islamic banking was recognized as a feasible and viable alternative to traditional conventional financial institutions (Hasan & Lewis 2007). Use of Islamic banking practices is no longer limited to Arabic and Muslim countries, but has furthered its reach:

> "from East to West, all the way from Indonesia and Malaysia towards Europe and the Americas…Many conventional banks, including some major multinational western banks have also started using Islamic banking techniques" (Siddiqi, 1983, p. 26).

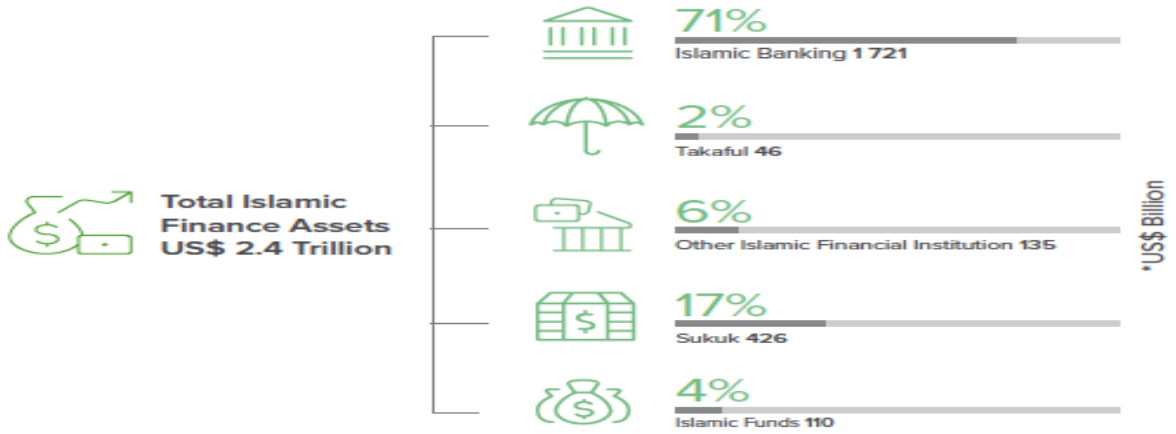
Deregulation in the 1980s and 1990s across the Western economies of Europe and the USA provided a great opportunity for Islamic banking, fostering as it did the development of a range of bespoke Sharia-compliant products. Prior to this, Islamic banks' product ranges were somewhat narrow. With the removal of the *red tape* on the types of products that financial institutions were able to create, bankers were free to devise a vast array of financial products tailored to every customer need, both religious and secular.

Since Siddiqi's (1983) observation, Islamic banking has continued to grow exponentially and is far from an anomaly, but has demonstrated its capability to not only present a realistic alternative to traditional forms of conventional banking (Al-Musali & Ismail, 2014; Ariff, 1988; Beck et al., 2013; Caporale et al., 2017); but has also established itself as a system which contains many unique principles which could benefit the stability of conventional banking if applied (Ali, 2012; Olson & Zoubi, 2011). Srairi (2010) asserts that although it was originally developed to satisfy the requirements of Muslims, at present Islamic banking has currently achieved worldwide acceptance to become one of the world's fastest growing banking and capital markets sector (PWC, 2018).

2.7 The Islamic banking movement worldwide

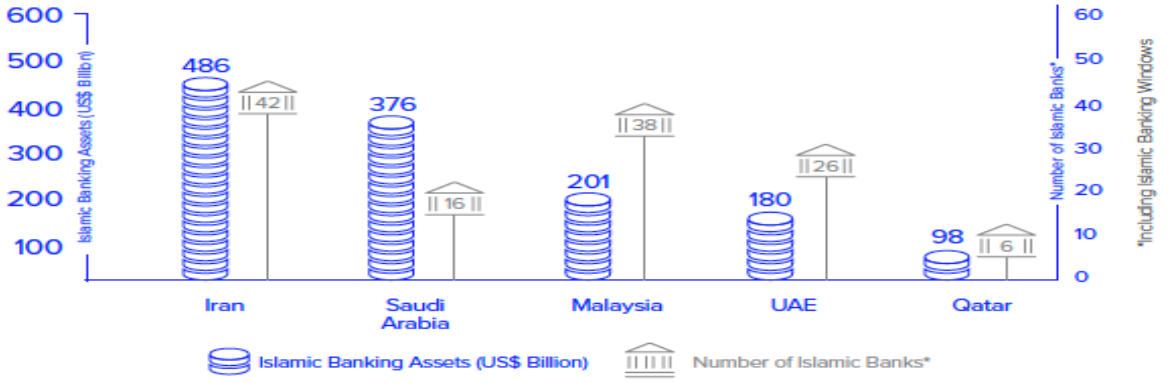
While the key elements or markers of Islamic banking are similar across the world, particularly since the rationalization of the format, there are subtle differences across the world. Sharia-compliant banking may have its root in nations which have a high percentage of Muslims within the population such as Egypt, Saudi Arabia and the United Arab Emirates, but there are Muslims living in most countries around the world. In many countries, there is a sufficient Muslim population to make the introduction of Sharia-complaint banking conventionally viable, either through dedicated Islamic banks, Islamic products offered within standard conventional banks, or both.

Islamic banking has continued to grow (see section 2.8) with the global Islamic finance assets growing to US$2.4 trillion in 2016 (The National, 2017). The US$2.4 trillion of global Islamic finance assets is composed of 71% from Islamic banking and 17% from Sukuk (IFSB, 2018). The remaining 12% comes from Islamic funds (4%), Takaful (2%) and the remainder from other Islamic financial institution products (see figure 3 below). Currently, there are 505 Islamic banks operating worldwide (IFSB, 2018). With respect to the distribution of the Islamic banks, the countries leading in terms of banking assets and number of Islamic banks are Iran (US$486 billion with 42 Islamic banks), Saudi Arabia (US$376 billion with 16 Islamic banks), Malaysia (US$201 with 38 banks) and UAE (US$180 with 26 banks) (IFSB, 2018) (see figure 4 below).



Source: IFSB, 2018

Figure 3: Total Islamic Finance Assets



Source: IFSB, 2018

Figure 4: Top global Islamic banking markets

2.8 An overview of the MENA region

2.8.1 The socio-economic context of the MENA region

The Middle East and North Africa (MENA) region is composed of 21 countries: Algeria, Bahrain, Djibouti, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Malta, Morocco, Oman, Qatar, Saudi Arabia, Syria, Tunisia, the United Arab Emirates (UAE), West Bank and Gaza and Yemen (World Bank, 2018). However, there is still some ambiguity regarding what countries the geographical region actually includes (OECD, 2016; UNICEF, 2018; World Bank, 2018). Thus, the World Bank classification is used in this study. Geographically, the region spans horizontally from Morocco to Iran, and is a bridge connecting Europe and Asia (see figure 5).

The region has a population of about 444.3 million (World Bank, 2018) with Egypt and Iran having the highest populations (93 million and 80 million respectively). The annual population growth rate was 1.7% in 2017 representing a slight decline from 1.9% in 2014 (World Bank, 2018). The region is urbanising fast at 3.3% per year with 65% of its population now in urban areas from only 35% in 1960 (World Bank, 2018). As the region is made up of different countries, there is more than one official language. However, Arabic is the most spoken language among the countries followed by Persian whilst English is often taught and used as a second language (World Population Review, 2018).

Unemployment rate, measured as a percentage of total labour force, in the region has reduced from 12.7% in 1991 to 11.6% in 2005 and 10% in 2016 (World Bank, 2018). The female labour force, however, still remains low at only 20% in 2017 (19% in 2000). This is low when compared to the world average of 39% and developing countries (e.g. UK, USA with 47%) (World Bank, 2018). Thus, the region is one of the highly gendered in the world where female participation remains low partly because of the socio-cultural fabric (Abed & Davoodi, 2003; Broadbridge & Hearn, 2008). The adult literacy rate has drastically increased from only 47% in 1980 to 79% in 2016. This improvement has been brought about through some national educational reforms (e.g. Saudi Arabia's King Abdullah Bin Abdulaziz's 10-year Project for the Development of Public Education) (Smith & Abouammoh, 2013).

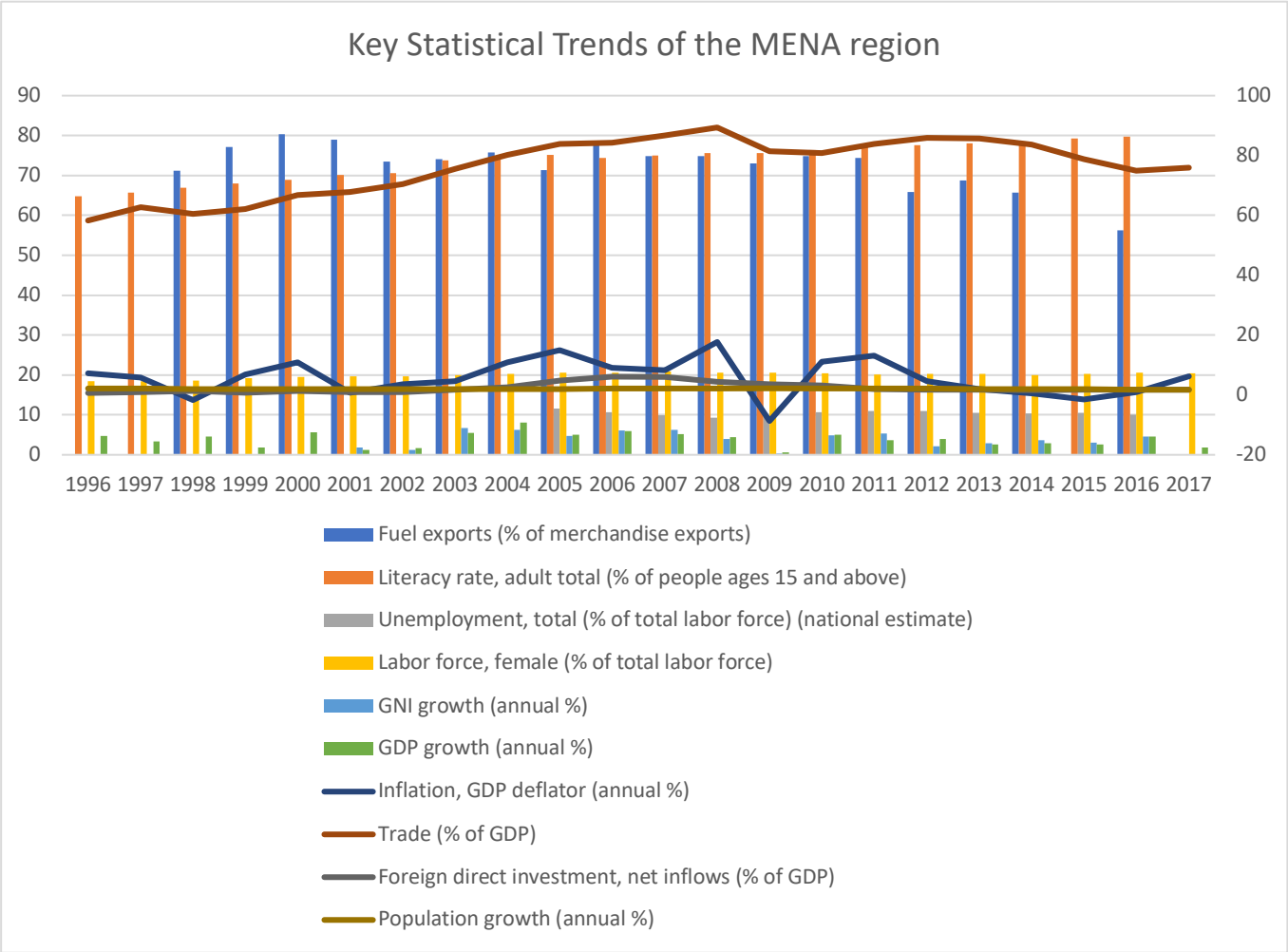
The MENA region can be separated into developing economies and emerging economies (World Bank, 2018), as it is composed of some oil rich countries and also poor countries. It is one of the world's richest regions in terms of resources, since it includes the oil-rich countries of the Gulf Cooperation Council (De Melo et al., 2012), holding more than 60 percent of the world's proven oil reserves and about half of the global gas reserves (World Bank, 2018). The fuel exports as percentage of merchandise exports has fluctuated from 80% in 2000, 74% in 2010 and 56% in 2016 (ibid). The fluctuations in the world oil prices strongly affect these figures. Thus, most the economies rely heavily on export of oil and oil related products to maintain their economies. Their economies are still largely undiversified except for instance, Israel, that has a more diverse economy (McKee et al., 2017). The region recorded gross domestic product (GDP) growth rates of 1.8% in 2017 down from 2.8% in 2014 and 3.6% in 2011 (World Bank, 2018). The region's GDP accounts to about 4.5% of the world's GDP with Saudi Arabia, Iran and UAE having the highest GDPs in the region. However, GDP per capita is highest in Qatar followed by the UAE (IstiZada, 2018). Trade as a percentage of GDP has

grown in the region from around 66% in 2000 (56% in 1970) to 75% in 2017 (World Bank, 2018). On the other hand, the percentage of net inflows foreign direct investment as percentage of GDP remains low at 1.8% (World Bank, 2018). Average annual inflation rate (GDP deflator) in the region has revolved from about 10.9% in 2000 to 6.3% in 2017. Figure 6 shows some key regional statistics.

Therefore, whilst the MENA countries could be distinguished based on different aspects, this study makes a distinction between the oil exporting countries, which comprise the GCC countries, and the non-GCC countries. The oil-exporters, GCC countries, are Bahrain, Kuwait, Qatar, Saudi Arabia, and UAE; and the non-GCC countries include Algeria, Bahrain, Djibouti, Egypt, Iran, Iraq, Israel, Jordan, Lebanon, Libya, Malta, Morocco, Oman, Syria, Tunisia, West Bank and Gaza and Yemen.

Source: IstiZada, 2018

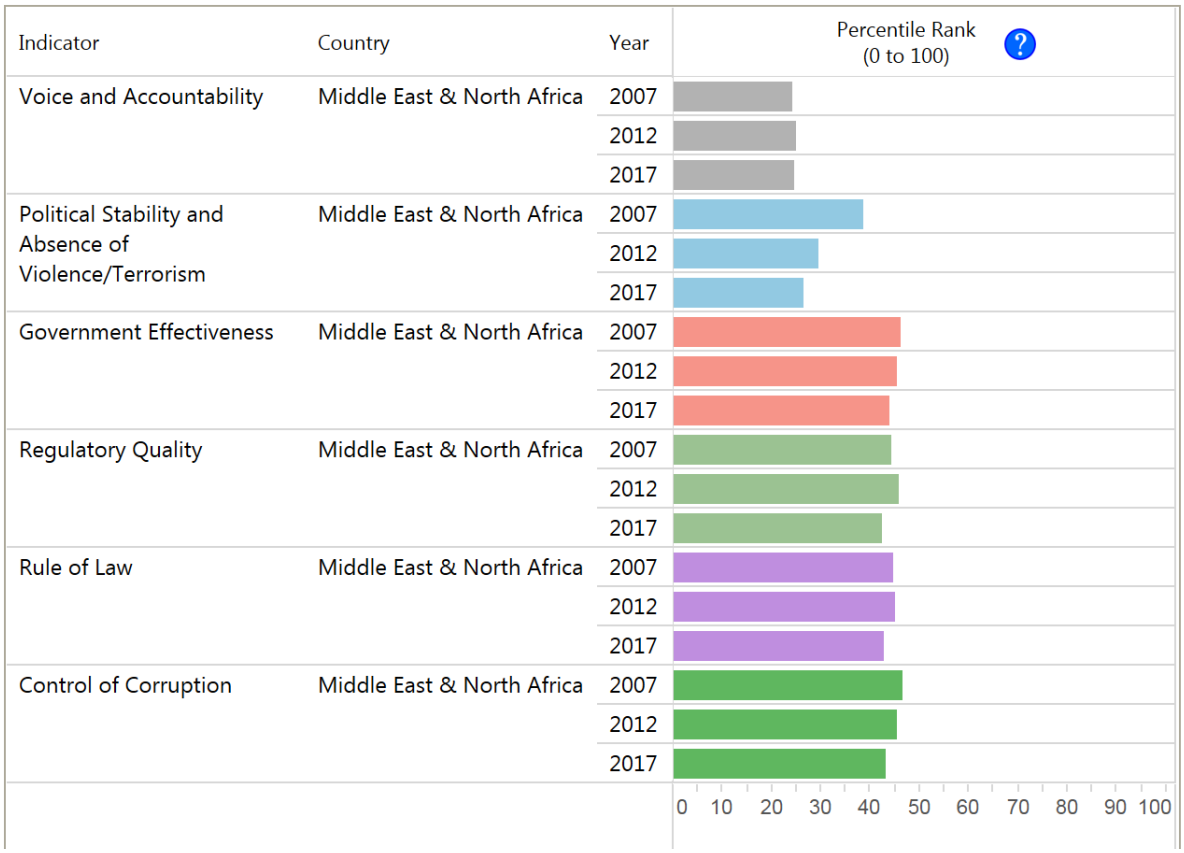
Figure 5: The MENA Region



Source: Worldbank Databank, 2018

Figure 6: Key statistical trends of the MENA region

Further, with respect to governance, the region has not recorded significant positive changes in aspects such as the control of corruption, the rule of law, government effectiveness and political stability and absence of violence/terrorism in the period 2007 to 2017 (WGI, 2018). In fact, the region has recorded a reduction in governance aspects of political stability and absence of violence/terrorism, government effectiveness, rule of law and control of corruption. These aspects have largely been influenced by the Arab Spring that started in 2010 in Tunisia and spread over the region (Springborg, 2011) leading to some regional instability. The positive consequence of the uprising is observable in the marginal increase in voice and accountability recorded from 2007 to 2017. Figure 7 shows some governance indicators on six dimensions.



Source: World Governance Indicators, 2018

Figure 7: World Governance Indicators (WGI) MENA region

The conflict in Syria and Yemen, in addition to the political transition after the Arab uprising, has had negative economic effects on the region. The effect of these two problems, for instance, have caused a 50% drop in FDI (McKee et al., 2017; OECD, 2016). The OECD (2016, p. 19) reported that "recent years have been particularly challenging for the region, with foreign direct investment (FDI) inflows decreasing from a peak of 5.3% of GDP in 2006 to less than 1% in 2015". As such, the OECD recommends a more openness to trade and investment and facilitating efforts to support national development plans. This, for instance, requires legal and institutional reforms. Egypt, Iraq, Jordan and Kuwait embarked on these legal and institutional reforms in 2014 and 2015, in order to boost FDI inflows.

2.8.2 The financial sector in the MENA countries

The MENA region is "one of the world's fastest growing markets in the banking and capital markets sector" (PWC, 2018, p. 1). The financial services sector is undergoing a massive overhaul and several factors are fostering the transformation. Among these factors is the nature

of the population which is getting younger, better educated and more demanding. Also, the financial products and services are getting more diverse whilst the regulatory requirements for better monitoring of processes is increasing (PWC, 2018). Investments to develop secure financial systems across the region have also increased in order to be internationally competitive (Ali, 2012). The impact of globalisation coupled with liberalisation policies have enabled foreign banks to enter this region (World Bank, 2017). This has led to more efficiency and competition in the sector (Jeon et al., 2011; Cull et al., 2010). As such, the entrance of new actors in the financial sector has increased the sector's competitiveness. This has resulted in more product offering and investment in financial technology (PWC, 2018). On the other hand, the openness of the sector to foreign entrants has exposed it more to external financial shocks (Ali, 2012).

The World Bank (2017, p. 1) observed, however, that the banking sector in spite of the gradual economic liberalisation,

> "remains largely shielded from the pressures of globalization and competition in most of the region. In several countries, the state retains a dominant role in the sector. Even in countries where most banks are privately owned, competition remains low. The result is financial systems that, while stable, perform inefficiently, not reaching large segments of the population. Most MENA banks tend to lag behind in product innovation and the provision of new services to both savers and borrowers".

In a few countries, especially the GCC countries, the banking sector is well developed, profitable and efficient whilst in many other countries, the banking sector is dominated by public sector banks (PWC, 2018). The government influences the operations of the public sector banks in aspects such as credit allocation, losses and liquidity issues, and wide interest rate spreads (World Bank, 2017). Further, PWC (2018) observed that in more than half of the MENA countries, the banking sector is highly concentrated whereby the largest three banks would account for total commercial bank assets of over 65%. With such concentration, it makes the entrance of new banks very slow. As such, the World Bank (2017, p. 1) recommends that the MENA countries need to develop strategies that encourage sector participation such as "opening the markets to new domestic and foreign entrants and further deregulation of interest rates and products, combined with strengthened prudential supervision". In addition, the countries need to embark on strategies that promote innovation, improved financial management and better intermediation of the banking system (PWC, 2018, World Bank, 2017). These developmental strategies would, in most countries, require legal and institutional reforms

so as to enhance transparency and accountability. One particular type of banking, Islamic banking has substantially grown in the region.

The next section reviews the literature on performance comparison between Islamic banks and conventional banks. The underlying argument is that the differences in the operational models of Islamic banks and conventional banks has implications on their performance (Alexakis et al., 2018; Cerovic et al., 2017).

2.9 Comparing the financial performance of Islamic banks and conventional banks

The growth of global Islamic finance has given rise to an increase in research interest in Islamic banking (Alexakis et al., 2018; Ben Selma Mokni & Rachdi, 2014; Caporale et al., 2017; Miah & Uddin, 2017; Parashar & Venkatesh, 2010; Srairi, 2013). These have been undertaken from different country or regional perspectives and employing different methodological approaches. One of the areas of focus has been on performance evaluation of the Islamic banks as compared to conventional banks (Abedifar et al., 2013; Belanes & Hassiki, 2012; Caporale et al., 2017; Hassan et al., 2019; Hussain & Al-Ajmi, 2012; Johnes et al., 2014; Zeitun, 2012). The interest to investigate banking performance has partly been fueled by the observable better performance of the Islamic banks (IBs) as compared to conventional banks (CBs) during the 2008 global financial crisis (Khediri et al., 2015; Parashar & Venkatesh, 2010; Zeitun, 2012). Thus, whilst the 2008 global financial crisis had a negative impact on both the Islamic banks and conventional banks, most studies showed that the losses sustained by the Islamic banks were lower than conventional banks (International Monetary Fund, 2010; Hassan & Kayed, 2009). The nature or operational models of the Islamic banks are perceived to have contributed to more stability and better performance (Alexakis et al., 2018; Srairi, 2013). Hassan & Kayed (2009, p. 38) argued that the 2008 financial crisis gave "credence to the Islamic scholars and economists who pointed out the inherent frailty and faults of the financial system and who reaffirm that the root of the crisis was inadequate market discipline resulting from lack of profit-sharing models of financing, from expanded use of derivatives and from the policy of 'too big to fail'". Wasiuzzaman & Tarmizi (2010) similarly argued that Islamic banks were not caught by toxic assets as Sharia law prohibits interest. However, some studies (e.g. Parashar & Venkatesh, 2010) have shown different results with Islamic banks found to have suffered more losses from the 2008 financial crisis than conventional banks. Other studies, such as Boukhris & Nabi (2013) did not find any significant differences with respect to the effect of the 2008

financial crisis on Islamic banks and conventional banks contrary to most studies (e.g. Hassan & Kayed, 2009). As such, the empirical evidence is mixed.

The next section builds the context of the 2008 global financial crisis after which a review of studies on bank performance in the MENA region, the focus of this study, is undertaken. In discussing the impact of the global financial crisis, the GCC countries, which are part of the MENA region, are used.

2.9.1 The 2008 Global Financial Crisis (GFC)

A banking crisis can be described as having been reached when the ratio of nonperforming assets compared to a given bank's total assets exceeds 10% (Demirguc-Kunt & Detragiache 1998). Agénor (2002) developed this further with his hypothesis that banking crises are caused by one or more of the following antecedents: mismatches between a bank's assets and liabilities; weaknesses in regulatory framework; failure of government guarantees and incentives; premature financial liberalization; microeconomic distortions and institutional failures; lending booms; the exchange rate regime, and self-fulfilling panics and information-based runs

The 2008 global banking crisis has a great deal of literature analysing it from many different viewpoints. Most of this literature assumes direct causality between the 2008 crisis and the economic boom/bust cycle (Harrison, 1999). Kindleberger & Aliber (2011) demonstrated that the 2008 crisis had the same catalyst as previous crises, namely the preceding *boom*, or *bubble*, as also predicted by Harrison (1999). They hypothesise that these *bubbles* typically commence with a rise in stock market prices, which is almost invariably caused by legitimate rationale. The rationale may be a simple rise in general prosperity, or may be linked to a specific event, such as a technological breakthrough. Examples of stock price rises created by such breakthroughs are the invention of the transistor radio and motor vehicle in the 1920s, and the creation of the internet (the *dot.com bubble*) in the late 1990s.

Excessive market confidence as described above was triggered in this case by an exceptional housing boom and linked hike in land prices. Buoyed by this seeming increase in prosperity and swell in property prices, many banks allowed mortgages to be extended to applicants who would traditionally be considered as unacceptable credit risks. This was undertaken in the belief

that, as the housing market continued to appreciate, that the worst-case scenario of default and resultant repossession would lead to profit for the institution (Downey, 2009; Sen, 2008).

This decision led to a glut of high-risk debt secured only on the assumption of a perpetually buoyant housing market. These debts were then packaged as assets and built into investment products, known as collateralized debt obligations (CDOs). When the property markets stalled, these debts proved worthless and the investment products based on them instantly devalued (Barnett-Hart, 2009). It is the exposure to these risks which then threatened investment banks and their associated retail businesses across the globe. In addition, the crisis has had a knock-on effect to other financial institutions outside the banking system, such as insurance companies (Schich, 2010).

Many believe that the prolonged period of low interest rates combined with lax regulation and supervision encouraged rapid and substantial growth of credit and, as a result, pushed house prices up. For instance, the United States Federal Reserve lowered the interest rate in 2001 from 6.5 percent to 1.75 percent and then to 1 percent in 2003, a 45-year low (Nonomiya & Lanman, 2008). Mirakhor & Krichene (2009), in an extensive work on the crisis, provide two major explanations: a conventional explanation and an alternative one. The conventional view holds that the emergence of the crisis was due to a number of factors, including: extraordinarily high liquidity; rapid pace of financial engineering which innovated complex, opaque, and difficult-to-understand financial instruments that were way ahead of the market; informational problems caused by lack of transparency in asset market prices, particularly in the market for structured credit instruments; outdated, lax or absent regulatory-supervisory oversight which encouraged excessive risk taking; faulty risk management and accounting models; and the emergence of an incentive structure that created a complicit coalition composed of financial institutions, real estate developers and appraisers, insurance companies and credit rating agencies whose actions led to a deliberate under-estimation and under-pricing of risk. This view is attributed to institutions such as, the International Monetary Fund (IMF), the Bank for International Settlements (BIS), the European Central Bank (ECB), and a number of prominent academics (Mirakhor & Krichene, 2009).

On the other hand, the alternative view suggests that the crises are an intrinsic attribute of financial capitalism that underpins the structure of the financial system. Such a structure is inherently fragile and favours the existence and confluence of certain conditions that converts

fragility into instability. One of the prominent figures of this view, Keynes (1976), pointed out a flaw in financial capitalism which was rooted in the predominance of interest-based debt contracts in these capitalist economies. Thus, there is no assurance that an amount of money lent now for more money guaranteed in the future is heading toward investment projects that generate employment in the real sector. Indeed, the money could be used for consumption or purchases of financial assets generated from previous period investments. According to Keynes (1976), it is this flaw in the financial capitalism that worsens the problem of coordination between saving and investment, which, in turn, constitutes a source of instability for the system (Mirakhor & Krichene, 2009).

Chapra (2011) blames excessive and imprudent lending as being the most important cause of the GFC. However, such a behaviour would not be possible without the existence of some factors that created a false sense of immunity from losses. Chapra (2011) identifies three factors which are: inadequate market discipline in the financial system, which was a consequence of the absence of profit and loss sharing; the mind-boggling expansion in the size of derivatives, particularly credit default swaps (CDSs); and the *too big to fail* concept which tended to give assurance to big banks that the central bank, for fear of systemic disruption, would come to their rescue and not allow them to fail. Some scholars (Usmani, 2009; Siddiqi, 2009) have explicitly dealt with some causes to show the elements of riba (interest), gharar (uncertainty on the terms of the contracts), and maysir (gambling) with various degrees of combination between juristic discussion and economic analysis.

Mirakhor (2008) makes a case for an effective and strong regulatory framework. Such a framework will have to develop Sharia standards as well as the usual regulatory-prudential-supervisory standards aiming at achieving safety and security for Islamic financial institutions and instruments. This is based on the lessons learned from the global financial crisis which indicate the ineffectiveness of a fragmented regulatory framework based on a flawed conception of divided asset-money-commodities markets. Financial innovation, information technology advances in recent decades and the rapid pace of financialization have blurred the traditional differentiation between various markets calling into serious question fragmented regulatory authority.

2.9.2 The effect of the 2008 GFC on banking in GCC countries

Initially, the GCC economies appeared immune to the effects of the 2008 banking crisis. However, subtle signs of the impact on the GCC markets soon began to appear. The conventional banks began to reduce their lending, which impacted on corporate finance and particularly the construction industry (Worth, 2008). The biggest impact appeared on the oil markets, with prices falling steadily from June 2008 onwards. Between July and December of 2008, the OPEC basket price for oil fell by 70% from a peak of just over $130 per barrel to less than $40 per barrel (Ahmed, 2010).

Given the GCC region's reliance on oil prices for its prosperity, the market response was predictable. Stock markets throughout the region responded to the rapid devaluation of oil prices and began to fall in direct response to this. Despite initial assurances from the Central Bank of UAE that the Emirates were *fully insulated* from financial troubles in evidence abroad, they proceeded to make available around US$13.6 billion in September 2008 to ease credit problems, in an echo of the bailout measures already seen in the USA. Concurrently, investor confidence was damaged by a series of high-level corporate scandals (Worth, 2008). Institutions in both Kuwait and Bahrain came closest in the GCC region to failing, with the Central Bank of Bahrain placing two banks in administration and the Kuwaiti authorities bailing out another that got into difficulty (Project Finance International, 2010).

2.9.3 Effects of the banking crisis on conventional banks

Immediately prior to the 2008 crisis, the levels of credit held in Dubai were growing by 49% per annum (Central Bank of UAE, quoted in Rahman, 2008), which was almost double the growth rate of deposits in the Emirate. This led to widely-held concern that the economy was overheating and required significant correction in order to ensure security of the banking system (Worth, 2008). Unlike the US and other Western economies, about 95% of companies within the GCC were small and medium-sized businesses. These smaller companies predominantly utilized private equity and had a much lower dependence on the international capital markets in comparison to US and European businesses (Smolo & Mirakhor, 2010). The corporate landscape painted a similar picture in terms of the situation in Oman, Kuwait, and Bahrain. This reduced the corporate sector throughout the GCC region's exposure to the international credit crisis, although some companies still experienced a reduced demand for exported products and

services as a result of the crisis (Rahman, 2008). In addition, the banks within the GCC region were partially insulated by their relative lower dependency on international markets, owing to their relatively higher liquidity levels and lower levels of international borrowing (Diaw, 2015). For example, at the time that the crisis began, European finance to total bank assets was less than 10%, whereas bank capital reserves in the UAE were 11.02% of total assets (Central Bank of UAE, quoted in Rahman, 2008).

Having been in relative free-fall since the end of 2007, the Emirates Interbank Offered Rate (EIBOR) increased dramatically around halfway through 2008, peaking in mid-Autumn. This sudden modification was due to a liquidity reduction following large withdrawals by speculators. These withdrawals followed the Emirati Government's decision not to revalue the Dirham and were also a response to similar international developments. This gave rise to a tightening of credit and served as a guard against high-risk loans (Rahman, 2008). Figure 8 below shows the fluctuations in the EIBOR interest rate over the last few years before 2008. The year 2008 shows the largest fluctuation, as well as the most dramatic divergence over the period shown.

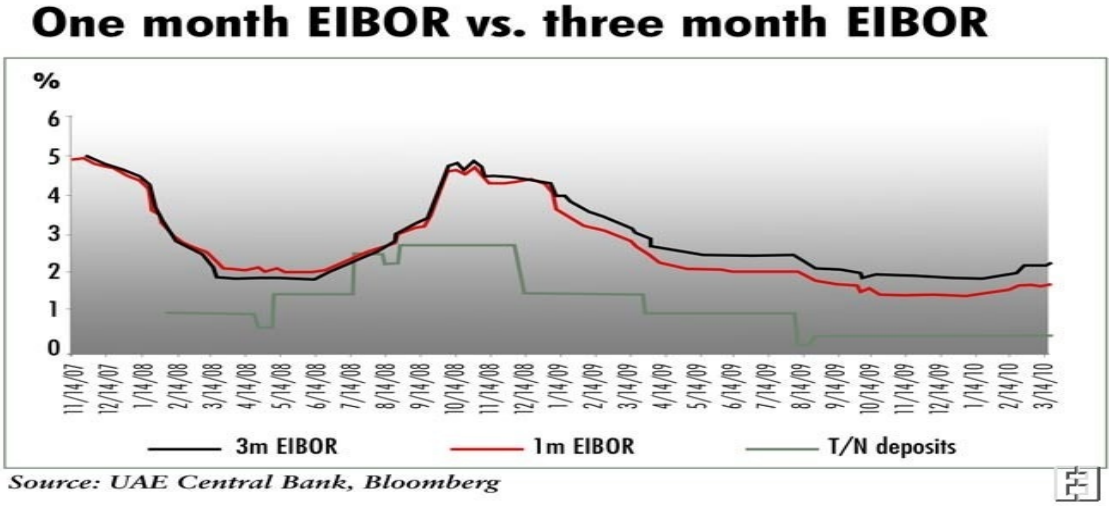


Figure 8: EIBOR Rate Fluctuations 2007 – 2010

2.9.4 Effects of the banking crisis on Islamic banking

In general, due to the sector's fundamental avoidance of both debt and share trading, Islamic banks in the GCC were indirectly affected by the global banking crisis (Ahmed, 2010; Alexakis et al., 2018; Karkal, 2010; Hasan, 2009; Srairi, 2013). For Islamic banks, the prohibition of debt trading, coupled with the anti-money laundering precautions inherent in Sharia-compliant

banking provided a shield against the mechanisms and practices which were responsible for the crisis (Hasan, 2009). This was augmented by the inherent risk-averse nature of Islamic banking as demonstrated in GCC nations (Al-Hamzani, 2008).

However, the initial perception that Islamic banks were completely insulated from external shocks were disputed (APS Review Downstream Trends, 2008; Parashar & Venkatesh, 2010). For instance, the APS Review Downstream Trends (2008) reported that Islamic banks were also badly affected by the global economic crunch, citing the stagnation of the property markets in the GCC region as a key factor in the downturn. It was suggested that, while the sector is inherently risk-averse owing to its structure and methods of doing business, it also had its own risks, such as a perceived lack of a viable Islamic inter-bank market. While deposits must be available for depositors to redeem on demand, Islamic bank assets are usually backed by property, and are therefore illiquid by their very nature. This forces Islamic banks to hold more by way of liquid assets than their conventional counterparts to pare down risk of illiquidity (APS Review Downstream Trends, 2008).

One of the biggest threats to the solvency of the Islamic banking sector within the Gulf region during the banking crisis came not from an exposure to credit risk, as was the case in the conventional sector, but from the Islamic banking sector's over-reliance on the petrochemical market:

> "There's an indirect but powerful link between the Islamic financial industry and the performance of the oil market. As long as oil remains expensive, which is our base-case scenario, Islamic banking will keep on growing successfully" – Anouar Hassoune, Banking Analyst, Moody's Credit Rating Agency (Financial Times, 2008, p. 5).

During the initial part of the financial crisis from 2007 onwards, the crisis placed the Islamic banking sector in a very favourable position, both in terms of market performance and the sectors' image in the worldwide media. As reported by Hasan & Dridi (2010), Islamic banks offered better performance and greater resilience than their conventional counterparts throughout 2008 from the perspective of asset growth as well as overall profitability. Whilst both sectors' profitability was damaged by the crisis, conventional banking suffered a loss of profitability in excess of 35% year on year between 2007 and 2008, whereas the comparative loss by the Islamic banking sector was less than 10% (Hasan & Dridi, 2010).

In addition, Hasan & Dridi (2010) also reported stronger growth in the Islamic sector compared to traditional banking options through the entire crisis. This, coupled with the growth in interest in Islamic banking from non-Muslims (Deloitte, 2018; Johnes et al., 2009; The Economist, 2018) and growing Muslim population (Hamdan, 2010), suggests that the sector has a lot more potential for growth and expansion of overall banking market share all over the World, both in recession and through recovery. Furthermore, Hasan & Dridi (2010) use this information to assert the possibility that an increased use of Islamic banking has the potential to assist in improving overall market stability going forward. These findings are supported by Caba-Maria (2011), who adds that, as the global financial crisis appears to be far from over and is an ongoing phenomenon without historical comparison, it is impossible to be certain of the long-term implications, but the present evidence seems to support ongoing growth for the Islamic banking sector.

Caba-Maria (2011) uses this analogy to assert that the principles on which Islamic banking is built are designed (albeit in part incidentally) to protect the global economic system by eschewing the practices which contributed to the global financial crisis. This is because the Islamic banking business model features protecting it from the initial impact of the global financial crisis, whereas what are seen as the excesses of contemporary banking culture are specifically prohibited. For example, while conventional banking practice is largely debt-based and allows for risk transfer between institutions, Islamic financial intermediation is based on assets and focuses on sharing risks reducing the risk to individuals. Risk transfer and excessive leverage are strictly prohibited according to *Sharia* principles, and it is these qualities which made the Islamic banking system less exposed to the credit crunch and more resilient by nature, which protected the industry from the effect of toxic collateralized debt obligations and other debt-based *assets* which originally triggered the global banking crisis (Caba-Maria, 2011).

A review of some studies in the MENA region on comparative financial performance analysis between Islamic banks and conventional banks is discussed next.

2.10 Selected comparative studies on the performance of Islamic and conventional banks

As this study focusses on the MENA region, a review of some studies conducted to investigate the financial performance of Islamic banks and conventional banks in the region is undertaken. The major studies reviewed are shown in the Appendix A. Different classification of these

studies can be observed. The studies can be classified based on country or region focus, based on periods (before or after the global financial crisis), based on the research method used, based on the dependent and independent variables etc. In studying Islamic banks' performance, some studies have devoted only to Islamic banking performance over a period (Al-Qudah & Jaradat, 2013; Ghosh, 2016; Asutay & Izhar, 2007; Smaoui & Salah, 2012; Wasiuzzaman & Tarmizi, 2010) while others have compared the Islamic banks' performance to conventional banks (El Massah & Al-Sayed, 2015; Khediri et al., 2015; Zarrouk et al., 2016). The approach relevant to this study is the comparative approach of Islamic banks to conventional banks. An increasing number of studies have been conducted to analyse the performance of Islamic banks and conventional banks using different methods and also different years (Alexakis et al., 2018; Khediri et al., 2015; Olson & Zoubi, 2008; Smaoui & Salah, 2012; Srairi, 2013). The review of these studies is organised around the period covered.

2.10.1 Comparative studies of financial performance before the 2008 global financial crisis

As the Islamic banking movement was growing even before the 2008 global financial crisis, a number of studies sort to investigate the relative performance of the Islamic banks as compared to conventional banks. For instance, Iqbal (2001) compared the profitability of 12 conventional banks and 12 Islamic banks for the period 1994 to 1998 using return on assets (ROA) and return on equity (ROE) as the dependent variables. Iqbal's (2001) study showed that Islamic banks were better capitalized and more profitable than conventional banks. Similarly, Olson & Zoubi (2008) compared the financial performance (profitability, efficiency, liquidity and risk) of 28 conventional banks and 16 Islamic banks in the GCC countries for the period 2000 to 2005. Olson & Zoubi (2008) employed logistic regression and neural network to demonstrate that accounting ratios are good discriminators between Islamic banks and conventional banks. Their study found that whilst Islamic banks were more profitable than conventional banks, they were less efficient than conventional banks. These results are consistent with Srairi' (2010) study. In particular, Srairi (2010) investigated the performance of Islamic banks and conventional banks using a stochastic frontier analysis for the period 1999 to 2007. In total, Srairi (2010) analysed 48 conventional banks and 23 Islamic banks in the GCC region. Srairi's (2010) study results suggested that conventional banks were more efficient than Islamic banks. This efficiency was measured with respect to cost and profit efficiency levels. As such, some similarities are

observable in these studies regarding the higher profitability of Islamic banks before the 2008 global financial crisis.

However, Metwally (1997) study of 15 Islamic banks and 15 conventional banks in the period 1992 to 1994 showed that there was no significant difference between the two banking types in terms of their profitability and efficiency. The differentiation of the two banking types, nonetheless, was observed in liquidity, leverage and credit risk. The period (2 years), however, is relatively short in Metwally (1997) when compared to other studies.

2.10.2 Comparative studies of financial performance during the 2008 global financial crisis

As discussed in section 2.9 above, the growing interest in Islamic finance research was partly fueled by the 2008 global financial crisis. Several studies focusing on this period were conducted (Khediri et al., 2015; Parashar & Venkatesh, 2010; Zeitun, 2012). Most of these studies, showed that whilst the 2008 global financial crisis had a negative impact on both the Islamic banks and conventional banks, the losses sustained by the Islamic banks were lower than conventional banks (International Monetary Fund, 2010; Hassan & Kayed, 2009). For instance, Khediri et al. (2015) studied 61 Islamic and conventional banks for the period 2003 to 2010 in the GCC countries. Their study investigated whether Islamic banks and conventional banks behave significantly different utilising 14 financial ratio in their comparison. Khediri et al. (2015) study found that the two banking types are significantly different with respect to credit and insolvency risk, operating leverage and off-balance sheet activities. However, some similarities were observed in their profitability and liquidity. Similarly, the financial crisis had a negative effect on both banking types despite the time shift. Their study findings suggested that Islamic banks are, on average, more profitable, more liquid, better capitalized, and have lower credit risk than conventional banks. Khediri et al. (2015) study also found that Islamic banks are, on average, less involved in off-balance sheet activities and have more operating leverage than their conventional peers. This implies that Islamic banks have better risk management approaches.

In the same vein, Belanes & Hassiki (2012) investigated the performance of Islamic banks and conventional banks during the financial crisis period from 2006 to 2009. Their study employed data envelopment analysis on 19 conventional banks and 13 Islamic banks in the MENA region.

Unlike El Massah & Al Sayed (2015) study, Belanes & Hassiki (2012) found that there is no significant difference in the performance of the banks (captured by efficiency) whether Islamic or conventional. Similarly, Johnes et al. (2014) study, using the data envelopment analysis, found that Islamic banks are relatively less efficient than conventional banks.

Abedifar et al. (2013) investigated 553 banks in 24 countries covering the period 1999 to 2009. Their study suggested that Islamic banks are more capitalized and profitable than conventional banks. In addition, Islamic banks have lower credit risk than conventional banks, specifically small, leveraged, or those operating in countries with more than 90% Muslim populations. These results are similar to Beck et al. (2013) study of 510 banks across 22 countries in the period 1995 to 2009 that showed that Islamic banks are less efficient, but have higher intermediation ratios, have higher asset quality, and are better capitalized than conventional banks.

Smaoui & Salah (2012) on the other hand, examined 44 Islamic banks over the period 1995 to 2009 in order to investigate how bank specific characteristics and macroeconomic environment affected the profitability of Islamic banks in the GCC countries. Their study highlighted that higher capital, better asset quality, and larger bank size lead to higher profitability. Further, favorable macroeconomic conditions were found to positively affect the profitability of banks in the GCC countries.

2.10.3 Comparative studies of performance after the 2008 global financial crisis

A review of the studies that cover the period after the 2008 global financial crisis reveal some similarities (and also differences) to those before the crisis. For instance, Srairi (2010) study results are largely consistent with Alexakis et al. (2018) study that employed financial ratio analysis and meta-frontier Malmquist productivity index to examine 19 Islamic and 43 conventional banks in 6 GCC countries for the period 2006 to 2012. The financial ratio analysis was aimed at assessing cost, revenue and profit performance, whist the Malmquist productivity index (MPI) captured efficiency and technological changes. Alexakis et al. (2018) study found that Islamic banks exhibited worse cost and profit performance but were on par with respect to revenue performance. Further, the MPI analysis suggested that conventional banks and Islamic banks have become more aligned following the global financial crisis. The implication of these

findings is that there should be less significant differences between Islamic banks than conventional banks after the 2008 global financial crisis.

In the same vein, Zarrouk et al. (2016) study investigated whether Islamic bank profitability was driven by same forces as conventional banks. Similar to Smaoui & Salah (2012) approach, Zarrouk et al. (2016) study aimed to identity the banks' specific determinants and the macroeconomic factors that influenced the profitability of 51 Islamic banks in the MENA region in the period 1994 to 2012. Their study used dynamic panel data model. Zarrouk et al. (2016) study showed that banks' profitability is positively affected by cost effectiveness, asset quality and the level of capitalization. Further, Zarrouk et al. (2016) revealed that there were several elements of similarities between determinants of profitability for Islamic banks and conventional banks. This might suggest the implication of Alexakis et al. (2018) studies. Caporale et al. (2017) took a similar approach to Zarrouk et al. (2016) but focussed more on the difference between domestic banks and foreign banks. Caporale et al. (2017) study showed that during the financial crisis, the domestic banks outperformed the foreign banks in the MENA region. El Massah & Al-Sayed (2015) on the other hand, undertook a comparative analysis of Islamic banks and conventional banks' performance using financial ratio analysis for 16 banks (11 conventional and 5 Islamic banks) in the United Arab Emirates (UAE). Their study, unlike Zarrouk et al. (2016) covered the period post financial crisis from 2008 to 2014. El Massah & Al-Sayed (2015) study found that conventional banks are more solvent, liquid, profitable and less risky than Islamic banks. These results are contrary to other studies in different settings (Abedifar et al., 2013; Beck et al., 2013; Hassan et al., 2019). Hassan et al. (2019), for instance, investigated 52 Islamic banks and conventional banks in the GCC countries for the period 2007 to 2015 and showed that Islamic banks are better than conventional banks in managing risks.

This review points to mixed results among the studies regarding the performance of Islamic banks and conventional banks. There is a general trend towards showing that Islamic banks are less efficient than conventional banks. On profitability, however, the results are widely mixed. Performance of Islamic banks during the financial crisis is generally found as better than conventional banks.

Further, given the differences in the Islamic banks and conventional banks' operational models, to effectively the same goal (Venardos, 2012), the underlying factors that influence performance could conceivably be different. In this respect, Zarrouk et al. (2016, p. 47) argue

that “in sum, we cannot make clear predictions whether Islamic banks’ profitability is influenced by same factors as conventional model. On the one hand, because of the specific Islamic activity, Islamic banks’ profitability would not be determined by the same factors retained in the conventional case”. As such, different studies have sought to investigate the factors that influence the banking performance (Belanes & Hassiki, 2012; Caporale et al., 2017; El Massah & Al-Sayed, 2015; Johnes et al., 2014; Ramlan & Adnan, 2016). This is discussed next.

2.11 Factors that influence banking performance

The financial performance of banks could be influenced or determined by different factors which can be categorised into internal factors and external factors (Abid et al., 2018; Ali & Puah, 2019; Abedifar et al., 2013; Al-Musali & Ismail, 2014; Daly & Frikha, 2017; Zarrouk et al. 2016). The internal factors relate to bank specific factors that could affect the financial performance. These could be numerous. However, the common bank specific characteristics which have been investigated in the literature include bank size, capitalisation, liquidity, loan intensity, financial leverage, asset quality, operating efficiency (overheads), age, ownership, taxation etc (Al-Musali & Ismail, 2014; Caporale et al., 2017; El-Masry, 2011; Micco et al., 2007; Van Horen, 2007). As there are several internal factors which could potentially affect the financial performance of banks, different studies have investigated the significance of only a selected number of factors identified as most important in the literature (Al-Qudah & Jaradat, 2013; Hassan & Bashir, 2003; Olson & Zoubi, 2011; Smaoui & Salah, 2012; Zarrouk et al., 2016).

2.11.1 Internal factors

Some studies, for instance, have shown that the size of the banks has an effect on profitability (Chronopoulos et al., 2015; Ghosh, 2016; Kassem & Sakr, 2018). The larger banks can gain from economies of scale, wider product offering and loan diversification (Chronopoulos et al., 2015). Thus, a positive relationship between bank size and profitability has been revealed by some studies (Chronopoulos et al., 2015; Mirzaei et al., 2013). Smaoui & Salah (2012) study of 44 GCC Islamic banks between the period 1995 to 2009 found that higher capital, better asset quality and larger size of banks contributed to better profitability. Similarly, Kassem & Sakr’s (2018) investigation of the effect of bank specific characteristics on the profitability of

Egyptian banks revealed that bank size and loan loss provision ratio were the main determinants of bank's profitability (measured by return on assets, return on equity and net interest margin). Contrary, other studies have shown a negative relationship (Căpraru & Ihnatov, 2014) while others suggest that bank size is insignificant (Olson & Zoubi, 2011). Caporale et al. (2017) study of 76 foreign and 46 domestic banks in 17-member countries, employing linear regression, found that size does not influence bank's performance.

Further, with respect to bank capitalisation, the literature suggests that more capitalised banks can invest more effectively than those banks with lower capital base which then impacts in profitability (Ghosh, 2016; Mamatzakis et al., 2016). As such, a positive relationship is conceived and shown by most studies (Ghosh, 2016; Mamatzakis et al., 2016). Contrary, other studies found a negative effect of bank capitalisation on performance (Chronopoulos, et al., 2015). An increase in loans issued (loan intensity) has also been investigated to identify how this affects the performance of banks (Beck et al., 2013). While some studies suggest that an increase in loans issued increases the default (bankruptcy) risk which makes banks less stable (Căpraru & Ihnatov, 2014), other studies argue that more loan issued increase the net interest earned and therefore the profitability of banks (Chronopoulos et al., 2015; Demirguc-Kunt & Huizinga, 1999; Lin & Zhang; 2009).

In addition, the quality of loans issued has been identified as a significant factor on the performance of banks (Căpraru & Ihnatov, 2014; Petria et al., 2015). The banks with sound quality of loans demonstrate effective credit risk management which reduces their risk and improves profitability (Athanasoglou et al., 2008; Petria et al., 2015). However, higher credit risk has been shown to negatively affect banking profitability (Heffernan & Fu, 2008). The way the bank is financed has also implications on its performance. This factor shows the financial leverage of the banks. Studies show that there is a negative relationship between financial leverage and profitability of a bank (Al-Qudah & Jaradat, 2013). Financial leverage in this case showing the amount of the total assets which have been financed by external debt.

The age of banks has also been examined with missed results found. Mirzaei et al. (2013) showed that old banks recorded better performance than new banks in the emerging economies. However, the opposite was observed in the advanced economies where new banks had better profitability. The profitability of new banks has also been shown by other studies (Dietrich & Wanzenried, 2014). Contrary, the effect of age was not found to be significant in Dedu & Chitan

(2013) study. The stability of banks has been investigated in several studies using Z-score (Abedifar et al., 2013; Beck et al., 2013). Most studies show that more stable banks with less default risk have higher returns (Ghosh, 2016; Mamatzakis et al., 2016; Mollah & Zaman, 2015). As such, there is a positive relationship between Z-score and bank performance.

The examination of bank ownership on performance has also shown mixed results. Athanasoglou et al. (2008), for instance, found that domestic ownership increases bank profitability contrary to others (Lin & Zhang, 2009; Micco et al., 2007) that suggest that foreign ownership improves performance. However, Mirzaei et al. (2013) study showed mixed results.

As shown above, the results on factors that could influence banking performance are mixed and the debate on which factors are most significant continues. This is exacerbated further by the countless number of internal factors that could affect the banking operations. Therefore, this study will utilize those factors identified as most significant in prior studies.

2.11.2 External (macroeconomic) factors

The economic conditions prevailing in a country (region or globally) also have an effect on the performance of banks (Caporale et al., 2017; Haron & Wan, 2008). This is observable, for instance, during the 2008 global financial crisis when banks (both Islamic banks and conventional banks) were adversely impacted (International Monetary Fund, 2010). As such, studies have examined the changes in the macroeconomic conditions on banking performance (Asutay & Izhar, 2007; Caporale et al., 2017; Haron & Wan, 2008; Johnes et al., 2014; Wasiuzzaman & Tarmizi, 2010; Zarrouk et al. 2016). The macroeconomic conditions are depicted by economic indicators which include gross domestic product (GDP), inflation, market capitalisation among other (Caporale et al., 2017).

The investigations of the relationship between the macroeconomic indicators and banks' profitability have largely shown a significant and positive association in prior studies (Hassan & Bashir, 2003; Asutay & Izhar, 2007; Kosmidou et al., 2006; Smaoui & Salah, 2012). For instance, Wasiuzzaman & Tarmizi (2010) studied the profitability determinant in Malaysia over the period 2005 to 2008 and revealed that GDP and inflation have both a positive and significant influence on bank performance. Other studies have also shown a positive relationship between the macroeconomic conditions and banking profitability in other country contexts (Asutay &

Izhar, 2007; Bashir, 2001; Hassan & Bashir, 2003; Kosmidou et al., 2006; Smaoui & Salah, 2012). The argument is that macroeconomic conditions have an effect on the supply and demand for loans and deposits in a country which then impacts the banks' performance (Smaoui & Salah, 2012). Favourable economic growth would be expected to stimulate demand for bank funding (Wasiuzzaman & Tarmizi, 2010). However, some studies have found that inflation has a negative effect on banking profitability (Rumler & Waschiczek, 2014; Zarrouk et al., 2016). The studies suggest that a rise in inflation rate could lead to a reduction of expenditure and borrowing by both individuals and companies which then reduces the net interest earned by banks (Rumler & Waschiczek, 2014). GDP and inflation are the widely used macroeconomic indicators in the literature on comparative banking financial performance analysis.

2.12 Reflections on the literature review

This chapter was aimed at reviewing the literature on Islamic banking. The chapter started with a discussion of the definition of what Islamic banking is and putting this into context, by comparing the Islamic banking model to the conventional banking model. As such, the key similarities and differences between the two-banking model were highlighted. The key principle is that Islamic banking is anchored into Sharia, the Islamic law. This is different to the conventional banking system that is tailored towards capitalistic ideology. After a discussion of the different ideological foundations of the two banking types, the developments in Islamic banking and an overview of the MENA region were outlined.

The chapter then reviewed the literature on studies that have taken a comparative financial performance analysis within the MENA region. This review was done by separating the periods of focus, before, during and after the 2008 global financial crisis. An overview of the comparative performance of the Islamic banks before the 2008 financial crisis shows that they performed more profitably than conventional banks despite being mainly inefficient. During the crisis period, most studies demonstrated more stability and less negative effect. After the 2008 global financial crisis, studies suggest significant alignment between the two banking types. Most studies, however, show better profitability of conventional banks than Islamic banks. Nonetheless, the results are still mixed, and a simplistic generalisability would be inappropriate. What is evident though, is the mixture of results and focus. More studies from different methodological approaches and also timeframes is imperative. This study makes a contribution to this wider debate which is still inconclusive by focussing on the MENA region

which has not been widely covered. The next chapter discusses the methodological approach taken.

Chapter Three: Methodology and methods

3.1 Aim of chapter

This chapter presents the research methodology adopted to implement the research objectives. It will outline the research philosophy (section 3.4), approach, strategy (section 3.5) and the data collection instruments (section 3.6). The detailed statistical data analysis methods employed are outlined in Section 3.7. This is followed by an overview of the research validity, including the strength and limitations of the adopted approach.

3.2 Methodological overview

Deciding on an appropriate research methodology and methods governed by the research questions is an imperative aspect of any study (Draper, 2004). A research methodology or design is presented so as to build an understanding of the research philosophy and research strategy adopted. The research methodology, including the time horizon of the study, is therefore outlined in this chapter. A research methodology (or design) in this study basically refers to:

> "the specifications of methods and procedures for acquiring the information needed. It is the overall operational pattern or framework of the project that stipulates what information is to be collected from which sources by what procedures. If it is a good design, it will ensure that the information obtained is relevant to the research questions and that it was collected by objective and economical procedures" (Green & Tull, 1970, p. 73).

A research methodology (or design) should therefore be perceived as "a plan, structure and strategy of investigation so conceived as to obtain answers to research questions or problems" (Kerlinger, 1986, p. 279). The essence of a plan is to give an overall scheme or programme of the research, outlining what the researcher will do. This plan provides a framework and direction to the research enquiry in the most efficient manner (Chawla & Sodhi, 2011). Further, a research design forms an important part of research that helps to understand that human actions can only be understood in the context of their place within different layers of social reality (Robson, 2011). Contrarily, research methods refer to "the various means by which data can be collected and/or analysed" (Collis & Hussey, 2013, p. 5). In distinguishing the two terms, Crotty (2005, p. 3) states that methods are "the techniques or procedures used to gather and analyse data related to some research question or hypothesis" while methodology represents

"the strategy, plan of action, process or design lying behind the choice and use of methods to the desired outcomes". In other words, methodology forms the procedural framework within which the investigation is carried out. Therefore, as argued by Berry (1983, p. 47) methodology "is not just about data collection and the rules for evidence; in its larger conception it is about the nature of explanation and the means by which explanations are produced".

In summary, this research adopts a positivist epistemological approach and employs a deductive quantitative data analysis. Based on the research aim, a positivist epistemological perspective is adopted as it seeks to predict and explain causal relationships, assuming a priori causal relationship between observable phenomena (Saunders et al., 2012). The priori causal relationship in this case, is between banks specific characteristics and macroeconomic indicators to the banks' financial performance. A case study strategy of the MENA banking industry is adopted with data collected quantitatively analysed using statistical multiple regression method.

3.3 Research questions

The universal principle applied in the design of the methodological framework is that the research strategy or strategies and the method or techniques employed, must be appropriate so as to address the research objectives (Creswell, 2013, Collis & Hussey, 2013). The research objectives and research questions are reiterated in this section in order to put the methodological discussion in context and thus, justify the appropriateness of the methodological choice. The research aims, objectives and research questions were outlined in sections 1.4 and 1.5.

This study aims to enhance knowledge and understanding of the comparative financial performance of Islamic banks and conventional bank before, during and after the 2007/2008 global financial crisis. In undertaking this comparative financial performance analysis of the Islamic banks and conventional bank before, during and after the 2007/2008 global financial crisis, the study seeks to answer the question "what was the relative performance of the Islamic banks as compared to the conventional banks before, during and after the 2007/2008 financial crisis"? In order to comprehensively address this key question, some guiding questions are considered which assisted in the development of hypotheses that contribute to addressing the research aim. The research questions that are addressed in the study are:

(a) Are there significant financial performance differences between conventional banks and Islamic banks?
(b) How was the financial performance of both Islamic and conventional banks before and after the 2007/2008 global financial crisis?
(c) How did the 2007/2008 financial crisis affect the performance of conventional banks and Islamic banks in the MENA countries?
(d) Are the determinants of bank performance the same for Islamic banks and conventional banks?
(e) Does the artificial neural network (ANN) improve the explanatory power of the significant difference between Islamic banks and conventional banks?

whilst the hypotheses that are tested are:

H1: There are no significant/fundamental financial performance differences between the operations of Islamic and conventional banks in MENA countries.
H2: There are no significant differences between the Islamic banks and conventional banks for the financial variables before and after the financial crisis.
H3: The 2008 global financial crisis had a similar negative effect on the performance of both the conventional banks and Islamic banks in the MENA countries.
H4: The determinants of bank performance for Islamic banks and conventional banks are the same.
H5: The artificial neural network (ANN) does not improve the explanatory power of the significant difference between Islamic banks and conventional banks.

It is essential that the methodology framework that guides this research process is made clear. This is particularly significant, not only for the possible replication and constructive criticism (Robson & McCartan, 2016) but also for the provision of a basis for logical and valid reasoning. Research is conceived as "a systematic investigation to find answers to a problem" (Burn, 2000, p. 3) which is "undertaken in order to contribute to knowledge and understanding in a particular field" (Myers, 2013, p. 6). Undertaking research is also about understanding the world and this understanding is informed by how one views the world, how one views understanding to be and the purpose of that understanding (Cohen et al., 2013). This view of the world is implied by value-based preferences which underlie one's philosophical perspective. Inevitably, every

research "brings with it a set of assumptions about the social world it investigates" (Denscombe, 1998, p. 3). The research philosophy is discussed next.

3.4 Research philosophy

One of the most important aspects when deciding a research design is the consideration of the research philosophy (Creswell, 2013). According to Saunders et al. (2012), this aspect is important as it reflects the way one thinks about the development of knowledge which consequently affects the way one goes about doing the research. Another important implication resulting from the philosophical considerations is that the choice of any particular method of research largely depends on the research philosophy (or paradigm) that researchers follow to conduct their research (Creswell, 2013; Silverman, 2016). Easterby-Smith et al. (2012, p. 27) usefully captures the relevance of the philosophical consideration in stating that,

> "First, it can help to clarify the research design. Second, knowledge of philosophy can help the researcher to recognise which designs will work and which will not. It should enable a researcher to avoid going up too many blind alleys and should indicate the limitations of particular approaches. Third, knowledge of philosophy can help the researcher identify, and even create, designs that may be outside his or her past experience. And it may also suggest how to adapt research designs according to the constraints of different subject of knowledge structures"

The fundamental condition for adopting a research philosophy is that it should fit the research problem that the researcher intends to investigate (Silverman, 2016). There are typically two major philosophical considerations: epistemology and ontology. Ontology is concerned with the nature of reality and existence (Saunders et al., 2012). Ontology is described as the science of study of being (Blaikie, 2010). This encompasses understanding 'what is' while epistemology tries to understand 'what it means to know' (Gray, 2013, p. 20). Therefore, whilst ontology is concerned with the nature of reality, epistemology is about "the nature of knowledge, its possibility, scope and general basis" (Hamlyn, 1995, p. 242). Generally, an interconnection exists between ontology, epistemology and methodology. This relationship exists because "ontology involves the philosophy of reality, epistemology addresses how we come to know that reality while methodology identifies the particular practices used to attain knowledge of it" (Krauss, 2005, p. 759). This interconnection between ontology, epistemology and methodology is similarly captured by Healy & Perry (2000, p. 120) in stating that "ontology is the 'reality' that researchers investigate, epistemology is the relationship between that reality and the researcher whereas methodology is the technique employed by the researcher in order

to investigate that reality". The interrelationship between these philosophical considerations is usefully represented in a research paradigm (Guba & Lincoln, 1994; Ponterotto, 2005). A research paradigm represents a general set of philosophical assumptions which define the nature of possible research (Mingers & Brocklesby, 1997). Kuhn (1970, p. viii) describes a research paradigm as "an integrated cluster of substantive concepts, variables and problems attached with corresponding methodological approaches and tools". Therefore, Gray (2013) states that a research paradigm in actual sense relates to a research culture embodying a set of beliefs, values, and assumptions that a community of researchers have in common regarding the nature and conduct of research.

This research's ontological and epistemological standpoints are underpinned within the positivism research paradigm. The philosophical assumptions of this paradigm is that reality is perceived to exist independently of consciousness or that there is an objective reality 'out there' (Gray, 2013). This ontological perspective is linked to objectivism which "portrays the position that social entities exist in reality external to social actors concerned with their existence" (Saunders et al., 2012, p. 23). Therefore, the ontological position is "that social phenomena and their meanings have an existence that is independent of social actors" (Bryman, 2016, p. 45). Epistemologically, the positivism paradigm seeks to explain and predict what happens in the social world by searching for regularities and causal relationships between its constituent elements (Burrell & Morgan, 1979). Applying to this study, the proposition is that there is a causal relationship between a bank's specific characteristics and macroeconomic indicators to its financial performance. From this epistemological stance, the aim is to discover the objective truth and in doing this, researchers should strive not to include their own feelings and values.

Merriam & Tisdell (2015) argues that the theory behind the concept of positivism is the possibility of considering a 'scientific' perspective to study social behaviour. As such, since reality exists external to the researcher, this must be investigated through the rigorous process of scientific inquiry (Crotty, 2005). A positivist researcher therefore, supposes that the world follows fixed laws of causation; that the complexity of phenomenon in this world could be confronted better through reductionism; and that emphasis should be placed more on objectivity, measurement, and repeatability (Fitzgerald & Howcroft, 1998). Further, contrary to interpretivists that postulate the existence of multiple realities, positivists view reality as singular, 'something out there' and independent of the researcher (Creswell, 2013, Decrop, 1999) which can be measured objectively e.g. by using a quantitative research instrument

(Davies, 2003). This indicates that a research paradigm adopted has implications on the research approach and methods (see section 3.4). In this respect, Creswell (2013) argues that the distinction between quantitative and qualitative research is that 'reality' in qualitative research is constructed by individuals involved in the research situation while 'reality' 'out there' in the world is in quantitative research. This agrees with the view of Krauss (2005, p. 750) that "ultimately, the heart of the quantitative-qualitative "debate" is philosophical, not methodological".

3.5 Research approach

As highlighted in section 3.4, the adopted research philosophy has implications on the research approach. Saunders et al. (2012) argue that the distinction between quantitative research and qualitative research is not only on the aspect of quantification but also on context of knowledge and objectivity. This can be perceived from the understanding that at the core of qualitative analysis lies the related process of describing phenomena, classifying it and seeing how the concepts interconnect (Gray, 2013). On the other hand, Amaratunga et al. (2002) state that a quantitative research design is characterized by the assumption that human behaviour can be explained by what may be termed social facts which can be investigated by methodologies that utilize the deductive logic of natural sciences. When applied to this study, this proposes that it is possible to observe the impact of the 2007/2008 global financial crisis on Islamic banks and conventional banks.

Further, whilst different modes of research allow researchers to understand different phenomena and for different reasons (Deetz, 1996), this research adopts a quantitative research approach. This approach enables the identification of any causal relationships between the variables of interest that are assumed to have a priori effect. As Amaratunga et al. (2002) contend, this approach utilises deductive reasoning. Deductive reasoning involves the development of a theory that is subjected to rigorous test (Saunders et al., 2012). The sequential stages which deductive research will progress include; the deducing of a hypothesis; expressing the hypothesis in operational terms; testing this operational hypothesis; examining the specific outcome of the inquiry and if necessary, modifying the theory in the light of the findings (Robson, 2011). This is contrary to the induction approach which involves an understanding of the way in which humans interpret their social world where theory follows data rather than vice versa (Gray, 2013).

The justification for this chosen research approach is that there exists an observable relationship between bank specific characteristics and bank's financial performance (Caporale et al., 2017; El Massah & Al-Sayed, 2015; Johnes et al., 2014; Ramlan & Adnan, 2016). For instance, banks that are more efficient and better capitalised are more likely to be profitable (Alexakis et al., 2018; Al-Qudah & Jaradat, 2013; Wasiuzzaman & Tarmizi, 2010). Similarly, the liquidity and operational efficiency of the banks has an effect on the banks' profitability (Belanes & Hassiki, 2012; Caporale et al., 2017; Khediri et al., 2015; Zarrouk et al. 2016). Other studies have also demonstrated a relationship between the bank's size and its financial performance (Caporale et al., 2017; Kosmidou et al., 2007). As such, there exists a priori relationship which needs to be investigated further in order to understand the direction of the relationship and whether this is impacted by the banking type or the region in which the banks operate. A priori relationship is also assumed between the macroeconomic development indicators and banks' financial performance (Caporale et al., 2017; Johnes et al., 2014; Wasiuzzaman & Tarmizi, 2010; Zarrouk et al. 2016).

Thus, the proposition is that the financial performance of banks is affected by both internal and external factors which are distinctively identifiable. Considering the numerous internal and external variables, there is need to simplify the complexity of the relationship between the bank specific characteristics and macroeconomic development indicators with the banks' financial performance. The study, however, has to be put in context. Thus, in order to gain a deeper understanding of the variables that impact bank's financial performance, a case study strategy is adopted. A case study is basically a "strategy for doing research which involves an investigation of a particular contemporary phenomenon within its real-life context using multiple sources of evidence" (Robson, 2002, p. 178). The phenomenon under consideration is the financial performance of banks before, during and after the 2007/2008 global financial crisis in the MENA region. The interest is to understand the financial performance of the Islamic banks and conventional banks during this longitudinal period. Thus, the MENA region's banking sector is selected to serve the crucial purpose of facilitating an understanding of the bank specific characteristics and macroeconomic indicators on the financial performance of Islamic banks and conventional banks. This understanding of the financial performance phenomenon as also influenced by economic instability could be of relevance to the transformation of society (Stake, 2000). A case study, according to Yin (2013) is also useful when 'how' or 'why' questions are being investigated, and when the researcher has little control over the events and when the focus is on a contemporary phenomenon within some real-life

context. Yin (2013, p. 14) further argues that a case study essentially constitutes a "comprehensive research strategy" that expresses "the logic of design, data collection techniques and specific approaches to data analysis". In this study, a case study strategy has been adopted as it offers a richer understanding of the influence of both internal and external factors on banks' financial performance.

Further, Saunders et al. (2012) contends that a case study strategy is often used in explanatory research. In explanatory research, a researcher begins with ideas about the possible causes of a social phenomenon, i.e., the researcher develops hypotheses before collecting any data (Silverman, 2016). This is the case in this study as hypothesis are developed based on priori relationship developed from the existing literature. Subsequently, after a researcher has established the possible causal relationship, a plan is devised to provide systematic evidence supporting (or not supporting) the initial ideas about the cause. The data collected should also provide a systematic description. In this respect, this study is an explanatory study which uses a quantitative deductive approach.

3.6 Data collection instruments

3.6.1 Data collection method

This study uses secondary data obtained from mainly two sources: Bankscope and World Bank databases. Bankscope provides some comprehensive financial information on both public and private banks. The financial data available in Bankscope is usually based on the annual reports published by the financial institutions which is normally presented in a detailed and standardised format (Bureau Van Dijk, 2018). The database consolidates the financial information from each bank report which "contains a detailed consolidated and/or unconsolidated balance sheet, an income statement and interim reports with up to 16 years of information. Bankscope also provides ratings, rating reports, country risk ratings and reports, news and detailed ownership information and bank structures" (Bureau Van Dijk, 2018, p. 2). This makes it a valuable source of secondary data for this research. The financial measures for the banks' financial performance has been easily obtained from this database. The richness of the database is such that the database gives "a detailed presentation of each bank's financials, containing up to 300 data items per bank and 50 pre-calculated ratios. It is divided into three primary sections: income statement, balance sheet (assets, off-balance sheet items, liabilities,

equity) and analytical ratios" (Bureau Van Dijk, 2018, p. 3). The period of focus for this study is from 2004 to 2014. Thus, the time horizon applied for this research is longitudinal as the study investigates the financial performance of the Islamic banks and conventional banks over a 10-year period.

In order to facilitate the achievement of the research objectives, the banks have had to be identified as being operational within the MENA countries for the period under consideration. Further, these banks have been separated into the Islamic and conventional banks accordingly. Thus, all data was organized as a panel data set. The Bankscope database, therefore, provided useful information about the banks' specific characteristics which have been examined in this study.

In addition to bank specific characteristics (see section 3.7.2 below), the study also examines the impact of macroeconomic factors on the banks' financial performance. However, Bankscope database does not have macroeconomic information relevant to this study. Therefore, another database, the World Bank database was used to obtain the macroeconomic indicators. The World Bank database (DataBank) contains a rich collection of developmental indicators that have been compiled from officially recognised international sources (World Bank, 2018). The Databank has also easy query functions that enables the generation of own reports, tables, charts and maps such for specific country, region or continent. Another advantage of the DataBank is that besides containing most macroeconomic developmental indicators, this World Bank database is free to access on the internet (World Bank, 2018).

3.6.2 Research sample

As discussed in chapter three, Islamic banking has increased in the MENA region. Nonetheless, despite some key similarities of the countries in the MENA region, some differences exist regarding the level of development which makes a key source of differentiating the banking sector. Within the MENA countries, there are still some identifiable differences regarding the economic structure, historical background, social norms and cultural values that exist (Zarrouk et al., 2016). One of these factors which significantly affect the banking sector is the level of economic development (Ayadi et al., 2015; Pradhan et al., 2014; Rousseau & Wachtel, 2017) and thus, within the MENA region, a distinction could be made between the emerging economies and developing countries. The emerging economies in the MENA region are mainly

the oil-rich economies which form the GCC countries. Thus, a classification between the GCC countries and non-GCC countries needs to be made. The GCC countries are the oil-exporting countries of Bahrain, Kuwait, Oman, Qatar, the Kingdom of Saudi Arabia and the United Arab Emirates. The other countries within the MENA region would be classified as non-GCC countries comprising Algeria, Egypt, Iran, Iraq, Libya, Morocco, Jordan, Tunisia, and Yemen. Thus, data on Islamic banks and conventional banks was obtained from a total of 15 countries (see table 2 below).

Table 2: Categorisation of countries in the MENA region

		No.	%
GCC countries	Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates	6	40
Non-GCC countries	Algeria, Egypt, Iran, Iraq, Libya, Morocco, Jordan, Tunisia, and Yemen	9	60
Total		15	100

From the 15 countries, a total of 108 banks were examined. Of these banks, 35 were Islamic banks (constituting 32.4% of the total sample), 73 conventional banks (constituting 67.6% of the total sample). As indicated in section 3.6.1, data on both conventional and Islamic banks in the 15 countries was obtained from the Bankscope and WorldBank databases.

Table 3: Frequency distribution by type of bank

	No.	%
Islamic Banks	35	32.4
Conventional Banks	73	67.6
Total	108	100.0

Table 3 above shows the summary composition of the sample of conventional and Islamic banks investigated in this study. Further, table 4 below gives the detailed names of the banks examined grouped according to the banking type.

Table 4: The names of banks in the study sample grouped according to banking type

	Islamic Banking	Conventional Banking
1	Parsian Bank	Emirates NBD
2	Abu Dhabi Islamic Bank	Abu Dhabi Conventional Bank
3	Jordan Dubai Islamic Bank	African Export-Import Bank
4	Bank Pasargad	Ahli Bank QSC
5	Bank Saderat Iran	Ahli Bank SAOG
6	Bank Sepah	Ahli United Bank (Egypt) SAE
7	Elaf Islamic Bank	Ahli United Bank BSC
8	Bank AlBilad	Al Ahli Bank of Kuwait (KSC)
9	Capivest	Al Khalij Conventional Bank
10	International Investor Company, K.S.C.	Arab Bank for Investment & Foreign Trade-A
11	Karafarin Bank	Arab Bank Group (Combined)
12	Masraf Al Rayan	Arab Banking Corporation
13	A'Ayan Leasing & Investment Company	Arab Banking Corporation BSC-Bank ABC
14	Ibdar Bank BSC	Arab Jordan Investment Bank
15	Rasameel Structured Finance Company K.S.C	Arab National Bank Public Joint Stock Comp
16	Boubyan Bank KSCP	Arab Tunisian Lease
17	Emirates Islamic Bank PJSC	Attijariwafa Bank
18	Islamic Corporation for the Development of the Private Sector	Bahrain Conventional Facilities Company BSc
19	Islamic Development Bank	Bahraini Saudi Bank (The) BSC
20	Kuwait Finance House in Bahrain	Bank al Etihad
21	Saba Islamic Bank	Bank Dhofar SAOG
22	Shamil Bank of Yemen & Bahrain	Bank Muscat SAOG
23	Abu Dhabi Islamic Bank - Public	Bank of Alexandria
24	Ahli United Bank KSC	Bank of Commerce & Development
25	Al Rajhi Bank Public Joint Stock Company	Bank of Jordan Plc
26	Albaraka Banking Group B.S.C.	Bank of Sharjah
27	Bank AlJazira JSC	Bank Sohar SAOG

28	Bank Mellat	BanqueMarocaine du Commerce Extérieur-BMC
29	Bank Tejarat	BanqueMarocaine pour le Commerce et l'Ind
30	Faisal Islamic Bank of Egypt	Banque Saudi Fransi JSC
31	Islamic International Arab Bank	BMI Bank BSC
32	Jordan Islamic Bank	BNP Paribas El Djazaïr
33	Kuwait Finance House in Kuwait	Conventional Bank of Dubai P.S.C.
34	Qatar Islamic Bank SAQ	Conventional Bank of Kuwait K.P.S.C.
35	Sharjah Islamic Bank	Crédit du Maroc
36		CréditImmobilier et Hotelier
37		Doha Bank
38		Egyptian Arab Land Bank
39		Egyptian Gulf Bank SAE
40		Fondsd'Equipement Communal
41		Fransabank El Djazair SPA
42		Global Investment House
43		GroupeBanquesPopulaires
44		Gulf Bank KSC
45		Housing Bank for Trade & Finance
46		HSBC Bank Egypt S A E
47		Industrial Bank of Kuwait K.S.C.
48		International Bank of Qatar Q.S.C.
49		Investcorp Bank BSC
50		Investment Bank of Iraq SA Co
51		Jordan Ahli Bank Plc
52		Jordan Conventional Bank
53		Jumhouria Bank
54		Maghreb Leasing Algérie
55		MISR Iran Development Bank SAE
56		National Bank of Umm Al-Qaiwain
57		National Bank of Yemen

58		National Conventional Bank SAL
59		Oman Arab Bank SAOC
60		Oman Development Bank SAOC
61		Oman International Development and Investment Company
62		Qatar National Bank
63		Sahara Bank
64		Samba Financial Group
65		Saudi British Bank JSC
66		Saudi Hollandi Bank
67		Saudi Investment Bank
68		Société Générale Algérie
69		Société Générale Marocaine de Banques
70		The Conventional Bank (QSC)
71		Trade Bank of Iraq
72		Union National Bank - Egypt SAE
73		United Finance Company

3.7 Data analysis

The performance of data analysis requires an identification of the dependent variables and independent variables which are discussed next.

3.7.1 Dependent variables

Several studies have utilised financial ratios in order to compare the financial performance of Islamic banks and/or conventional bank (Bilal & Amin, 2015; Caporale et al., 2017; Demirguc-Kunt & Huizinga, 1999; Micco et al., 2007; Samad & Hassan, 2006; Van Horen, 2007). Most of these studies have used either one or two of the financial ratios: return on assets (ROA) and return on equities (ROE) in order to measure bank performance (Al-Qudah & Jaradat, 2013; Hassan & Bashir, 2003; Olson & Zoubi, 2011; Smaoui & Salah, 2012; Zarrouk et al., 2016) (see Appendix A). Olson & Zoubi (2011) for instance, examined the performance of 83 Islamic and conventional banks in 10 countries of the MENA region over an 8-year period from 2000 to 2008 using ROA and ROE as the dependent variables. Similarly, Beck et al. (2013) used both ROA and ROE in their study of 510 Islamic and conventional banks from 22 countries covering a period of 15 years from 1995 to 2009. In the same vein, Caporale et al. (2017)

examined 122 banks (76 foreign and 46 domestic) from 17 MENA countries covering the period 2000-2012. Caporale et al. (2017), however, used return on average assets (ROAA) and return on average equity (ROAE) to measure banks' performance. The majority of the studies have used ROA and ROE, nonetheless (Alexakis et al., 2018; Khediri et al., 2015; Ramlan & Adnan, 2016; Zarrouk et al, 2016). Thus, in this study, these two financial ratios will be employed to measure bank performance.

Return on Assets (ROA) in this case captures the total profitability of the banks as a percentage of total assets. This ratio is obtained by dividing the bank's net after-tax income by its total assets and thus, represents the ability of the bank to use its assets to generate income (Olson & Zoubi, 2011; Zarrouk et al., 2016). A higher ROA ratio suggests that a firm is more efficient in its utilisation of its resources (Guillén et al., 2014).

Return on Equity (ROE) is obtained by dividing the bank's net after-tax income by its total equity capital (Ben Selma Mokni & Rachdi, 2014; Zarrouk et al., 2016). ROE basically measures the total profitability of the bank as a percentage of total equity. The ratio captures the banks' ability to use its equity financing to generate profits. As such, a higher ROE indicates that a bank is more efficient in utilising the shareholders' capital to generate profits.

Table 5: Study variables and measures

	Variable	**Measure**
Dependent Variables	Return on assets	Net income over total assets ratio
	Return on equity	Net income over equity ratio
Independent Variables	Bank size	The natural logarithm of total assets
	Capital risk	The ratio of equity to total assets
	Loan intensity	Loans over total assets ratio
	Financial leverage	The ratio of total assets to equity
	Credit Risk	Loan loss provision over gross loans
	Operating ratio	The ratio of fixed assets to total assets
	Z-score	Logarithm of Z-score
	Capital ratio	(the loan loss provision (LLP) + the equity and the total) divided by total loan
	GDP	Logarithm of gross domestic production
	Inflation	Inflation rates

3.7.2 Independent variable

The independent variables can be divided into bank specific characteristics and macroeconomic variables. As depicted in table 5, the selected bank specific variables are bank size, capital risk, loan intensity, financial leverage, credit risk, operating ratio and Z-score. The macroeconomic variables are gross domestic product (GDP) and inflation.

3.7.2.1 Bank specific characteristics

Bank size in this study is measured as the natural logarithm of total assets. Several studies have investigated the impact of bank size on profitability (Bertay et al., 2013; Chronopoulos et al., 2015; Ghosh, 2016; Lee & Kim, 2013; Shehzad et al., 2013; Olson & Zoubi, 2011; Petria et al., 2015). Petria et al. (2015), for instance, investigated the influence of bank size on bank performance in 27 European countries over a period of 7 years from 2004 to 2011. Petria et al. (2015) study found that the size of banks (measured by total assets) significantly and positively affected the banks' performance (measured by ROA). Other studies support this positive relationship between bank size and financial performance (Chronopoulos et al., 2015; Houston et al., 2010; Mirzaei et al., 2013; Shehzad et al., 2013; Smaoui & Salah, 2012). However, other studies have shown a contradictory effect where smaller sized banks have been found to be more profitable than larger firms (Altunbas & Marques, 2008; Barry et al., 2011; Căpraru & Ihnatov, 2014; Haan & Poghosyan, 2012; Lin & Zhang, 2009). Further, unlike the studies which have revealed a significant influence of bank size on bank performance, other studies suggest that bank size is insignificant or unimportant (Al-Musali & Ismail, 2014; Caporale et al., 2017; Ghosh, 2016; Mollah & Zaman, 2015; Olson & Zoubi, 2011; Shah & Jan, 2014).

Capital ratio is captured as the ratio of equity to total assets. It thus shows the size of shareholder capital compared to the bank's total assets. This ratio has been used in several studies as an indicator of financial stability (DeYound & Torna, 2013; Horvàth et al., 2014; Nguyen & Nghiem, 2015; Schaeck & Cihàk, 2014). Other studies, on the other hand, have sought to establish a relationship between capitalisation and profitability (Apergis, 2014; Căpraru & Ihnatov, 2014; Chitan, 2012; Ghosh, 2016; Kutan et al., 2012; Mamatzakis et al., 2016; Mirzaei et al. 2013; Sufian & Habibullah, 2010). The study, for instance, by Căpraru & Ihnatov (2014) analysed the effect of bank capitalisation on 143 banks in the period 2004 to 2011 in 5 countries and revealed a significant positive relationship between profitability (captured as ROA and

ROE) and capitalisation. The proposition is that banks with higher capital assets can invest effectively more than those with a lower capital base which results in higher profitability. These findings are supported by many other studies (Apergis, 2014; Chitan, 2012; Ghosh, 2016; Kutan et al., 2012; Mamatzakis et al., 2016; Mirzaei et al. 2013; Sufian & Habibullah, 2010). However, other studies have shown a negative relationship between profitability and capitalisation (Altunbas & Marques, 2008; Chronopoulos, et al., 2015; Ćurak et al., 2012; Dietrich & Wanzenried, 2011; Mollah & Zaman, 2015; Shehzad, et al., 2013) while some studies have shown mixed results (Olson & Zoubi, 2011; Westman, 2011). Olson & Zoubi (2011) study, for instance, suggest that capitalisation enhances the ROA but decreases the ROE.

Loan intensity is represented by the ratio loans over total assets. Essentially, this ratio shows the proportion of loans issued by banks to their total assets (Kohler, 2015). This basically shows the loan portfolio of the banks. In general, the more the loan portfolio (compared to the total assets), the higher the default (bankruptcy) risk which might make banks less stable (Beck et al., 2013; Berger et al., 2009; Bourkhis & Nabi, 2013). Contrary, an increase in the loan portfolio has been found to improve the banks' profitability as more net interest is earned. Several studies support this proposition that providing more loans leads to higher profitability (Chronopoulos et al., 2015; Demirguc-Kunt & Huizinga, 1999; Lin & Zhang; 2009). As such, increased lending activity could raise banks' lending earnings resulting in higher profitability.

Financial leverage measures the proportion of the total assets to total equity which represents the amount of the total assets financed by shareholders' equity and the proportion financed by external debt (Abu-Alkheil et al., 2012). Abu-Alkheil et al. (2012) study investigated the influence of financial leverage on banks' efficiency in selected countries over a 4-year period from 2005 to 2008 and found that there was a significant and negative relationship. These results are similar to Al-Qudah & Jaradat (2013) study on the profitability of Jordanian Islamic banks in the period 2000 to 2011 that revealed significant and negative effects of leverage (measured by total deposits to total assets) on profitability (measured by ROA and ROE). These results are however, contrary to other studies (Bashir, 2001; Zarrouk et al., 2016) that suggest that high leverage leads to higher profitability.

Credit risk is represented by the ratio of loan loss provision over gross loans. This ratio has been used in several other studies (Athanasoglou et al., 2008; Căpraru & Ihnatov, 2014; Liang et al., 2013; Petria et al., 2015). The ratio not only is used to capture credit risk but also measures

the banks' asset quality. A bank with sound quality of loans would be expected to be more profitable. In accordance with the risk-return hypothesis, a high ratio would imply that there is a positive relationship between risk and profitability. For instance, Heffernan & Fu (2008) study on determinants of bank performance found a positive and significant coefficient on the loan loss ratio provision over gross loans indicating that loan loss provisioning improves performance. These results are consistent with Kosmidau et al. (2005), Athanasoglou et al. (2008) and Vong & Hoi (2009) studies. Contrary, Miller & Noulas (1997) found a negative relationship between credit risk and profitability. This ratio, however, could indicate mixed signals as higher provision of loan losses could signal a higher probability of possible future loan losses (Heffernan & Fu, 2008). On the other hand, it could also indicate a prudent approach by banks in their timely recognition of weak loans (Athanasoglou et al., 2008; Heffernan & Fu, 2008). As such, investigating this variable with respect to Islamic and conventional banks in this study enlightens understanding of the relationship between credit risk and bank performance.

Operating ratio is captured as the ratio of fixed assets to total assets which represents the banks' operating leverage or the fixed assets intensity. Several studies have used this ratio to investigate the effect of bank performance, either with respect to bank stability or profitability (Berger et al., 2009; ElBannan, 2015; Srairi, 2013; Williams, 2014; Wang et al., 2015). Srairi (2013) study on 175 Islamic and conventional banks in 10 MENA countries proposed that banks should invest more in fixed assets as this increased their Z-score making banks more stable and profitable in the long term. Contrary, Beck et al. (2013) study findings suggest that an increase in fixed assets leads to a decline in profitability as captured by ROE. Similarly, Berger et al. (2009) study revealed that an increased investment in fixed assets could negatively affect the financial stability of banks raising the potential risk of failure. ElBannan (2015) argues that banks with more fixed assets take more risk which causes this negative relationship.

Z-score has been utilised in many studies that investigate the determinants of banks' performance (Abedifar et al., 2013; Beck et al., 2013; Faye et al., 2013; Ghosh, 2016; Mamatzakis et al., 2016; Mollah & Zaman, 2015). The Z-score (developed by Boyd et al. 1993) statistically represent the probability of bankruptcy with a higher Z-score indicating a more stable bank which is less likely to go bankrupt (lower insolvency risk). An association between Z-score and profitability has been investigated in many studies (Mamatzakis et al., 2016; Mollah & Zaman, 2015). For instance, Mollah & Zaman (2015) investigated the determinants

of bank profitability across 86 Islamic and 86 conventional banks across 25 countries over a 6-year period from 2005 to 2011. Mollah & Zaman (2015) considered the Z-score as a determinant of profitability and found a positive and significant relationship between profitability and the Z-score. These results suggest that more stable banks with less default risk have higher returns. These results are similar to Mamatzakis et al. (2016) study that revealed a positively significant relationship between the Z-score and profitability (represented by ROA) suggesting that the less banks involved themselves in risky projects, the higher their profitability.

3.7.2.2 Macroeconomic variables

The macroeconomic variables of gross domestic product (GDP) and inflation are considered in this study as these are the most used in several other studies (Caporale et al., 2017; Haron & Wan, 2008; Asutay & Izhar, 2007; Johnes et al., 2014; Wasiuzzaman & Tarmizi, 2010; Zarrouk et al. 2016). The examination of the relationship between these macroeconomic variables and banks' profitability has revealed contrasting results in prior studies. Wasiuzzaman & Tarmizi (2010) study on the profitability of 16 Islamic banks in Malaysia over the period 2005 to 2008, employing the ordinary least square method, found that GDP and inflation have both a positive and significant influence on bank profitability. These results are consistent with several other studies in different countries (Bashir, 2001; Hassan & Bashir, 2003; Asutay & Izhar, 2007; Kosmidou et al., 2006; Smaoui & Salah, 2012). For instance, Smaoui & Salah (2012) study on 44 GCC Islamic banks from 1995 to 2009 showed that favorable macroeconomic conditions have a positive effect on bank profitability. Similarly, Bashir (2001) investigation on banks in 8 countries (Bahrain, Egypt, Jordan, Kuwait, Qatar, Sudan, Turkey, UAE) found a positive relationship between GDP and bank profitability while Asutay & Izhar (2007) study on Indonesian Islamic banks revealed that inflation has a positive and significant impact on bank profitability. The positive relationship between macroeconomic variables and bank profitability is attributed to the improved quality of loan portfolio in high economic growth conditions, generating less credit losses and reducing the banks loan loss provisions held, which results in improved bank profitability (Zarrouk et al. 2016). Macroeconomic conditions have an effect on the supply and demand for loans and deposits, which then impacts on banks' profitability. In general, a higher GDP growth in a country is expected to stimulate demand for bank loans which then improves bank profitability (Hassan & Bashir, 2003; Kosmidou et al., 2006).

With reference to the relationship between inflation rate and bank profitability, the proposition is that an increase in inflation rates is often associated with high interest rates on loans which then increases banks' profitability (Asutay & Izhar, 2007; Wasiuzzaman and Tarmizi, 2010). However, a rise in inflation rates could also cause expenditure and borrowing by firms and households to actually reduce causing a decrease in banks' profitability. This negative relationship is supported by Zarrouk et al. (2016) study on 51 banks in 11 countries which revealed a negative association of inflation rate with Islamic banks' profitability. Similarly, Rumler & Waschiczek (2014) found that inflation reduced banks' risk-taking suggesting that banks reduce their activities when inflation increases. Eljelly (2013), on the contrary, found that external macroeconomic factors did not seem to affect Islamic banks' performance. Eljelly (2013) study investigated the effect of internal and external factors on profitability of Islamic banks in Sudan and found that only internal factors had a significant impact on banks' profitability as measured by return on assets, return on equity and net financing margin. The external macroeconomic factor in Eljelly's (2013) study, however, did not have a significant effect on profitability. Therefore, data will be collected for these bank specific characteristic variables and macroeconomic variables which represent the independent variables. The connection between the dependent and independent variables is discussed next.

3.7.3 Financial performance model

This study proposes a relationship between the dependent variables (section 3.7.1) and the independent variables (section 3.7.2). The dependent variables (ROE and ROA) capture the bank's financial performance whilst the independent variables are made up of bank specific characteristics and macroeconomic variables. As discussed in section 3.7, there is a perceived relationship between the macroeconomic variables and banks' financial performance, and also a relationship between the banks' specific characteristics and bank performance. The general model for this relationship is depicted below:

$$P_{ijt} = a_o + \alpha_i B_{it} + \beta_j X_{jt} + \xi_{it}$$

$$\xi_{it} = u_i + \mu_{it}$$

Where P_{ijt} is the measure of financial performance for bank i in country j at time t. B_{it} are the bank specific variables (bank size, capital risk, loan intensity, financial leverage, credit risk,

operating ratio and Z-score) for bank i at time t. X_{jt} are macroeconomics variables for country j at time t while a_o is a constant term and α_i and β_j are coefficients. ξ_{it} denotes to an error term, with u_i is the unobserved bank-specific effect and μ_{it} is the idiosyncratic error.

3.8 Statistical methods

As indicated above, the data collected in this research is analysed statistically using multivariate regression analysis and artificial neural networks in studying the relationship between bank specific characteristics (internal factors) and macroeconomic variables (external factors) on banks' financial performance. Further, as stated above, a longitudinal approach is taken in investigating the banks' performance over the 10 years period from 2004 to 2014. This essentially captures the pre, during and post financial crisis performance of Islamic and conventional banks. The next section discusses some key statistical elements.

The quantitative analysis of data was performed statistically with the aid of statistical computer software. In particular, the statistical tool, Statistical Package for the Social Sciences (SPSS) Version 22, was used in executing the data analysis. Thus, after collecting the data, Microsoft Excel was used to set it up and then SPSS was used to run the regression.

3.8.1 Descriptive statistics

Descriptive statistics will be used to describe the dependent and independent variables used in this study. This is presented in chapter five. The description of the variables includes the mathematical mean, frequency distribution, standard deviation, skewness and kurtosis of the study variables. Thus, the descriptive statistics will show the mean (the arithmetic mean across the variables), the standard deviation (which measures the spread of the variables), skewness (which measures the degree and direction of asymmetry of the data) and kurtosis (which measures the heaviness of the tails of the distributions). The normality of the data is assessed through the skewness and kurtosis values calculated of the variable. The descriptive statistics tables are followed by an interpretation that explains the results obtained. Further, the t-test has been used to evaluate the existence of a significant difference in the study variables between the Islamic and conventional banks and to also test the existence of significant difference before, during and after the financial crisis in both banking types. In addition, correlation is

calculated in order to measure the range and direction of the relationship between the dependent and independent variables: whether it is positive or negative, and how significant.

In investigating the relationship between the dependent variables (ROE, ROA) and one or more of the independent variables, multivariate regression and stepwise regression are utilised. A determinant coefficient R^2 is used to measure the ability of the independent variables (bank specific characteristics and macroeconomic variable) in explaining the change that happens to the dependent variable (ROE, ROA).

3.8.2 Artificial neural networks

In addition to the use of multivariate linear regression models, this study employs the Artificial Neural Networks (ANN) method. The artificial neural networks form a powerful nonlinear regression technique inspired by theories drawn from the operationalisation mechanism of the brain (Wanke et al., 2016). Neural networks provide a useful means to derive meanings from complicated or imprecise data as these are able to retrieve and establish patterns or trends that are too complex to be directly observable by humans or other computer techniques (Datt, 2012; Stergiou & Siganos, 2014). Datt (2012, p. 160) describes ANN as an "information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information" (Datt, 2012, p. 160). In this paradigm, the fundamental component is the novel structure of the information processing system (Lam, 2004). An Artificial Neural Network is basically,

> "composed of a large number of highly interconnected processing elements (neurons) working in unison to solve specific problems. ANNs, like people, learn by example. An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process. Learning in biological systems involves adjustments to the synaptic connections that exist between the neurones. This is true for ANNs as well" (Stergiou & Siganos, 2014, p. 1)

Thus, ANNs are basically formed by a group of computing units, the neurons, that are closely linked to each other. The operational sequence of each neuron is in two consecutive steps (Wanke et al., 2016). The first step is a linear combination of inputs which is then followed by a nonlinear computation of the result to obtain an output value (Kuhn & Johnson, 2013; Stergiou & Siganos, 2014). The second phase is where the results obtained in the first phase become an input that is fed to other neurons in the network (Kuhn & Johnson, 2013). The common type of

artificial neural network consists of three groups (or layers) of units: a layer of *input* units is connected to a layer of *hidden* units, which is connected to a layer of *output* units (Lam, 2004; Stergiou & Siganos, 2014).

In this respect, the activity of the input units represents the raw information that is fed into the network (Kuhn & Johnson, 2013). The activity of each hidden unit is influenced by the activities of the input units and the weights on the connections between the input and the hidden units (Stergiou & Siganos, 2014). Further, the behaviour of the output units is determined by the activity of the hidden units and the weights between the hidden and output units. Conceiving this simple type of network is motivating because the hidden units are free to construct their own representations of the input. In addition, the weights between the input and hidden units dictates when each hidden unit is active, and so by modifying these weights, a hidden unit can choose what it represents (Payandeh, 2016). A distinction can also be drawn regarding single-layer and multi-layer architectures (Stergiou & Siganos, 2014). In general, a single-layer organization where all units are connected to one another is most common and has more potential computational power than the hierarchically structured multi-layer organizations (Datt, 2012; Lam, 2004). Unlike in single-layer networks, units are often numbered by layer, instead of following a global numbering in multi-layer networks (Payandeh, 2016).

As stated above, the behaviour of an artificial neural network depends on both the weights and the input-output function (transfer/activation function) that is specified for the units (Datt, 2012; Lam, 2004; Stergiou & Siganos, 2014). The activation function links the weighted sums of units in a layer to the values of units in the succeeding layer (IBM, 2013, p. 12). The activation function in this study will be based on sigmoid which takes real-valued arguments and transforms them to the range (0,1). The sigmoid activation function that this study uses is:

$$\text{Sigmoid} = f(a) = 1/(1 + exp^{(-a)})$$

The output boundaries are (0,1). *f*(a) is the function of observable variable while $\exp(^{-a})$ is the exponential values of variable (a).

In multi-layer architectures, a class of feed forward networks consisting of three or more layers of units called multilayer perceptron (MLP) is identifiable (Payandeh, 2016). A layer is a group of units receiving connections from the same units. Units inside a layer are not connected to

each other (Tkacz, 2001; Zou et al., 2007). MLP consists of three types of layers: the input layer, one or more hidden layers, and the output layer (Stergiou & Siganos, 2014). The input layer is the first layer of network and it receives no connections from other units, but instead holds the network's input vector as activation of its units. It is fully connected to first hidden layer. The hidden layer *i* is then fully connected to hidden layer *i + 1*. The last hidden layer is fully connected to the output layer. Activation of output units is considered to be the output of the network.

When inputting data into the ANN, it needs to be partitioned. The dataset is partitioned into training, testing and holdout sample. The training sample is made up of "data records used to train the neural network ….(whilst) the testing sample is an independent set of data records used to track errors during training in order to prevent overtraining" (IBM, 2013, p. 13). Further, in this partitioning, it's advisable for the testing sample to be smaller than the training sample in order to improve the efficiency of the model (IBM, 2013).

The output of the network is calculated in a process called forward propagation in three steps (Lam, 2004; Stergiou & Siganos, 2014). The first step is the network's input copied to activations of input units; second step is the hidden layers that computes their activations in topological order, and the third step is where the output layer computes its activation and copies this to network's output. Figure 9 below depicts the multilayer perceptron.

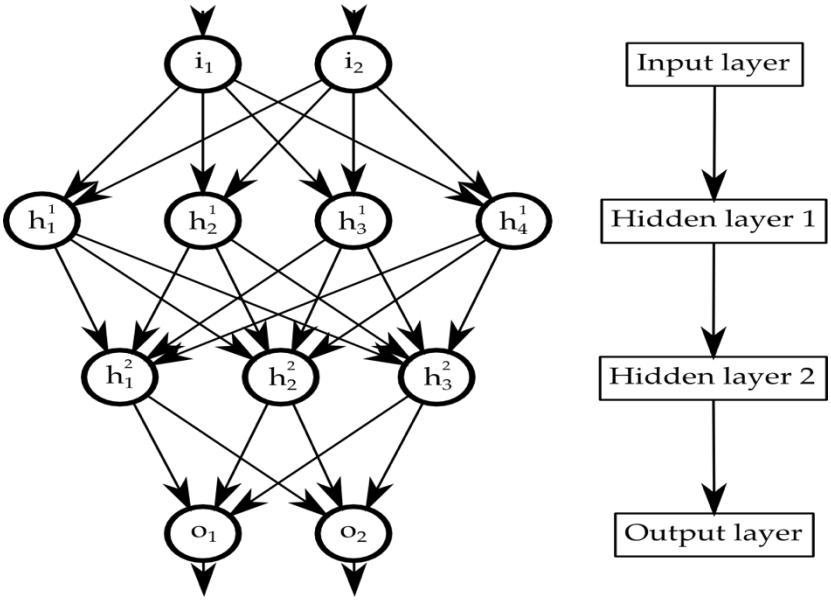


Figure 9: Multilayer Perceptron (MLP) with two hidden layers.

The schematic diagram of MLP depicted in figure 8 consists of an input layer with two units, two hidden layers with four and three units respectively, and the output layer with two units. The usefulness of neural networks is that it offers a powerful method in determining the most important independent variables that affect the financial performance variables (Kuhn & Johnson, 2013) of the two banking types in this study. The application of neural networks in financial performance (analysis and forecasting) offers some valuable insights not obtained from other statistical approaches. Lam (2004, p. 568) aptly summarises the usefulness of the neural networks approach in financial performance by stating that:

> "First, neural networks are numeric in nature, which is especially suitable for processing numeric data such as financial information and economic indicators… Neural networks can accept numeric data directly as input for mining purposes. Second, neural networks do not require any data distribution assumptions for input data. This feature allows neural networks be applicable to a wider collection of problems than statistical techniques such as regression or discriminant analysis. Third, neural networks are an incremental mining technique that permits new data be submitted to a trained neural network in order to update the previous training result… Fourth, neural networks are model-free estimators. This feature allows interaction effect among variables be captured without explicit model formulations from users"

The use of artificial neural networks in investigation of financial performance of financial institutions is still developing which offers a contribution of this study to this methodological approach. The most usage of neural network approach has been on banks (firms) bankruptcy predition, credit card performance, credit evaluation and insurance fraud detection (Baker & Tahir, 2009; Burrell & Folarin, 1997; Vellido et al., 1999). There have been a few studies, however, that have used this approach in bank performance evaluation. Wanke et al. (2016) for instance, applied the ANN approach in evaluating the efficiency of 16 Islamic banks in Malaysia over the period 2009 to 2013. Wanke et al. (2016) study uses a two-stage approach in assessing the bank efficiency, applying TOPSIS (a multi-criteria decision analysis method) in the first stage and then combining this with the artificial neural networks approach in the second stage. Similarly, Baker & Tahir (2009) used multiple linear regression and neural network in evaluating the performance of 13 banks over the period 2001 to 2006. The same approach has been taken by other studies (Arulsudar et al., 2005; Nghiep & Al, 2001). In this research, the artificial neural networks approach is combined with the multivariate regression approach.

3.9 Research validity

Some approaches to improve robustness of the research process have been undertaken. Firstly, the approach taken in this study to combine the multiple regression analysis with the artificial neural networks approach improves the quality of the results. Several studies have compared the performance of artificial neural network approach to other traditional statistical techniques (Arulsudar et al., 2005; Baker & Tahir, 2009; Delen et al., 2005; Leshno & Spector, 1996; Nghiep & Al, 2001). The critical aspect is that the artificial neural networks has performed better than the traditional statistical techniques in all the studies. For instance, the artificial neutral network approach has been compared to multiple linear regression approach (Arulsudar et al., 2005; Nghiep & Al, 2001), to stepwise regression and ridge regression (Chokmani et al., 2008), to logistic regression (Baker & Tahir, 2009), to discriminant analysis and logistic regression (Leshno & Spector, 1996). Thus, the application of the artificial neural network in this study improves the quality of results obtained. Nghiep & Al (2001) in particular showed that the artificial neural network far outperformed the multiple regression analysis method when moderate to large data sample sizes are used. This makes the application to this study very relevant. Further, in assessing the robustness of the results, a test to determine whether there is any correlation between the independent variables was undertaken. This refers to multicollinearity which aims to test whether there is any pair-wise correlation between the independent variables. In general, any multicollinearity of more than 80% should be considered (Draper & Smith, 2014). The robustness test on multicollinearity did not reveal any high levels of correlations between the independent variables which gives justification the inclusion of these variables in the regression equation.

In addition, as argued by Zarrouk et al. (2016) and Athanasoglou et al. (2008), banks' financial performance has a tendency to persist over time which might be explained by asset quality impediments, market structure imperfections or macroeconomic shocks. As such, testing this lagging effect was applied to see any changes to the results. As such, a lagged dependent variable was added to the regression equation to capture this lagging effect for the bank performance. The lagged financial performance model evaluated become:

$$P_{ijt} = a_o + \partial P_{ij,t-1} + \alpha_1 B_{it} + \beta X_{jt} + \xi_{it}$$

In this revised equation, $P_{ij,t-1}$ denotes the one-year lagged financial performance (profitability) whilst ∂ measures the speed of adjustment to equilibrium as these lagged effect term to normalize over time (Zarrouk et al., 2016). A value of ∂ between 0 and 1 denotes that profits are persistent though these will then return to their normal level. A value close to 0 implies a high speed of adjustment to normality and denotes a reasonably competitive market structure, while a value of close to 1 implies a very slower adjustment and, therefore, less competitive market. This robustness test, however, did not reveal any significant difference to the unlagged financial performance equation.

3.10 Limitations and conclusion

This chapter has presented the methodological approach that underlie this research aimed at comparing the financial performance of the Islamic banks and conventional bank before, during and after the 2008 global financial crisis. The study seeks to answer the question "what was the relative performance of the Islamic banks as compared to the conventional banks before, during and after the 2008 global financial crisis"? In undertaking this research, data of 108 banks collected from 15 countries in the MENA region is examined over a ten-year period from 2004 to 2014. The 108 banks comprise 35 Islamic banks and 73 conventional banks. The study, in undertaking a comparative performance analysis adopts a positivist epistemological orientation in seeking for a causal relationship between the dependent variables and independent variables. The dependent variables capturing the bank performance are ROE and ROA whilst the independent variables are composed of two parts: bank specific characteristics and macroeconomic variables. The bank specific variables are bank size, capital risk, loan intensity, financial leverage, credit risk, operating ratio and Z-score whilst the macroeconomic variables are gross domestic product (GDP) and inflation.

In seeking for the causal relationship between the dependent variables and independent variables, a deductive and quantitative approach is employed using both multiple regression analysis and artificial neural networks. The two methods complement each other with the artificial neural network shown in prior studies to outperform multiple regression (Baker & Tahir, 2009). Therefore, this strengthens the results obtained in this study.

Nonetheless, like any research, there are inherent limitations that need to be acknowledged in any research. Firstly, a positivists epistemological approach assumes that the financial

performance of the banks and their determinant can be expressed in identifiable variables. This might not be fully the case as there are other unobservable factors which may not be represented in the regression equation for instance. Further, whilst 9 independent variables have been used in this study, the number of variables that logically affect bank performance are more than this. The regression equation captures some of these unobservable variables. Similarly, there are many macroeconomic variables that could be used which is not limited to GDP and inflation.

In the same vein, financial performance of banks would not be simplified to only ROE and ROA. Thus, this might be an over simplification of the representation of the financial performance of banks despite the wide usage in the literature.

Further, with respect to the research methods adopted of artificial neutral network, despite strengthening the results of multiple regression analysis, this approach has some limitation. Lam (2004, p. 568) observes that "one common difficulty for neural network applications involves the determination of the optimal combination of training parameters including the network architecture (the number of hidden layers and the number of hidden nodes), the learning rate, the momentum rate, the order of submitting training examples to the network, and the number of training epochs". Another problem with the method relates to noisy data when this data is collected empirically from different sources. The data may be subject to corruptions during the retrieval, encoding, transfer and decoding process (Lam, 2004). As such, care is taken when applying the research method. Sun et al. (2014) argues that a lack of more systematic and integrated approach in artificial neural network approach in the literature puts this modelling technique into perspective. As such, more research should be conducted.

Chapter Four: MENA Region - Linear Regression Results and Analysis

4.1 Aim of chapter

The two research techniques of linear regression model (involving multiple regression analysis) and non-linear model (artificial neural network) adopted in this comparative study were outlined in the previous chapter. The aim of this chapter is to present the results from the first research technique of multiple linear regression analysis on the MENA region. The descriptive statistics are presented first, following by a presentation of the results that tested the hypothesis and then a summary.

4.2 Descriptive statistics for variables of study

Table 6 shows the descriptive statistics for both the independent and dependent variables in the current study. The descriptive statistics show the mean (arithmetic mean across the variables), standard deviation (which measures the spread of these variables), skewness (which measures the degree and direction of asymmetry of the data) and Kurtosis (which measures the heaviness of the tails of the distributions). The normality of the data is examined through the skewness and kurtosis values. Normal distributions would be expected to have value of skewness closer to 0 and kurtosis close to 3 (Sullivan, 2015).

In general, the data are not normally distributed because the skewness for a normal distribution is zero whilst the results shown in Table 7 show values different from zero. Negative values indicate that the data are skewed to the left side and positives indicate that the data are skewed to right side. In this case, the data for variables (inflation, capital ratio, credit risk, capital risk, financial leverage and operating ratio) is positively skewed whist the other 6 variables (GDP, bank size, loan intensity, Z-score, ROE and ROA) are negatively skewed.

Among the variables, inflation (6.4%), financial leverage (5%), capital ratio (2.3%) and bank size (2.1%) fluctuated the most as captured by standard deviation. Furthermore, Kurtosis is a measure of whether the data are heavy-tailed, or light tailed relative to the normal distribution. The data with high Kurtosis tends to have heavy tails, and data with low Kurtosis tends to have light tails. As presented in Table 6, the Kurtosis of capital ratio is 125.818 which means that the capital ratio tends to have heavy tails. This implies that the independent variable capital

ratio is highly peaked with an asymmetric tail extending towards more positive values (positive skewness). The average inflation among the 15 MENA countries in the period 2004 to 2014 was 5.906 with a recorded fluctuation of 6.419%. This is broken down further in table 7.

With respect to bank performance in the sample, the average ROE was about 11.5%, with a standard deviation of 14.1% whilst the average ROA was lower at 1.7% with standard deviation of 3.0%. The bank sizes in MENA also varies with standard deviation 2.114% around the mean of 8.073 (natural log of total assets).

Table 6: Descriptive statistics of MENA banks (N=988)

	Mean	Std. Dev.	Skewness	Kurtosis
Inflation	5.906	6.419	3.996	36.046
Log GDP	11.013	0.479	-0.061	-1.033
Capital ratio	0.761	2.300	9.871	125.818
Bank size	8.073	2.114	-0.841	1.868
Credit risk	0.071	0.102	4.539	29.117
Capital risk	0.186	0.176	2.951	9.051
Loan intensity	0.522	0.208	-0.551	-0.046
Financial leverage	8.263	5.041	1.903	6.245
Operating ratio	0.019	0.026	6.678	71.808
Z-score	1.013	0.370	-0.474	0.096
Return on equity (ROE)	0.115	0.141	-3.551	35.474
Return on asset (ROA)	0.017	0.030	-2.792	34.126

Table 7 shows the descriptive statistic for economic variables, showing the means and standard deviations for the countries in the sample whilst figure 10 and figure 11 capture the mean inflation and GDPs of the countries respectively. Table 7 shows a high rate of inflation in Iran, where the mean inflation rate is 19.849% with standard deviation of 8.595%. This is followed by Yemen with a mean of 11.903% and a standard deviation of 4.237%. Of the 15 countries, Bahrain was the country with the least inflation where the mean inflation rate was 2.424% with a standard deviation of 1.087%**.**

With respect to GDP, Saudi Arabia was the top country with a mean of GDP (log GDP) of 11.791 and a standard deviation of 0.146. It was followed by Iran with a mean of 11.610 and a

standard deviation 0.153. Among the 15 countries, Jordan had the least GDP where the mean (log GDP) was 10.354 with an associated standard deviation 0.162%.

Table 7: Descriptive statistic for economic variables on all country (N=988)

Countries		Inflation	Log GDP
Algeria	Mean	10.347	11.247
	Std. Dev.	20.027	0.074
Bahrain	Mean	2.424	10.390
	Std. Dev.	1.087	0.106
Egypt	Mean	10.067	11.240
	Std. Dev.	3.232	0.199
Emirates	Mean	6.137	11.449
	Std. Dev.	5.829	0.130
Iran	Mean	19.849	11.610
	Std. Dev.	8.595	0.153
Iraq	Mean	6.526	11.213
	Std. Dev.	12.107	0.164
Jordan	Mean	5.059	10.354
	Std. Dev.	3.471	0.162
Kuwait	Mean	4.485	11.083
	Std. Dev.	2.365	0.135
Libya	Mean	6.181	10.791
	Std. Dev.	4.569	0.120
Morocco	Mean	1.500	10.981
	Std. Dev.	0.957	0.050
Oman	Mean	3.752	10.719
	Std. Dev.	3.099	0.163
Qatar	Mean	4.866	11.039
	Std. Dev.	6.249	0.253
Saudi	Mean	4.002	11.705
	Std. Dev.	2.535	0.146
Tunisia	Mean	4.167	10.611
	Std. Dev.	1.033	0.066
Yemen	Mean	11.903	10.397
	Std. Dev.	4.237	0.145
Total	Mean	5.906	11.012
	Std. Dev.	6.419	0.479

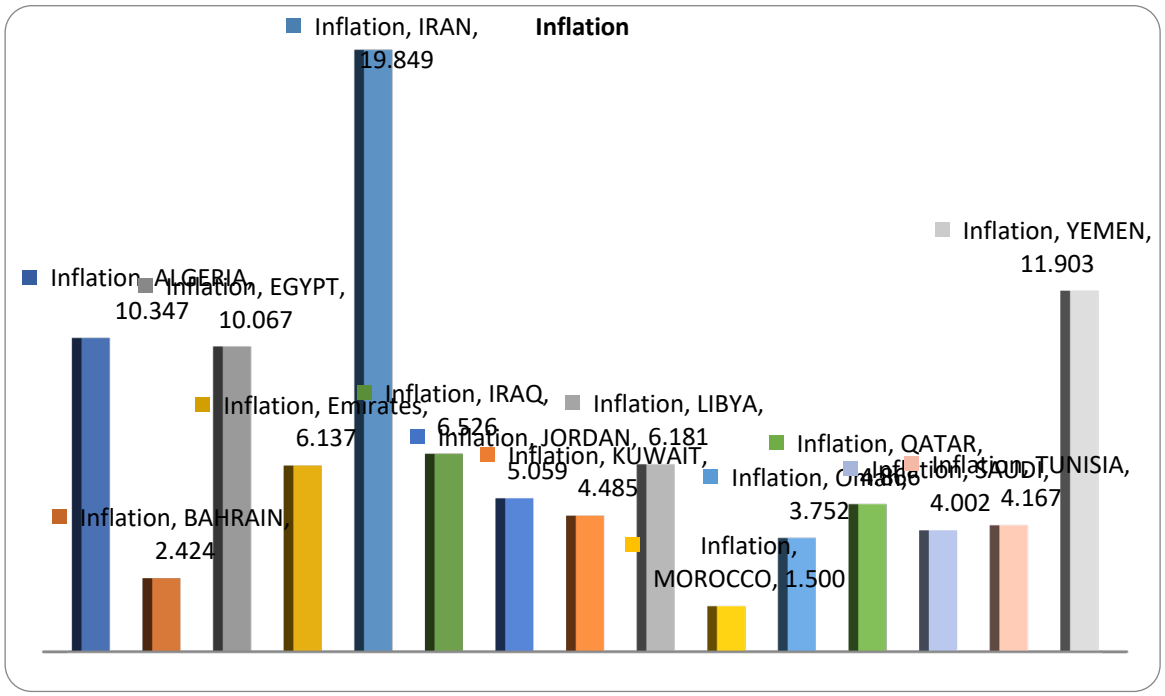


Figure 10: Inflation

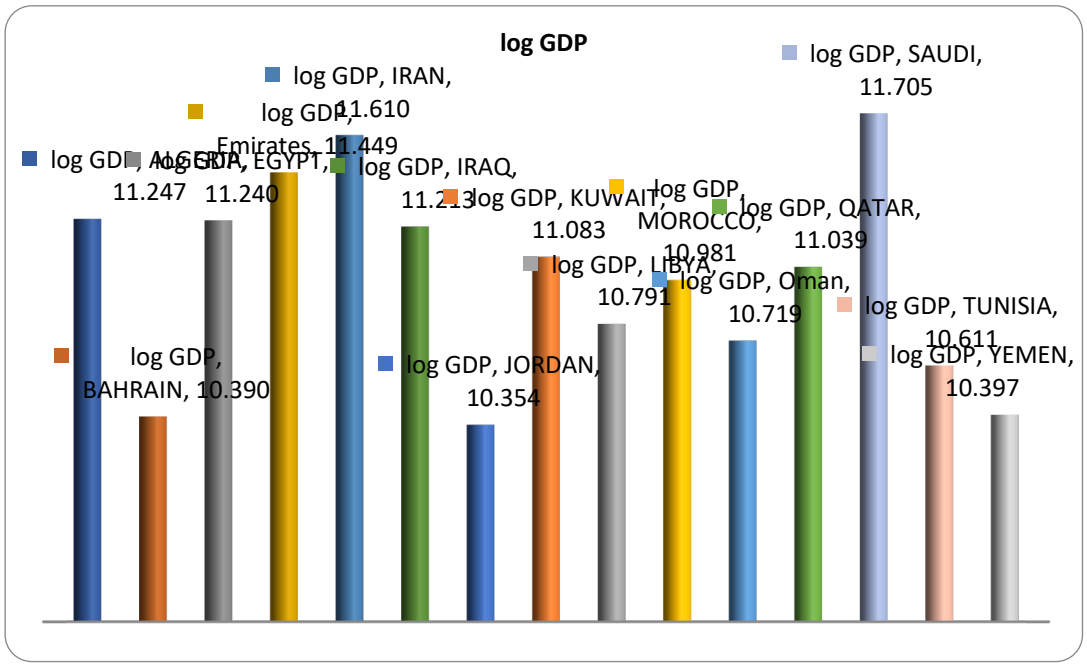


Figure 11: Log GDP

4.3 Hypotheses testing

This section discusses the results obtained when testing the first four hypothesis: there are no significant financial performance differences between the Islamic banks and conventional banks in MENA countries; there are no significant differences between the Islamic banks and conventional banks for the financial variables before and after the 2008 global financial crisis; the 2008 global financial crisis had a similar negative effect on the performance of both the conventional banks and Islamic banks in the MENA countries; and the determinants of bank performance for Islamic banks and conventional banks are the same.

4.3.1 Significant differences in the financial variables of banks in the MENA countries

The hypothesis tested is:

Hypothesis H1: There are no significant differences between the Islamic banks and conventional banks for the financial variables in the MENA region.

Table 8 shows the descriptive statistics and the test results for financial variables between the Islamic and conventional banks in MENA countries in the sample. From the table, the value of the Z-score is higher in conventional banks than in Islamic banks, with a mean value of 1.045 and standard deviation of 0.352 for conventional bank. For Islamic banks, the average value is 0.939 with a standard deviation of 0.400 for Islamic banks. Similarly, the average values of both ROA and ROE were higher in conventional banks than in Islamic banks. The ROE, however, fluctuated more in the conventional banks unlike the ROA. This suggests some volatility in profitability of the conventional banks. To test the significance of the mean of both categories, the T-test was used.

From Table 8, it is evident that there is a significant difference between Islamic banking and conventional banking on most variables at 1% significant level (bank size, capital risk, loan intensity, operating ratio and Z-score**)** and 10% significant level (financial leverage, ROA, ROE) since the P-value or Sig. are less than the significance level. Only credit risk values were not significantly different. This suggests that credit risk management is integral to both banking models. Therefore, there are significant differences observable between the Islamic and conventional banks for the financial variables.

Table 8: Descriptive statistic and test results for financial variables between the Islamic and conventional banks in MENA countries in sample

	Islamic Banking		Conventional Banking		T Test	
	Mean	Std. Dev.	Mean	Std. Dev.	T	Sig.
Inflation	7.705	7.527	5.137	5.718	5.857	.000**
log GDP	11.133	0.534	10.961	0.445	5.256	.000**
Capital ratio	1.390	3.939	0.492	0.833	5.709	.000**
Bank size	7.387	2.583	8.367	1.803	-6.823	.000**
Credit risk	0.065	0.127	0.073	0.089	-1.031	.303
Capital risk	0.229	0.241	0.168	0.135	5.060	.000**
Loan intensity	0.481	0.207	0.540	0.207	-4.105	.000**
Financial leverage	8.701	6.358	8.076	4.349	1.787	.074***
Operating ratio	0.028	0.040	0.015	0.015	7.452	.000**
Z-score	0.939	0.400	1.045	0.352	-4.175	.000**
Return on equity (ROE)	0.102	0.139	0.120	0.141	-1.890	.059***
Return on asset (ROA)	0.014	0.038	0.018	0.026	-1.838	.066***

** Significant at a significant level of 1%

***Significant at a significant level of 10%

Thus, with respect to the first hypothesis 'H1: there are no significant differences between the Islamic banks and conventional banks for the financial variables in the MENA countries', this is rejected and the alternative is accepted as 'there are significant differences between the Islamic banks and conventional banks for the financial variables in the MENA region.

These results are largely consistent with Caporale et al. (2017) study on the 17 MENA countries using the ordinary least square method with return on average assets (ROAA) and return on average equity (ROAE) as the dependent variable. Caporale et al. (2017) also used macroeconomic variables of GDP and inflation together with bank specific characteristics (bank size, liquidity, net interest revenues). On the contrary, Belanes & Hassiki (2012) study that did not find significant differences among the 19 conventional banks and 13 Islamic banks in the MENA region. This was the same with Zarrouk et al. (2016) study of 51 banks in 10 MENA countries which found several elements of similarities among the bank specific variables (liquidity, risk and solvency, efficiency ratios, asset quality, capital, operations, annual stock data) and macroeconomic variables (GDP, inflation) examined on banks' profitability (represented by ROA, ROE and net profit margin) between Islamic banks and conventional banks.

4.3.2 Significant differences in the financial variables of banks before and after the 2008 financial crisis in the MENA countries

The hypothesis tested is:

Hypothesis H2: There are no significant differences between the Islamic banks and conventional banks for the financial variables before and after the 2008 financial crisis.

Table 9 shows the descriptive statistics and the test results for financial variables in the Islamic banks before and after the financial crisis in MENA countries. From the results, it can be seen that there is a higher value of the capital ratio after 2008 compared to the period before 2008 with a value 1.402 for after 2008 and 1.143 for before 2008. This reflects an increased capitalisation of Islamic banks following the global financial crisis partly explained by regulatory requirement (Almanaseer, 2014; Farooq & Zaheer, 2015). There is also a decline in the values of both the ROA and ROE after 2008 when compared to period before 2008. These dependent variables also fluctuated more in the period after the financial crisis. In order to gain a deeper understanding of the significance of the average values obtained, the T-test results are obtained for both periods and included in Table 9.

As shown in Table 9, the differences in the means of the variables before and after the financial crisis are not significant. The results show that there is an insignificant difference on all variables except credit risk at a 5% significant level as the P-values or Sig. are more than the significance level. The bank performance indicators (ROE and ROA), however, recorded a significant difference in the mean values before and after the financial crisis at 1% significant level. Thus, in general, there is an insignificant difference in the observed variables for the periods before and after the global financial crisis with respect to the Islamic banks.

Table 9: Descriptive statistic and test results for financial variables in Islamic banking before and after 2008 in MENA countries

	Before 2008		After 2008		T-Test	
	Mean	Std. Dev.	Mean	Std. Dev.	t	Sig.
Inflation	7.212	5.068	7.040	8.387	.179	.858
log GDP	10.929	0.520	11.236	0.517	-4.593	.000**
Capital ratio	1.143	2.762	1.402	4.125	-.541	.589
Bank size	7.196	2.574	7.460	2.545	-.800	.425
Credit risk	0.045	0.087	0.080	0.149	-2.048	.042*
Capital risk	0.243	0.260	0.216	0.225	.894	.372
Loan intensity	0.476	0.195	0.480	0.213	-.139	.889
Financial leverage	8.850	7.370	8.733	5.830	.143	.887
Operating ratio	0.029	0.046	0.025	0.026	.865	.388
Z-score	0.955	0.390	0.929	0.405	.509	.611
Return on equity (ROE)	0.137	0.091	0.087	0.153	2.873	.004**
Return on asset (ROA)	0.027	0.028	0.008	0.041	3.938	.000**

**Significant at a significant level of 1%
* Significant at a significant level of 5%

Table 10 gives the comparative version to Table 9 with respect to conventional banks. It shows the descriptive statistics and the test results for financial variables of the conventional banks before and after the financial crisis in the MENA countries. From the table, there is a high value of the bank size variable after 2008 than before 2008 with a value of 8.547 for after 2008 and 7.997 for before 2008. This reflects some increase in cross-border mergers among conventional banks after the financial crisis (Sahut & Mili, 2011). Slight increases are also observed for loan intensity, and Z-scores. Further, similar to the Islamic banks, the values of the bank performance indicators (ROA and ROE) declined in the period after the crisis as compared to the period before the crisis. There has been, on the other hand, less fluctuations in both ROE and ROA in the period after the crisis. The significance in the mean values of the variables is compared using the T-Test in respect to the conventional banks in the MENA region with results presented shown also in Table 10.

As reflected in Table 10, there is a significant difference on most variables at the 1% significant level 1% since the P-value or Sig. are less than the1% significance level. Only capital ratio, capital risk, financial leverage and Z-score mean values were not significantly different in the periods before and after the crisis for the conventional banks. Thus, overall, there are significant

differences in the conventional banks for the financial variables before and after the financial crisis.

Table 10: Descriptive statistic and test results for financial in conventional banking variables before and after 2008 in MENA countries

	Before 2008		After 2008		T Test	
	Mean	Std. Dev.	Mean	Std. Dev.	t	Sig.
Inflation	5.761	5.272	3.825	5.413	4.290	.000**
log GDP	10.785	0.444	11.052	0.422	-7.399	.000**
Capital Ratio	0.544	0.962	0.478	0.791	.922	.357
Bank Size	7.997	1.625	8.547	1.898	-3.616	.000**
Credit risk	0.090	0.115	0.066	0.073	3.071	.002**
Capital Risk	0.169	0.141	0.171	0.134	-.139	.890
Loan intensity	0.501	0.202	0.558	0.205	-3.351	.001**
Financial leverage	8.196	4.256	7.755	3.802	1.321	.187
Operating ratio	0.012	0.009	0.016	0.017	-3.172	.002**
Z-score	1.032	0.343	1.057	0.354	-.836	.403
Return on Equity (ROE)	0.168	0.155	0.093	0.126	6.545	.000**
Return on Asset (ROA)	0.027	0.028	0.014	0.022	6.056	.000**

**Significant at a significant level of 1%

From the results above, the second hypothesis, H2, is rejected for conventional banks in the MENA countries. The alternative hypothesis is accepted as 'there are significant differences in conventional banks for the financial variables before and after the financial crisis in MENA countries.' On the other hand, the hypothesis is accepted for Islamic banks as 'there are no significant differences in Islamic banks for the financial variables before and after the financial crisis in MENA countries.'

4.3.3 The effect of the 2008 financial crisis on banks in the MENA countries

The hypothesis tested is:

Hypothesis H3: The 2008 global financial crisis had a similar negative effect on the performance of both the conventional banks and Islamic banks in the MENA countries.

Linear regression analysis was performed to investigate the effect of the financial crisis on banking performance. Table 11 presents the association between financial crisis and bank performance measured by ROE and ROA. The financial crisis variable was obtained through adding a dummy variable to the regression equation (see section 3.7.3). A dummy variable equal to 1 is used for years between 2007-2008, zero if years are between 2004-2006 and 2009-

2014. Table 11 below shows the Pearson Correlation matrix for Islamic Banks in the MENA countries. Based on the results obtained, it can be concluded that there is a significantly negative and weak correlation between the financial crisis and the banks' performance (represented by ROE and ROA) at a 1% significance level, with the value of the correlation coefficient of -0.174 and -.0236 respectively.

Table 11: Pearson correlation matrix in Islamic banks in the MENA countries

	Return on equity (ROE)	Return on asset (ROA)	Financial crisis
Return on equity (ROE)	1		
Return on asset (ROA)	.764**	1	
Financial crisis	-.174**	-.236**	1

** Correlation is significant at the 0.01 level.

A further analysis of bank performance using only the ROE for Islamic banks in the MENA countries is presented in Table 12 below. The results show an f-value of 8.256 (p-value of 0.004) at a 1% significant level indicating that the regression coefficients are not zero. A negative correlation coefficient of 5% is observed from the regression results. As such, the financial crisis had a significantly negative effect on Islamic banks' ROE in the MENA countries as the value of Sig= 0.004 (0.4%) is less than 1%. Further, the coefficient of determination, R^2, is 0.030, which implies that the financial crisis explains 3.0% of the changes that occur in the dependent variable (ROE).

Table 12: Bank performance measured by (ROE) and financial crisis in Islamic banks in the MENA countries

F (P-value)	**R^2**	**Coefficients**			
			β	t	P-value
8.256 (0.004)	0.030	Constant	.187	6.204	.000**
		Financial Crisis	-.050	-2.873	.004**

** Significant at the 0.01 level.

Table 13 presents the simple regression results for the dependant variable (ROA) for Islamic bank in the MENA countries. The results show an F value of 15.508 with a p-value of 0.000 implying the significance of the financial crisis variable at 1% significance level to the changes in ROA. The F values shows that the regression coefficient are non-zero. The financial crisis negatively influenced the ROA as the regression coefficient is -0.019 and the p-value or Sig is 0.000 which is less than 1% (the significance level). Further, the coefficient of determination,

R^2 is 0.055, which implies that the financial crisis accounted for 5.5% of the changes that occurred in the dependent variable, ROA.

Table 13: Bank performance measured by ROA and financial crisis in Islamic banks in the MENA countries

F (P-value)	**R^2**	**Coefficients**			
			β	t	P-value
15.508 (0.000)	0.055	Constant	.046	5.580	.000**
		Financial Crisis	-.019	-3.938	.000**

** Significant at the 0.01 level.

In relation to the association between financial crisis and bank performance represented by ROE and ROA in the MENA countries for conventional banks, Table 14 below shows the Pearson Correlation results. From the results which measure the correlation between the variables, there is a significantly weak negative correlation between financial crisis and bank performance (captured by ROE and ROA) at 1% significance level, as the values of the correlation coefficient are -0.253 and -0.237, respectively.

Table 14: Pearson correlation matrix in conventional banking in the MENA countries

	Return on equity (ROE)	**Return on asset (ROA)**	**Financial crisis**
Return on Equity (ROE)	1		
Return on Asset (ROA)	.723**	1	
Financial Crisis	-.254**	-.237**	1

** Correlation is significant at the 0.01 level.

To further understand the impact of the financial crisis on conventional banks' performance, regression analysis was directed at each dependent variable. Table 15 presents the simple regression results for conventional banks for the dependent variable (ROE) only in the MENA countries. The results show a high f value of 42.841 and a p-value of 0.000 implying the significance of the financial crisis variable on ROE. The regression coefficient are non-zero as these improve the predictive capacity of the relationship. The significance of the financial variable changes is because the p-value (Sig) is 0.000 less than the 1% alpha value. The predictive strength is that 6.4% of the changes in ROE is explained by the financial crisis variable since the coefficient of determination, R^2, is 0.064.

Table 15: Bank performance measured by (ROE) and financial crisis in conventional banks in the MENA countries

F (P-value)	R^2	Coefficients			
			β	t	P-value
42.841 (0.000)	0.064	Constant	.244	12.310	.000**
		Financial Crisis	-.075	-6.545	.000**

** Significant at the 0.01 level.

Table 16 presents the results of the simple regression model for conventional banks for the dependent variable (ROA) only in MENA countries. The results show that the financial crisis variable has a significant impact on the ROA as the p-value (Sig) is 0.0000 at the 1% significance level. Further, the coefficients improve the predictive capacity of the association between financial crisis and ROA as the f-value is 36.671 (p-value 0.000). Thus, there is a significant association between the ROA and financial crisis variable. This association, however, is a negative association as the regression coefficient is -0.012. The predictive strength of the association between ROA and financial crisis is captured by the coefficient of determination, R^2, of 0.056, which indicates that the changes that occur in the ROA of the regression model are explained up to 5.6% by the changes in the financial crisis variable. As such, other factors account for the remaining 94.4% changes. The significance of the relationship is because the p-value (Sig) of 0.000 is less than the 1% significance level.

Table 16: Bank performance measured by (ROA) and financial crisis in conventional banks in the MENA countries

F (P-value)	R^2	Coefficients			
			β	t	P-value
36.671 (0.000)	0.056	Constant	.039	11.106	.000**
		Financial Crisis	-.012	-6.056	.000**

** Significant at the 0.01 level.

From the above, the hypothesis 'H3: The global financial crisis had a negative effect on the performance of both the conventional banks and Islamic banks in the MENA countries' is therefore accepted. The effect of the financial crisis have widely been acknowledged by other studies that have empirically evidenced the negative effects of the global financial crisis on the performance of both the conventional and Islamic banking sectors in the MENA countries as a whole (Alexakis et al., 2018; Al-Musali & Ismail, 2014; Beck et al., 2013; Caporale et al., 2017). However, the effect of the financial crisis, as suggested by the explanatory power of the

results obtained using ROE as the dependent variable, was more in the conventional banks than the Islamic banks in the MENA region. These results are consistent, for instance, with Beck et al. (2010) study that showed that Islamic banks had relatively performed better than conventional banks despite both banking types having been negatively affected by the financial instability.

4.3.4 The determinants of bank performance in the MENA countries

The hypothesis tested is:

Hypothesis H4: The determinants of bank performance for Islamic banks and conventional banks are the same.

Table 17 shows the Pearson correlation between the independent variables (bank specific and macroeconomic variables) and bank performance (measured by ROE and ROA) of the Islamic Banks in the MENA countries. From the results, there is a significant but weak negative correlation between credit risk and bank performance (ROE and ROA) at 1% significance level represented by correlation coefficients of -0.361 and -0.340 for ROE and ROA respectively. Similarly, Miller & Noulas (1997) found a negative relationship between credit risk and profitability. Contrary, Heffernan & Fu (2008) study on bank performance found a positive and significant coefficient of credit risk (measured by loan loss ratio provision over gross loans) to bank performance. Other studies also highlighted the positive effects of credit risk on bank performance (Athanasoglou et al., 2008; Kosmidau et al., 2007; Vong & Hoi, 2009).

In addition, there is a significantly weak negative relationship between capital ratio and bank performance at 1% significance level with respective correlation coefficient of -0.268 for ROE and -0.213 for ROA. These results are largely consistent with other studies that have shown a similar negative relationship between capital ratio (capitalisation) and profitability (Altunbas & Marques, 2008; Chronopoulos, et al., 2015; Ćurak et al., 2012; Dietrich & Wanzenried, 2011; Mollah & Zaman, 2015; Shehzad, et al., 2013). Contrary, other studies have shown a positive relationship between capital ratio and profitability (Apergis, 2014; Căpraru & Ihnatov, 2014; Chitan, 2012; Ghosh, 2016; Kutan et al., 2012; Mamatzakis et al., 2016; Mirzaei et al. 2013; Sufian & Habibullah, 2010). On the other hand, some studies have shown mixed results (Olson & Zoubi, 2011; Westman, 2011). Further, from Table 17 below, it can be observed that there is a significantly weak inverse relationship between operating ratio and bank performance with

correlation coefficients of -0.161 (ROE) and -0.164 (ROA). These findings are similar to Beck et al. (2013), Berger et al. (2009) and ElBannan (2015) that showed a negative association between operating ratio and bank performance but contrary to Srairi (2013) that found a positive relationship.

Loan intensity was found to be positively significant though weakly correlated to bank performance at a 1% significance level with correlation coefficients of 0.323 and 0.199 for ROE and ROA respectively. This reflects that an increase in loans provided by banks led to an increase in profitability. This positive relationship is supported by other studies (Chronopoulos et al., 2015; Demirguc-Kunt & Huizinga, 1999; Lin & Zhang; 2009). However, others argue that increasing loan provisions causes an increased in the default (bankruptcy) risk which then reduces the bank's profitability (Beck et al., 2013; Berger et al., 2009; Bourkhis & Nabi, 2013).

With respect to GDP and bank performance, the results show a weak positive relationship between the independent variable, log GDP, and bank performance variables. The relationship is significant at 1% significance level for ROE where the value of the correlation coefficient is 0.170, and positively significant at 5% significance level for ROA where the value of the correlation coefficient is 0.136. The positive effect of GDP has been empirically supported in other studies from different country contexts (Bashir, 2001; Hassan & Bashir, 2003; Asutay & Izhar, 2007; Kosmidou et al., 2006; Smaoui & Salah, 2012).

Table 17: Pearson correlation in Islamic banks in the MENA countries

	ROE	ROA
Inflation	.209**	.025
log GDP	.170**	.136*
Capital ratio	-.268**	-.213**
Bank size	-.006	.091
Credit risk	-.361**	-.340**
Capital risk	-.265**	-.018
Loan intensity	.323**	.199**
Financial leverage	.166**	-.100
Operating ratio	-.161**	-.164**
Z-score	.149*	.266**

** Correlation is significant at the 0.01 level.
* Correlation is significant at the 0.05 level.

In order to reveal more relationships between the independent variables and dependent variables, a multivariate regression analysis was performed for each dependant variable in turn

for each banking type. Table 18 presents the multivariate regression results for Islamic banks in MENA countries for the independent variables on the dependent variables (ROE). The results show an f-value of 10.838 and p-value 0.000 indicating that the independent variables improve the predictive power of the dependent variable. As such, it is unlikely that all the coefficients of the independent variables equal zero. Thus, the overall assessment of all the coefficients (the regression model) is significant. The statistically significant variables, obtained through a t-test to obtain p-values, are credit risk, capital risk and Z-score at the 1% significance level. Credit risk and capital risks recorded negative regression coefficients of -0.233 and -0.183 respectively while Z-score recorded a positive regression coefficient of 0.111. Inflation was statistically significant at a 10% significance level.

With respect to the predictive power of the relationship between the independent variables and ROE, the study showed a coefficient of determination, R^2, of 0.276. This implies that the independent variables explained 27.6% of the changes that occurred in the dependent variable, ROE, in Islamic banks in the MENA countries.

Table 18: Multivariate regression results of Islamic banks' performance measured by ROE in MENA countries

F (P-value)	**R^2**	**Coefficients**			
			β	**t**	**P-value**
10.838 (0.000)	**0.276**	Constant	-.233	-1.467	.143
		Inflation	.003	1.962	.051***
		log GDP	.019	1.259	.209
		Capital ratio	.001	.346	.729
		Bank size	.005	1.336	.183
		Credit risk	-.233	-3.541	.000**
		Capital risk	-.183	-3.616	.000**
		Loan intensity	.030	.617	.538
		Financial leverage	.001	.741	.459
		Operating ratio	-.196	-1.003	.317
		Z-score	.111	4.672	.000**

** Significant at the 0.01 level
*** Significant at the 0.10 level

In order to analyse the significant variables further, a stepwise regression analysis was performed. Table 19 presents the multivariate stepwise regression results for Islamic banks in the MENA countries for the dependent variables, ROE. The f-value increased to 25.346 (from 10,838) reflecting the improved predictive power of the regression model. The significance of credit risk, capital risk and Z-score coefficients (-0.263, -0.228 and 0.111 respectively) is

observable at the 1% significance level since p-value (Sig) is 0.000 which is less 1%. The constant coefficient is significant at 10% significance level.

Thus, from the results obtained, the most important independent variables affecting the dependent variable, ROE, in their respective predictive or causal effect is credit risk, capital risk, Z-score and Log GDP. The importance of these 4 variables in influencing the dependant variable, ROE, is depicted by the coefficient of determination, R^2, of 0.258 which implies that these independent variables explain 25.8% of the changes that occur in the dependent variable for Islamic banks in the MENA countries.

Table 19: Stepwise regression model in Islamic banks' performance measured by ROE in the MENA countries

F (P-value)	R^2	Coefficients			
			β	t	P-value
25.346 (0.000)	0.258	Constant	-.273	-1.847	.066***
		Credit risk	-.263	-4.485	.000**
		Capital risk	-.228	-6.300	.000**
		Z-score	.111	5.099	.000**
		Log GDP	.031	2.308	.022*

** Significant at the 0.01 level
* Significant at the 0.05 level
*** Significant at the 0.10 level

A corresponding analysis was performed for dependent variable, ROA. Table 20 presents the multivariate regression results obtained for Islamic banking in MENA countries. The f-value is 7.794 which reflects relatively the combined predictive capacity of the model as it implies that all regression coefficient would not be zero. At a 1% significance level, the regression coefficient of credit risk (-0.078) was statistically significant as the p-value of 0.000 is less than 1%. The regression coefficients for capital ratio (-0.001) and Z-score (0.023) are statistically significant at 95% confidence level.

The explanatory power of the independent variables on ROA is depicted by the coefficient of determination, R^2, of 0.215. This means that the independent variables combined explain 21.5% of the changes that occur in the dependent variable, ROA, of Islamic banks in the MENA countries.

Table 20: Multivariate regression results of Islamic banks' performance measured by ROA in the MENA countries

F (P-value)	**R^2**	**Coefficients**			
			β	t	P-value
7.794 (0.000)	0.215	Constant	-.062	-1.357	.176
		Inflation	.000	.740	.460
		log GDP	.006	1.488	.138
		Capital ratio	-.001	-1.977	.049*
		Bank size	.001	1.202	.230
		Credit risk	-.078	-4.142	.000**
		Capital risk	-.019	-1.322	.187
		Loan intensity	-.016	-1.123	.262
		Financial leverage	-.001	-1.567	.118
		Operating ratio	-.091	-1.620	.106
		Z-score	.023	3.342	.001*

** Significant at the 0.01 level
* Significant at the 0.05 level

A stepwise regression was performed to analyse the predictive power of the observed significant variables on ROA. Table 21 presents the multivariate stepwise regression results for Islamic banks in the MENA countries on the dependent variable, ROA. The predictive capability of the model has increased with the f-value of 22.921. At 1% significance level, the regression coefficients for credit risk (-0.075), Z-score (0.025) and Capital ratio (-0.002) are statistically significant as their p-values from the t-test is less than 1%.

The combined predictive power of these three variables (credit risk, Z-score and capital ratio) is 19.1% as reflected from the coefficient of determination. This implies that of the 21.5% observed in Table 21, 19.1% is captured by these three variables. In terms of their importance, this is reflected in the values of their regression coefficients with credit risk being the most important independent variable followed by Z-score and capital ratio on ROA in MENA countries Islamic banks.

Table 21: Stepwise regression results of Islamic Banks' performance measured by ROA in the MENA countries

F (P-value)	R^2	Coefficients			
			β	t	P-value
22.921 (0.000)	0.191	Constant	-.001	-.226	.821
		Credit risk	-.075	-4.423	.000**
		Z-score	.025	4.704	.000**
		Capital ratio	-.002	-3.177	.002**

** Significant at the 0.01 level

The results for conventional banks in the MENA countries are presented next. Table 22 shows the Pearson correlation between independent variables and bank performance for conventional banks in the MENA countries. From the table, weak significantly negative correlation is observed between credit risk and bank performance at 1% significance level with values of the correlation coefficient of -0.251 for ROE and -0.118 for ROA respectively. Similarly, a weak significant negative relationship is observed between the operating ratio and bank performance with correlation coefficient of -0.251 (ROE) at 1% significance level and -0.078 (ROA) at 5% significance levels respectively. On the other hand, there is a weak positive relationship between log GDP and ROE at 1% significance level with correlation coefficient value of -0.121. Loan intensity recorded weak positive significant correlation at 1% significance level for ROA (0.130) and at 5% significance level for ROA (0.130). Bank size revealed weak positive significant relationship at 1% to ROE and weak negative significant relationship to ROA. Further regression analysis was undertaken to understand the relationships more.

Table 22: Pearson correlation in conventional banking in the MENA countries

	ROE	ROA
Inflation	.089*	.035
log GDP	.121**	.049
Capital ratio	-.159**	.076*
Bank size	.144**	-.097*
Credit risk	-.251**	-.118**
Capital risk	-.090*	.383**
Loan intensity	.081*	.130**
Financial leverage	.093*	-.259**
Operating ratio	-.251**	-.078*
Z-score	.122**	.273**

** Correlation is significant at the 0.01 level.
* Correlation is significant at the 0.05 level.

Table 23 presents the multivariate regression results obtained for conventional bank in the MENA countries for dependent variables, ROE. There is an overall statistical significance in the relationship between the independent variables and the dependent variable, ROE, as revealed by f-value of 11.227. Thus, the coefficients of the independent variables are jointly significant. At the 1% significant level, the regression coefficients of credit risk (-0.218), operating ratio (-1.550) and Z-score (0.054) are statistically significant. At the 5% significance level, the regression coefficients for log GDP (0.024) and financial leverage (0.003) were significant whilst inflation coefficient was significant at 10% significance level. Loan intensity was also significant with a 90% confidence level. The collective independent variables accounted for 14.2% of the changes in the ROE as implied from the coefficient of determination, R^2, of 0.142.

Table 23: Multivariate regression results of conventional banks' performance measured by ROE in the MENA countries

F (P-value)	**R^2**	**Coefficients**			
			β	**t**	**P-value**
11.227 (0.000)	0.142	Constant	-.171	-1.588	.113
		Inflation	.001	1.824	.069***
		Log GDP	.024	2.474	.014*
		Capital ratio	-.008	-1.166	.244
		Bank size	.001	.300	.764
		Credit risk	-.218	-3.737	.000**
		Capital risk	.028	.583	.560
		Loan intensity	-.051	-1.735	.083***
		Financial leverage	.003	2.266	.024*
		Operating ratio	-1.550	-5.091	.000**
		Z-score	.054	4.404	.000**

** Significant at the 0.01 level
* Significant at the 0.05 level
*** Significant at the 0.10 level

In Table 24, the multivariate stepwise regression results for conventional banks in the MENA countries for the dependent variable, ROE, is presented. The overall predictive power has increased with the f-value being 18.225 (compared to 11.227). Significant regression coefficients are observed at 1% confidence level for operating ratio, Z-score, credit risk and financial leverage. At 5% confidence level, the macroeconomic variables, log GDP and inflation, are statistically significant. In terms of ranking the independent variables with respect to causal effect on ROE, the highest is operating ratio followed by credit risk, Z-score and financial leverage respectively. The coefficient of determination, R^2, is 0.138 implying that the

significant independent variables explain 13.8% of the changes that occur in the dependent variable, ROE, in conventional banking in MENA countries.

Table 24: Stepwise regression results of conventional banks' performance measured by ROE in the MENA countries

F (P-value)	R^2	Coefficients			
			β	t	P-value
18.225 (0.000)	0.138	Constant	-.197	-1.863	.063***
		Operating ratio	-1.595	-5.449	.000**
		Z-score	.056	4.754	.000**
		Credit risk	-.182	-3.731	.000**
		Financial leverage	.004	3.640	.000**
		Log GDP	.024	2.558	.011*
		Inflation	.002	2.136	.033*

** Significant at the 0.01 level
* Significant at the 0.05 level
*** Significant at the 0.10 level

A multivariate regression analysis for conventional banks in the MENA region for the dependent variable, ROA, only was performed with the results presented in Table 25. At 1% significance level, the analysis shows that credit risk, capital risk, operating ratio and Z-score have significant regression correlation of -0.043, 0.078, -0.345 and 0.013 respectively. As such, operating ratio among the four significant variables has a higher regression coefficient. The predictive capacity of overall independent variables on the dependent variable (ROA) is high with f-value of 22.331. Regarding the explanatory power of the independent variables, these accounted for 24.8% of the changes that occurred in the dependent variable as implied from the coefficient of determination, R^2, of 0.248.

Table 25: Multivariate regression results of conventional banks' performance measured by ROA in the MENA countries

F (P-value)	R^2	Coefficients			
			β	t	P-value
22.331 (0.000)	0.248	Constant	-.015	-.687	.493
		Inflation	.000	.819	.413
		log GDP	.002	1.031	.303
		Capital ratio	.000	.148	.883
		Bank size	-.001	-1.485	.138
		Credit risk	-.043	-3.725	.000**
		Capital risk	.078	8.309	.000**
		Loan intensity	-.003	-.511	.610
		Financial leverage	.00001	.254	.799
		Operating ratio	-.345	-5.737	.000**
		Z-score	.013	5.317	.000**

** Significant at the 0.01 level

Further, Table 26 presents a multivariate stepwise regression model for conventional banks in the MENA countries for the dependent variables (ROA) on the identified significant variables. The overall predictive capacity of the relationship has increased as reflected by the f-value of 54.673. At 1% significance level, the regression coefficients of the four variables are more visible with the negative relationship of credit risk and operating ratio to the performance variable (ROA) and a positive relationship for capital risk and Z-score. The explanatory power of the independent variables on the performance variable have remained relatively the same which is also observable in the regression coefficient values shown in Tables 24 and 25 which have marginally changed. The four variables are accounting for 24.2% of the changes in ROA, when other variables are not included. The independent variables that have the most influence on conventional banks' ROA, in their order are operating ratio, capital risk, credit risk and Z-score.

Table 26: Stepwise regression results of conventional banks' performance measured by ROA in the MENA countries

F (P-value)	R^2	Coefficients			
			β	t	P-value
54.673 (0.000)	0.242	Constant	-.0003	-.138	.890
		Capital Risk	.079	11.865	.000**
		Operating ratio	-.338	-5.770	.000**
		Z-score	.013	5.434	.000**
		Credit risk	-.036	-3.714	.000**

** Significant at the 0.01 level

4.4 Summary of the results

This section summarises the results obtained above in order to give some perspective to the key findings. Table 27 below shows the summary of the results for the impact of the global financial crisis on the Islamic banks and conventional banks in the MENA countries. It can be concluded, based on the results obtained, that the financial crisis impacted the performance of Islamic banks and conventional banks weakly. This conclusion is reached because the global financial crisis variable is responsible for 5.6% of the changes that occurred in the dependent variable, ROA, for conventional banks in the MENA countries. These results were observed at 99% confidence level with the coefficients of determination showing the relative explanatory power of the global financial crisis variable. Further, with respect to Islamic banks, the global financial crisis can be credited for 5.5% of the changes that occurred in the ROA in the MENA countries. The relative difference in the impact of the financial crisis on the Islamic banks and conventional banks using the ROA as the dependent variable was insignificant.

Using the ROE as the dependent variable for bank performance, the global financial crisis can be credited for only 3.0% of the changes in the dependent variable of Islamic banks in the MENA countries. On the other hand, the global financial crisis variable accounted for 6.4% of the changes in the ROE of conventional banks in the MENA countries. As such, these results show that whilst the effect of the global financial crisis were overall weak in the MENA region, the impact on conventional banks was relatively more than the impact on the Islamic banks. These results are inconsistent, for instance, with Bourkhis & Nabi (2013) study that showed no

significant difference on the impact of the financial crisis on the two banking types in the MENA region.

Table 27: Summary of results on the impact of financial crisis in the MENA region.

		MENA	
		ROE	**ROA**
Islamic banks	r	-.174**	-.236**
	R^2	0.030	0.055
Conventional banks	r	-.254**	-.237**
	R^2	0.064	0.056

** Correlation is significant at the 0.01 level

Further, the correlation results between the independent variables (inflation, GDP, capital ratio, bank size, credit risk, capital risk, loan intensity, financial leverage, operating ratio and Z-score) and the dependent variables (ROA and ROE) for both Islamic banks and conventional banks in the MENA countries are summarised in Table 28 below. From the table, it can be concluded that there is a significantly negative weak correlation between credit risk and bank performance represented at 1% significance level. The negative relationship between credit risk and bank performance has been found in several studies (Athanasoglou et al., 2008; Căpraru & Ihnatov, 2014; Kutan et al., 2012; Liang et al., 2013; Petria et al., 2015). However, other studies have found mixed relationship (Kanas et al., 2012; Olson & Zoubi, 2011) whilst others found a positive relationship (Kosmidau et al., 2007; Vong & Hoi, 2009). Further, consistent with Mamatzakis et al. (2016) and Mollah & Zaman (2015) findings, the Z-score was found to be positively correlated with bank performance at a 1% significance level. Further, many studies, such as Houston et al. (2010) and Chronopoulos et al. (2015) propose that size of banks influence profitability significantly and positively whilst others suggest the opposite that smaller sized banks were more profitable. This study reveals that bank size matters in the MENA countries. However, the effect of bank size applies to conventional banks rather than Islamic banks. Thus, these findings are inconsistent with study findings, for instance, of Căpraru & Ihnatov (2014) and Haan & Poghosyan (2012) that suggest that bank size has a negative influence on banking profitability.

In addition, the study has revealed that capital ratio impacts the bank performance, ROA and ROE, negatively at 1% and 5% confidence levels, respectively. This suggests that lowering capitalization could lead to an increase in profitability. These results are largely consistent with

other studies (Altunbas & Marques, 2008; Chronopoulos, et al., 2015; Ćurak et al., 2012; Dietrich & Wanzenried, 2011; Mollah & Zaman, 2015; Shehzad, et al., 2013) that showed a negative relationship between capitalization and bank profitability. However, other studies suggest the need for more bank capitalization (Apergis, 2014; Chitan, 2012; Ghosh, 2016; Kutan et al., 2012; Mamatzakis et al., 2016; Mirzaei et al. 2013; Sufian & Habibullah, 2010).

Table 28: Summary of results of correlation for Islamic banks and conventional banks in the MENA region.

	MENA			
	Islamic banks		Conventional banks	
	ROE	ROA	ROE	ROA
Inflation	(+)**		(+)*	
Log GDP	(+)**	(+)*	(+)**	
Capital ratio	(-)**	(-)**	(-)**	(+)*
Bank size			(+)**	(-)*
Credit risk	(-)**	(-)**	(-)**	(-)**
Capital risk	(-)**		(-)*	(+)**
Loan intensity	(+)**	(+)**	(+)*	(+)**
Financial leverage	(+)**		(+)*	(-)**
Operating ratio	(-)**	(-)**	(-)**	(-)*
Z-score	(+)*	(+)**	(-)**	(-)**

** Correlation is significant at the 0.01 level.
* Correlation is significant at the 0.05 level.

4.5 Conclusion

The aim of this chapter was to present the results of the multiple linear regression analysis. This analysis was performed in order to test the first four hypotheses developed in chapter 1:

- Hypothesis One: There are no significant/fundamental financial performance differences between the operations of Islamic and conventional banks in MENA countries.
- Hypothesis Two: There are no significant differences between the Islamic banks and conventional banks for the financial variables before and after the financial crisis.
- Hypothesis Three: The 2008 global financial crisis had a similar negative effect on the performance of both the conventional banks and Islamic banks in the MENA countries.
- Hypothesis Four: The determinants of bank performance for Islamic banks and conventional banks are the same.

In summary, the results have shown that:

- there are significant financial performance differences as reflected by the financial variables between the Islamic banks and conventional banks in the MENA region.
- there are significant differences in conventional banks for the financial variables before and after the 2008 global financial crisis in MENA countries.
- The 2008 global financial crisis had a negative effect on the performance of both the conventional banks and Islamic banks in the MENA countries. However, the results suggest that the negative effect of the financial crisis on the conventional banks was more than on the Islamic banks.
- Some similarities exist with respect to factors that influence financial performance of Islamic banks and conventional banks (e.g. credit risk and Z-score). However, there are observable significant differences as some factors most important to financial performance of conventional banks are not significant for Islamic banks (e.g. bank size).

Having undertaken the linear regression analysis and discussed the results of the MENA region as a whole, the next chapter goes further to present results obtained using the artificial neural network method.

Chapter Five: MENA Region - Artificial Neural Network Results and Analysis

5.1 Aim of chapter

The previous chapter presented the results of the multiple linear regression analysis of the data on bank performance for the MENA region. The aim of this chapter is to present the results obtained from the second research method employed which uses the non-linear modelling technique of artificial neural network (ANN). The results are presented in this chapter together with their interpretation.

5.2 Performance of Islamic banks in the MENA countries based on ROE.

5.2.1 MLP on all independent variables in MENA countries

The first analysis using the multilayer perceptron (MLP) procedure was performed for the dependent variable, ROE, for the Islamic banks in the MENA region. In order to perform the analysis using the MLP, the data was divided into 3 sets: training, testing, and excluded. As presented in Table 29, 72.6% of the observations were used for training and 27.4% for testing. The training set was used for the estimation of the synaptic weights in the neural network whilst the predictions were made in the testing set. On the basis of the errors observed in the training set, the weights of the neural network were adjusted in order to minimize the errors in the testing set and also correct any overtraining problems. This MLP process is repeated for the different areas of focus with respective results for each focus area discussed in the different sections in this chapter and in chapter six.

Table 29: Case processing summary for ROE in Islamic banks in the MENA countries

		N	Percent
Sample	Training	215	72.6%
	Testing	81	27.4%
Valid		296	100.0%
Excluded		0	
Total		296	

The information about the neural network architecture is given in Table 30. It shows that the network has an input layer, a single hidden layer, and an output layer. In the hidden layer the number of units is 7 whilst the activation function used is Sigmoid. The activation function

links the weighted sums of units in a layer to the values of units in the succeeding layer (IBM, 2013). The rescaling of scale dependent variable are controls available only if at least one scale-dependent variable has been selected. This network information table will be largely identical for the other analysis with changes occurring in the covariates and number of units in the input layer, number of units in the hidden layer and the dependent variable (whether return on equity or return on assets).

Table 30: Network information for ROE in Islamic banking in the MENA countries

Input Layer	Covariates**	1	Inflation
		2	Log GDP
		3	Capital ratio
		4	Bank size
		5	Cred risk
		6	Capital risk
		7	Loan intensity
		8	Financial leverage
		9	Operating ratio
		10	Z-score
	Number of units [a**]		10
	Rescaling method for covariates		Standardized
Hidden Layer(s)	Number of hidden layers		1
	Number of units in hidden layer 1 [a**]		7
	Activation function		Sigmoid
Output Layer	Dependent variables	1	Return on equity**
	Number of units		1
	Rescaling method for scale dependents		Normalized
	Activation function		Sigmoid
	Error function		Sum of squares

a. Excluding the bias unit
** Values that will be changing in the subsequent test analysis.

The architecture of the network is shown in Figure 12. Light colour lines show weights greater than zero and the dark colour lines show weight less than zero. The synaptic weights reveal "the coefficient estimates that show the relationship between the units in a given layer to the units in the following layer. The synaptic weights are based on the training sample even if the active dataset is partitioned into training, testing, and holdout data" (IBM, 2013, p. 10). The model summary and the fit statistics for the training and testing data sets are given in Table 31. It shows that Sum of Squares Error is 0.690 and Relative Error is 0.451 in training stage.

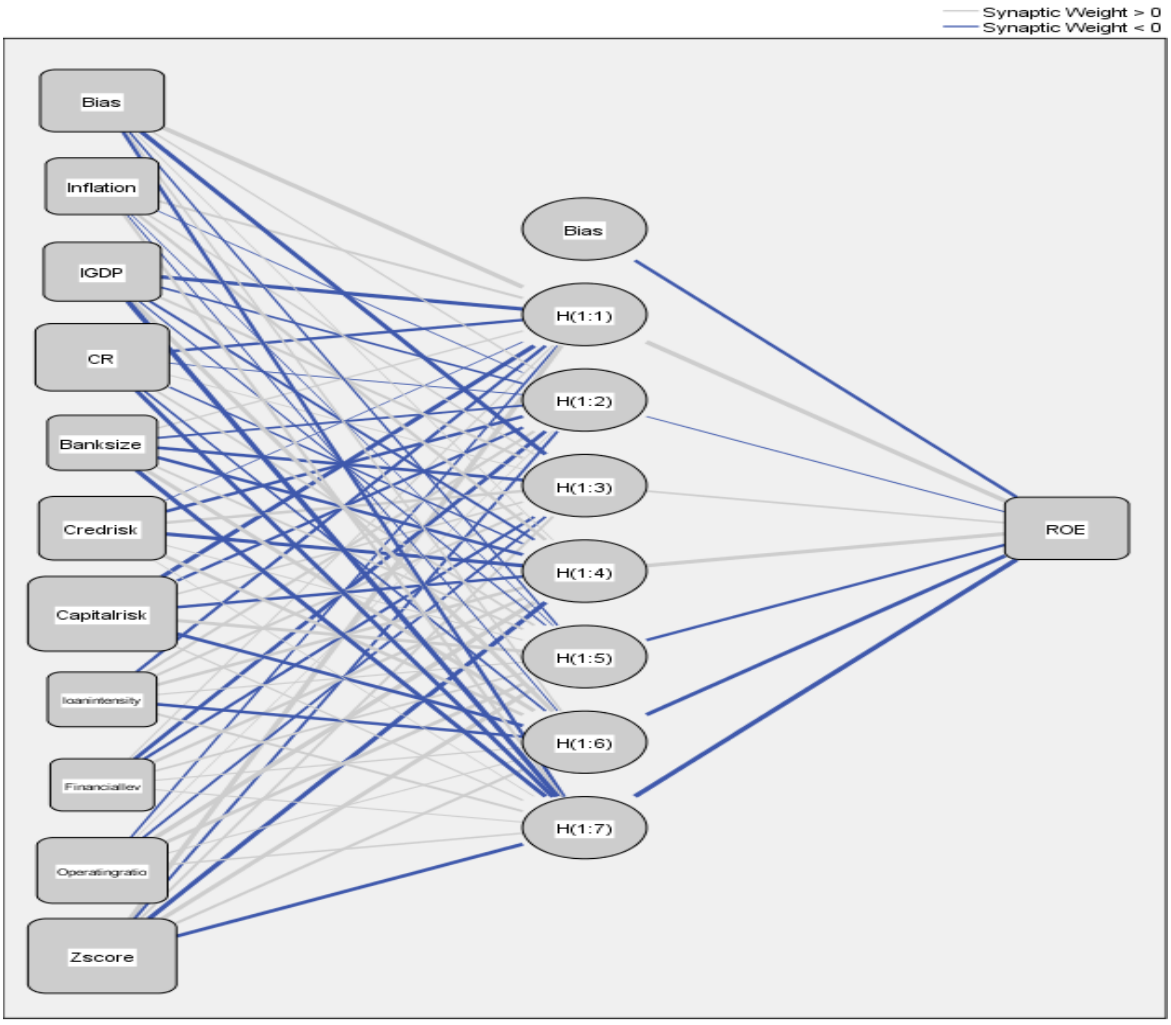


Figure 12: The architecture of the network for ROE in Islamic banking in MENA countries

For the testing stage the Sum of Squares Error is 0.472 and Relative Error is 0.601. The relative error is the percentage of incorrect predictions in the data set. In this respect, the percentage of incorrect predictions was higher at 60.1% in the testing sample than 45.1% in the training data set indicating no evidence of overtraining.

Table 31: Model summary for ROE in Islamic banking in the MENA countries

Training	Sum of Squares Error	.690
	Relative Error	.451
	Stopping rule used	1 consecutive step (s) with no decrease in error[a]
	Training time	0:00:00.08
Testing	Sum of Squares Error	.472
	Relative Error	.601
Dependent Variable: Return on equity a. Error computations are based on the testing sample.		

The estimates of the weights and bias are given in Appendix C, Table C1. The results in this table show the value of weights from input to the hidden layer and from the hidden layer to the output layer. H (1:1) means hidden layer 1 and 1St neuron. The weight attached to the neuron from bias are 1.862; 0.131; -0.749; 0.060; -0.148; 0.163; and -0.398; respectively. The weights from the hidden layer to the output layer for bias is -0.407 and from the 1st neuron in the hidden layer to the output are 2.409; -0.088; 0.193; 0.940; -0.398; -0.657 and -1.453, respectively.

The importance of an independent variable is a measure of how much the network's model-predicted value changes for different values of the independent variable (IBM, 2013). The normalised importance then presents the relative importance of the variable to the largest important variable. Table 32 and Figure 13 show the relative importance of the independent variables in the neural network model. The table shows the relative importance of the independent variable, capital risk, which reached 0.199 and thus its normalised importance value of 100%. The next important variable is Z-score which reached 0.198 with a normalised importance value of 99.6%. The relative importance of the other independent variables places capital risk as the next important followed by operating risk. The least important, based on the dataset was financial leverage.

Figure 13 depicts the relative importance of the independent variables sorted in descending value of importance. The capital risk which essentially measures the banks' capitalisation and Z-score which capture the banks' stability in terms of insolvency risk are the two most important variables that influence bank performance (measured by dependent variable ROE) of Islamic banks in the MENA region. These results, when compared to the multiple linear regression results discussed in section 4.3 show similarities with respect to the most important independent variables that influence the dependent variable, ROE, on Islamic banks in the MENA region. In order to rank the independent variables more reliably, further ANN analysis using only the significant variables is needed.

Table 32: Independent variable importance for ROE in Islamic banks in the MENA countries

	Importance	Normalized importance
Inflation	.055	27.5%
Log GDP	.072	36.3%
Capital ratio	.139	69.7%
Bank size	.042	21.2%
Credit risk	.110	55.5%
Capital risk	.199	100.0%
Loan intensity	.039	19.8%
Financial leverage	.019	9.8%
Operating ratio	.126	63.4%
Z-score	.198	99.6%

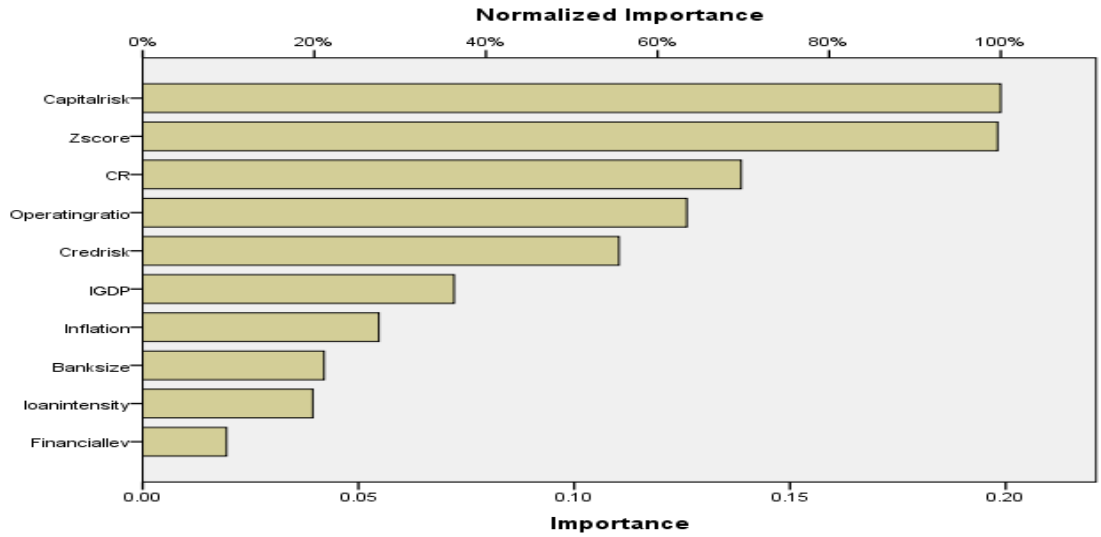


Figure 13: Independent variable importance for ROE in Islamic Banks in the MENA Countries

In order to understand the relationship further, the multilayer perceptron (MLP) procedure was performed for only the independent variables that had a normalised importance value higher than 50% (capital risk, Z-score, capital ratio, operating ratio and credit risk). The next section discusses the findings on these selected independent variables only.

5.2.2 MLP on five selected independent variables in the MENA countries

The dataset, as outlined in section 5.2.1 above, was divided into 3 sets: training, testing and excluded. As shown in Table 33, 69.3% of the observations were used for training and 30.7%

for testing. The training set, to reiterate, is used for the estimation of the weights in the neural network and then predictions are made in the testing set. On the basis of the errors observed in the training set, the weights of the neural network are adjusted to minimize the errors in the testing set.

Table 33: Case processing summary for ROE in Islamic banks in the MENA countries

		N	Percent
Sample	Training	205	69.3%
	Testing	91	30.7%
Valid		296	100%
Excluded		0	
Total		296	

The network information for the MLP procedure is identical to Table 30 but now based on the 5 independent variables (see appendix B). The number of units is now lower at 5 as compared to 10 in table 30 since the focus is only on the 5 most importance independent variables. The number of units in the hidden layer 1 has also reduced to 3 from the previous 7. As already highlighted in section 3.8.2 and 5.2.1, the activation function is the sigmoid function.

The corresponding architecture of the network is shown in Figure 14. The light colour lines show weights greater than zero while the dark colour lines show weights less than zero.

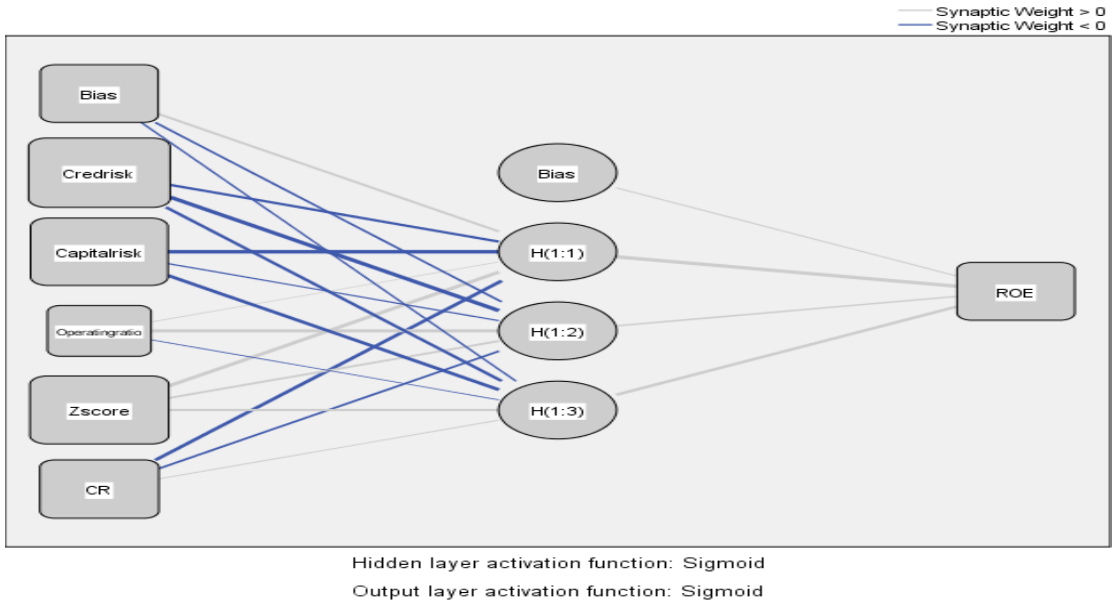


Figure 14: The architecture of the network for ROE in Islamic banks in the MENA countries

The model summary and the fit statistics for the date sets: training and testing are presented in Table 34 below. The model summary shows that the Sum of Squares Error was 0.936 with an associated Relative Error of 0.782 in the training stage whilst the Sum of Squares Error was 0.148 with a Relative Error of 0.814 in testing stage. Further, the estimation algorithm stopped after 2 milliseconds because the error did not decrease after a step in the algorithm.

Table 34: Model summary for ROE in Islamic banks in the MENA countries

Training	Sum of Squares Error	.936
	Relative Error	.782
	Stopping rule used	1 consecutive step(s) with no decrease in error[a]
	Training time	0:00:00.02
Testing	Sum of Squares Error	.148
	Relative Error	.814

Dependent Variable: Return on Equity.

a. Error computations are based on the testing sample.

The estimates of the weights and bias are given in Appendix C, Table C2 which shows the value of weights from input to the hidden layer and from the hidden layer to the output layer. As stated in section 5.2.1, H (1:1) means hidden layer 1 and 1^{St} neuron. From the results, the weights attached to the neuron from bias are 0.393; -0.279; -0.256, respectively. These values are determined by the estimation algorithm obtained from the activation function. The weights from the hidden layer to the output layer for bias is –0.201 and from 1st neuron in the hidden layer to the output are 0.649; 0.260 and 0.456 respectively.

Table 35 and Figure 15 show the relative importance of the selected five independent variables in the neural network model. The table reveals that the relative importance of the independent variable, credit risk, was highest at 0.280 and thus allocated normalised value of 100%. The relative importance of the other independent variables has increased such as Z-score which has increased to 0.264 (from 0.198) with an associated standard value of 94.3%.

Table 35: Independent variables importance for ROE in Islamic banks in the MENA countries

	Importance	Normalized Importance
Credit risk	.280	100.0%
Capital risk	.255	91.4%
Operating ratio	.055	19.8%
Z-score	.264	94.3%
Capital ratio	.146	52.3%

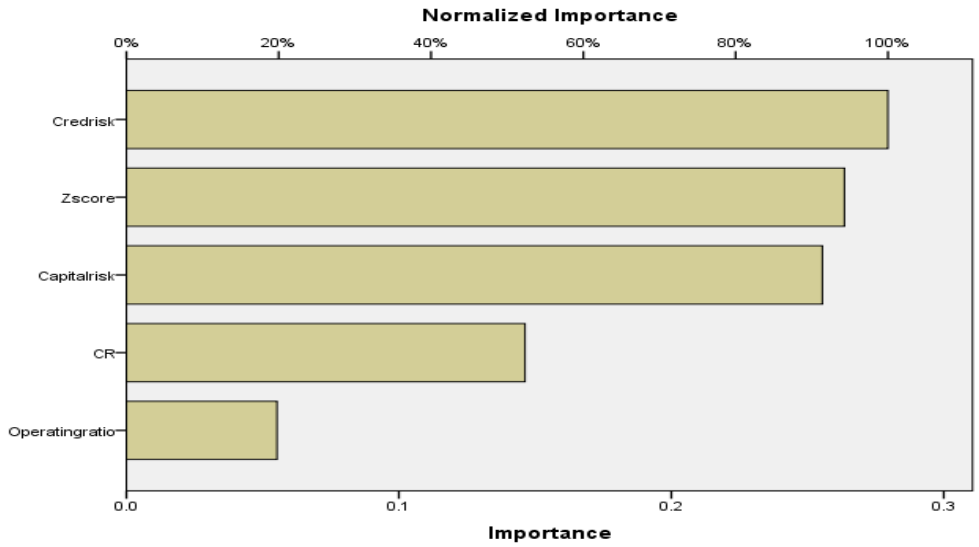


Figure 15: Independent variable importance for ROE in Islamic banking in MENA countries

Figure 16 shows actual and estimated values of ROE for Islamic banks using neural networks in the MENA countries. From the figure, it can be concluded that the estimated values approach the actual value of the dependent variable, ROE, of Islamic banks in the MENA region.

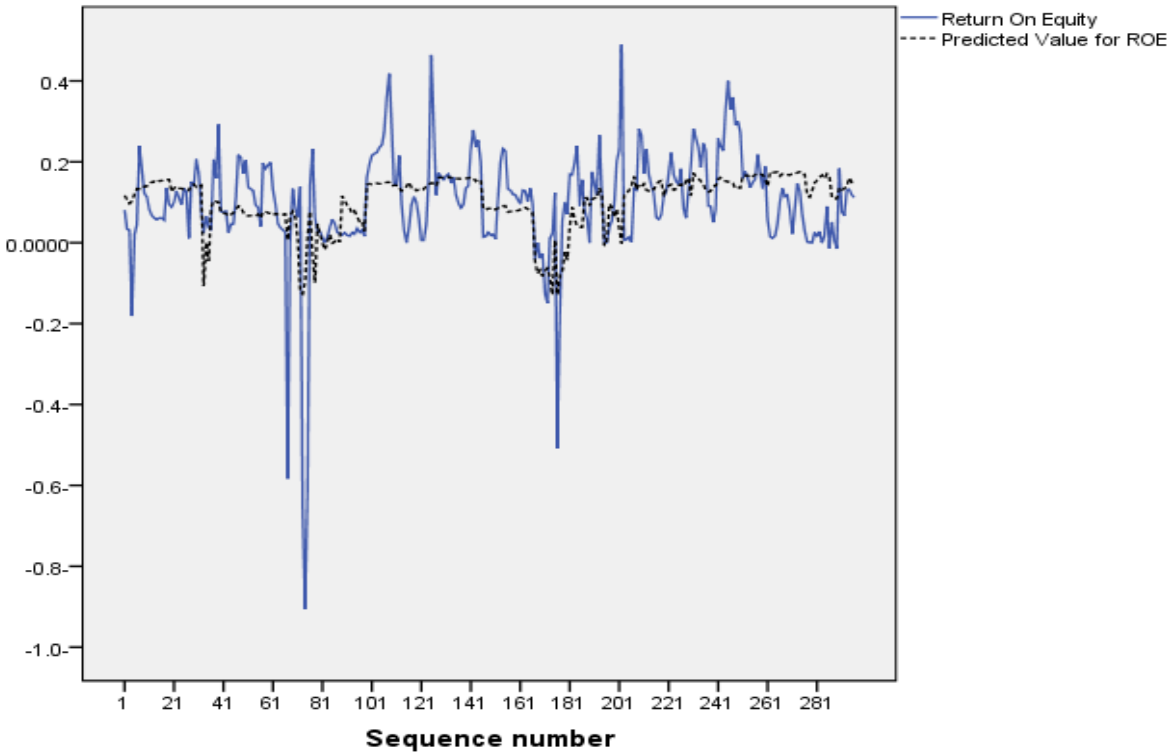


Figure 16: Actual and estimated values using neural for ROE in Islamic banking in the MENA countries

An analysis of the explanatory power of the neural network model gave a coefficient of determination, R^2 of 0.490. This implies that the independent variables explained 49.0% of the changes that occurred in the dependent variable, ROE, for the Islamic banks in the MENA countries when using the ANN approach. This explanatory strength of the neural network model can be compared to the 25.8% obtained when using the multiple linear regression model (see section 4.3.4). The significance of credit risk, Z-score and capital risk as key determinants of bank performance has been shown in several other studies (Abedifar et al., 2013; Athanasoglou et al., 2008; Ghosh, 2016; Mamatzakis et al., 2016; Mollah & Zaman, 2015; Nguyen & Nghiem, 2015; Petria et al., 2015). The next section discusses the Islamic banks' performance in the MENA as captured by the dependent variable, ROA.

5.3 Performance of Islamic banking in the MENA countries based on ROA.

5.3.1 MLP for all the independent variables in the MENA countries

As previously, the data was divided into 3 sets: training, testing and excluded. This is depicted in Table 36 with 69.3% of observations used in training and 30.7% for testing. No dataset was allocated to the excluded/holdout sample category as all observations were allocated to the training and testing partitions.

Table 36: Case processing summary for ROA in Islamic banks in the MENA countries

		N	Percent
Sample	Training	205	69.3%
	Testing	91	30.7%
Valid		296	100%
Excluded		0	
Total		296	

The network information is similar to Table 30 except for the dependent variable which is now return on asset (ROA). The number of units in the input layer is 10 whilst that in the hidden layer is 7. As indicated above, the activation function is based on the Sigmoid function.

Putting the neural network into perspective, figure 17 shows the architecture of the neural network. The light colour lines in figure 17 show weights greater than zero and the dark colour lines show weight less than zero. The synaptic weights display the coefficient estimates that show the relationship between the units in a given layer to the units in the following layer.

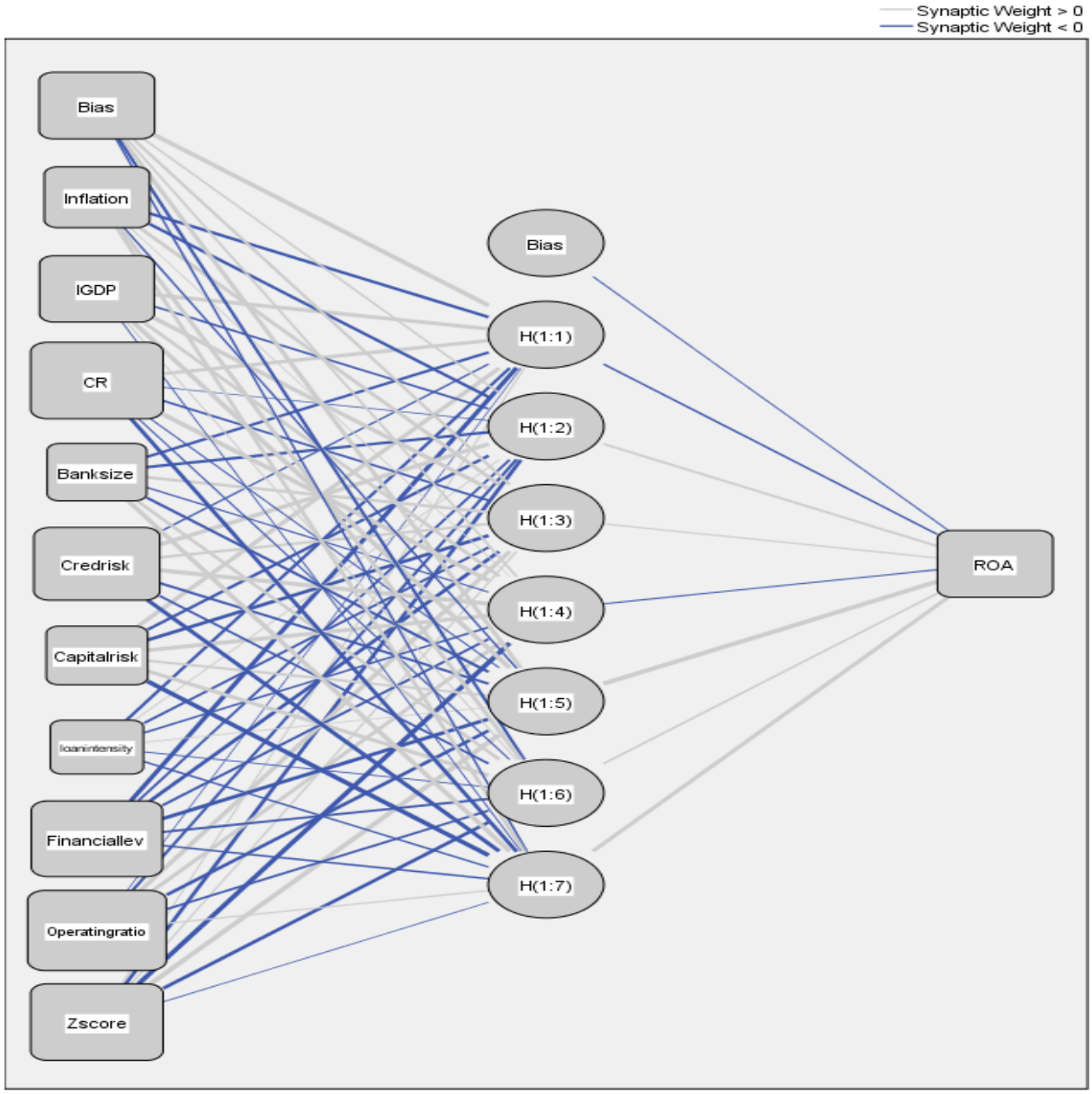


Figure 17: The architecture of the neural network for ROA in Islamic banks in MENA countries

Further, the model summary of the MLP for ROA for Islamic banks in the MENA region is presented in Table 37. The model summary provides fit statistics for the training and testing data sets. These summary statistics determine whether the model is 'good' fit. From Table 37, the results show the Sum of Squares Error of 0.593 and Relative Error 0.823 in training stage. The Sum of Squares Error is 0.089 and Relative Error is 0.998 in testing stage. The sum of squares errors has reduced from the training phase at 0.593 to 0.089 in the testing stage reflecting the improvement in the fitness of the model. The sum of squared errors in the ANN basically measures the differences between the network outputs and the target (desired) outputs,

which can be perceived as a 'cost' (Ruxanda & Badea, 2014). In this instance, the cost has been reduced. The stopping rule used, as above, is when the estimation algorithm step does not result in an associated decrease in the estimation error. Put simply, no further 'cost' reduction is achieved by undertaking more steps in the algorithm.

Table 37: Model summary for ROA in Islamic banks in the MENA countries

Training	Sum of Squares Error	.593
	Relative Error	.823
	Stopping rule used	1 consecutive step(s) with no decrease in error[a]
	Training time	0:00:00.03
Testing	Sum of Squares Error	.089
	Relative Error	.998

Dependent Variable: Return on Asset,
a. Error computations are based on the testing sample.

The estimates of the weights and bias are given in Appendix C, Table C3 which shows the value of weights from input to the hidden layer and from the hidden layer to the output layer. As indicated above, H(1:1) means the hidden layer 1 and 1St neuron. The weights attached to the neuron from bias are 0.422, 0.107, 0.209, 0.135, 0.318, -0.188 and -0.093, respectively. The weight from the hidden layer to the output layer for bias is -0.045 and from 1st neuron in the hidden layer to the output are -0.104, 0.143, 0.078, -0.053, 0.718, 0.132 and 0.332 respectively. All the weights greater than zero have been depicted with light colour lines and those with weights less than zero have been depicted by the dark colour lines in figure 17.

The next stage in the MLP procedure was aimed at identifying the most important independent variables. Table 38 and Figure 18 show the results from the neural network model of the relative importance of the independent variables. The table reveals that the relative importance of the independent variable, operating ratio, is highest with value of 0.185. This indicates that the network's model-predicted value changed more for the different values of the operating ratio. The operating ratio is allocated the normalised importance value 100% to put the relative importance of the other independent variables in context. The independent variable Z-score and capital ratio were next in importance with values of 0.160 and 0.159, with their associated normalised importance of 86.7% and 86.1% respectively. The other independent variable with normalised importance above 50% were financial leverage (83.8%), and credit risk (72.1%).

Table 38: Independent variable importance for ROA in Islamic banks in the MENA countries

	Importance	Normalized Importance
Inflation	.051	27.7%
log GDP	.089	48.2%
Capital ratio	.159	86.1%
Bank size	.028	15.4%
Credit risk	.133	72.1%
Capital risk	.036	19.4%
Loan intensity	.002	1.2%
Financial leverage	.155	83.8%
Operating ratio	.185	100.0%
Z-score	.160	86.7%

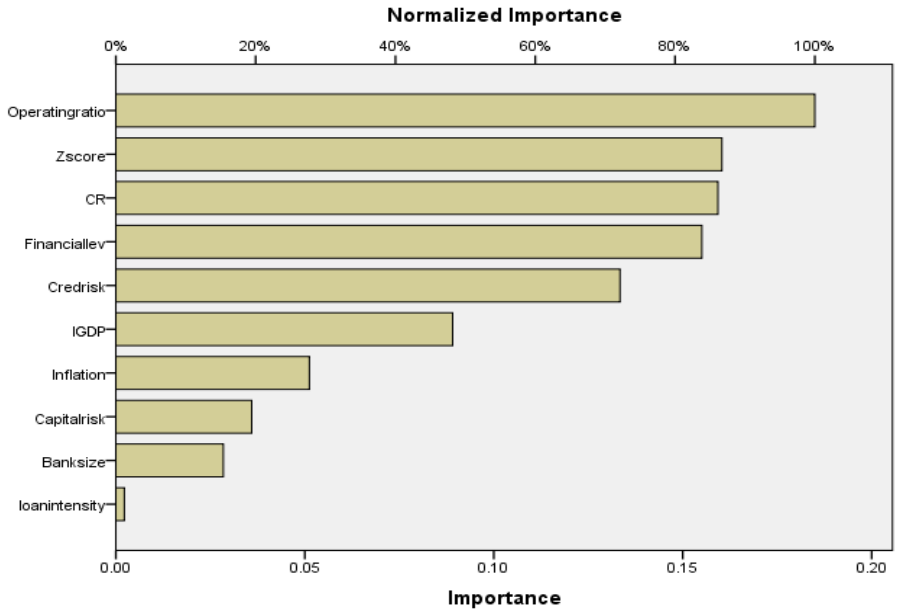


Figure 18: Independent variable importance for ROA in Islamic banks in the MENA countries

The MLP was next performed for only these five independent variables on their effect on ROA for Islamic banks in the MENA countries. The results are discussed next.

5.3.2 MLP on five selected independent variables for ROA in the MENA countries

The data was partitioned into three sets: training, testing and excluded. Nothing was allocated to the excluded set, however, as all data sample was partitioned to training and testing set. The excluded (or holdout) sample is usually another independent set of data records used to assess the final neural network. Given the number of observations, 296, it was not necessary to allocate

some observations to this set. As shown in Table 39, 68.6% of the observations were used for training and 31.4% for testing.

Table 39: Case processing summary for ROA in Islamic banks in the MENA countries

		N	Percent
Sample	Training	203	68.6%
	Testing	93	31.4%
Valid		296	100%
Excluded		0	
Total		296	

The neural network architecture is as depicted in Appendix B. As only five independent variables are examined, the number of units in the input layer is now 5 instead of 10 whilst the number of units in the hidden layer is 3 reducing from 7 (compared to table 30 in section 5.2.1).

The architecture of the revised network for only the five independent variables (capital ratio, credit risk, financial leverage, operating ratio and Z-score) is shown in Figure 19. As indicated above, the light colour lines show weights greater than zero and the dark colour lines show weight less than zero.

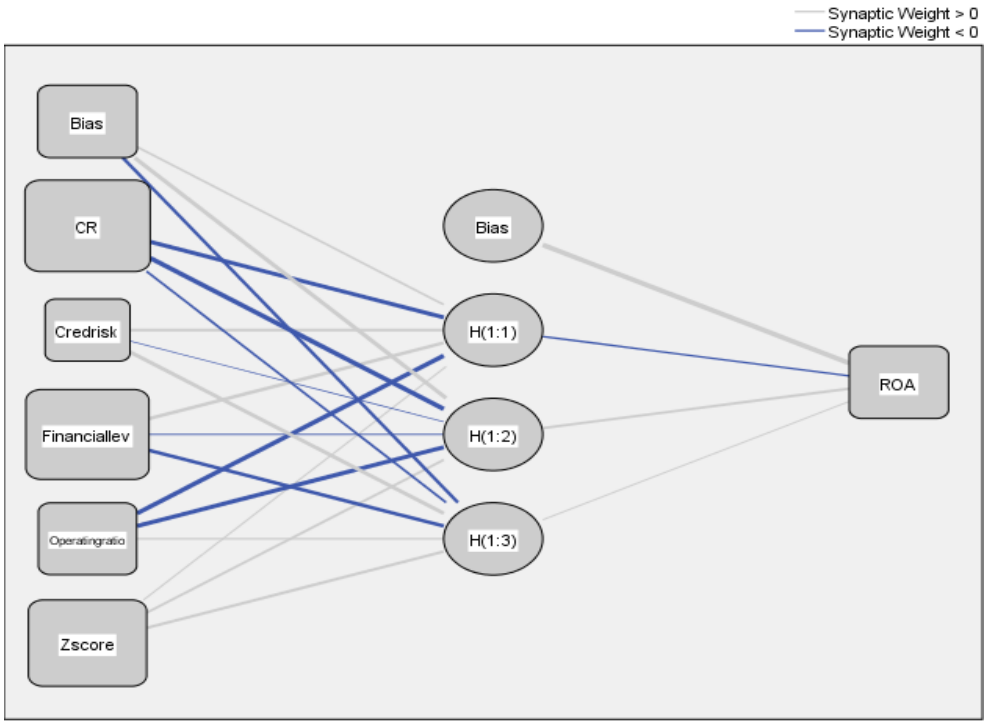


Figure 19: The architecture of the network for ROA in Islamic banks in the MENA countries

The model summary for the training set and testing set are shown in Table 40. The goodness of fit of the neural network model has improved as depicted from the reduction in the Sum of Squares Error. This reduced from 0.608 in the training stage to 0.181 in the testing stage. Further, the percentage of incorrect predictions as shown by the relative errors is almost equal across the training and testing samples with values of 0.960 and 0.946 respectively.

Table 40: Model summary for ROA in Islamic banks in the MENA countries

Training	Sum of Squares Error	.608
	Relative Error	.960
	Stopping rule used	1 consecutive step(s) with no decrease in error[a]
	Training time	0:00:00.00
Testing	Sum of Squares Error	.181
	Relative Error	.946

Dependent Variable: Return on Asset,
a. Error computations are based on the testing sample

The estimates of the weights and bias are given in Appendix C, Table C4. The results in this table show the value of weights from input to the hidden layer and from the hidden layer to the output layer. These values are obtained from the activation function which is based on the Sigmoid function. H (1:1) means hidden layer 1 and 1St neuron. The weights attached to the neuron from bias are 0.164, 0.354 and -0.255, respectively. The weights from the hidden layer to the output layer for bias is 0.559 and from 1st neuron in the hidden layer to the output are -0.145, 0.239 and 0.072, respectively.

The relative importance of the five selected independent variables based on the neural network model is presented in Table 41 and Figure 20. The relative importance of the independent variable, capital ratio, is highest with importance value of 0.283 and therefore allocated normalised importance of 100%. The second most important independent variable that affects the ROA predicted values changes in the neural network model is financial leverage with relative importance of 95.9% followed by Z-score with a normalised importance of 86.5%.

Table 41: Independent variable importance for ROA in Islamic banking in the MENA countries

	Importance	Normalized importance
Capital Ratio	.283	100.0%
Cred risk	.064	22.8%
Financial leverage	.271	95.9%
Operating ratio	.137	48.4%
Z-score	.245	86.5%

Figure 20 puts the relative importance of these five independent variables into context.

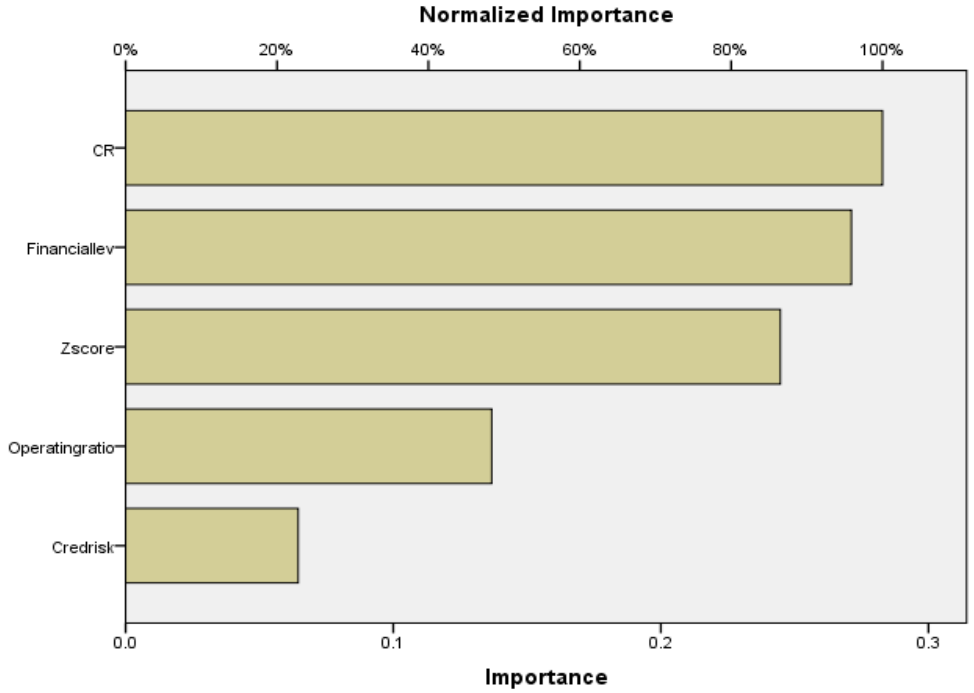


Figure 20: Independent variable importance for ROA in Islamic banks in the MENA countries

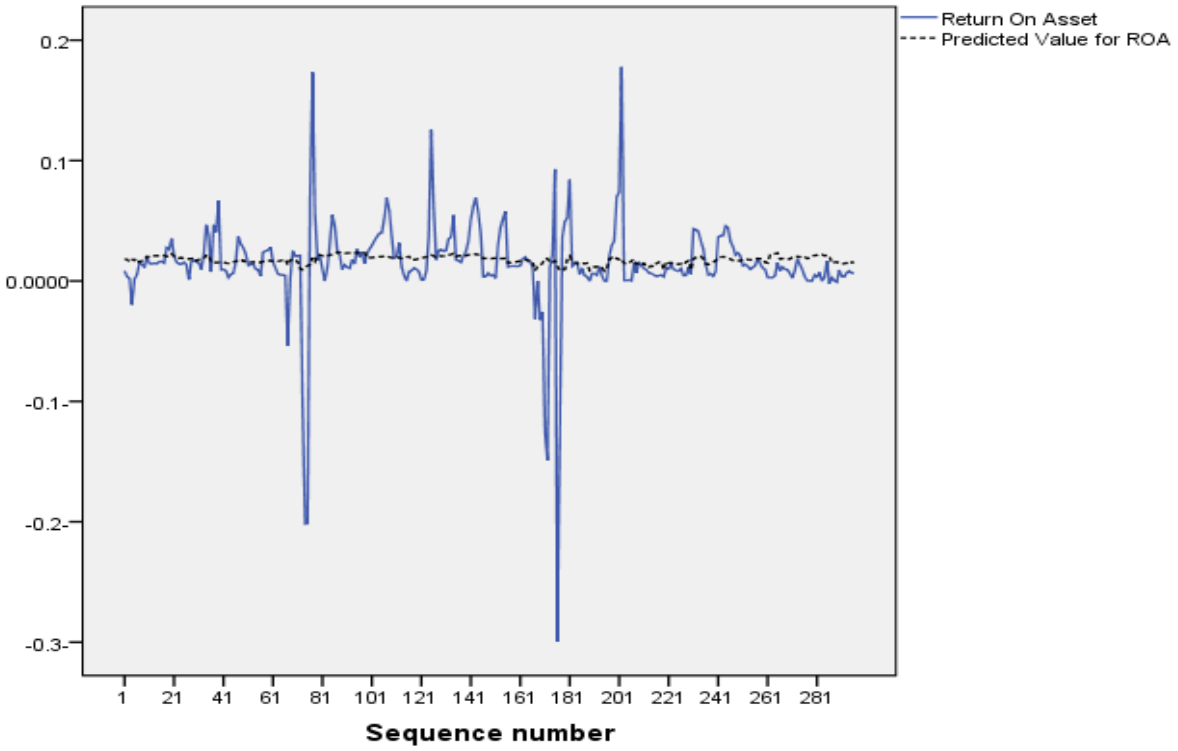


Figure 21: Actual and estimated values using neural for ROA in Islamic banks in the MENA countries

Further, the goodness of the neural network model is pictorially depicted in Figure 21 above which shows the actual and estimated values. In this respect, the actual and estimated values of the dependent variable, ROA, for Islamic banks in the MENA using neural networks shows that the estimated values significantly approach the actual values. A further analysis of the goodness of fit of the ANN approach gave a coefficient of determination, R^2 of 0.164, which indicates that the independent variables accounted for 16.4% of the changes in the dependent variable, ROA, for the Islamic banks in the MENA countries when using the ANN approach.

The next section analyses the performance of the conventional banks using the ANN approach in the MENA region. The analysis starts with the dependent variable, ROE, for the conventional banks in the MENA region.

5.4 Performance of conventional banks in the MENA countries for ROE dependent variable

5.4.1 MLP on all independent variables for ROE in conventional banking in the MENA countries

As dictated by the MLP procedure, the dataset was partitioned into 3 sets training, testing and excluded/holdout sample. As the number of observations is higher for the conventional banks, as compared to Islamic banks, partitioning to excluded/holdout set is possible. As depicted in Table 42, 67.5% of the observations were used for training and 32.5% for testing. Of the total 692 observations, 3 observations were excluded. Further, as the MLP procedure guides, the training set was used for the estimation of the synaptic weights in the neural network whilst the predictions were made in the testing set. Then on the basis of the errors observed in the training set, the weights of the neural network are adjusted in order to minimize the errors in the testing set.

Table 42: Case processing summary for ROE in conventional banks in the MENA countries

		N	Percent
Sample	Training	465	67.5%
	Testing	224	32.5%
Valid		689	100.0%
Excluded		3	
Total		692	

The revised network information for the dependent variable, ROE, for conventional banks in the MENA countries is similar to Table 30. As shown in Table 30 (section 5.2.1), the neural network architecture shows that the network has an input layer, a single hidden layer and an output layer. The number of units in the input layer is 10 which are the independent variables examined. In the hidden layer, the number of units is 7 and as the focus is on only one dependent variable, ROE, the number of units in the output layer is 1. The activation function as used in all the MLP procedures in this study is Sigmoid.

The architecture of the neural network is shown in Figure 22 below with the light colour lines showing weights greater than zero and the dark colour lines showing weights less than zero.

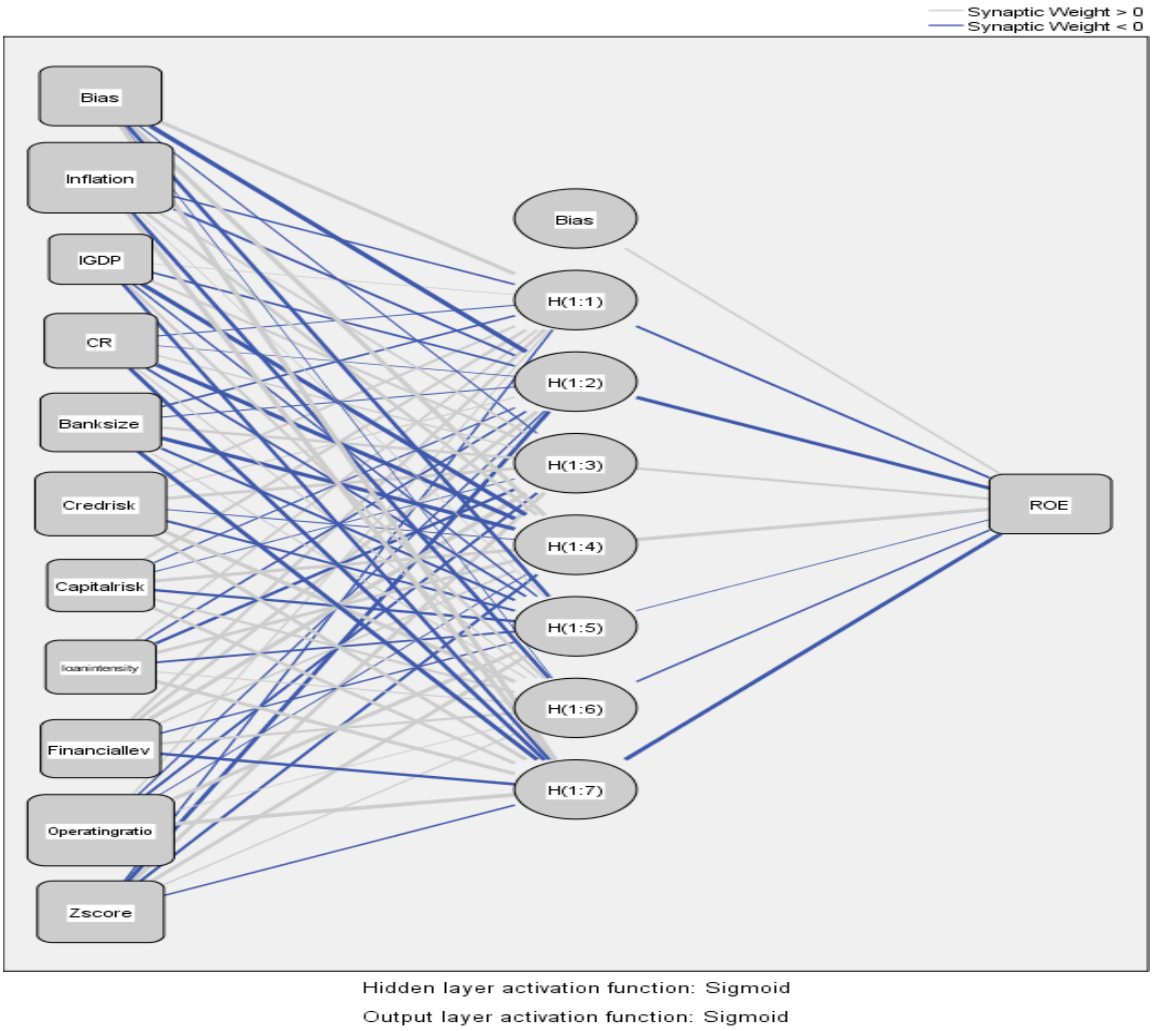


Figure 22: The architecture of the network for ROE in conventional banks in the MENA countries

The model summary of the neural network showing the Sum of Squares Errors, Relative Error, Stopping rule used and the training time is shown in Table 43. The table shows that the training time was 8 milliseconds when the estimation algorithm did not result in a subsequent decrease in the observed errors. The neural network gave the Sum of Squares Error of 0.500 and Relative Error of 0.820 in the training stage and Sum of Squares Error of 0.485 and Relative Error 0.686 in the testing stage. The reduction in the Sum of Squares Errors from the training stage to the testing stage reflects the improvements the neural network model drew from the training sample.

Table 43: Model summary for ROE in conventional banks in the MENA countries

Training	Sum of Squares Error	.500
	Relative Error	.820
	Stopping rule used	1 consecutive step(s) with no decrease in error[a]
	Training time	0:00:00.08
Testing	Sum of Squares Error	.285
	Relative Error	.686

Dependent Variable: Return on Equity
a. Error computations are based on the testing sample

The associated synaptic weights which resulted in the neural network architecture shown in Figure 22 are specified in Appendix C, Table C5. The weights from the input layer to the hidden layer and from the hidden layer to the output layer are presented in the table. For instance, the weights attached to the neuron from bias are 0.425, -0.670, -0.079, 0.524, -0.340, -0.022 and 0.531 respectively. The weights for the credit risk to the hidden neurons are 0.217, 0.074, 0.424, -0.052, -0.240, 0.565 and 0.360 respectively. The weights from the hidden layer to the output layer for bias is 0.157 and from 1st neuron in the hidden layer to the output are -0.213, -0.439, 0.287, 0.513, -0.038, -0.135 and -0.497 respectively.

The relative importance of the independent variables to the dependent variable, ROE, for the neural network model are shown in Table 44 and Figure 23. The neural network showed that the independent variable, operating ratio, had the highest importance value of 0.199 giving a standard value of 100% followed by inflation (0.192), credit risk (0.136) and Z-score (0.118) with associated normalised importance of 96.5%, 68.5% and 59.4% respectively.

Table 44: Independent variable importance for ROE in conventional banks in the MENA countries

	Importance	Normalized importance
Inflation	.192	96.5%
Log GDP	.022	11.2%
Capital ratio	.061	30.5%
Bank size	.093	46.9%
Cred risk	.136	68.5%
Capital risk	.038	19.2%
Loan intensity	.051	25.8%
Financial leverage	.089	45.0%
Operating ratio	.199	100.0%
Z-score	.118	59.4%

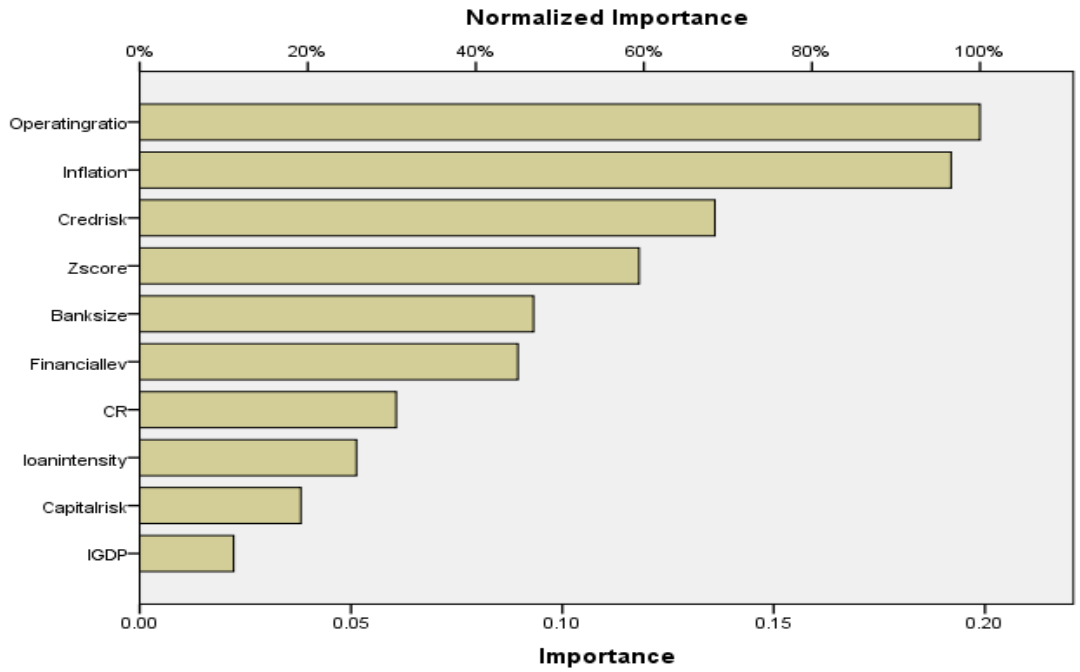


Figure 23: Independent variable importance for conventional banking in MENA countries

In order to understand the relative importance of the independent variables on the ROE for conventional banks in the MENA region, an MLP procedure was reperformed for the independent variables identified as most significant among the 10 variables. The criteria for selection of the important variables was based on those that had a relative importance of 50% and above (operating ratio, inflation, credit risk and Z-score).

5.4.2 MLP on four selected independent variable on ROE for conventional banks in the MENA countries

The partition of the date set resulted in 69.7% of the observations allocated to training and 30.3% of the observations allocated to testing sample. Table 45 below depicts this partitioning step of the MLP process.

Table 45: Case processing summary for ROE in conventional banks in the MENA countries

		N	Percent
Sample	Training	480	69.7%
	Testing	209	30.3%
Valid		689	100%
Excluded		3	
Total		692	

The revised network information is as captured in Appendix B with now 4 independent variables. Thus, the neural network architecture has an input layer with 4 units, a single hidden layer with 3 units and an output layer with 1 dependent variable, return on equity (ROE). The activation function as stated above is Sigmoid.

The neural network architecture associated with the revised MLP using the four independent variables (inflation, credit risk, operating ratio and Z-score) on the ROE is shown in Figure 24. The light colour lines in the architecture show weights greater than zero whilst the dark colour lines show weights less than zero.

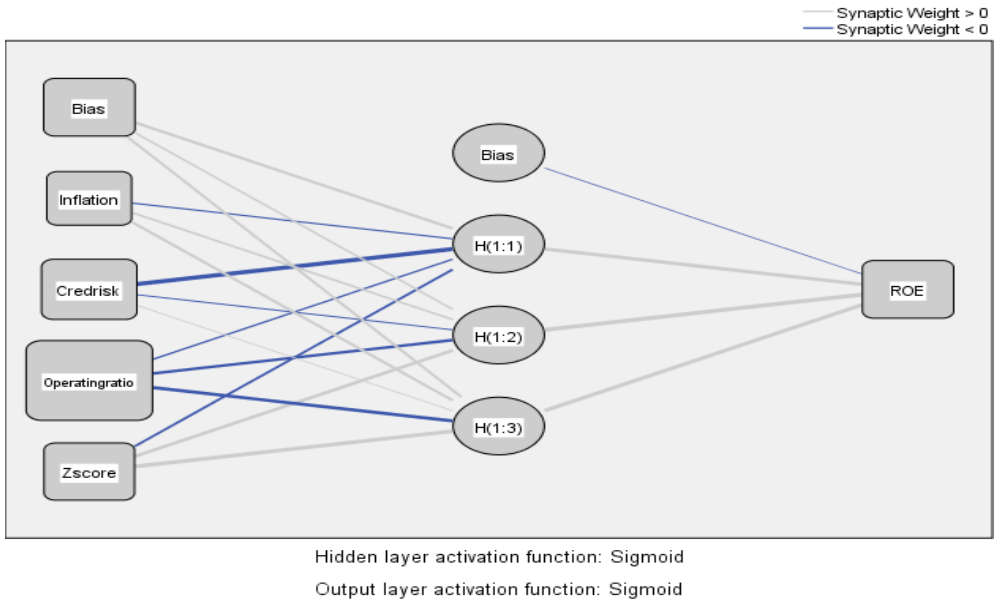


Figure 24: The architecture of the network for ROE in conventional banking in the MENA countries

The model summary for the four independent variables identified as most important in the MLP process in section 5.4.1 above is presented in Table 46. The model summary shows that Sum of Squares Error is 1.210 and the Relative Error is 0.837 in training stage. In the testing stage, the Sum of Squares Error is 0.933 and Relative Error is 0.977. As such, the testing errors identified in the training stage have been reduced as depicted by the Sum of Squares Error. The training stage took 3 milliseconds in total with the algorithm stopping when no further reduction in errors occurred.

Table 46: Model summary for ROE in conventional banks in the MENA countries

Training	Sum of squares error	1.210
	Relative error	.837
	Stopping rule used	1 consecutive step(s) with no decrease in error[a]
	Training time	0:00:00.03
Testing	Sum of squares error	.933
	Relative error	.977

Dependent Variable: Return on Equity,
a Error computations are based on the testing sample

The detailed estimates of the synaptic weights and bias are given in Appendix C, Table C6. The results in this table show the value of weights from input to the hidden layer and from the hidden layer to the output layer. H(1:1) means hidden layer 1 and 1st neuron. The weights attached to the neuron from bias are 0.299, 0.169 and 0.259 respectively whilst that of credit risk to the hidden layer were -0.530, -0.134 and 0.078 respectively. The weights from the hidden layer to the output layer for bias is -0.065 and from 1st neuron in the hidden layer to the output are 0.428, 0.477 and 0.440 respectively.

The results from the neural network model on the relative importance of the four independent variables on the dependent variable, ROE, for conventional banks in the MENA region is shown in Table 47 and Figure 25. The importance of the independent variables is measured by how much the neural network's predicted ROE values change for the different values of the independent variables. Table 47 shows the relative importance of the independent variable, operating ratio, which recorded the highest value of 0.408 resulting in a normalised importance of 100%. This is followed by credit risk (55.5%) and Z-score (48.8%) and finally inflation (40.8%). Figure 25 gives a pictorial presentation of this relative importance.

Table 47: Independent variable importance for ROE in conventional banks in the MENA countries

	Importance	Normalized importance
Inflation	.166	40.8%
Credit risk	.227	55.7%
Operating ratio	.408	100.0%
Z-score	.199	48.8%

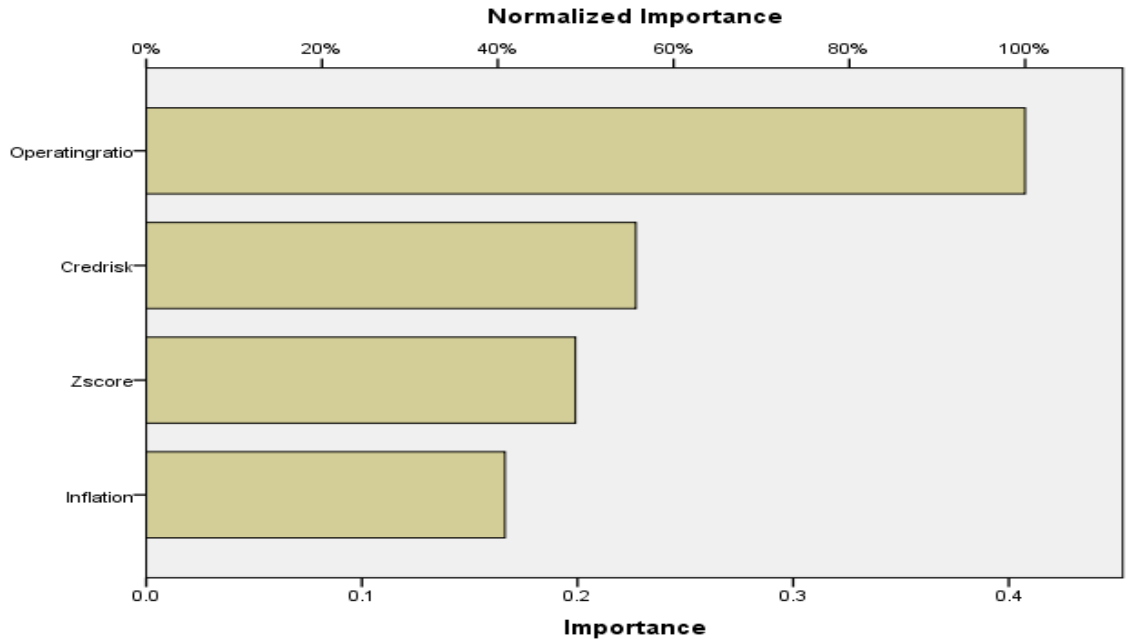


Figure 25: Independent variable importance for ROE in conventional banks in the MENA countries

The fitness of the actual and estimated values of ROE using neural network model for conventional banks in the MENA region is shown in Figure 26. Based on the results, there is a closeness of fit between the estimated ROE values and the actual values of the dependent variable.

A further analysis of the explanatory strength of the ANN model using the coefficient of determination revealed an R^2 of 0.664 which means that the independent variables explained 66.4% of the changes that occurred in the dependent variable, ROE, for the conventional banks in the MENA countries.

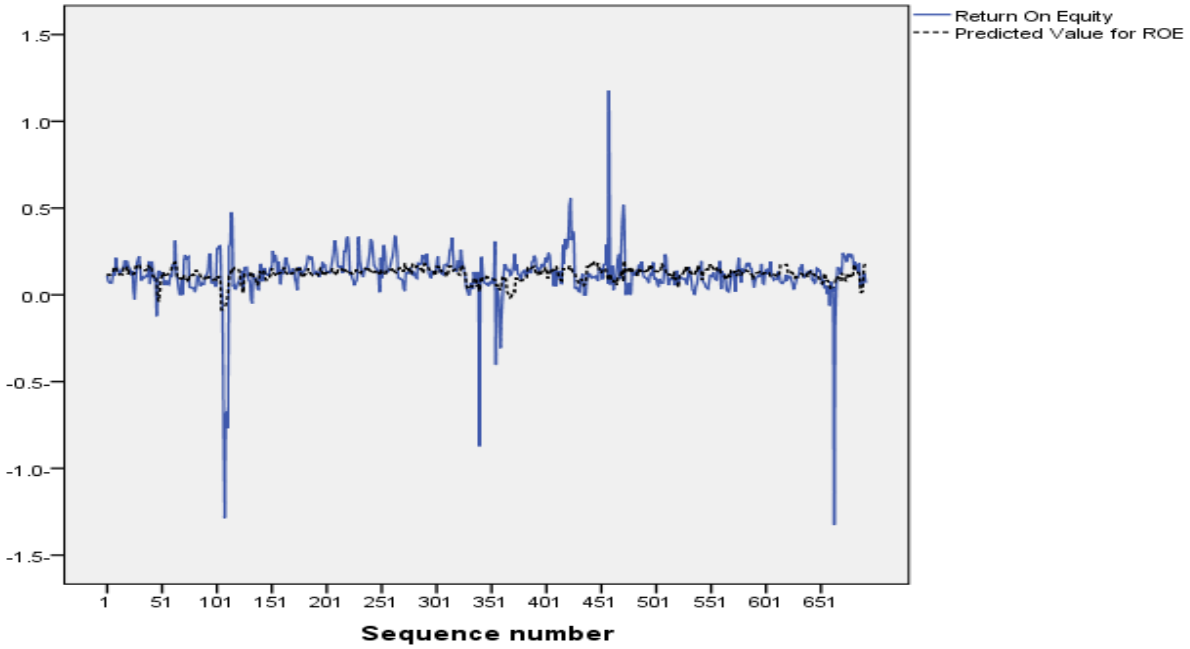


Figure 26: Actual and estimated values using neural for ROE in conventional banks in the MENA countries

The next section presents results for the dependent variable, ROA, for conventional banks in the MENA region using ANN method. This replicates the process discussed above but with the dependent variable changed to ROA.

5.5 Performance of conventional banks in the MENA countries for ROA dependent variable

The first MLP analysis was performed on all independent variables in order to identify the most significant among them.

5.5.1 MLP on all independent variables on ROA for conventional banks in the MENA countries

The first step of partitioning the data set into training, testing and excluded is shown in Table 48 where 66.9% of observations were used for training and 33.1% for testing. 3 observations were excluded. As indicated above, the training set was used for the estimation of the synaptic weights in the neural network whilst the predictions were made in the testing set. Then on the basis of the errors observed in the training set, the weights of the neural network were adjusted in order to minimize the errors in the testing set.

Table 48: Case processing summary for ROA in conventional banks in the MENA countries

		N	Percent
Sample	Training	461	66.9%
	Testing	228	33.1%
Valid		689	100.0%
Excluded		3	
Total		692	

The information about the neural network architecture is identical to Table 30 with 10 units in the input layer, a single hidden layer with 7 units, and an output layer with ROA as the dependent variable. As before, the activation function used is Sigmoid whilst the rescaling method for the dependent variable was normalised.

The architecture of the neural network for the independent variables on the dependent variable, ROA, is shown in Figure 27 below with the light colour lines showing weights greater than zero and the dark colour lines showing weights less than zero.

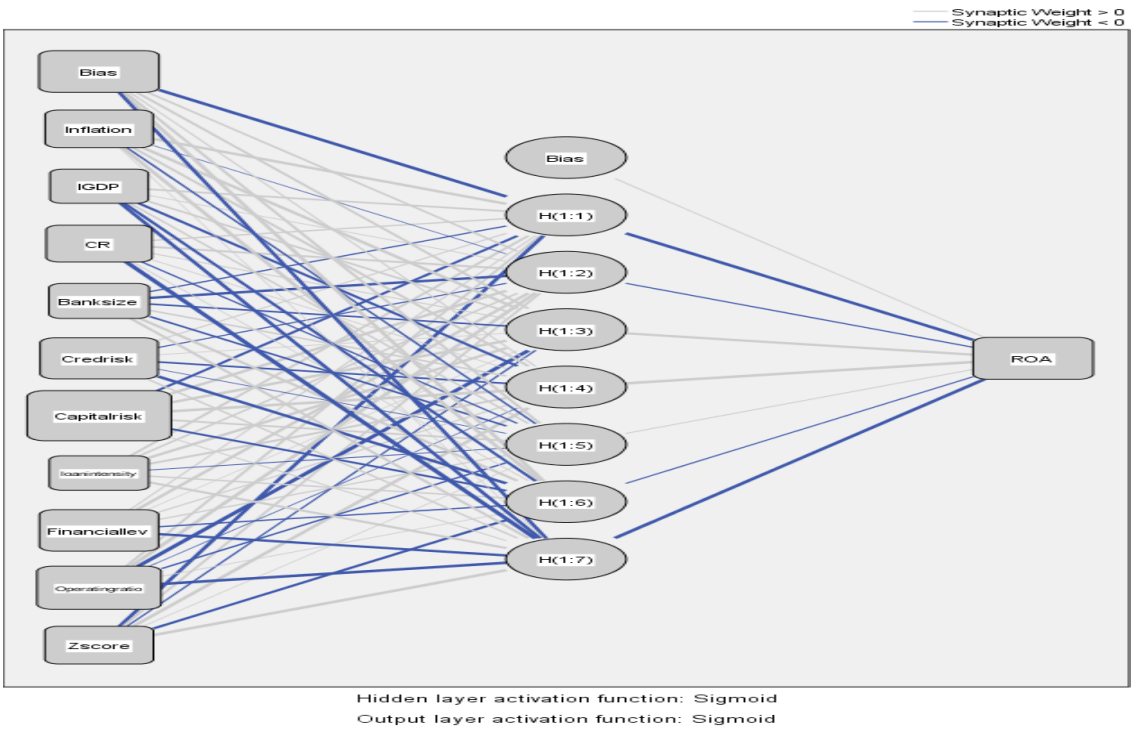


Figure 27: The architecture of the network for ROA in conventional banks in the MENA countries

The model summary showing fit statistics for the training and testing sets are given in Table 49 below. The MLP results show the Sum of Squares Error of 0.369 and Relative Error of 0.602 in the training stage and a Sum of Squares Error of 0.220 and Relative Error of 0.690 in the

testing stage. One of the positives from these statistics is that the relative error or percentage of incorrect predictions is roughly equal across training and testing samples. Further, the Sum of Squares Error has reduced with the estimation algorithm stopping when no further reduction in the errors was recorded. The training time took 6 milliseconds.

Table 49: Model summary for ROA in conventional banks in the MENA countries

Training	Sum of squares error	.367
	Relative error	.602
	Stopping rule used	1 consecutive step(s) with no decrease in error[a]
	Training time	0:00:00.06
Testing	Sum of squares error	.220
	Relative error	.690

Dependent variable: Return on asset
a. Error computations are based on the testing sample.

The detailed estimates of the synaptic weights are given in Appendix C, Table C7 showing the links between the input layer to the hidden layer and from the hidden layer to the output layer. H (1:1) represents the hidden layer 1 and 1st neuron. The weights attached to the neuron from bias is -0.521, 0.225, 0.264, 0.121, 0.272, 0.382 and -0.346 respectively. The synaptic weights from the hidden layer to the output layer for bias is 0.090 and from 1st neuron in the hidden layer to the output are -0.510, -0.154, 0.477, 0.583, 0.100, -0.141 and -0.487, respectively.

The next step in the MLP process was the identification of the most important independent variables. Table 50 and Figure 28 show the results of the relative importance of the independent variables in the neural network model. The most importance independent variable was capital risk with value of 0.292 and an associated normalised importance of 100%. This is followed by operating ratio (0.171), financial leverage (0.140) and credit risk (0.133) in their order respectively.

Table 50: Independent variable importance for ROA in conventional banks in the MENA countries

	Importance	Normalized importance
Inflation	.071	24.3%
log GDP	.013	4.5%
Capital ratio	.059	20.3%
Bank size	.026	8.8%
Credit risk	.133	45.4%
Capital risk	.292	100.0%
Loan intensity	.019	6.5%
Financial leverage	.140	48.1%
Operating ratio	.171	58.5%
Z-score	.075	25.8%

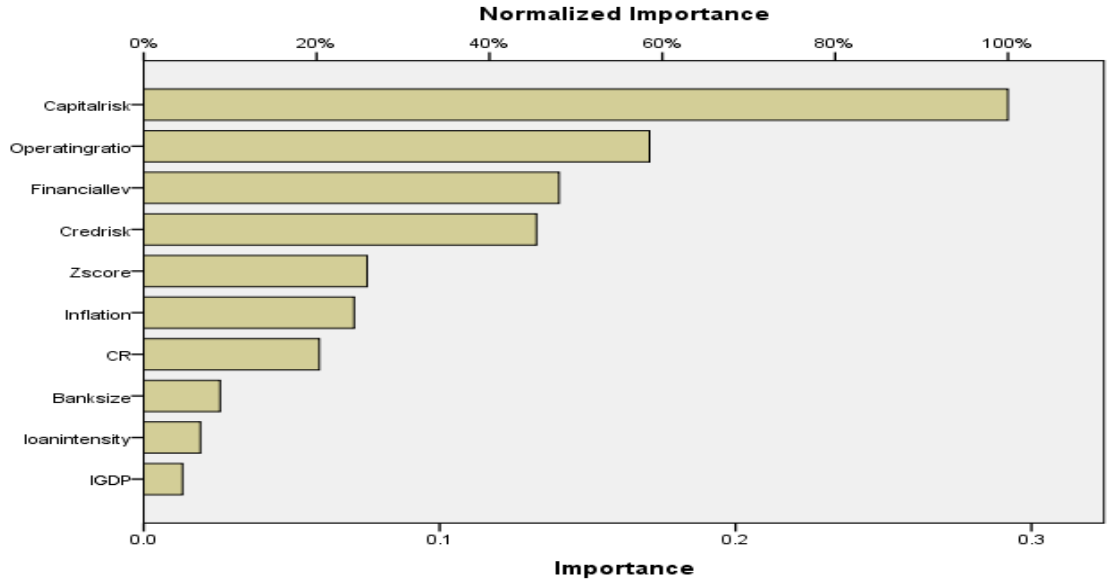


Figure 28: Independent variable importance

The next section builds on this MLP process to further analyse the identified most important independent variables.

5.5.2 MLP on four selected independent variables for ROA in conventional banks in the MENA countries

The partitioning of the dataset resulted into 72.1% of observations allocated to training and 27.9% allocated to testing. Table 51 shows the partitioning summary.

Table 51: Case processing summary for ROA in conventional banks in MENA countries

		N	Percent
Sample	Training	498	72.1%
	Testing	193	27.9%
Valid		691	100%
Excluded		1	
Total		692	

The revised network information for only the four selected independent variables (credit risk, operating ratio, financial leverage and capital risk) is identical to the neural network information in appendix B. The number of covariates is now 4, the number of units in the hidden layer 3 and the dependent variable, ROA.

The neural network architecture of the relationship between the input layer, hidden layer and output layer is shown in Figure 29. The light colour lines in the figure show weights greater than zero whilst the dark colour lines show weights less than zero.

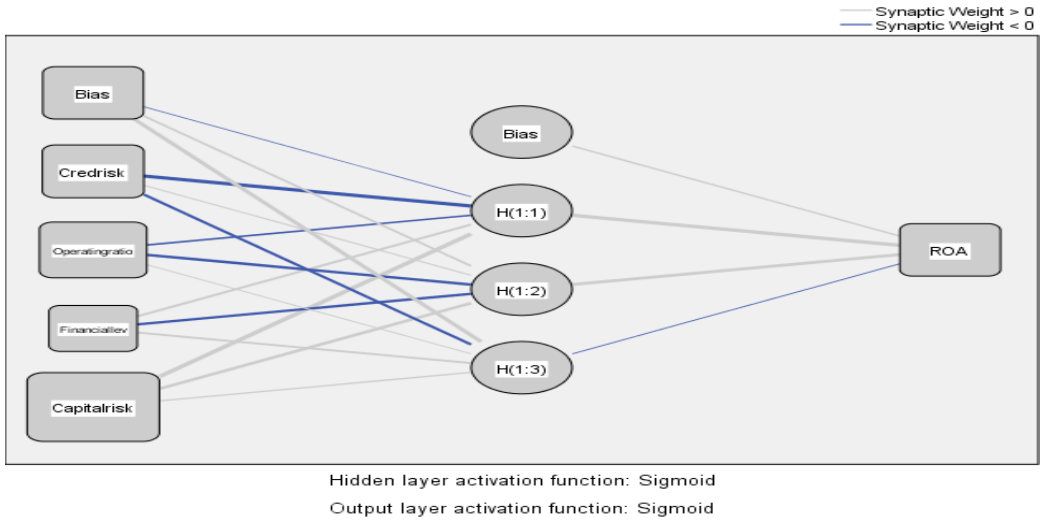


Figure 29: The architecture of the network for ROA in conventional banks in the MENA countries

The neural model summary showing the fit statistics for the training and testing data sets is shown in Table 52. The training time was 3 milliseconds stopping when the subsequent algorithm did not result in a further reduction of errors. The sum of squares error is 0.608 and relative error 0.960 in the training stage whilst in the testing stage, the sum of squares error is 0.181 and relative error 0.946 in testing stage.

Table 52: Model summary for ROA in conventional banks in the MENA countries

Training	Sum of squares error	.961
	Relative error	.814
	Stopping rule used	1 consecutive step(s) with no decrease in error[a]
	Training time	0:00:00.03
Testing	Sum of squares error	.316
	Relative error	.691

Dependent variable: Return on asset,
a. Error computations are based on the testing sample

The estimates of the synaptic weights are given in Appendix C, Table C8. According to the results obtained, the synaptic weights attached to the neuron from bias are -0.009, 0.204 and 0.374 respectively. The weights from the hidden layer to the output layer for bias is 0.177 and from 1st neuron in the hidden layer to the output are 0.972, 0.366 and -0.016 respectively. The weights from the hidden layer neurons to the output are 0.972, 0.366 and -0.016 respectively.

The relative importance of the four selected independent variables is shown in Table 53 and Figure 30. The neural network model has revealed capital risk as the most important independent variable with value of 0.414 and thus a normalised importance of 100%. This is followed by operating ratio (60.3%), credit risk (51.0%) and financial leverage (30.2%). This indicates that the neural network models' predicted values of ROA changed more for the different values of capital risk as compared to the other independent variables.

Table 53: Independent variable importance for ROA in conventional banks in the MENA countries

	Importance	Normalized importance
Credit risk	.211	51.0%
Operating ratio	.250	60.3%
Financial leverage	.125	30.2%
Capital risk	.414	100.0%

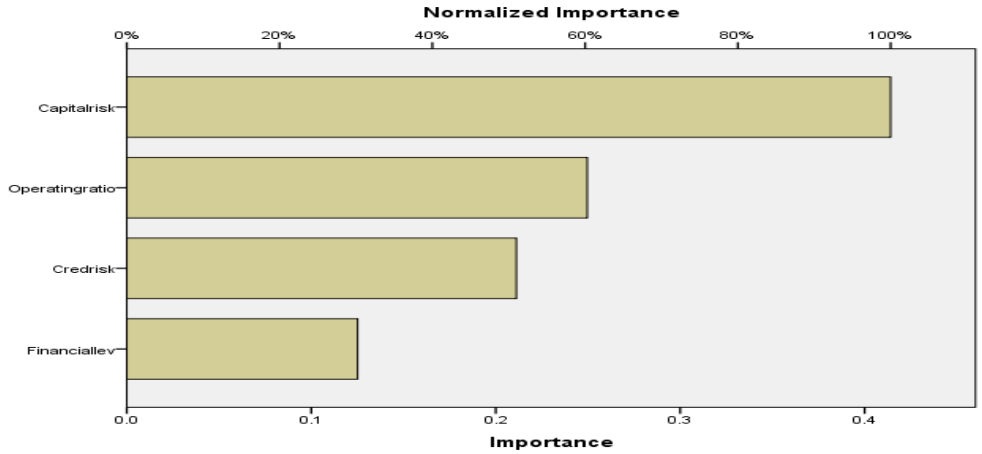


Figure 30: Independent variable importance for ROA in conventional banks in the MENA countries

Further, figure 31 shows the actual and estimated values of ROA obtained using the neural networks model for the conventional banks in the MENA region. The figure proves the strength of the model as the estimated values approach the actual values of the dependent variable, ROA.

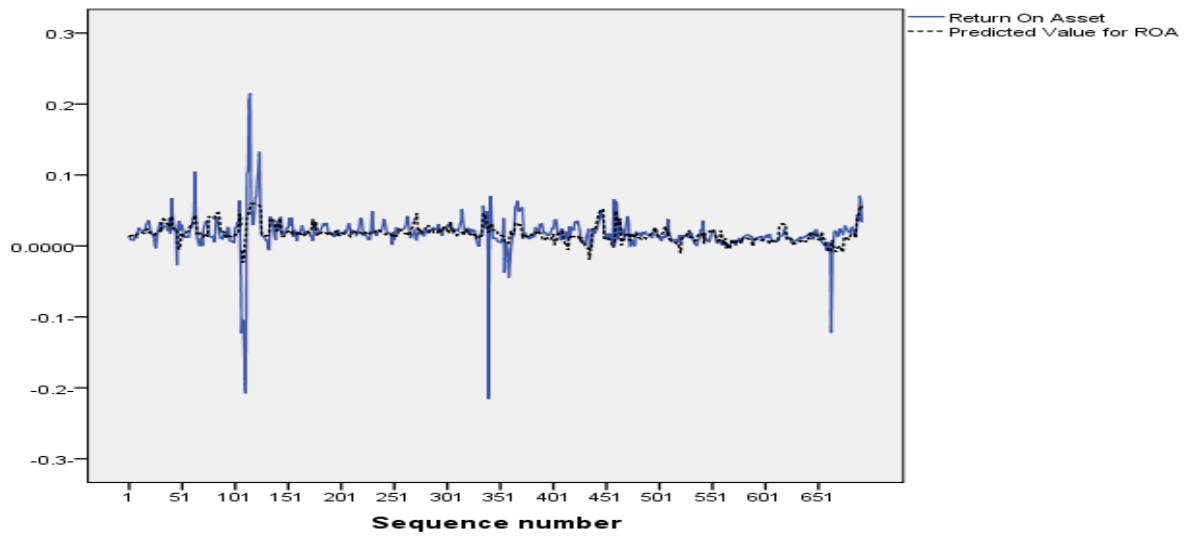


Figure 31: Actual and estimated values using neural for ROA in conventional banks in the MENA countries

The explanatory strength of the ANN model was further assessed using the coefficient of determination. The coefficient of determination, R^2, obtained was 0.502 implying that the independent variables explained 50.2% of the changes that occurred in the dependent variable, ROA, for the conventional banks in the MENA countries when using the ANN method. The explanatory power of the ANN model for conventional banks in the MENA countries using

ROA as the dependent variable shows an improvement compared to the multivariate regression model obtained in section 4.3.4 which had R^2 of 0.242.

5.6 Summary of results

In order to put the results into perspective, a comparison is undertaken of the results obtained using the multiple linear regression model and the non-linear artificial neural network model for the MENA region. These findings also contribute to addressing the fifth research hypothesis. **Hypothesis H5: The artificial neural network (ANN) does not improve the explanatory power of the significant differences between Islamic banks and conventional banks.**

This hypothesis is addressed through reviewing the findings obtained when using the two research techniques (stepwise regression and ANN). A summary of the findings using the multiple linear regression model and the artificial neural network is presented in Table 54. The table summarises the results obtained for both Islamic banks and conventional banks using the two research techniques for the MENA region. The results presented in the table suggest that there is an increase in the value of the coefficients of determination when using artificial neural network model for almost all the observation. However, in the case of estimating model for ROA in Islamic banks in MENA countries, the value of the coefficient of determination decreased from 0.191 to 0.164 when using the ANN. In general, nonetheless, the use of neural networks to determine the most important independent variables affecting the dependent variables has increased the explanatory power of the results.

Table 54: Summary of results from Stepwise Regression Analysis and Artificial Neural Network for both Islamic banks and conventional banks in the MENA countries

	Islamic banks				**Conventional banks**			
	ROE		ROA		ROE		ROA	
	Stepwise Reg.	ANN	Stepwise Reg.	ANN	Stepwise Reg.	ANN	Stepwise Reg.	ANN
Inflation					√	√		
Log GDP	√				√			
Capital ratio		√	√	√				
Bank size								
Credit risk	√	√	√	√		√	√	√
Capital risk	√	√					√	√
Loan intensity								
Financial leverage				√	√			√
Operating ratio		√		√	√	√	√	√
Z-score	√	√	√	√	√	√	√	
R^2	0.258	0.490	0.191	0.164	0.138	0.664	0.242	0.502

√ means that the variable was found to be significant.

Based on these results, the research hypothesis 'H5: the artificial neural network (ANN) does not improve the explanatory power of the significant differences between Islamic banks and conventional banks' is rejected. Instead, the alternative is accepted that 'the artificial neural network (ANN) does improve the explanatory power of the significant differences between Islamic and conventional banks. This is the case in the MENA region for the conventional banks and Islamic banks overall. These findings support the extant literature of the superiority of the neural network technique over multiple linear regression techniques (Arulsudar et al., 2005; Baker & Tahir, 2009; Chokmani et al., 2008; Datt, 2012; Delen et al., 2005; Knez & Ready, 1996; Krishnaswamy et al., 2000; Leshno & Spector, 1996; Nghiep & Al, 2001; Stergiou & Siganos, 2014). A few studies, however, have shown mixed results (Olson & Mossman, 2001). Further, operating ratio is significant for Islamic banks when using the ANN model but not the multiple linear regression model. On the other hand, operating ratio affects financial performance of conventional banks in the MENA region based on both models. This suggests that an increased investment in fixed assets by conventional banks could positively influence their performance more than Islamic banks. Further, macroeconomic changes in inflation affect conventional banks only in the MENA region.

5.7 Conclusion

The aim of this chapter was to present the results of the data analysis using the non-linear model of artificial neural network. The results have been presented for the conventional banks and Islamic banks in the MENA region for both ROE and ROA dependent variables. Further, a summary and comparison of the results obtained using the multiple linear regression analysis and the non-linear technique (artificial neural network) methods is made in order to address the fifth research hypothesis which looks at the explanatory power of the ANN as compared to the multiple linear regression. The next chapter delves deeper into segregating the banks in the GCC countries.

Chapter Six: The GCC Region – Results and Analysis

6.1 Aim of chapter

This chapter builds on the empirical analysis discussed in chapters four and five to focus on the banks (conventional and Islamic banks) in the GCC countries only. The aim is to gain a deeper understanding on the comparative performance of conventional banks and Islamic banks by segregating the MENA region into GCC countries and non-GCC countries. The GCC countries account for 42% of the 72% of the MENA regions' share in total global Islamic finance assets, hence their relative importance. The first section will discuss the multiple linear regression results.

6.2 Multiple linear regression results

6.2.1 Descriptive statistics

Table 55 below shows the descriptive statistics for both independent and dependent variables in the GCC countries only. As reflected in the table, in general, the data is not normally distributed because the skewness for a normal distribution is zero. Among these variables, the least skewed data was for bank size (-0.097) and financial leverage (-0.024) which were close to normal distribution. These variables also recorded the least Kurtosis with financial leverage data having a flatter distribution. As shown in Table 55, the Kurtosis of capital ratio is highest at 72.198. This means that the capital ratio data has heavy tails which are positively skewed. This can be observed with respect to credit risk and operating ratio also. The average inflation in the GCC countries for the period was 4.276% with fluctuations of 4.042% around this average.

The banks' performance represented by ROE had a mean of 10.7% with fluctuations of about 15.2%. The ROA, on the other hand, recorded an average of 1.9% with standard deviation of 3.7%. The sizes of banks also varied in the GCC countries. The bank size mean was at 8.840 with standard deviation of 1.646**.** The macroeconomic variable, GDP, represented by log GDP was 11.098 with a standard deviation of 0.474%. The GCC banks, therefore, recorded lower performance on ROE but slightly higher on ROA when compared to the MENA region as a whole (see section 4.2).

Table 55: Descriptive statistic in the GCC countries (N=564)

	Mean	Std. Dev.	Skewness	Kurtosis
Inflation	4.276	4.042	1.123	1.140
log GDP	11.098	0.474	-.147	-1.068
Capital ratio	1.034	3.004	7.510	72.198
Bank size	8.840	1.646	-.097	0.522
Credit risk	0.062	0.111	5.546	36.696
Capital risk	0.231	0.208	2.436	5.221
Loan intensity	0.560	0.193	-1.212	1.504
Financial leverage	6.351	2.857	-.024	-.353
Operating ratio	0.017	0.030	6.727	63.909
Z-score	0.919	0.379	-.333	0.197
Return on equity (ROE)	0.107	0.152	-4.080	26.057
Return on asset (ROA)	0.019	0.037	-2.799	24.208

6.2.2 Significant differences in the financial variables of conventional banks and Islamic banks

Table 56 shows the descriptive statistics and the T-test results for financial variables between the Islamic and conventional banks in the GCC countries in the sample. Table 56 reveals that there is a low value of the capital ratio in conventional banks when compared to Islamic banks. Capital ratio average values of 0.562 with standard deviation of 1.086 for conventional banks was observed as compared to 2.033 with standard deviation of 4.924 for Islamic banks. Similarly, the conventional banks' performance based on average ROE and ROA was higher than Islamic banks with less fluctuations from the means. To further test the significance of the mean values in both categories, the T-test was also used with results shown in Table 56.

From Table 56, significant differences between Islamic banks and conventional banks were observed on most variables at 1% significant level (GDP, capital ratio, capital risk, loan intensity, financial leverage, operating ratio) and 10% significant level (return on assets) since the p-value or Sig. obtained are less than the significance level. However, no significant difference in the mean values was observed in inflation, bank size, credit risk and Z-score in the banking types in the GCC countries. The significant differences between conventional banks and Islamic banks in the GCC region has been revealed by other studies also (Alexakis et al., 2018; Khediri et al., 2015; Olson & Zoubi, 2008). For instance, Khediri et al. (2015) examined conventional banks and Islamic banks' performance in the GCC region between the period 2003-2010, employing both parametric and non-parametric model, using dependent

variables (ROA and ROE) and fourteen independent variables (liquidity ratios, credit risk, insolvency risk, asset structure ratios). Khediri et al. (2015) study revealed some significant differences between the two banking types on most aspects.

Table 56: Descriptive statistics and test results for variables between the Islamic banks and conventional banks in the GCC countries

	Islamic Banking		Conventional Banking		T Test	
	Mean	Std. Dev.	Mean	Std. Dev.	T	Sig.
Inflation	4.356	3.859	4.239	4.130	.322	.747
log GDP	11.182	0.490	11.059	0.462	2.887	.004***
Capital Ratio	2.033	4.924	0.562	1.086	5.569	.000**
Bank Size	8.721	1.818	8.897	1.557	-1.184	.237
Credit risk	0.067	0.145	0.059	0.090	.793	.428
Capital Risk	0.305	0.273	0.196	0.157	6.004	.000**
Loan intensity	0.493	0.216	0.591	0.172	-5.822	.000**
Financial leverage	5.614	3.186	6.700	2.620	-4.280	.000**
Operating ratio	0.026	0.047	0.013	0.017	4.480	.000**
Z-score	0.933	0.454	0.912	0.337	.596	.551
Return on Equity (ROE)	0.083	0.157	0.119	0.149	-2.648	.008***
Return on Asset (ROA)	0.015	0.046	0.021	0.032	-1.802	.072***

**Significant at a significant level of 1%

***Significant at a significant level of 10%

With reference to the first hypothesis, 'H1: there are no significant differences between the Islamic banks and conventional banks for the financial variables in the GCC countries', this is rejected and the alternative is accepted as there are significant differences in some financial variables between the Islamic and conventional banks in the GCC countries.

An examination of the differences in the financial variables of conventional banks and Islamic banks in the GCC countries before and after the financial crisis was also conducted. Table 57 shows the descriptive statistics and the test results for the financial variables in the Islamic banks before and after the financial crisis in the GCC countries. From the results obtained, there is a high value of the capital ratio after 2008 than before 2008 with a value of 2.057 and 1.658 respectively. Slight increases are observed also in the bank size, credit risk, loan intensity, financial leverage and a slight decrease in the capital risk, operating ratio and Z-score. In respect to the bank performance indicators, these have both decreased with a higher level of fluctuations

in the period after the crisis. ROE recorded a decline in the average values from 16.1% to 4.1% whilst ROA recorded a decrease from 3.9% to 0.2%.

An analysis of the significant differences of the mean values shows that half of the variables were insignificantly difference at 5% significant level for the periods before and after the global financial crisis. Bank size and financial leverage variables were only significantly different at 10% significant level whilst macroeconomic variables and performance variables were significant at 1% level. It can thus, be inferred that overall, there are insignificant differences in the financial variables (bank specific) in the two periods before and after the financial crisis for the Islamic banks.

Table 57: Descriptive statistics and test results for financial variables of Islamic banks before and after 2008 In the GCC countries

	Before 2008		After 2008		T Test	
	Mean	Std. Dev.	Mean	Std. Dev.	t	Sig.
Inflation	5.359	4.472	2.756	2.020	5.068	.000**
log GDP	11.021	0.459	11.270	0.493	-3.145	.002**
Capital Ratio	1.658	3.360	2.057	5.273	-.520	.604
Bank Size	8.387	2.048	8.889	1.583	-1.732	.085***
Credit risk	0.055	0.106	0.078	0.173	-.889	.375
Capital Risk	0.333	0.287	0.280	0.261	1.189	.236
Loan intensity	0.474	0.216	0.505	0.212	-.894	.373
Financial leverage	5.059	3.028	6.065	3.163	-1.968	.051***
Operating ratio	0.030	0.056	0.020	0.023	1.592	.113
Z-score	0.982	0.426	0.897	0.471	1.138	.257
Return on Equity (ROE)	0.161	0.097	0.041	0.164	5.083	.000**
Return on Asset (ROA)	0.039	0.028	0.002	0.048	5.364	.000**

**Significant at a significant level of 1%
***Significant at a significant level of 10%

Table 58 shows the descriptive statistics and the test results for financial variables in the conventional banks for the periods before and after the financial crisis in GCC countries. The results show a higher mean value of the loan intensity after 2008 than before 2008 with values of 0.604 and 0.562 respectively. A slight increase also occurred in the bank size variable (9.159 after 2008 compared to 8.444 before 2008). The results also show a decline in the mean values of both the ROA and ROE after 2008 compared to before 2008. The volatility of the ROE values has also increased after 2008 whilst that of the ROA has remained the same.

Based on the T-test results presented in Table 58, it can be concluded that there is a significant difference on most variables at significant levels 1% and 5% since the p-value or Sig. are more than the significance level. Significant differences in the mean values were obtained for inflation, GDP, bank size, ROE and ROA at 1% significant level and loan intensity and operating ratio at 5% significant level. Thus, overall, there are significant differences in the mean values for most financial variables in the periods before and after the financial crisis for the conventional banks in the GCC countries.

Table 58: Descriptive statistic and test results for financial variables of conventional banks before and after 2008 in the GCC countries

	Before 2008		**After 2008**		**T Test**	
	Mean	Std. Dev.	Mean	Std. Dev.	t	Sig.
Inflation	5.538	4.594	2.398	2.046	8.732	.000**
log GDP	10.894	0.451	11.153	0.446	-5.206	.000**
Capital ratio	0.605	1.222	0.551	1.043	.431	.667
Bank size	8.444	1.578	9.159	1.484	-4.247	.000**
Credit risk	0.064	0.111	0.060	0.079	.411	.681
Capital risk	0.198	0.161	0.196	0.157	.114	.910
Loan intensity	0.562	0.172	0.604	0.171	-2.183	.030*
Financial leverage	6.786	2.869	6.563	2.403	.778	.437
Operating ratio	0.010	0.009	0.015	0.020	-2.473	.014*
Z-score	0.940	0.334	0.903	0.337	1.002	.317
Return on equity (ROE)	0.187	0.085	0.080	0.162	6.936	.000**
Return on asset (ROA)	0.034	0.030	0.014	0.029	5.970	.000**

**Significant at a significant level of 1%
*Significant at a significant level of 5%

Based on the results obtained, the hypothesis 'H2: There are no significant differences between the Islamic banks and conventional banks for the financial variables before and after the 2008 global financial crisis' is rejected for the conventional banks in the GCC countries only as the Islamic banks, on the other hand, showed insignificant differences. The alternative hypothesis is accepted that 'there are significant differences in the financial variables for conventional banks in the GCC countries before and after the financial crisis.'

These findings are largely similar to Smaoui & Salah (2012) and Srairi (2010) study in the GCC countries before the financial crisis. Srairi (2010) study, for instance, examined 71 banks (43 conventional banks and 23 Islamic banks) in the GCC countries for the period 1999-2007. Srairi

(2010) found significant differences between Islamic banks and conventional banks with respect to the observed variables (bank specific and macroeconomic variables) in the period before the financial crisis. On the other hand, El Massah & Al-Sayed (2015) showed the significant difference between Islamic banks and conventional banks after the financial crisis period.

6.2.3 The effect of the 2008 financial crisis on banks in the GCC countries

The regression analysis (Pearson correlation and Simple regression) was conducted for the Islamic banks and conventional banks in the GCC countries only. The first part was to understand the association between the financial crisis variable and bank performance using the Pearson correlation. Table 59 presents the Pearson correlation matrix for Islamic banks in the GCC countries only. From the correlation matrix, it is observed that there is a weak negative and significant correlation between the financial crisis effect and banks' performance at a 1% significance level, as the values of the correlation coefficient are -0.374 for ROE and -0.391 for ROA respectively.

Table 59: Pearson correlation matrix of Islamic banks in the GCC countries

	Return on Equity (ROE)	Return on Asset (ROA)	Financial Crisis
Return on equity (ROE)	1		
Return on asset (ROA)	.802**	1	
Financial crisis	-.374**	-.391**	1

** Correlation is significant at the 0.01 level.

Further regression analysis was directed at the ROE and ROA separately. Table 60 presents the simple regression results for dependant variable, ROE, only for Islamic banks in the GCC countries. The results show an f-value of 25.840 and p-value (Sig) of 0.000. Thus, the predictive capability of the regression model is improved by the regression coefficients (-0.120 for financial crisis and 0.281 constant). The association between the financial crisis variable and ROE is significant as the p-value (Sig) is 0.000 which is less than 1% of the significance level. Further, the predictive power of the financial crisis variable is that it accounts for 14% of the changes that occur in the dependent variable, ROE. This is higher than the 3% predictive power observed for Islamic banks in the MENA region as a whole (see section 4.3.3).

Table 60: Bank performance measured by ROE, and financial crisis impact on Islamic banks in the GCC countries

F (P-value)	R^2	Coefficients			
			β	t	P-value
25.840 (0.000)	0.140	Constant	.281	6.976	.000**
		Financial crisis	-.120	-5.083	.000**

** Significant at the 0.01 level

With respect to dependant variable, ROA, Table 61 presents the simple regression results obtained for the Islamic banks in the GCC countries. The results show the predictive strength arising from the non-zero coefficients (-0.037 for financial crisis variable) as the f-value is 28.777. The association between the dependant variable (ROA) and financial crisis variable is significant at the 1% significance level since the p-value (Sig) is 0.000. The regression coefficients, constant (0.076) and financial crisis (-0.037) are significant at this 1% significance level. Regarding the predictive power of the model, the coefficient of determination, R^2, obtained is 0.153 which means that the financial crisis explains 15.3% of the changes that occur in the dependent variable, ROA. This is higher than the 5.5% obtained for Islamic banks in the MENA region as a whole (see section 4.3.3).

Table 61: Bank performance measured by ROA, and financial crisis impact on Islamic banks in the GCC countries

F (P-value)	R^2	Coefficients			
			β	t	P-value
28.777 (0.000)	0.153	Constant	.076	6.416	.000**
		Financial crisis	-.037	-5.364	.000**

** Significant at the 0.01 level

With respect to the association between the financial crisis (captured by introducing a dummy variable) and banks' performance (represented by ROE and ROA), Table 62 shows the Pearson correlation matrix for conventional banks in the GCC countries only. The results show a significantly but weak negative correlation between the financial crisis variable and the banks' performance at a 1% significance level with correlation coefficient of -0.350 and -0.306 for ROE and ROA respectively.

Table 62: Pearson correlation matrix in conventional banks in the GCC countries

	ROE	ROA	Financial Crisis
ROE	1		
ROA	.765**	1	
Financial Crisis	-.350**	-.306**	1

** Correlation is significant at the 0.01 level.

Further, regression analysis was performed for ROE and ROA respectively to understand the impact of the financial crisis on these performance values. Table 63 gives the simple regression results for dependent variable, ROE, for conventional banks in the GCC countries. The result reveals an increased predictive capability of the regression model arising from the significant correlation coefficients (constant of 0.293 and financial crisis of -0.106) resulting in the f-value of 48.109. The association between financial crisis and ROE is significant as p-value (Sig) is 0.000 at the 1% significance level. In addition, the results show a coefficient of determination, R^2 of 0.122 implying that changes in dependent variable, ROE, are 12.2% explained by impact of the financial crisis.

Table 63: Bank performance measured by ROE, and financial crisis in conventional banks in the GCC countries

F (P-value)	R^2	Coefficients			
			β	t	P-value
48.109 (0.000)	0.122	Constant	.293	11.276	.000**
		Financial Crisis	-.106	-6.936	.000**

** Significant at the 0.01 level

Table 64 gives the simple regression results obtained with respect to the dependent variable, ROA, for conventional banks in the GCC countries. The results show an f-value of 35.647 and p-value (Sig) of 0.000. A significant relationship is therefore observed between the financial crisis and the ROA at the 1% significance level. The t-test reveals that the correlation coefficients (constant of 0.053 and -0.020 for financial crisis) are both significant. The explanatory power of the relationship is such that 9.4% of the changes that occur in the ROA is explained by the financial crisis as implied by the coefficient of determination value (0.094).

Table 64: Bank performance measured by ROA, and financial crisis in conventional banks in GCC countries

F (P-value)	R^2	Coefficients			
			β	t	P-value
35.647 (0.000)	0.094	Constant	.053	9.622	.000**
		Financial Crisis	-.020	-5.970	.000**

** Significant at the 0.01 level

The results obtained from the GCC countries for both conventional banks and Islamic banks show that the financial crisis had a negative impact on the banks' financial performance. In the GCC countries, however, the financial crisis explains more of the changes in the dependent variables (ROE and ROA) for Islamic banks than conventional banks. Relating these findings to the hypothesis 'H3: the global financial crisis had a negative effect on the performance of both the conventional banks and Islamic banks in the MENA countries', this is accepted. However, the results suggest that the impact on Islamic banks was more than the impact on conventional banks. These results are largely consistent with Parashar & Venkatesh (2010) study on Islamic banks in the GCC countries which revealed that Islamic banks suffered more than conventional banks during the global financial crisis.

6.2.4 The determinants of bank performance in the GCC countries

The first analysis was aimed at obtaining an understanding of the relationship that exist between the independent variables and the dependent variables. This was performed firstly, for the Islamic banks in the GCC countries only. The results are presented in Table 65 for the Pearson correlation between the dependent variables for bank performance (ROE and ROA) and independent variable for the Islamic banks in the GCC countries.

The results show a moderate significant negative relationship between credit risk and bank performance with correlation coefficients of -0.450 and -0.449 for ROE and ROA respectively at a 1% significance level. This is different to the negative but weak significant correlation found for the Islamic banks in the MENA countries as a whole (see section 4.3.4).

In addition, at the 1% significance level, there was a weak and negative significant relationship observed for capital ratio (-0.267 and -0.242) and operating ratio (-0.237 and -0.258) to ROE and ROA respectively. On the other hand, there is a weak but positive relationship between

loan intensity (0.398 and 0.266), bank size (0.364 and 0.245) and Z-score (0.219 and 0.283) to the performance variables (ROE and ROA) respectively. Financial leverage, contrary, was weak but positively significant to ROE only at 5% significance level. Similar patterns were observed for Islamic banks as a whole in the MENA countries for these variables (see section 4.3.4).

Table 65: Pearson Correlation in Islamic Banks in the GCC countries

	Return on Equity (ROE)	Return on Asset (ROA)
Inflation	.041	.042
Log GDP	.091	.124
Capital ratio	-.267**	-.242**
Bank size	.364**	.245**
Credit risk	-.450**	-.449**
Capital risk	-.244**	-.073
Loan intensity	.398**	.266**
Financial leverage	.181*	-.004
Operating ratio	-.237**	-.258**
Z-score	.219**	.283**

** Correlation is significant at the 0.01 level.
* Correlation is significant at the 0.05 level.

Further to the Pearson correlation, a multivariate regression analysis was performed in order to understand the relationship between the dependent variable, ROE, and the independent variables further. From the f-value (16.328) obtained, the results show that the regression coefficients are all not zeros and therefore the overall regression model is significant. An examination of the coefficient of determination, R^2, showed that the independent variables accounted for 49% of the changes that occurred in the ROE for Islamic banks in the GCC countries.

As reflected in Table 66, the p-value results show that at 1% significance level, log GDP, bank size, credit risk, capital risk, Z-score and the constant had significant regression coefficients. The regression coefficient for financial leverage, on the other hand, was significant at 5% significance level. Stepwise regression analysis was then performed to determine the most important among these significant variables to ROE for Islamic banks. The results are presented in Table 67.

Table 66: Multivariate regression results of Islamic banks' performance measured by ROE in the GCC countries

F (P-value)	**R^2**	**Coefficients**			
			β	t	P-value
16.328 (0.000)	0.490	Constant	1.149	4.797	.000**
		Inflation	.001	.377	.707
		Log GDP	-.138	-5.684	.000**
		Capital ratio	-.001	-.291	.771
		Bank size	.031	4.789	.000**
		Credit risk	-.224	-3.166	.002**
		Capital risk	-.222	-3.338	.001**
		Loan intensity	-.100	-1.358	.176
		Financial leverage	.015	2.523	.013*
		Operating ratio	-.363	-1.626	.106
		Z-score	.283	7.669	.000**

** Significant at the 0.01 level
* Significant at the 0.05 level

Table 67 shows that the focus on the significant variables only has improved the overall significance of the regression model as reflected by the f-value of 27.366. The explanatory power of the 6 variables (credit risk, bank size, Z-score, capital risk, log GDP and financial leverage) is at 47.9%, compared to 49% of all observed variables. Thus, the insignificant variables (including error terms) account for the other 1.1% of the changes in ROE. Using the stepwise regression model, the most important independent variables affecting ROE for Islamic banks in the order of entry into the model are credit risk, bank size, Z-score, capital risk, log GDP and financial leverage. Thus, compared to the results obtained for Islamic banks in the MENA region as a whole (see section 4.3.4), bank size and financial leverage were not significant or key determinants for ROE. The significance of bank size in the GCC countries has also been evidenced in the Ghosh (2014) study of Islamic banks and conventional banks in the period 1996 to 2011.

Table 67: Stepwise regression results of Islamic banks' performance measured by ROE in the GCC countries

F (P-value)	R^2	Coefficients			
			β	t	P-value
27.366 (0.000)	0.479	Constant	1.121	4.845	.000**
		Credit risk	-.205	-3.078	.002**
		Bank size	.027	4.552	.000**
		Z-score	.284	8.480	.000**
		Capital risk	-.184	-3.052	.003**
		Log GDP	-.140	-5.898	.000**
		Financial leverage	.016	3.063	.003**

** Significant at the 0.01 level

Multivariate regression analysis was also performed for the Islamic banks in the GCC countries on the dependent variable, ROA, only. Table 68 presents the results of this analysis. The significance of the linear regression model is demonstrated by the f-value of 9.780 with an associated explanatory power of 36.5% of the changes in the dependent variable (ROA) explained by the changes in the independent variables. At 99% confidence level, GDP, bank size, credit risk, operating ratio and Z-score are significantly correlated with the dependent variable. Of these variables, bank size and Z-score have positive regression coefficients. At 95% confidence level, capital risk and loan intensity become significantly correlated whilst capital ratio is significant with 90% confidence level.

As highlighted above, some aspects become significant for Islamic banks in the GCC countries but not in the MENA countries. The effect of bank size, for instance, is evident in GCC Islamic banks. The positive effect of bank size has been suggested in other studies (Chronopoulos et al., 2015; Houston et al., 2010; Mirzaei et al., 2013; Shehzad et al., 2013; Smaoui & Salah, 2012). The effect of loan intensity, operating ratio and GDP become more evident in the Islamic banks in the GCC countries as compared to the MENA countries as a whole (see section 4.3.4).

Table 68: Multivariate regression results of Islamic banks' performance measured by ROA in the GCC countries

F (P-value)	R^2	Coefficients			
			β	t	P-value
9.780 (0.000)	0.365	Constant	.210	2.660	.009**
		Inflation	.000	.544	.587
		Log GDP	-.022	-2.731	.007**
		Capital ratio	-.001	-1.803	.073***
		Bank size	.006	3.046	.003**
		Credit risk	-.099	-4.228	.000**
		Capital risk	-.050	-2.270	.024*
		Loan intensity	-.055	-2.255	.025*
		Financial leverage	.000	-.091	.927
		Operating ratio	-.206	-2.793	.006**
		Z-score	.052	4.315	.000**

** Significant at the 0.01 level
* Significant at the 0.05 level
*** Significant at the 0.10 level

Further, in order to determine the most important independent variables affecting the ROA, a multivariate stepwise regression analysis was performed on the identified significant independent variables depicted in Table 68 above. The results of this analysis are presented in Table 69 below. What is observed is that of the significant independent variables, credit risk, Z-score and capital risk are the most important determinants of ROA of Islamic banks in the GCC countries. This is the case as these variables were statistically significant at 99% confidence level with credit risk having the highest relative regression coefficient value. The strength of the regression model as captured by f-value is 22.815 and the three independent variables accounted for 27.9% of the changes in the dependent variable.

Table 69: Stepwise regression results of Islamic Banks' performance measured by ROA in GCC countries

F (P-value)	R^2	Coefficients			
			β	t	P-value
22.815 (0.000)	0.279	Constant	-.001	-.134	.893
		Credit risk	-.111	-5.030	.000**
		Z-score	.038	4.363	.000**
		Capital Risk	-.040	-2.742	.007**

** Significant at the 0.01 level

Having examined the performance of the Islamic banks in the GCC countries, the focus is next directed to conventional banks' performance in the GCC countries. The first part sought to

investigate the relationships between the independent variables and the dependent variables (ROA and ROE). Table 70 presents the Pearson Correlation results for the Conventional Banking in the GCC countries. The results show that there is a moderate significant positive correlation between Z-score and bank performance represented by ROA where the value of the correlation coefficient is 0.462 but a weak positive correlation to ROE at the 1% significance level. Loan intensity also recorded significantly weak positive relationship to both ROE and ROA at the 1% significance level with correlation values of 0.306 and 0.133 respectively. Credit risk, operating ratio and capital ratio, on the other hand, recorded a weak negative relationship to ROE only at the 99% confidence level with correlation coefficient of -0.351, -0.323 and -0.207 respectively. Bank size on the other hand, had weak positive significant relationship with ROE but weak negative significant relationship to ROA at the 1% significance level.

Table 70: Pearson Correlation in conventional banking in the GCC countries

	ROE	ROA
Inflation	.044	.028
Log GDP	.098	-.040
Capital ratio	-.207**	.054
Bank size	.148**	-.152**
Credit risk	-.351**	-.070
Capital risk	-.088	.340**
Loan intensity	.306**	.133**
Financial leverage	.125*	-.263**
Operating ratio	-.323**	-.090
Z-score	.313**	.462**

** Correlation is significant at the 0.01 level.
* Correlation is significant at the 0.05 level.

In order to investigate the relationship between the variables further, a multivariate regression analysis was performed for the respective bank performance indicators (ROE and ROA). Table 71 presents the results from the multivariate regression model for conventional banks in the GCC countries for the bank performance variable, ROE, only. The significance of the regression model is high as reflected by the f-value of 17.900 with the independent variables' explanatory power of the changes in the dependent variable (ROE) at 32.6%. Thus, as depicted by the coefficient of determination, R^2, value of 0.326, the changes in the dependent variable (ROE) is explained 32.6% by the independent variables. Further, the results show significant regression coefficients for financial leverage, operating ratio and Z-score at a 99% confidence

level as revealed by the p-values from the t-test. Significant regression coefficients were also obtained for GDP and credit risk at the 5% significance level.

Table 71: Multivariate regression results of conventional banks' performance measured by ROE in the GCC countries

F (P-value)	R^2	Coefficients			
			β	t	P-value
17.900 (0.000)	0.326	Constant	.228	1.502	.134
		Inflation	-.001	-.585	.559
		Log GDP	-.037	-2.544	.011*
		Capital ratio	.008	1.003	.316
		Bank size	-.002	-.424	.672
		Credit risk	-.210	-2.537	.012*
		Capital risk	-.017	-.253	.800
		Loan intensity	.012	.232	.817
		Financial leverage	.021	5.997	.000**
		Operating ratio	-.948	-2.588	.010**
		Z-score	.221	9.804	.000**

** Significant at the 0.01 level
* Significant at the 0.05 level

Since GDP, credit risk, financial leverage, operating ratio and Z-score were found to be significant to the ROE for the conventional banks in the GCC countries, a further analysis to understand which variables were most important was performed. Table 72 presents the multivariate stepwise regression model performed in this respect. As the focus is only on the significant variables, the strength of the regression model has increased as depicted by the f-value of 35.750 (increasing from 17.900). Further, the explanatory power of the 5 significant variables is at 32.3% as reflected by R^2. At a 99% confidence level, Z-score, financial leverage, GDP and credit risk were significantly related to the dependent variable. The most important determinants of ROE reflected by the cumulative changes in the coefficient of determination in their order were Z-score, financial leverage, operating ratio, GDP and credit risk.

Table 72: Stepwise regression results of conventional banks' performance measured by ROE in the GCC countries

F (P-value)	R^2	Coefficients			
			β	t	P-value
35.750 (0.000)	0.323	Constant	.257	1.913	.057***
		Z-score	.214	10.582	.000**
		Financial leverage	.020	6.978	.000**
		Operating ratio	-.893	-2.511	.012*
		Log GDP	-.040	-3.086	.002**
		Credit risk	-.198	-2.884	.004**

** Significant at the 0.01 level
* Significant at the 0.05 level
*** Significant at the 0.10 level

Similar analysis was performed for the dependent variable, ROA, for the conventional banks in the GCC countries. Table 73 presents the multivariate regression analysis results obtained. With an f-value of 16.202 and R^2 value of 0.305, the regression model is statistically significant. The independent variables are accounting for 30.5% of the observed changes in the ROA. With a 99% confidence, GDP, credit risk, capital risk, financial leverage, operating ratio and Z-score have significant regression coefficients. The constant in the model is also significant at the 5% confidence level.

Table 73: Multivariate regression results of conventional banks' performance measured by ROA in the GCC countries

F (P-value)	R^2	Coefficients			
			β	t	P-value
16.202 (0.000)	0.305	Constant	.079	2.095	.037*
		Inflation	.000	-.784	.434
		Log GDP	-.010	-2.653	.008**
		Capital ratio	.002	1.026	.305
		Bank size	-.001	-1.083	.279
		Credit risk	-.061	-2.969	.003**
		Capital risk	.063	3.845	.000**
		Loan intensity	.001	.056	.955
		Financial leverage	.002	2.578	.010**
		Operating ratio	-.253	-2.766	.006**
		Z-score	.042	7.518	.000**

** Significant at the 0.01 level
* Significant at the 0.05 level

A further analysis to determine the most important variable among the six significant independent variables was carried out using Stepwise multivariate regression analysis. The results are presented in Table 74. As depicted from the f-value, the statistical significance of

the model has improved as the six significant variables accounted for 29.8% of the changes in the dependent variable, ROA, out of the 30.5% observed in Table 73 for all the independent variables. At 1% confidence level, Z-score, GDP, operating ratio, capital risk and credit risk were statistically significant. The relative changes in R^2 as the variables were important shows that Z-score had the highest change followed by GDP and operating ratio. Interestingly, whilst the macroeconomic variable, GDP, is an important determinant for bank performance, as measured by ROA, for conventional banks in the GCC countries, the results for the MENA region as a whole are different for both Islamic banks and conventional banks (see section 4.3.4). This suggests the relative responsiveness of the GCC countries' economies to global macroeconomic changes (World Bank, 2017).

Table 74: Stepwise regression results of conventional banks' performance measured by ROA in the GCC countries

F (P-value)	R^2	Coefficients			
			B	t	P-value
26.502 (0.000)	0.298	Constant	.087	2.468	.014*
		Z-score	.040	7.532	.000**
		Log GDP	-.011	-3.382	.001**
		Operating ratio	-.237	-2.647	.008**
		Capital risk	.071	4.624	.000**
		Credit risk	-.056	-2.911	.004**
		Financial leverage	.002	2.243	.026*

** Significant at the 0.01 level
* Significant at the 0.05 level

Putting these results into perspective with reference to the hypothesis, 'H4: the determinants of bank performance for Islamic banks and conventional banks are the same', this is rejected as there are observable significant differences in the factors that influence Islamic banks and conventional banks in the GCC countries. For instance, the credit risk and Z-score are the common influencing factors for both conventional banks and Islamic banks in the GCC countries, differences exist regarding the influence of capital risk, financial leverage and operating ratio.

6.3 Artificial neural network results

In order to understand further the performance of Islamic banks and conventional banks, the ANN model was applied also to the banks in the GCC countries only. The discussion below starts with Islamic banks' performance in the GCC countries using ROE as the dependent variable.

6.3.1 Performance of Islamic banks in the GCC countries based on ROE

6.3.1.1 MLP on all independent variables

The data set for the Islamic banks in the GCC countries was partitioned into training, testing and excluded/holdout as before. Table 75 shows the allocation of 70.2% of the 181 observations to training and 29.3% (53) to testing. To reiterate the MLP process, the training set was used for the estimation of the synaptic weights in the neural network whilst the predictions were made in the testing set. On the basis of the errors observed in the training set, the weights of the neural network were adjusted in order to minimize the errors in the testing set and also correct any overtraining problems.

Table 75: Case processing summary in Islamic banks in the GCC countries

		N	Percent
Sample	Training	128	70.7%
	Testing	53	29.3%
Valid		181	100.0%
Excluded		0	
Total		181	

The information about the neural network architecture is again identical to Table 30. This basically repeats the MLP analysis results discussed in section 5.2.1 for the Islamic banks in the MENA regions for dependent variable, ROE. The difference, however, in this case is the focus on the Islamic banks in the GCC countries only. The number of observations for the MENA region for Islamic banks was 296 compared to 181 observations for the GCC countries only. As depicted in Table 30, the network information has the number of units in the input layer of 10, in the hidden layer 7 and the output 1 since the dependent variable is ROE only.

The network architecture showing the linkage between the input layer, hidden layer and output layer is shown in Figure 32 below with the light colour lines showing synaptic weights greater than zero and the dark colour lines showing synaptic weights less than zero.

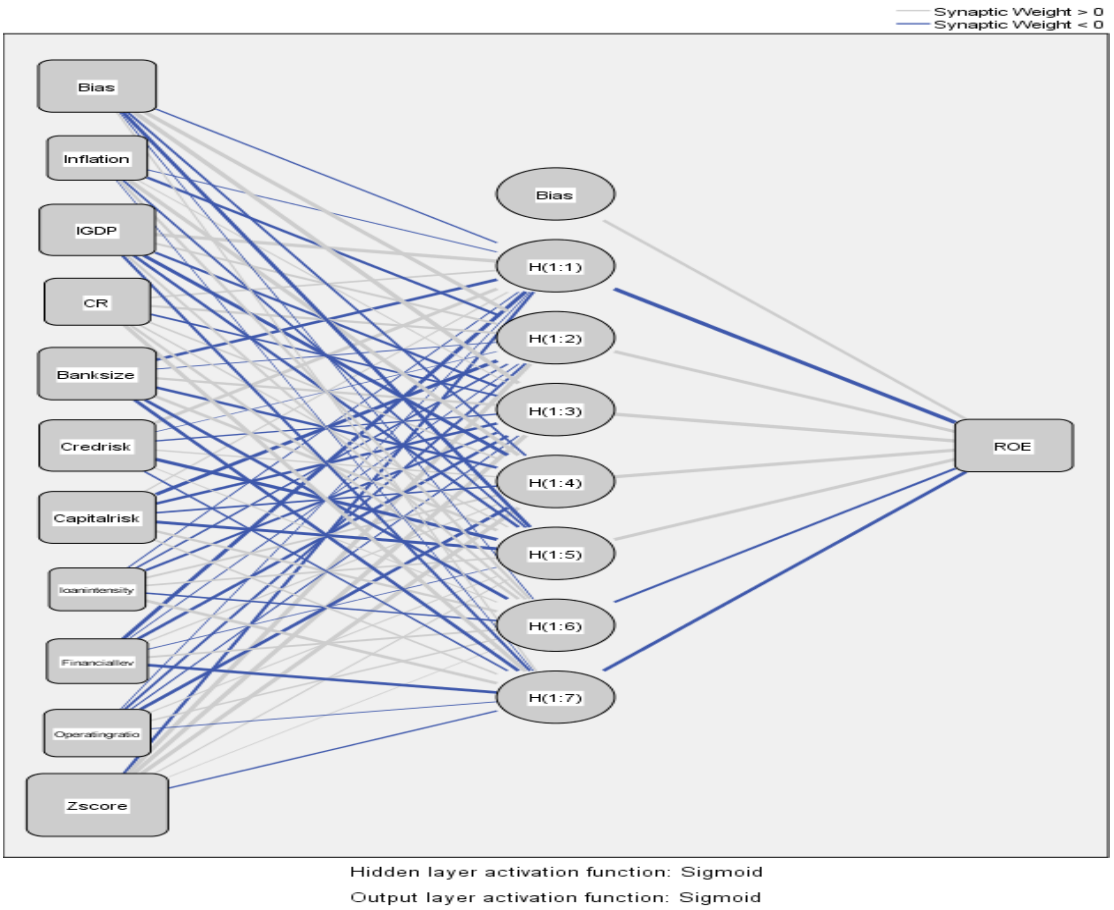


Figure 32: The architecture of the network in Islamic banks in the GCC countries

The model summary presenting the fit statistics for the training and testing data sets are given in Table 76. The testing phase revealed a reduction in the Sum of squares error from 0.370 in the training phase to 0.210 in the testing phase. The training phase lasted for 2 milliseconds when the algorithm could not reduce the errors any further for an additional step. In addition, the percentage of incorrect predictions or relative errors is almost equal across the training and testing samples with values of 0.484 and 0.464 respectively indicating the relative strength of the ANN model

Table 76: Model summary in Islamic banks in the GCC countries

Training	Sum of squares error	.370
	Relative error	.484
	Stopping rule used	1 consecutive step(s) with no decrease in error[a]
	Training time	0:00:00.02
Testing	Sum of squares error	.210
	Relative error	.494
Dependent Variable: Return on Equity, a. Error computations are based on the testing sample		

The detailed estimates of the weights and bias are given in Appendix C, Table C9. As defined above, the synaptic weights reveal the coefficient estimates that show the relationship between the units in a given layer to the units in the following layer. These synaptic weights are based on the training sample even if the active dataset is partitioned into training, testing, and holdout data (IBM, 2013). As presented in Table C9 (Appendix C), the synaptic weights attached to the neuron from bias are -0.108, 0.553, 0.888, -0.171, -0.368, -0.039 and 0.110 respectively. The weights, on the other hand, from the hidden layer to the output layer for bias is 0.305 and from the 1st neuron in the hidden layer to the output are -1.025, 0.480, 1.014, 0.665, 0.522, -0.209, and -0.397 respectively.

The next stage in the MLP process was the identification of the relative importance of the independent variables. Table 77 and Figure 33 presents the results which show Z-score with the highest importance value of 0.271 with a normalised importance of 100%. This is followed by the independent variables bank size (49.7%), capital risk (47.7%), credit risk (45.9%) and GDP (45.2%) respectively. Figure 33 shows a pictorial conception of the relative importance of the independent variables.

Table 77: Independent variable importance for Islamic banks in the GCC countries

	Importance	Normalized importance
Inflation	.032	12.0%
Log GDP	.123	45.2%
Capital ratio	.066	24.2%
Bank size	.135	49.7%
Cred risk	.125	45.9%
Capital risk	.129	47.7%
Loan intensity	.012	4.5%
Financial leverage	.037	13.6%
Operating ratio	.070	25.8%
Z-score	.271	100.0%

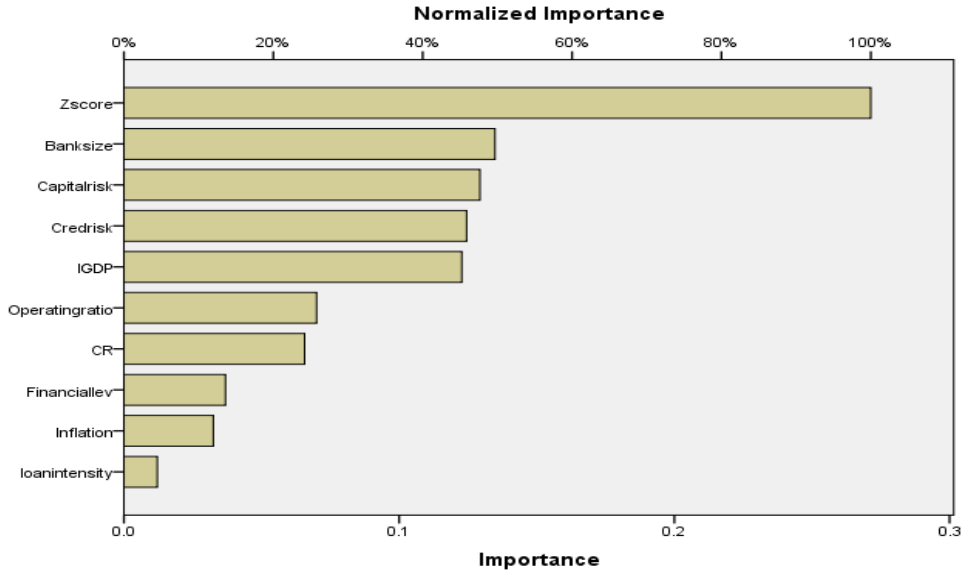


Figure 33: Independent variable importance for ROE on Islamic banks in the GCC countries

In order to understand the relative importance of the independent variables on the dependent variable, ROE, for the Islamic banks in the GCC countries, an MLP analysis was conducted for the five most significant independent variables (Z-score, bank size, capital risk, credit risk, and GDP) identified above.

6.3.1.2 MLP on selected five independent variables on ROE for Islamic banks in the GCC countries

The first step of data partitioning resulted in 72.4% of the 181 observations used for training and 27.6% (50) used in the testing stage. This partitioning of the 181 observations is shown in Table 78 below.

Table 78: Case processing summary in Islamic banks in the GCC countries

		N	Percent
Sample	Training	131	72.4%
	Testing	50	27.6%
Valid		181	100%
Excluded		0	
Total		181	

Further, the network information for the MLP can be represented from the table in Appendix B. The number of units in the input layer (excluding the bias unit) is now 5 whilst in the hidden layer is 3 and as expected in the output layer 1 since the dependent variable is only one, the return on equity. The other aspects of the network information remain the same such as the activation function being the Sigmoid function.

The associated neural network architecture linking the neurons is shown in Figure 34 below in which the light colour lines show weights greater than zero and the dark colour lines show weight less than zero as above.

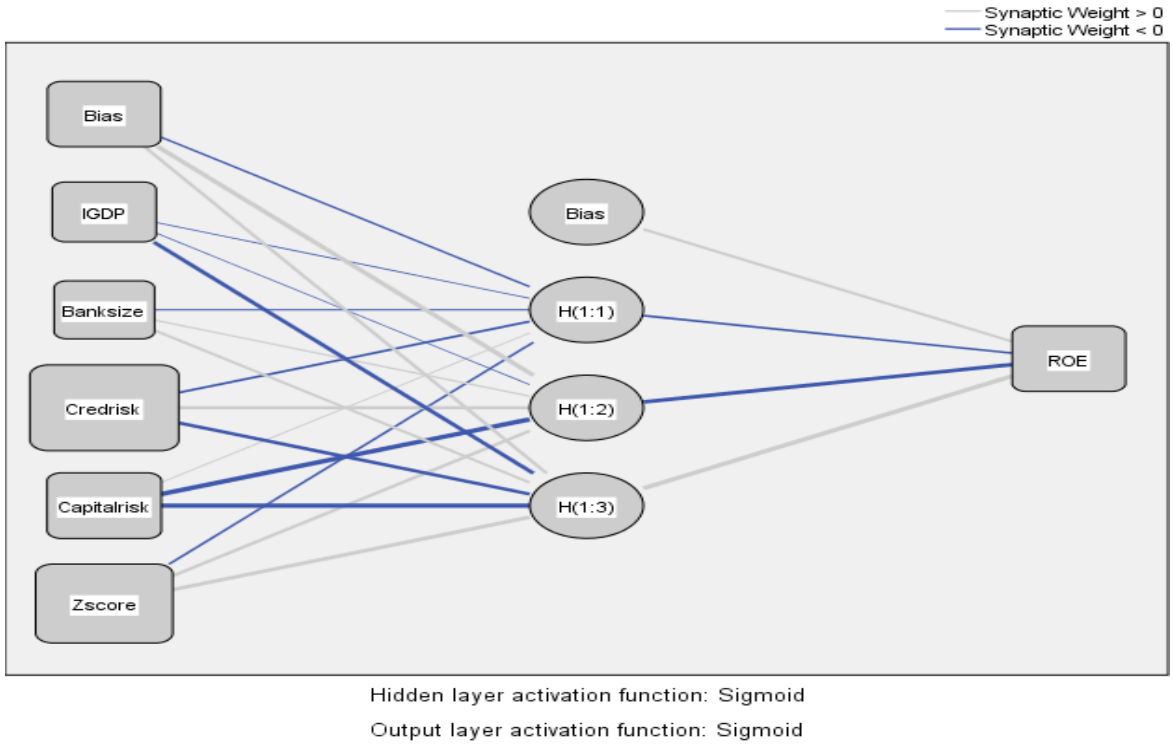


Figure 34: The architecture of the network

In addition, the neural network model summary showing the fit statistics for the training and testing stages are presented in Table 79 below. The neural network shows Sum of squares error of 0.558 and Relative error of 0.477 in the training stage. The testing stage Sum of squares error

was 0.213 with the Relative error of 0.342. After 2 milliseconds, the estimation algorithm stopped as no further reduction was recorded in the errors.

Table 79: Model summary in Islamic banks in the GCC countries

Training	Sum of squares error	.558
	Relative error	.477
	Stopping rule used	1 consecutive step(s) with no decrease in error[a]
	Training time	0:00:00.02
Testing	Sum of squares error	.213
	Relative Error	.342

Dependent variable: Return on equity
a Error computations are based on the testing sample

The detailed estimates of the synaptic weights between the neurons in the neural network architecture are shown in Appendix C, Table C10. The results are for all the layers (input, hidden and output). As reiterated above, H(1:1) means hidden layer 1 and 1st neuron. The weights attached to the neuron from bias for example are -0.371, 2.683 and 0.799 respectively. The weight from the hidden layer to the output layer for bias is 0.694 and from the 1st neuron in the hidden layer to the output are -0.561, -2.345 and 2.996 respectively.

The next phase was to determine the most important of the five independent variables selected for this MLP procedure. Table 80 and Figure 35 show the results of the relative importance of the independent variables obtained in the neural network model. The table shows the relative importance of the independent variable, credit risk, which increased to 0.330 (from 0.125 in Table 77). The normalised importance of credit risk becomes 100%. The next relative important independent variable is Z-score with value of 0.275 and normalised importance of 83.3%.

Table 80: Independent variable importance for ROE in Islamic banks in the GCC countries

	Importance	Normalized importance
Log GDP	.121	36.6%
Bank size	.105	31.8%
Cred risk	.330	100.0%
Capital risk	.168	50.9%
Z-score	.275	83.3%

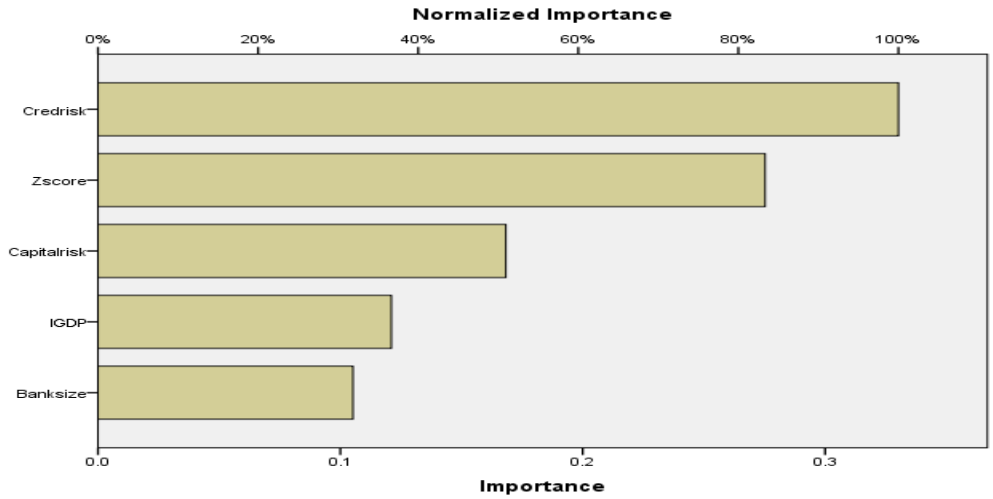


Figure 35: Independent variable importance for ROE in Islamic banks in the GCC countries

The fitness of the neural network model is shown in Figure 36 where the actual and estimated values of the ROE for Islamic banks in the GCC countries are compared. From Figure 36 below, it can be concluded that the estimated values approach the actual values of the dependent variable, ROE.

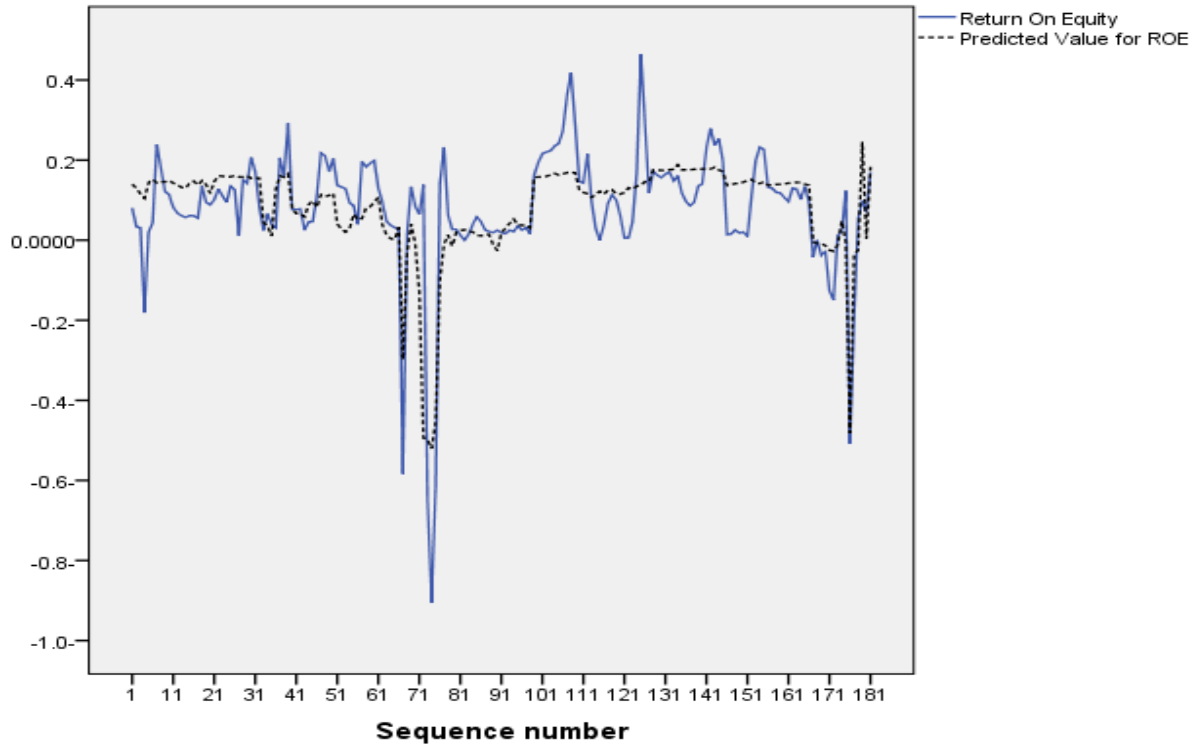


Figure 36: Actual and estimated values using neural in Islamic banking in GCC countries

An examination of the explanatory strength of the ANN model gave a coefficient of determination, R^2, of 0.667. This meant that the independent variables explained 66.7% of the

changes that occurred in the dependent variable, ROE, for Islamic banks in the GCC countries when using the ANN method.

The next section discusses the ANN analysis for the Islamic banks in the GCC countries with ROA as the dependent variable.

6.3.2 Performance of Islamic banks in the GCC countries based on ROA

6.3.2.1 MLP on all independent variable

The dataset comprised of 181 observations as shown in section 6.3.1 above. This was divided into 122 (67.4%) observations for training stage and 59 (32.6%) for the testing stage. The partitioning of the data set for MLP analysis is shown in Table 81 below. To reiterate also, based on the errors observed in the training set, the weights of the neural network were adjusted in order to minimize the errors in the testing set and also correct any overtraining problems.

Table 81: Case processing summary in Islamic banks in the GCC countries

		N	Percent
Sample	Training	122	67.4%
	Testing	59	32.6%
Valid		181	100%
Excluded		0	
Total		181	

The network information is similar to Table 30 (section 5.2.1) with the only change now being the dependent variable, return on assets (ROA). As before, the number of units in the input layer is 10, in the hidden layer 7 and in the output layer 1 (ROA). The error function is Sum of squares whilst the activation function used is Sigmoid.

The neural network architecture that depicts the linkage between the input layer, hidden layer and output layer is shown in Figure 37 in which the light colour lines show weights greater than zero and the dark colour lines show weights less than zero.

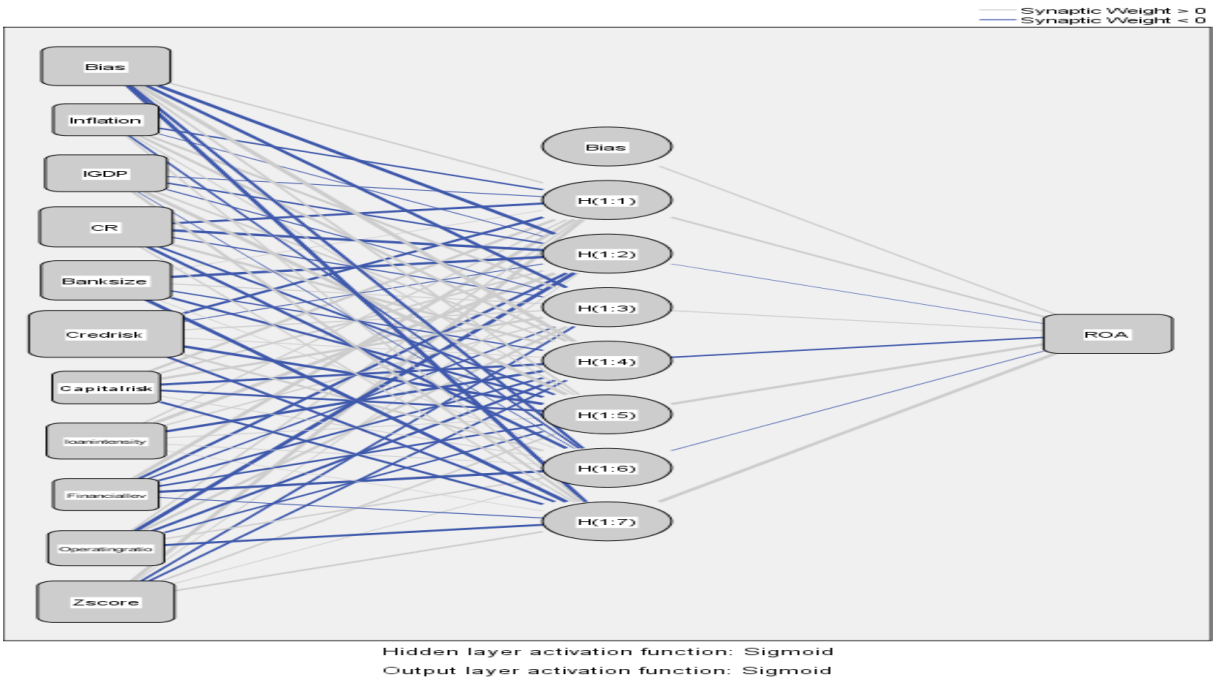


Figure 37: The architecture of the network for Islamic banks in the GCC countries

Further, the model summary resulting from the MLP process is presented in Table 82. From Table 82, it can be observed that the running time was 2 milliseconds beyond which the estimation algorithm could not reduce the errors any more. The Sum of squares error was 0.542 and Relative error 0.828 in the training stage whilst in the testing stage, the Sum of squares error was 0.073 with a Relative error value of 0.950.

Table 82: Model summary of Islamic banks in the GCC countries

Training	Sum of squares error	.542
	Relative error	.828
	Stopping rule used	1 consecutive step(s) with no decrease in error[a]
	Training time	0:00:00.02
Testing	Sum of squares error	.073
	Relative error	.950
Dependent variable: Return on asset, a. Error computations are based on the testing sample.		

The detailed estimates of the synaptic weights are given in Appendix C, Table C11. The results in this table show that the value of weights from the input layer to the hidden layer and from the hidden layer to the output layer. These values are determined by the estimation algorithm obtained from the activation function. As before, H(1:1) means hidden layer 1 and 1st neuron. The results show that the weights attached to the neuron from bias is 0.196, -0.454, -0.365, 0.497, 0.182, -0.278 and -0.383 respectively. Further, the weights from the hidden layer to the

output layer for bias are 0.153 and from the 1st neuron in the hidden layer to the output are 0.247, -0.015, 0.129, -0.227, 0.420, -0.048 and 0.429, respectively.

The next stage in the MLP process was to determine the most important independent variables that affected ROA. Table 83 and Figure 38 show the relative importance of the independent variables obtained from the neural network model. Credit risk had the highest importance value of 0.258 followed by Z-score, capital ratio and bank size in that order. These independent variables' normalised importance was 100%, 66%, 57.9% and 52.2% respectively. This shows that the ROA predicted value changed more for different values of the credit risk than the other independent variables.

The next section presents results of the further analysis of the four identified independent variables that were relatively more important.

Table 83: Independent variable importance for ROA of Islamic banks in the GCC countries

	Importance	Normalized importance
Inflation	.013	5.0%
Log GDP	.094	36.2%
Capital ratio	.150	57.9%
Bank size	.135	52.2%
Credit risk	.258	100.0%
Capital risk	.023	9.0%
Loan intensity	.079	30.7%
Financial leverage	.013	4.9%
Operating ratio	.065	25.2%
Z-score	.170	66.0%

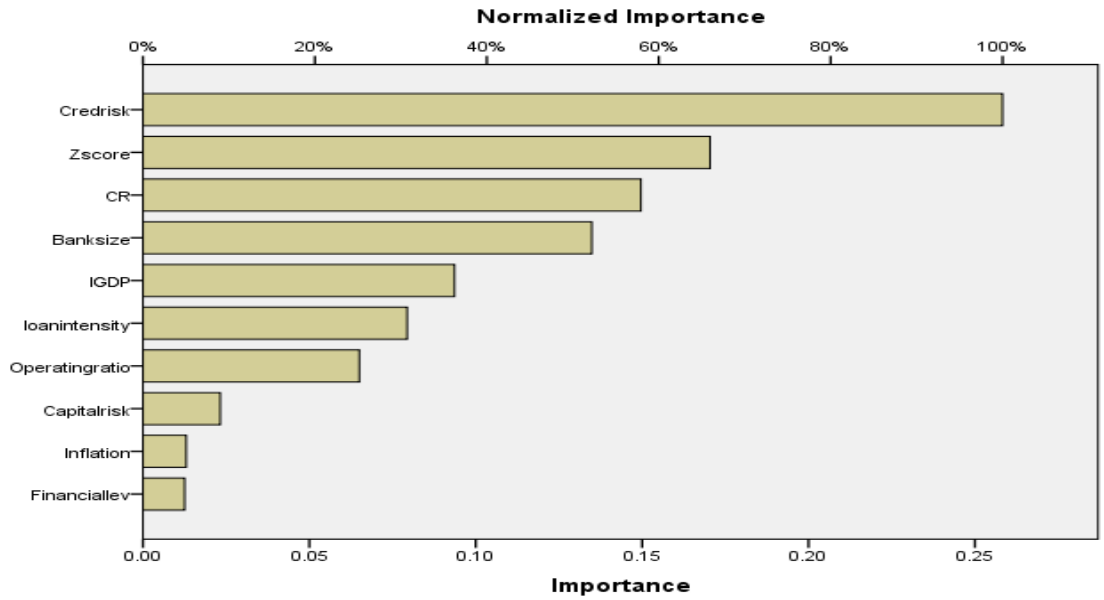


Figure 38: Independent variable importance for ROA of Islamic banks in the GCC countries

6.3.2.2 MLP on the selected four independent variable for ROA of Islamic banks in the GCC

The MLP procedure was repeated with only four independent variables (capital ratio, bank size, credit risk and Z-score). Table 84 shows the division of the 181 observations which resulted in 122 (67.4%) observations for training and 59 (32.6%) for testing.

Table 84: Case processing summary of Islamic banks in the GCC countries

		N	Percent
Sample	Training	122	67.4%
	Testing	59	32.6%
Valid		181	100%
Excluded		0	
Total		181	

The revision to the network information is with respect to the number of units. Appendix B depicts the network information with now 4 units in the input layer, 3 in the hidden layer and 1 (ROA) in the output layer. The Sigmoid function (see section 3.8.2) is the activation function whilst the error function remains as the Sum of Squares.

The resultant neural network architecture is shown in Figure 39 with the light colour lines depicting weights greater than zero and the dark colour lines showing weights less than zero.

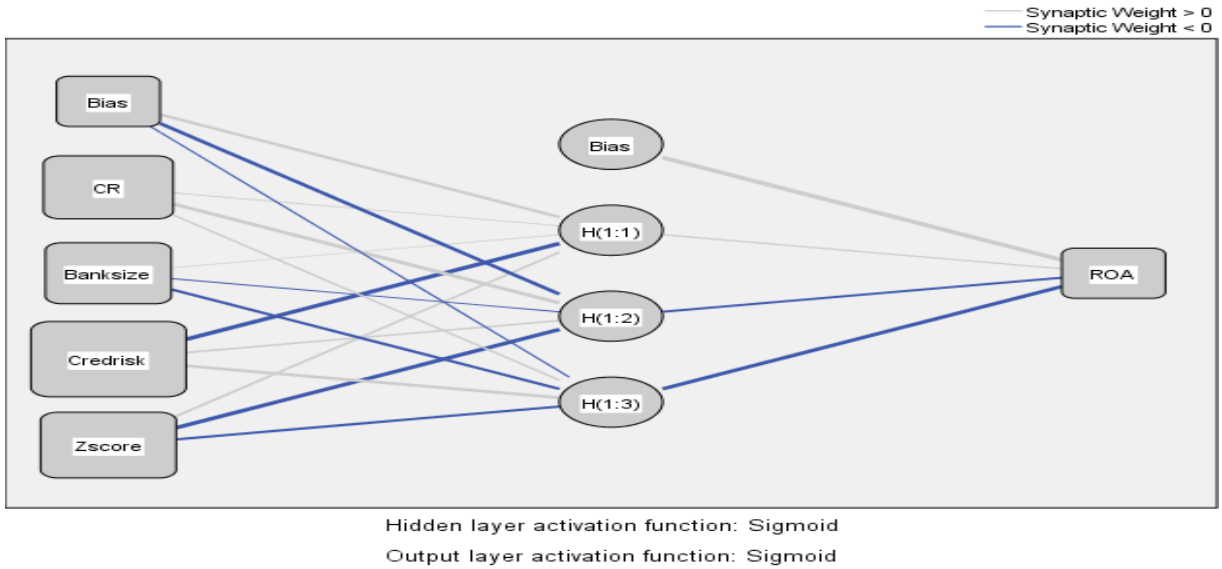


Figure 39: The architecture of the network in Islamic banks in the GCC countries

The model summary showing the fit statistics for the training and testing data sets are given in Table 85. The table shows an improvement in the neural network model from the training to the testing stages as depicted in the reduction in the Sum of Squares Error (0.478 to 0.089). Further, the percentage of incorrect predictions as shown by the relative errors is almost equal across the training and testing samples with values of 0.785 and 0.710 respectively.

Table 85: Model summary of Islamic banks in the GCC countries

Training	Sum of squares error	.478
	Relative error	.785
	Stopping rule used	1 consecutive step(s) with no decrease in error[a]
	Training time	0:00:00.02
Testing	Sum of squares error	.089
	Relative error	.710

Dependent variable: Return on asset,
a. Error computations are based on the testing sample

Further, the detailed estimates of the weights connecting the neurons from the input layer to the hidden layer and from the hidden layer to the output layer is shown in Appendix C, Table C12. The parameter estimates give the weights attached to the neuron for bias as 0.474, -0.537 and -0.117 respectively. The weights on the other hand from the hidden layer to the output layer for bias is 0.940 and from 1st neuron in the hidden layer to the output are 0.122, -0.232 and -0.652 respectively.

A further analysis of the relative importance of the four independent variables is presented in Table 86 and Figure 40 below. The neural network model revealed credit risk with an importance value of 0.305 (100%) followed by Z-score with value of 0.247 (80.9%) and then capital ratio with importance value of 0.230 (75.3%). This relative importance is pictorially depicted in Figure 40 below. Thus, credit risk had the highest effect on ROA for the Islamic banks in the GCC countries.

Table 86: Independent variable importance in Islamic banks in the GCC countries

	Importance	Normalized importance
Capital ratio	.230	75.3%
Bank size	.218	71.6%
Credit risk	.305	100.0%
Z-score	.247	80.9%

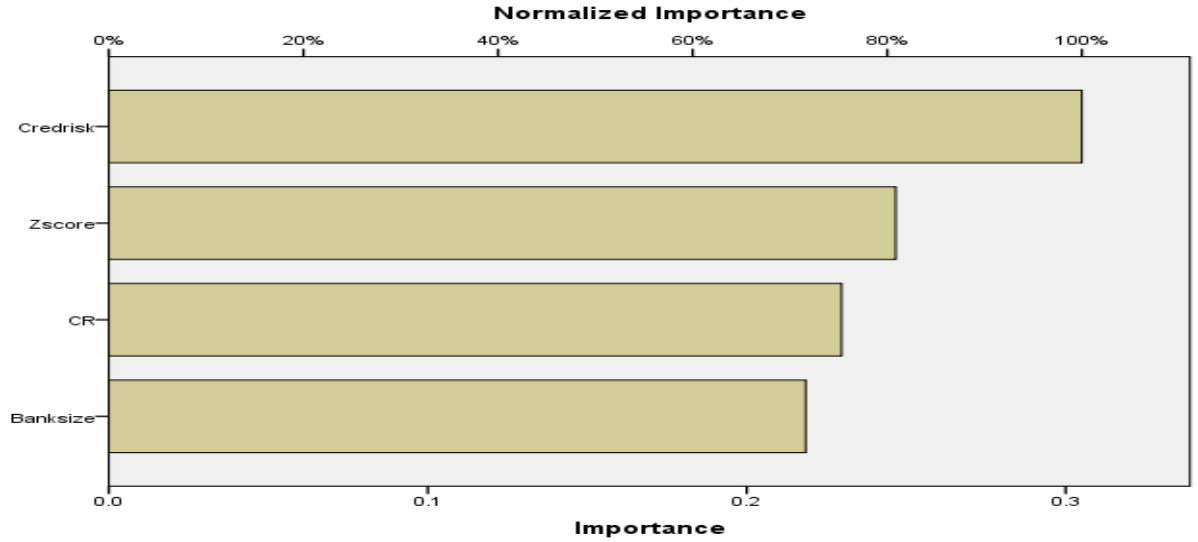


Figure 40: Independent variable importance

The fitness of the neural network model is depicted in Figure 41 which shows that the actual and estimated ROA values using neural networks for Islamic banks is strong as the estimated values approach the actual value of the dependent variable.

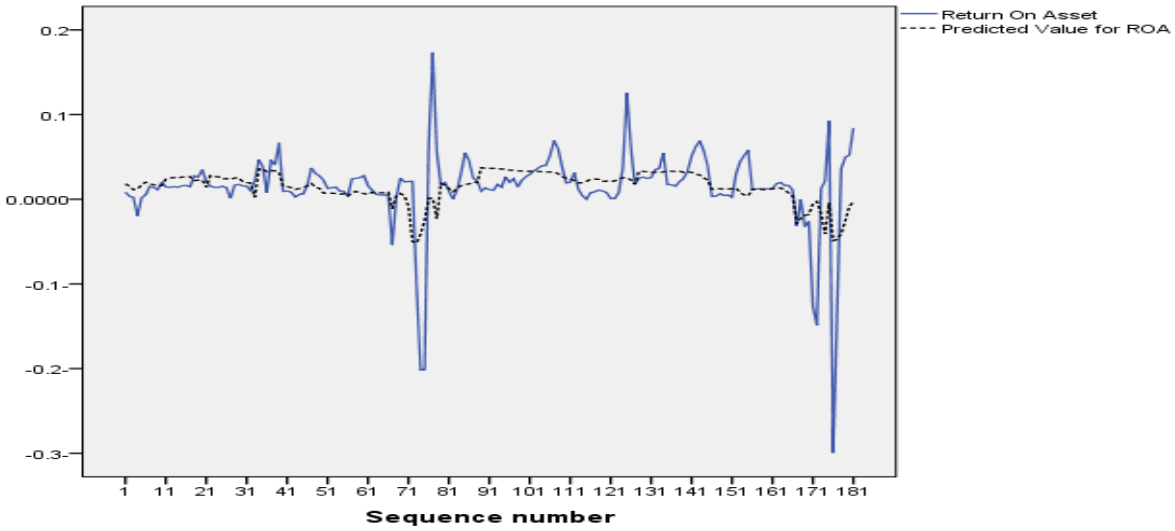


Figure 41: Actual and estimated values using neural in Islamic banks in the GCC countries

A further analysis of the strength of the results obtained using the ANN model gave a coefficient of determination, R^2 of 0.300. This reflected that the independent variables explained 30.0% of the changes that occurred in the dependent variable, ROA, for the Islamic banks in the GCC countries. This is an improvement from the value obtained when using the stepwise regression model (see section 6.2.4).

The next section shifts focus to the conventional banks in the GCC countries using the same ANN method.

6.3.3 Performance of conventional banks in the GCC countries for ROE dependent variable

6.3.3.1 MLP on all independent variables for ROE in conventional banks in the GCC countries

The first step in the MLP process was the partitioning of the data set. In total, 383 observations were divided into training, testing and excluded. Table 87 shows the partitioning of 68.0% of the observations into training and 32.0% into testing samples whilst 2 observations were excluded.

Table 87: Case processing summary for ROE in conventional banks in the GCC countries

		N	Percent
Sample	Training	259	68.0%
	Testing	122	32.0%
Valid		381	100.0%
Excluded		2	
Total		383	

The associated network information is again identical to Table 30 in section 5.2.1 except that the focus now is on conventional banks in the GCC countries (not Islamic banks) while the dependent variable remains as ROE.

The relationship between the input layer, hidden layer and output is presented through a neural network architecture. This is presented in Figure 42 in which the neurons are connected by weights where the light colour lines show weights greater than zero and the dark colour lines show weight less than zero.

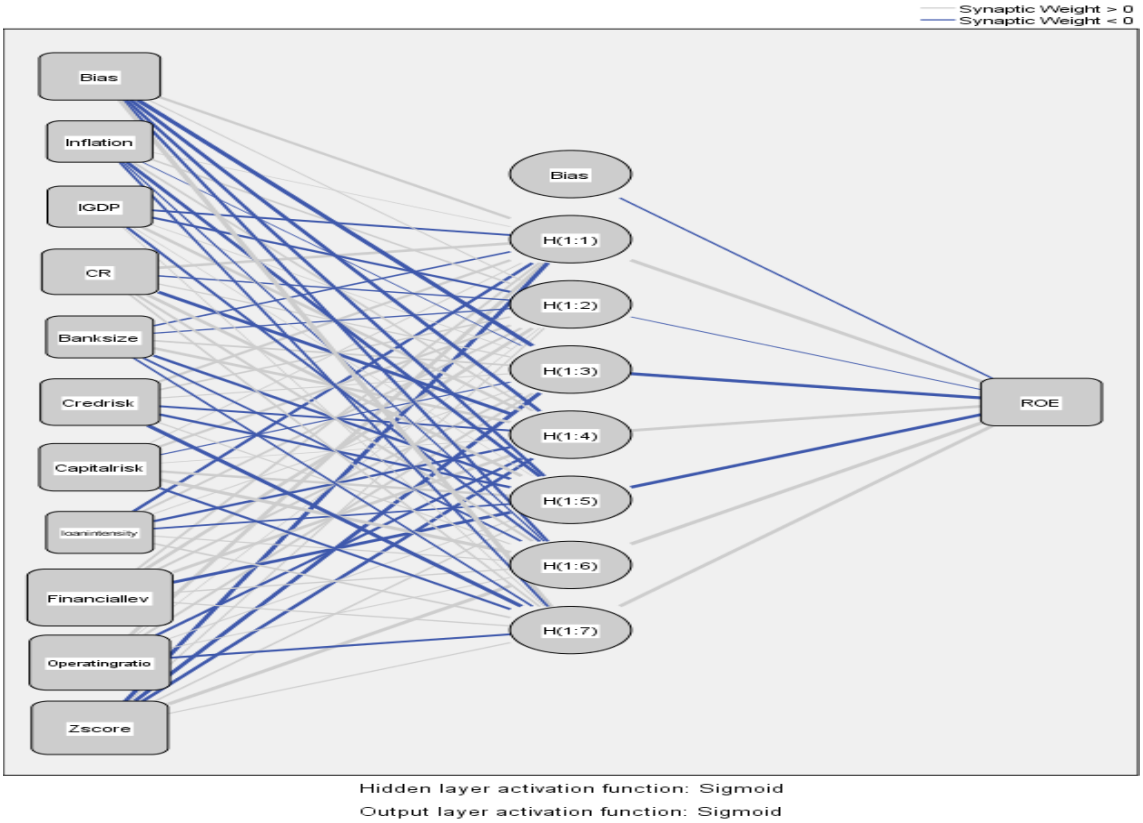


Figure 42: The architecture of the network for ROE in conventional banks in the GCC countries

The MLP process produced the model summary shown in Table 88 below. The results show that the training stage lasted for 6 milliseconds after which the estimation algorithm could not reduce the errors any further. The Sum of squares error has reduced from 0.257 in the training stage to 0.213 in the testing stage.

Table 88: Model summary for ROE in conventional banks in the GCC countries

Training	Sum of squares error	.257
	Relative error	.326
	Stopping rule used	1 consecutive step(s) with no decrease in error[a]
	Training time	0:00:00.06
Testing	Sum of squares error	.213
	Relative error	.297
Dependent variable: Return on equity, a. Error computations are based on the testing sample.		

The detailed estimates of the weights are presented in Appendix C, Table C13. These results in the table show the values of weights from the input layer to the hidden layer and from the hidden layer to the output layer. These weights reflect the coefficient estimates that show the relationship between the units in a given layer to the units in the following layer. For instance, the weights attached to the neuron from bias are 0.501, 0.104, -1.613, -0.634, -0.487, -0.377 and 1.269 respectively. The weights from the hidden layer to the output layer for bias are -0.232 and from 1st neuron in the hidden layer to the output are 0.888, -0.076, -1.565, 0.885, -0.982, 1.402 and 0.785 respectively.

The MLP process also produced the relative importance of the independent variable. The results are presented in Table 89 and Figure 43. As shown in Table 89, the neural network model recorded the highest relative importance of 0.208 (normalised importance 100%) for financial leverage. This is followed by operating ratio (0.187), Z-score (0.169) and capital risk (0.104). The normalised importance values are depicted in Figure 43.

Table 89: Independent variable importance for ROE in conventional banks in the GCC countries

	Importance	Normalized importance
Inflation	.037	17.8%
Log GDP	.033	16.1%
Capital ratio	.082	39.4%
Bank size	.043	20.8%
Credit risk	.095	45.5%
Capital risk	.104	50.0%
Loan intensity	.043	20.8%
Financial leverage	.208	100.0%
Operating ratio	.187	89.9%
Z-score	.169	81.5%

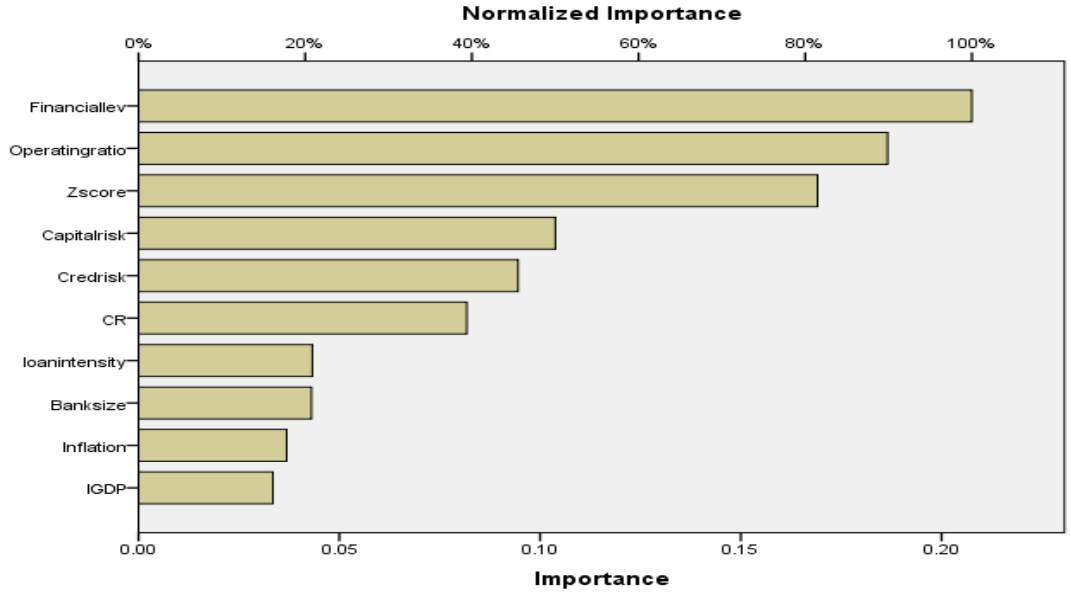


Figure 43: Independent variable importance for conventional banks in the GCC countries

The MLP procedure was repeated for only the important independent variables identified (financial leverage, operating ratio, Z-score and capital risk). This is discussed next.

6.3.3.2 MLP on four selected independent variables for ROE in conventional banks in the GCC countries

The MLP process, as before, started with the dividing of the observations. The data partitioning is shown in Table 90 with 72.2% of 381 observations allocated to training and 27.8% allocated to testing stage. 2 observations were excluded from the sample. To reiterate, the training set was used for the estimation of the synaptic weights in the neural network (see below) whilst the predictions were made in the testing set.

Table 90: Case processing summary for ROE in conventional banks in the GCC countries

		N	Percent
Sample	Training	275	72.2%
	Testing	106	27.8%
Valid		381	100%
Excluded		2	
Total		383	

The resultant network information, based on the selected four independent variables (capital risk, financial leverage, operating ratio and Z-score) can be reflected from appendix B. The network information now has 4 units in the input layer and 3 in the hidden layer as compared to 10 units in the input layer and 7 units in the hidden layer respectively. The other aspects of the network information remain the same with the activation function based on Sigmoid and error function captured by Sum of squares. The rescaling method for dependent variable is normalised.

The associated network architecture for the revised neural network model based on the four independent variables is shown in Figure 44 below. As highlighted in the other network architecture above, the light colour lines show weights greater than zero and the dark colour lines show weights less than zero.

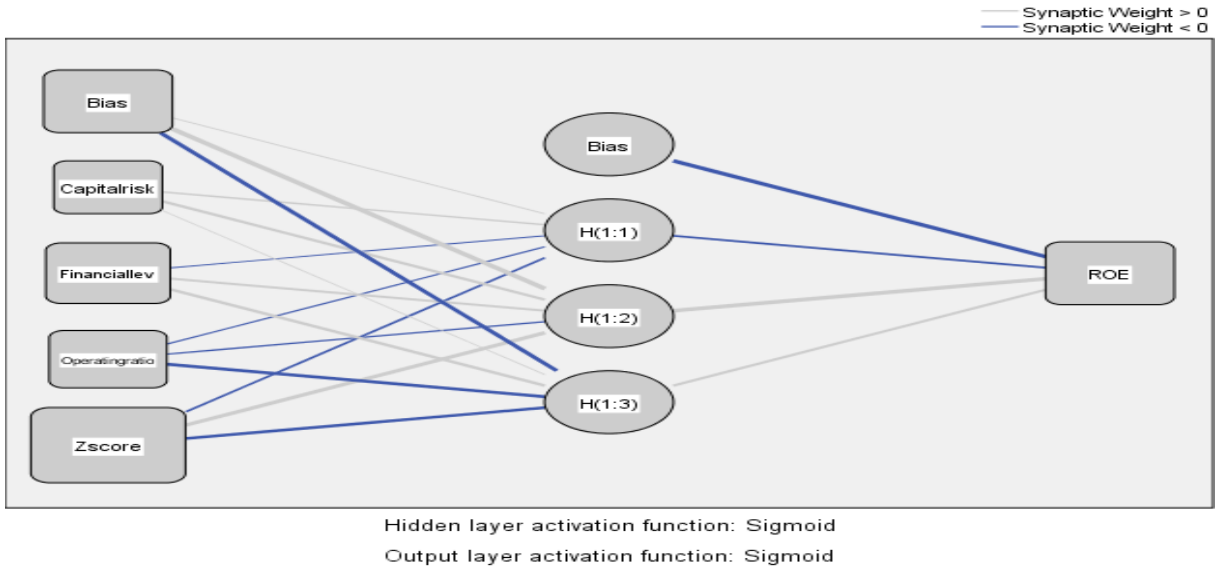


Figure 44: The architecture of the network for ROE in conventional banks in the GCC countries

Table 91 below shows the model summary of the MLP process. The results show the Sum of Squares Error of 0.396 and 0.284 in the training and testing stage respectively. The percentage of incorrect predictions was 0.303 and 0.500 in the training and testing stages respectively. The estimation algorithm which produced the estimation weights stopped after 3 milliseconds when the errors could not be reduced any further from subsequent iterations.

Table 91: Model Summary for ROE in conventional banks in the GCC countries

Training	Sum of squares error	.396
	Relative error	.303
	Stopping rule used	1 consecutive step(s) with no decrease in error[a]
	Training time	0:00:00.03
Testing	Sum of squares error	.284
	Relative error	.500

Dependent Variable: Return on Equity,
a. Error computations are based on the testing sample

The associated estimates of the weights are given in Appendix C, Table C14 which shows the value of weights from the input layer to the hidden layer and from the hidden layer to the output layer. To reiterate, the expression H(1:1) means hidden layer 1 and 1st neuron. The weights attached to the neuron from bias are 0.077, 4.316 and -1.522 respectively whilst the weight from the hidden layer to the output layer was -2.028 and from 1st neuron in the hidden layer to the output -0.493, 3.244 and 0.659 respectively.

The next stage is a sensitivity analysis as performed by the neural network on both the training sample and testing sample for each independent variable. The results of this sensitivity analysis for each independent variable on ROE are shown in Table 92 and Figure 45. The independent variable that produced the highest changes in the neural network was Z-score with value of 0.554 (normalised importance 100%) followed by financial leverage with value of 0.230 (normalised importance of 41.5%). The normalised importance for all the four independent variables is usefully depicted in figure 45 below.

Table 92: Independent variable importance for ROE in conventional banks in the GCC countries

	Importance	Normalized importance
Capital risk	.059	10.7%
Financial leverage	.230	41.5%
Operating ratio	.157	28.3%
Z-score	.554	100.0%

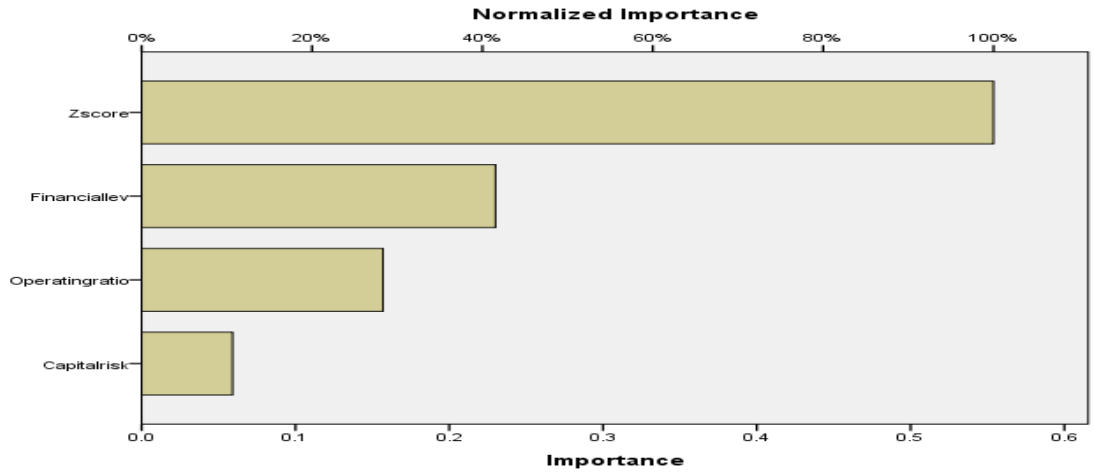


Figure 45: Independent variable importance for ROE in conventional banks in the GCC countries

The strength of the neural network is captured by comparing the movements of the actual values of ROE and predicted values. These are shown in Figure 46. The interpretation of this movement shows a close fit as the estimated values approach the actual values of the dependent variable, ROE, for the conventional banks in the GCC countries.

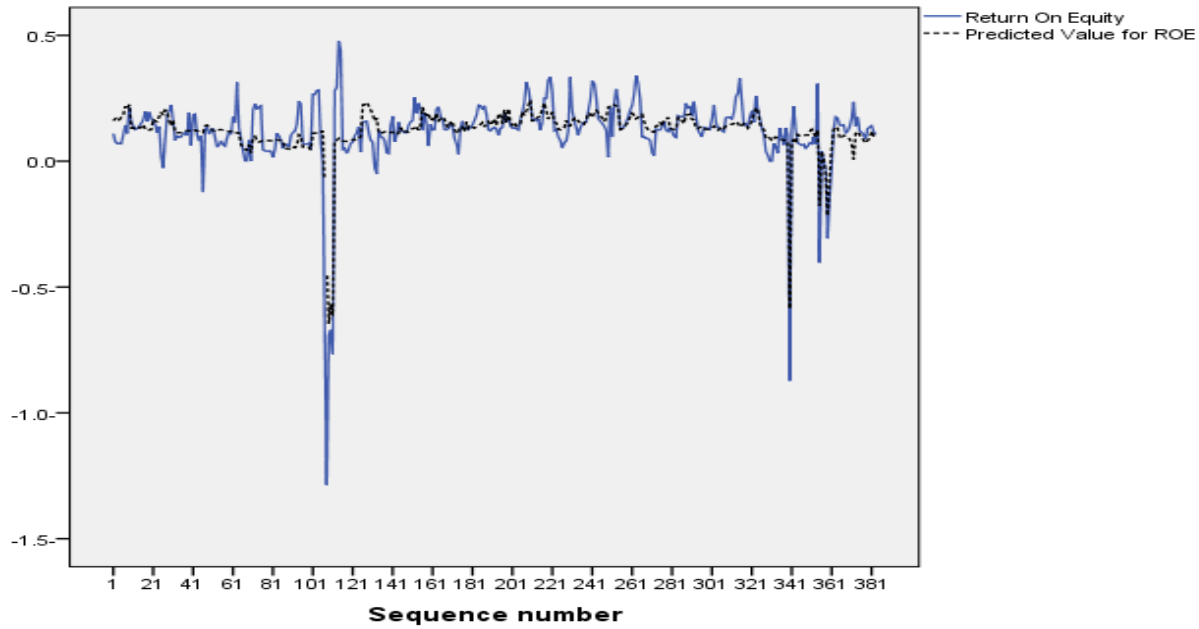


Figure 46: Actual and estimated values using neural for ROE in conventional banks in the GCC countries

The explanatory strength of the ANN was assessed using the coefficient of determination, R^2. This gave a value of 0.849 showing that the independent variables accounted for 84.9% of the changes in the dependent variable, ROE, using the ANN for conventional banks in the GCC countries. This is a higher explanatory power exhibited by the ANN method when compared to 32.3% explanatory power of the multiple linear regression model (see section 6.2.4).

The MLP process was reperformed for the dependent variable, ROA, on conventional banks in the GCC countries. The findings are discussed next.

6.3.4 Performance of conventional banks in the GCC countries based on ROA

6.3.4.1 MLP on all independent variables for ROA in conventional banks in the GCC countries

The data partitions are shown in Table 93 below. Of the data, 67.7% was allocated to training sample and 32.3% allocated to testing sample. As shown above (section 6.3.3), 2 observations were excluded from the data set

Table 93: Case processing summary for ROA in conventional banks in the GCC countries

		N	Percent
Sample	Training	258	67.7%
	Testing	123	32.3%
Valid		381	100.0%
Excluded		2	
Total		383	

The network information for this part of the MLP procedure is identical to Table 30 (section 5.2.1) with the only difference being the dependent variable which is now return on assets. As shown in Table 30, the number of units in the input layer was 10, in the hidden layer 7 and output layer 1 which is dependent variable, ROA.

The neural network architecture for the network information above is shown in Figure 47 where the light colour lines show weights greater than zero and the dark colour lines show weight less than zero.

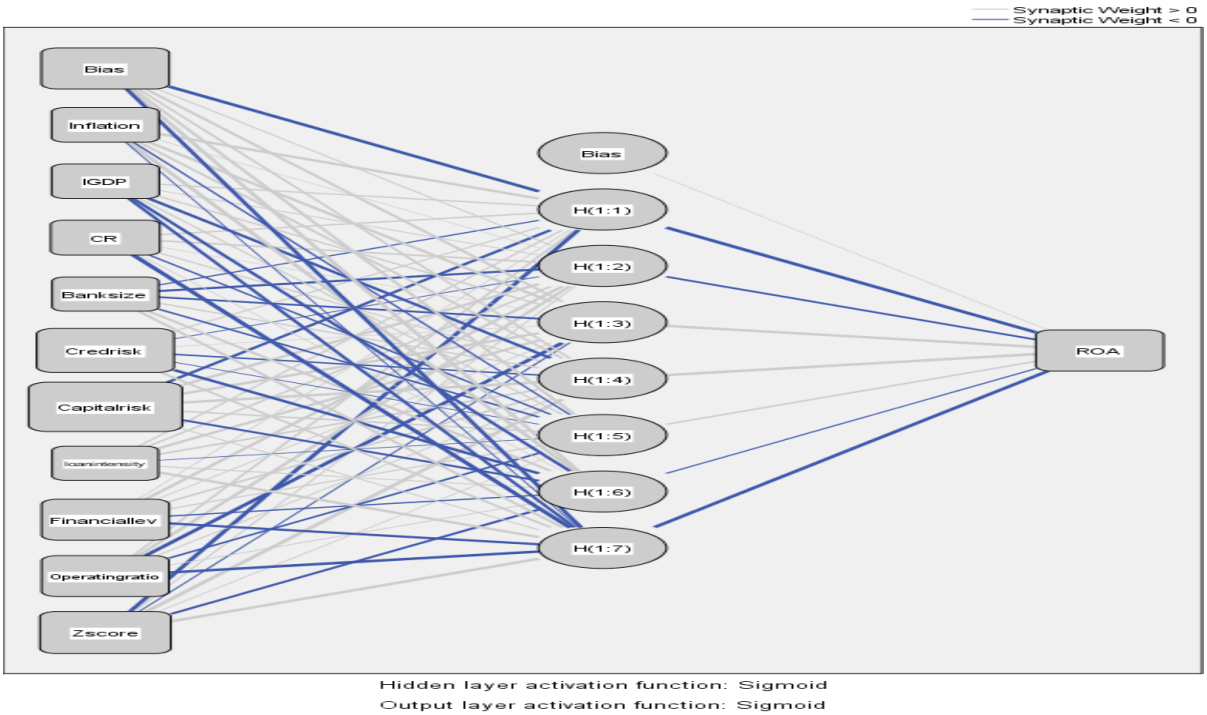


Figure 47: The architecture of the network for ROA of conventional banks in the GCC countries

The MLP process produced the model summary shown in Table 94 below. This has revealed a closeness of the percentage of incorrect predictions in the training sample to the testing sample of 0.504 and 0.586 respectively. The testing stage reduced the errors in the model from 0.271 to 0.168 after iterations for 6 milliseconds further to which no decrease in errors was captured.

Table 94: Model summary for ROA in conventional banks in the GCC countries

Training	Sum of squares error	.271
	Relative error	.504
	Stopping rule used	1 consecutive step(s) with no decrease in error[a]
	Training time	0:00:00.06
Testing	Sum of squares error	.168
	Relative error	.586
Dependent variable: Return on asset, a. Error computations are based on the testing sample.		

The detailed estimates of the weights and bias of the neural network are given in Appendix C, Table C15. The results in this table show the value of weights from input to the hidden layer and from the hidden layer to the output layer with that of the neuron from bias of -0.695, 0.151, 0.294, 0.223, 0.282, 0.387 and -0.385 respectively. The weights from the hidden layer to the output layer for bias are 0.043 and from 1st neuron in the hidden layer to the output are -0.813, -0.284, 0.604, 0.776, 0.241, -0.167 and -0.569 respectively.

The sensitivity analysis of the MLP between the independent variable and the dependent variable based on the neural network model produced importance results that put capital risk as the most important independent variable with value of 0.270 and thus associated with 100% normalised importance. The independent variable is followed by credit risk with importance value 0.184 (68.1%), Z-score (55.8%), financial leverage (49.1%) and operating ratio (49.1%). The relative importance is depicted in Figure 48 below.

Table 95: Independent variable importance for ROA in conventional banks in the GCC countries

	Importance	Normalized importance
Inflation	.026	9.8%
Log GDP	.027	10.0%
Capital ratio	.035	13.1%
Bank size	.021	8.0%
Credit risk	.184	68.1%
Capital risk	.270	100.0%
Loan intensity	.021	7.9%
Financial leverage	.133	49.3%
Operating ratio	.132	49.1%
Z-score	.150	55.8%

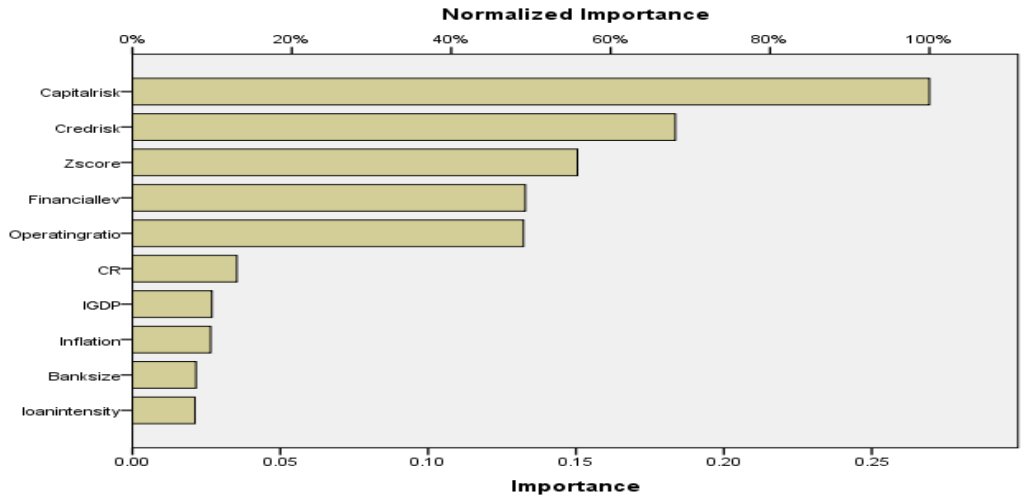


Figure 48: Independent variable importance for ROA in conventional banks in the GCC countries

A further MLP analysis was performed for the five independent variables identified as most important in Table 95 above. The results are discussed next.

6.3.4.2 MLP on five selected independent variables for ROA in conventional banks in the GCC countries

The MLP process above was reperformed for the five independent variables (capital risk, credit risk, Z-score, financial leverage and operating ratio) identified in section 6.3.4.1 above as most important. The data partitioning was the same with 67.7% of 381 observations allocated to training set, 32.3% allocated to testing set and 2 observation excluded. This is shown in Table 96 below.

Table 96: Case Processing summary for ROA in conventional banks in the GCC countries

		N	Percent
Sample	Training	258	67.7%
	Testing	123	32.3%
Valid		381	100%
Excluded		2	
Total		383	

The revised network information can be represented from Appendix B with a reduction in the number of units in the input layer to 5, in the hidden layer to 3 whilst the output layer still 1

since the dependent variable, ROA, remains the same. All other aspects of the network information are the same.

The linkage between the input layer, hidden layer and output shown by neurons. Figure 49 shows the network architecture showing how the neurons are connected. In the figure, the light colour lines show weights greater than zero and the dark colour lines show weights less than zero.

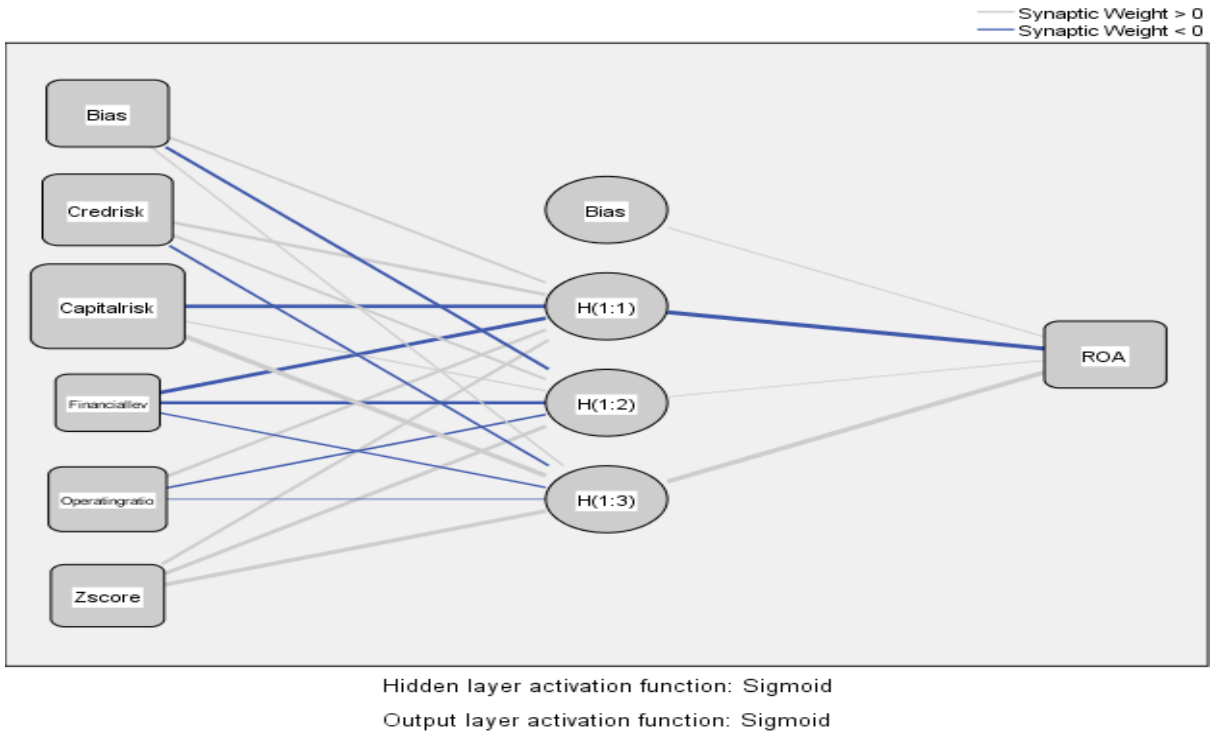


Figure 49: The architecture of the network for ROA in conventional banks in the GCC countries

The MLP process has produced the model summary that shows the fit statistics for the training and testing datasets (see Table 97). In this case, the Sum of squares error has reduced from 0.484 in the training stage to 0.067 in the testing stage. The Relative error has also changed from 0.703 in the training stage to 0.614 in the testing stage. The estimation algorithm took 3 milliseconds stopping when no further error decrease was being recorded.

Table 97: Model summary for ROA in conventional banks in the GCC countries

Training	Sum of squares error	.484
	Relative error	.703
	Stopping rule used	1 consecutive step(s) with no decrease in error[a]
	Training time	0:00:00.03
Testing	Sum of squares error	.067
	Relative error	.614

Dependent variable: Return on asset, a. Error computations are based on the testing sample

The detailed parameter estimates of the weights and bias are presented in Appendix C, Table C16. As already indicated above, and reiterated again, these values are determined by the estimation algorithm obtained from the activation function. The weights attached to the neuron from bias are 0.241, -0.297 and 0.199 respectively. The weights from the hidden layer to the output layer for bias is 0.136 and from 1st neuron in the hidden layer to the output are -0.781, 0.096 and 0.841 respectively.

The next stage was to analyse the relative importance of these independent variables. Table 98 and Figure 50 show the relative importance of the five independent variables based on the neural network model. The table shows the relative importance of the independent variable, capital risk, which reached 0.375 (from 0.270 in section 6.3.4.1) with an allocated normalised importance of 100%. This is followed by credit risk with 0.237, operating ratio (0.165) and Z-score (0.138) with associated normalised importance of 63.1%, 44.0% and 36.8% respectively.

Table 98: Independent variable importance for ROA in conventional banks in the GCC countries

	Importance	Normalized Importance
Credit risk	.237	63.1%
Capital risk	.375	100.0%
Financial leverage	.085	22.8%
Operating ratio	.165	44.0%
Z-score	.138	36.8%

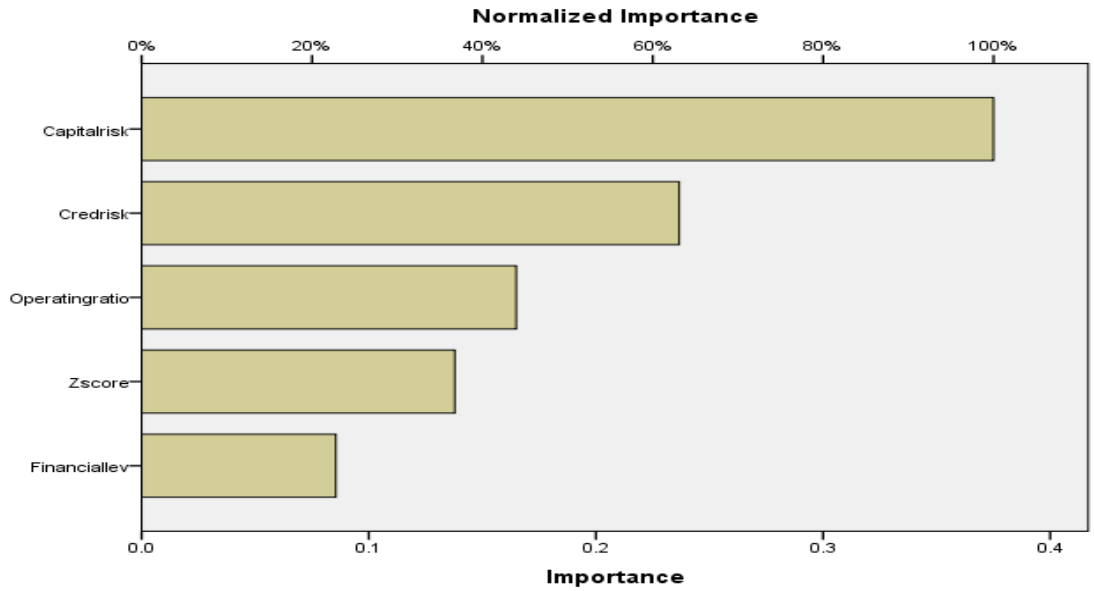


Figure 50: Independent variable importance for ROA in conventional banks in the GCC countries

A further examination of the goodness of fit of the ANN model can be observed from the movements in the actual and estimated values of the ROA. This is shown in Figure 51 which captures the two parameters highlighting close match between the estimated values and the actual values of the dependent variable, ROA, of conventional banks in the GCC countries.

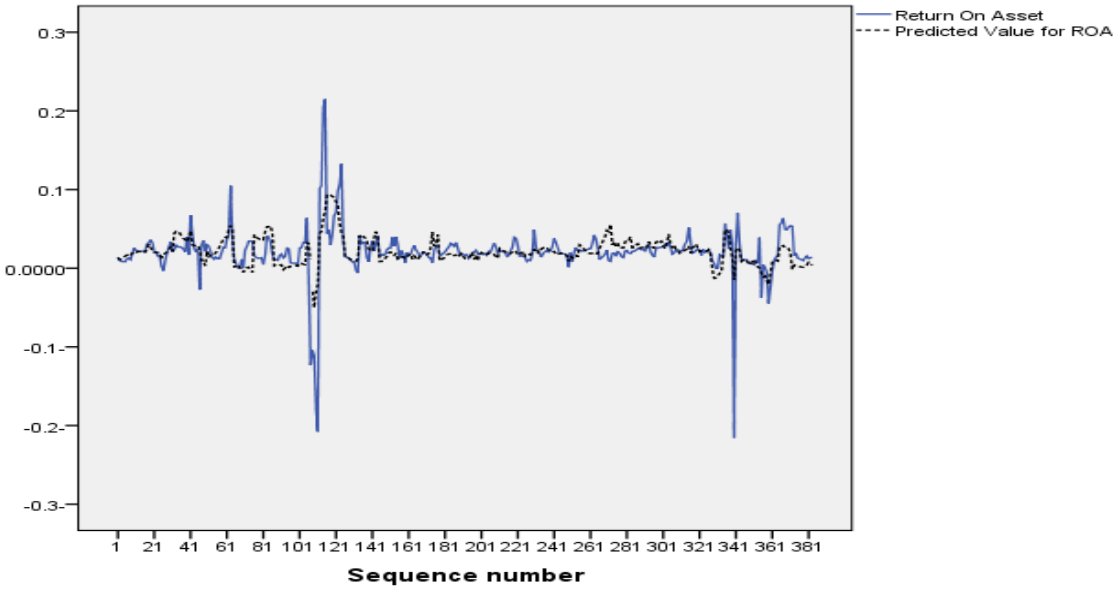


Figure 51: Actual and estimated values using neural for ROA in conventional banking in GCC countries

In order to understand the explanatory strength of the ANN method, the coefficient of determination, R^2, was calculated which gave a value of 0.562. This showed that the independent variables accounted for 56.2% of the changes in the dependent variable (ROA) in conventional banks in the GCC countries when using the ANN method. This is an observable increase when compared to 30.5% obtained when using the multivariate linear regression method.

6.4 Summary of results and conclusion

In order to put the results into perspective, a comparison is undertaken of the results obtained using the multiple linear regression model and the non-linear artificial neural network model. Table 99 shows the summary of the results for the impact of the 2008 global financial crisis in the MENA and GCC countries on the Islamic banks and conventional banks. It can be concluded, based on the results obtained, that the financial crisis impacted the performance of

Islamic banks and conventional banks weakly. This conclusion is reached because the global financial crisis variable is responsible for 9.4% and 5.6% of the changes that occurred in the dependent variable, ROA, for conventional banks in the GCC countries and MENA countries respectively. These results were observed at 99% confidence level with the coefficients of determination showing the relative explanatory power of the global financial crisis variable. Further, with respect to Islamic banks, the global financial crisis can be credited for 15.3% of the changes that occurred in the dependent variable, ROA, in the GCC countries and only 5.5% of the changes that occurred in the ROA in the MENA countries.

In addition, using the ROE as the dependent variable for bank performance, the global financial crisis can be credited for 14.0% of the changes that occurred in this dependent variable for Islamic banks in the GCC countries and only 3.0% of the changes in the dependent variable in the MENA countries. Further, the global financial crisis variable also accounted for 12.2% of the changes that occurred in the ROE of the conventional banks in the GCC countries and 6.4% of the changes in ROE of conventional banks in the MENA countries. As such, these results show that whilst the effect of the global financial crisis were overall weak in the MENA region, the effects were relatively more in the GCC countries than non-GCC countries in the MENA region. In addition, when the effects of the global financial crisis are compared between the Islamic banks and conventional banks, the results show that Islamic banks suffered relatively more than conventional banks in the GCC countries. These results are largely consistent with Parashar & Venkatesh (2010) study on Islamic banks in the GCC countries which revealed that Islamic banks suffered more than conventional banks during the 2008 global financial crisis.

Table 99: Summary of results for impact of financial crisis in the MENA and GCC regions

		MENA		GCC	
		ROE	**ROA**	**ROE**	**ROA**
Islamic banks	r	-.174**	-.236**	-.374**	-.391**
	R^2	0.030	0.055	0.140	0.153
Conventional banks	r	-.254**	-.237**	-.350**	-.306**
	R^2	0.064	0.056	0.122	0.094

** Correlation is significant at the 0.01 level

The correlation results between the independent variables (inflation, GDP, capital ratio, bank size, credit risk, capital risk, loan intensity, financial leverage, operating ratio and Z-score) and the dependent variables (ROA and ROE) for both Islamic banks and conventional banks in the MENA and GCC countries are summarised in Table 100 below. From the table, it can be

concluded that there is a significantly negative weak correlation between credit risk and bank performance represented at 1% significance level. The negative relationship between credit risk and bank performance has been found in several studies (Athanasoglou et al., 2008; Căpraru & Ihnatov, 2014; Kutan et al., 2012; Liang et al., 2013; Petria et al., 2015). However, other studies have found mixed relationship (Kanas et al., 2012; Olson & Zoubi, 2011) whilst others found a positive relationship (Kosmidau et al., 2007; Vong & Hoi, 2009). Further, consistent with Mamatzakis et al. (2016) and Mollah & Zaman (2015) findings, the Z-score was found to be positively correlated with bank performance at a 1% significance level. Further, many studies, such as Houston et al. (2010) and Chronopoulos et al. (2015) propose that size of banks influence profitability significantly and positively whilst others suggest the opposite that smaller sized banks were more profitable. This study reveals that bank size seems to matter more in the GCC countries than the MENA countries. Further, the effect of bank size applies mostly to conventional banks than Islamic banks. Most the of the results show a positive effect of bank size on conventional banks. Thus, these findings are inconsistent with study findings of Căpraru & Ihnatov (2014) and Haan & Poghosyan (2012) for instance.

Further, the study has revealed that capital ratio impacts the bank performance, ROA and ROE, negatively at 1% and 5% confidence levels, respectively. This suggests that lowering capitalization could lead to an increase in profitability. These results are largely consistent with other studies (Altunbas & Marques, 2008; Chronopoulos, et al., 2015; Ćurak et al., 2012; Dietrich & Wanzenried, 2011; Mollah & Zaman, 2015; Shehzad, et al., 2013) that showed a negative relationship between capitalization and bank profitability. However, other studies suggest the need for more bank capitalization (Apergis, 2014; Chitan, 2012; Ghosh, 2016; Kutan et al., 2012; Mamatzakis et al., 2016; Mirzaei et al. 2013; Sufian & Habibullah, 2010).

Table 100: Summary of results for correlation for Islamic banks and conventional banks in the MENA and GCC countries

	MENA				GCC			
	Islamic banks		Conventional banks		Islamic banks		Conventional banks	
	ROE	ROA	ROE	ROA	ROE	ROA	ROE	ROA
Inflation	(+)**		(+)*					
Log GDP	(+)**	(+)*	(+)**					
Capital ratio	(-)**	(-)**	(-)**	(+)*	(-)**	(-)**	(-)**	
Bank size			(+)**	(-)*	(+)**	(+)**	(+)**	(-)**
Credit risk	(-)**	(-)**	(-)**	(-)**	(-)**	(-)**	(-)**	
Capital risk	(-)**		(-)*	(+)**	(-)**			(+)**
Loan intensity	(+)**	(+)**	(+)*	(+)**	(+)**	(+)**	(+)**	(+)**
Financial leverage	(+)**		(+)*	(-)**	(+)*		(+)*	(-)**
Operating ratio	(-)**	(-)**	(-)**	(-)*	(-)**	(-)**	(-)**	
Z-score	(+)*	(+)**	(-)**	(-)**	(+)**	(+)**	(+)**	(+)**

** Correlation is significant at the 0.01 level.
* Correlation is significant at the 0.05 level.

The next section summarises the findings obtained using the ANN and multiple linear regression model. These findings also contribute to addressing the fifth research hypothesis 'H5: The artificial neural network (ANN) does not improve the explanatory power of the significant differences between Islamic banks and conventional banks'. This hypothesis is addressed through reviewing the findings obtained when using the two research techniques (multiple linear regression and ANN).

A summary of the findings using the multiple linear regression model and the artificial neural network is presented in Table 101. This table summarise the results obtained for both Islamic banks and conventional banks using the two research techniques in the GCC countries. The results presented in the table suggest that there is an increase in the value of the coefficients of determination when using artificial neural network model for all the observation. Thus, similar to section 5.6 conclusion, the use of neural networks to determine the most important independent variables effecting the dependent variables has increased the explanatory power of the model.

Based on these results, the research hypothesis 'the artificial neural network (ANN) does not improve the explanatory power of the significant differences between Islamic banks and conventional banks' is rejected. Instead, the alternative is accepted that 'the artificial neural network (ANN) does improve the explanatory power of the significant differences between Islamic and conventional banks. This is the case in both MENA and GCC countries supporting the extant literature of the superiority of the neural network technique over multiple linear regression techniques (Arulsudar et al., 2005; Baker & Tahir, 2009; Chokmani et al., 2008; Datt, 2012; Delen et al., 2005; Knez & Ready, 1996; Krishnaswamy et al., 2000; Leshno & Spector, 1996; Nghiep & Al, 2001; Stergiou & Siganos, 2014).

Table 101: Summary of results from Stepwise regression analysis and Artificial Neural Networks in the GCC for both Islamic banks and conventional banks

	Islamic banks				**Conventional banks**			
	ROE		ROA		ROE		ROA	
	Stepwise Reg.	ANN	Stepwise Reg.	ANN	Stepwise Reg.	ANN	Stepwise Reg.	ANN
Inflation								
Log GDP	√	√			√		√	
Capital ratio				√				
Bank size	√	√		√				
Credit risk	√	√	√	√	√		√	√
Capital Risk	√	√	√			√	√	√
Loan intensity								
Financial leverage	√				√	√	√	√
Operating ratio					√	√	√	√
Z-score	√	√	√	√	√	√	√	√
R^2	**0.479**	**0.667**	**0.279**	**0.300**	**0.323**	**0.849**	**0.289**	**0.562**

√ means that the variable was found to be significant.

Further, the results suggest that in addition to credit risk and Z-score, banks' financial performance in the GCC countries is affected by capital risk. This suggests that an increased investment in bank capitalisation could have positive effects on banking performance. Other key factors of financial leverage and operating leverage, however, affect conventional banks only as compared to Islamic banks in the GCC countries. Further, bank size seems to matter more for Islamic banks than conventional banks in the GCC countries. The next chapter summarises the research and makes suggestions for future research drawing on the findings of this study.

Chapter Seven: Summary and Conclusion

7.1 Aim of chapter

This chapter summarises the research and discusses the main findings of the study. The chapter begins with an overview of the research process, followed by a discussion of the key findings from the research. These key findings are discussed with respect to the research questions so as to highlight the accomplishment of the research aim. Based on the study's findings, the implications for policy and practice are then highlighted. The chapter also discusses this research's contribution to knowledge, its limitations and suggestions for future research.

7.2 Overview of research process

The financial performance of banks is affected by both internal (bank specific) and external (macroeconomic) factors (Abid et al., 2018; Ali & Puah, 2019; Abedifar et al., 2013; Al-Musali & Ismail, 2014; Daly & Frikha, 2017). Through investigating the relationship between these bank specific characteristics and macroeconomic factors on bank's performance, a comparative financial performance analysis can be undertaken between Islamic banks and conventional banks. This study aimed to undertake a comparative financial performance analysis of Islamic banks and conventional bank through examining the influence of bank specific factors (represented by bank size, capital risk, loan intensity, financial leverage, credit risk, operating ratio and Z-score) and macroeconomic factors (represented by gross domestic product (GDP) and inflation) on banks' financial performance (captured by return on assets (ROA) and return on equity (ROE)) in the MENA region. These accounting measurement variables have been widely used in the literature (Bilal & Amin, 2015; Caporale et al., 2017; Micco et al., 2007; Van Horen, 2007).

The MENA region was chosen because it comprises the highest number of Islamic banks (Bourkhis and Nabi, 2013; Caporale et al., 2017) with the banking sector playing a major role in the developmental agendas of the economies (Ali, 2012). Importantly, Islamic banking in the region is a growing business as it satisfies the financial needs of the people in congruent to their social and religious values (Ali, 2012; Caporale et al., 2017). The study aimed to answer the question 'what is the relative financial performance of Islamic banks as compared to

conventional banks in the MENA region before, during and after the 2008 global financial crisis?'. In order to answer this question, five research hypotheses were developed and tested.

Appropriate to the research objectives, the study adopted a positivist epistemological approach which involved a deductive quantitative analysis. In this case, a positivist epistemological perspective is appropriate as there is an assumed relationship between the bank specific characteristics, macroeconomic factors and banks' performance. The study, in investigating the comparative financial performance of Islamic banks and conventional banks in the MENA region analysed data obtained from Bankscope and Worldbank Databank for 108 banks comprising 35 Islamic banks (32.4% of the total sample) and 73 conventional banks (67.6% of the total sample). The 108 banks are from 15 countries: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates, Algeria, Egypt, Iran, Iraq, Libya, Morocco, Jordan, Tunisia, and Yemen. The data obtained was for the periods 2004 to 2014 in order to capture the pre, during and post 2008 global financial crisis periods for a wider comparative analysis of the financial performance of the two banking types. The analysis of the financial performance was further segregated into the GCC countries only in order to gain a deeper understanding of the uniqueness of this region, relative to the entire MENA region.

The quantitative analysis of data involved two research techniques: linear regression and non-linear models. The linear regression technique employed was the multivariate regression model whilst the non-linear model used was the artificial neural network (ANN) model. The application of the Artificial Neural Network (ANN) model enhanced the results obtained from multiple regression model. The results of the data analysis are presented for the MENA region as a whole and then for the GCC countries only. The key findings as related to the research questions are discussed next.

7.3 Key findings

The key findings from the statistical analysis are highlighted next with reference to the research questions.

RQ1: Are there significant differences between conventional banks and Islamic banks

With respect to the first research question which related to identifying any significant differences between the conventional banks and Islamic banks, the study revealed a number of contrasting results between the two banking types. In the MENA region, the study has revealed that there are significant differences between the Islamic banks and conventional banks in the financial variables examined. Among the variables examined, only credit risk was not statistically significant between Islamic banks and conventional banks. This might suggest that credit risk management approaches might be similar in both banking types. Further, the study found that whilst bank performance (captured by ROE and ROA) was relatively higher in conventional banks, this fluctuated more. This might suggest some volatility in performance of conventional banks. The observed significant difference in the financial variables is largely consistent with Caporale et al. (2017) study on the 17 MENA countries but inconsistent with Belanes & Hassiki (2012) study that did not find significant differences among the 19 conventional banks and 13 Islamic banks in the MENA region.

Unlike the MENA region, no significant differences were observed for the variables of inflation, bank size, credit risk and Z-score among the Islamic banks and conventional banks in the GCC countries. Further, whilst the conventional banks' performance variables (ROE and ROA) were relatively higher, these fluctuated less in the GCC countries. This might suggest a close monitoring of profitability in conventional banks. The results of significant differences observed are inconsistent with those found in other studies of the GCC countries (Alexakis et al., 2018; Khediri et al., 2015; Olson & Zoubi, 2008).

Based on the findings of the study, the research hypothesis 'H1: there are no significant differences between the Islamic and conventional banks for the financial variables in the MENA countries', is rejected. In the GCC countries, however, the hypothesis was partly rejected as some financial variables were not significantly different.

RQ2: How was the financial performance of both Islamic and conventional banks before and after the 2007/2008 global financial crisis?

In the MENA region, the study found that overall, there is an insignificant difference in the observed financial variables of Islamic banks before and after the 2008 global financial crisis in the region. Some changes, however, were observed in the higher values of capital ratio after 2008 compared to before 2008 which suggests increased capitalisation of Islamic banks partly attributed to regulatory changes (Almanaseer, 2014; Farooq & Zaheer, 2015). Further, the performance of Islamic banks (reflected by ROE and ROA) after 2008 was low and seen to fluctuate more than before 2008 which suggests some responses to tougher economic conditions, reflected for instance, in the relatively unstable and low oil prices (The National, 2017). Contrary to the Islamic banks, conventional banks recorded significant differences in the observed financial variables before and after the 2008 global financial crisis in the MENA countries. One observed change was high values in bank sizes which suggests some increase in cross-border mergers among conventional banks after the financial crisis (Sahut & Mili, 2011).

In respect to the GCC countries, insignificant differences were observed for bank specific variables among Islamic banks for the period before and after 2008. This suggests some relative consistency in the operational models of Islamic banks. Macroeconomic variables, on the other hand, were significantly different before and after 2008 which reflects the unstable economic conditions in the oil dependant region. Significant differences, however, were observed for conventional banks in the GCC countries. Among the financial variables, loan intensity of conventional banks increased after 2008 which might suggest more financial product offering or diversity in financial services. Bank sizes slightly increased too in the region for both Islamic banks and conventional banks. Significant differences in financial variables before the 2008 global financial crisis were also observed in Smaoui & Salah (2012) and Srairi (2010) study in the GCC countries. On the other hand, El Massah & Al-Sayed (2015) showed this significant difference between Islamic banks and conventional banks post 2008 financial crisis period.

Based on the results, the research hypothesis ‘H2: There are no significant differences between the Islamic banks and conventional banks for the financial variables before and after the 2008 global financial crisis’, is accepted for Islamic banks but rejected for conventional banks in the GCC countries and MENA region as a whole.

RQ3: How did the 2007/2008 financial crisis affect the performance of conventional banks and Islamic banks in the MENA countries?

This study has demonstrated that the global financial crisis had a negative effect on the performance of both the conventional and Islamic banking sectors in the MENA countries as a whole, and in the GCC countries, consistent with extant literature (Alexakis et al., 2018; Al-Musali & Ismail, 2014; Beck et al., 2013; Caporale et al., 2017).

An examination of the effect of the 2008 global financial crisis in the MENA region suggests that conventional banks were affected more than Islamic banks. The study revealed that the 2008 global financial crisis explained 6.4% of the changes that occurred in the dependent variable, ROE, in the conventional banks in the MENA countries as compared to 3.0% for Islamic banks. As such, this suggests that conventional banks in the MENA countries were more vulnerable to the financial instability than the Islamic banks.

On the other hand, in the GCC countries, the 2008 global financial crisis attributed to 14.0% and 15.3% of the changes that occurred in the dependent variables, ROE and ROA, respectively, in the Islamic bank. This is compared to 12.2% and 9.4% for ROE and ROA respectively for conventional banks. As such, these results suggest that the Islamic banks in the GCC countries were relatively more vulnerable to the negative effects of the financial instability than conventional banks. This might be partly explained by the relative openness of the GCC countries' financial sector as compared to non-GCC countries in the region. The banking sector is still dominated by public sector banks in non-GCC countries (PWC, 2018). The results on the impact of the 2008 global financial crisis in the GCC countries are largely consistent with Parashar & Venkatesh (2010) study on Islamic banks in the GCC countries which revealed that Islamic banks suffered more than conventional banks during the global financial crisis.

Based on the findings with respect to the research hypothesis 'H3: The 2008 global financial crisis had a similar negative effect on the performance of both the Islamic banks and conventional banks in the MENA countries', is rejected as there are noticeable differences in the impact on the two banking types.

RQ4: Are the determinants of bank performance the same for Islamic banks and conventional banks?

Applying the research methods, the study has identified some key financial variables that impact financial performance of Islamic banks and conventional banks in the MENA region. In general, the study has found that credit risk and Z-score are the key determinants of firm performance for Islamic banks and conventional banks in the MENA region, and in the GCC countries only. This suggests that effective credit risk and insolvency risk management remain fundamental to banking performance. The importance of credit risk management for banking performance has been widely acknowledged in the literature (Athanasoglou et al., 2008; Căpraru & Ihnatov, 2014; Kutan et al., 2012; Liang et al., 2013; Petria et al., 2015). However, other studies have shown that increased credit risk positively affects bank performance (Kanas et al., 2012; Olson & Zoubi, 2011).

In the MENA region, the study has shown that capital ratio is a key determinant for Islamic banks but not conventional banks. This suggests that increased bank capitalisation is necessary for Islamic banks in order to improve their performance. On the other hand, operating ratio had a significant effect on the conventional banks' financial performance but not on the Islamic banks. Therefore, for the conventional banks in the MENA region, an increased investment in fixed assets could positively influence their performance. These results are largely consistent with studies that show that operating ratio has an impact on bank performance (Berger et al., 2009; ElBannan, 2015; Srairi, 2013; Williams, 2014; Wang et al., 2015). The study has also revealed that macroeconomic changes in inflation affect conventional banks only in the MENA region. The changes in GDP, on the other hand, only affected the ROE financial variable for both Islamic banks and conventional banks.

The study has further shown that bank size and loan intensity in the MENA region are not significant factors. As such, these results are inconsistent with studies that have found bank size (Bertay et al., 2013; Chronopoulos et al., 2015; Ghosh, 2016; Lee & Kim, 2013; Shehzad et al., 2013; Olson & Zoubi, 2011; Petria et al., 2015) and loan intensity (Chronopoulos et al., 2015; Demirguc-Kunt & Huizinga, 1999; Lin & Zhang; 2009) to have a significant effect on bank performance.

With a particular reference to the GCC countries, the study revealed that in addition to credit risk and Z-score, Islamic banks and conventional banks' financial performance is also affected by capital risk and GDP. Thus, contrary to the MENA region, macroeconomic factors (GDP) and an increased investment in bank capitalisation matters more in the GCC countries. Further, in the GCC countries, the size of the Islamic banks matters as this affects their financial performance. On the contrary, bank size has no effect on conventional banks' financial performance in the GCC countries. For the conventional banks, the study suggests that instead of increasing their sizes, the conventional banks in the GCC countries should focus on financial leverage and operating ratio as these have significant effect on their performance. Thus, increased investment in fixed assets, financed by shareholders' equity, could have positive effects on their performance. This study's findings on the importance of operating leverage for conventional banks in the GCC countries is contrary to Khediri et al. (2015) study that showed that operating leverage was an insignificant factor.

Based on the research findings, the research hypothesis, 'H4: the determinants of bank performance for Islamic banks and conventional banks are the same in the MENA region', is rejected as there are observable significant differences in the factors that influence Islamic banks and conventional banks. However, some similarities do exist with respect to credit risk and Z-score.

RQ5: Does the artificial neural network (ANN) improve the explanatory power of the significant difference between Islamic banks and conventional banks?

Further, in the examination of the relationship between the bank specific characteristics (internal factors) and macroeconomic indicators (external factors) to the banks' performance, the study found that the value of the coefficient of determination when using the artificial neural networks (ANN) increased. These results are largely consistent with several studies that have shown the improved explanatory power provided by the neural networks research method (Arulsudar et al., 2005; Baker & Tahir, 2009; Delen et al., 2005; Leshno & Spector, 1996; Nghiep & Al, 2001).

However, in the case of the estimation model for ROA in Islamic banks in the MENA countries, the value of the coefficient of determination actually decreased from 0.191 to 0.164. This produces mixed results in this respect which agrees with Olson & Mossman (2001) who argue

that linear regression provides better results than neural network. Nonetheless, the study found that, in general, the use of artificial neural networks to determine the most important independent variables affecting the dependent variable increased the explanatory power of the model. This supports the extant literature on the superiority of the neural network technique (Arulsudar et al., 2005; Baker & Tahir, 2009; Chokmani et al., 2008; Datt, 2012; Knez & Ready, 1996; Krishnaswamy et al., 2000; Leshno & Spector, 1996; Nghiep & Al, 2001; Stergiou & Siganos, 2014).

Based on the results obtained, the research hypothesis: 'H5: The artificial neural network (ANN) does not improve the explanatory power of the significant difference between Islamic banks and conventional banks', is rejected as the ANN increased the explanatory power of the results in the MENA region and GCC countries segregated.

7.4 Contribution to knowledge

This study makes a contribution to the growing but still crescent literature on bank performance in developing and emerging countries (Alexakis et al., 2018; Caporale et al., 2017; Wanke et al., 2016; Zarrouk et al., 2016). Most of the literature on bank performance evaluation has been in developed countries (Chronopoulos et al., 2015; Kanas et al., 2012; Liang et al., 2013; Petria et al., 2015). In particular, in investigating the comparative performance of Islamic banks and conventional banks in the MENA region, this research makes a contribution to studying banking financial performance, not only in a developing and emerging region, but also to the literature on Islamic finance, specifically to the literature that compares performance of Islamic banks to conventional banks (Bilal & Amin, 2015; Caporale et al., 2017; Demirguc-Kunt & Huizinga, 1999; Micco et al., 2007; Samad & Hassan, 2006; Van Horen, 2007). This literature on comparative performance between the Islamic banks and conventional banks has produced mixed results, and thus, this study contributes to the existing debate.

To this literature, the study contributes in showing that there exist significant differences in the financial performance of Islamic banks and conventional banks in the MENA region. However, the significant differences exist more in the non-GCC countries as compared to the GCC countries of the MENA region. Further, Islamic banks' financial performance before and after the 2008 global financial crisis has remained relatively the same. On the contrary, conventional

banks' financial performance has significantly changed, for instance, in terms of loan intensity. This might suggest increased innovation in product offering or services.

Through its focus on the GCC countries and then MENA region, this study makes a contribution to Islamic finance literature in going beyond a one country analysis as compared to other studies (Al-Qudah & Jaradat, 2013; Ramlan & Adnan, 2016; Wasiuzzaman & Tarmizi, 2010) and beyond the GCC countries (Khediri et al., 2015; Olson & Zoubi, 2008; Smaoui & Salah, 2012; Srairi, 2010) to cover 15 countries in the MENA region. This is important as it helps to give a much broader perspective to the comparative performance of the two banking types. As the study has shown, segregating the MENA countries between GCC countries and non-GCC countries gives further insight on financial performance. For instance, changes in macroeconomic factors, GDP, had a significant influence on banks' financial performance in the GCC countries but not non-GCC countries. This could be explained by the ownership structure of the banks in GCC and non-GCC countries. Non-GCC countries' financial sector is still largely dominated by public sector banks unlike in the GCC countries (PWC, 2018).

Further, this study makes a contribution in covering a wider period of 10 years (2004 to 2014) which includes a period of financial instability of the 2008 global financial crisis. This can be contrasted to other studies (Abedifar et al., 2013; Beck et al., 2013; Srairi, 2010) that concentrated on the pre-financial crisis period only or post-financial crisis period only. The contribution lies in showing the financial performance changes of conventional banks and Islamic banks in the period before, during and after the 2008 financial instability. For instance, the study has shown that despite the fall in overall performance of banks (conventional and Islamic banks) after the 2008 global financial crisis, the Islamic banks' financial performance fluctuated more after 2008 than before when compared to conventional banks in the GCC countries. This could be attributed to the unstable economic situation in the region.

Beyond the comparative financial performance, the contribution to the Islamic finance literature how the "compliance to the Sharia's principles may affect financial performance" (Wanke et al., 2016, p. 486) in the MENA region. As such, the results obtained from this study contributes to the body of knowledge from prior studies that have revealed mixed results on the comparative performance of Islamic banks to conventional banks. For instance, Ramlan & Adnan (2016) found that Islamic banks are more profitable than conventional banks whilst El Massah & Al-Sayed (2015) showed that conventional banks are more solvent, liquid and profitable and less

risky than Islamic banks. Belanes & Hassiki (2012), on the other hand, did not find any significant difference between conventional banks and Islamic banks. This shows that the body of knowledge on financial performance comparison is still unclear. This study contributes in showing that conventional banks were relatively more profitable in the MENA region, despite higher fluctuations than Islamic banks.

In addition, the study contributes in showing that macroeconomic changes have a much higher impact on conventional banks than Islamic banks, particularly in the GCC countries. However, bank size seems to matter more in Islamic banks than conventional banks. This has implications on growth strategies of these banks. Nonetheless, some bank specific characteristics (credit risk, Z-score, capital ratio) are important in both banking types.

This research has also made a methodological contribution. The methodological contribution lies in the use of two research methods: multivariate linear regression and artificial neural network approach which are linear and non-linear techniques respectively. The benefit in using the artificial neutral network technique is that it improves the research results. The study has contributed in showing that the application of the artificial neural network technique produced better results than the linear regression results as it increased the explanatory power. As such, the study makes a contribution to a growing number of studies that support the superiority of the artificial neural network approach in statistical analysis (Arulsudar et al., 2005; Baker & Tahir, 2009; Delen et al., 2005; Leshno & Spector, 1996; Nghiep & Al, 2001). Thus, in employing this research method, this study makes a methodological contribution in advancing the usage of non-linear models.

7.5 Implications for policy and practice

Some policy and practical implications can be drawn from the results of this study. Firstly, the study has shown that credit risk and Z-score have an impact on both the Islamic banks and conventional banks in the MENA region. These remain key determinant of financial performance of the banks. As such, it is imperative that banks in the MENA region prioritise the management of these two bank specific aspects. Bank specific policies should thus, be focussed on strengthening credit risk management so as to improve the banks' asset quality. Further, policies should be directed at reducing the insolvency or bankruptcy risk through reduced investment in very risk projects. This would reduce the banks' Z-scores. As such, the

implication for bank management is that effective risk management and monitoring should remain paramount for the banks. In this respect, conventional banks should apply more vigorously international regulatory frameworks such as the Basel III in order to strengthen the regulation, supervision and risk management in their banks. Similarly, Islamic banks should adhere more steadily to the Islamic Financial Services Board (IFSB)'s standards as a minimum guide for risk management.

Further, the study has revealed that bank size is not a major influence on bank performance in the MENA region for conventional banks. As such, the implication to investors and bank management is that rapid growth strategies, for instance, through mergers and acquisition would not significantly improve financial performance of conventional banks. However, increasing the bank sizes for Islamic banks in the GCC countries should be promoted. Therefore, policy makers (government) in the GCC countries need to encourage investment and growth of Islamic banks. This could be through loosening the regulatory requirements for investment in the financial sector, including mergers.

On the other hand, bank management/investors of conventional banks in the GCC countries should focus more on stability, risk management and operational efficiency, as compared to increasing their sizes. More equity financed investment in fixed assets should be promoted by conventional banks' management and investors.

Further, in addition to policies that enhance risk management and bank stability, policy makers (government) should promote more bank capitalisation measure in the GCC countries (more than non-GCC countries). This is because bank capitalisation has a positive impact on financial performance of Islamic banks and conventional banks in the GCC countries. Therefore, with respect to development of standards for the banks, IFSB could integrate increased bank capitalisation requirements for the Islamic banks. For conventional banks, this should involve above average adherence to Basel III requirements.

The study has further shown that increasing the proportion of loans issues would not improve the bank's performance. Therefore, the management of both Islamic banks and conventional banks should focus more on improving the quality of loans disbursed instead of the quantity of loan issued. Improving credit risk management and bank stability remains key to improving bank performance instead of increasing the number of loans issued.

Another implication is to policy makers in GCC countries (and other emerging economies). The study has shown that changes in macroeconomic factors (GDP) has more effect in the GCC countries than non-GCC countries. As such, policy makers in emerging economies need to protect the integrity of the financial system from external shocks, for instance, through increased reserve ratios in order to provide additional buffers to these shocks. In addition, bank management should closely monitor the macroeconomic trends in order to adopt appropriate mitigating measures before economic situations get worse. This means investment in better economic forecasting tools. Further, as these external macroeconomic changes are largely beyond the banks' control, more focus should be directed on improving the bank specific factors. In short, taking appropriate strategies in order to mitigate external shocks such as reduced loan disbursements when there is increased economic uncertainties.

The wider implication of this study to both bank management and policy makers (applicable generally) is the need for bank management to develop/enhance effective internal risk management strategies and monitoring techniques that would continuously and sufficiently reduce credit risk and bankruptcy risk and increase bank stability.

7.6 Research limitations

This research has some inherent limitations which should be acknowledged.

Firstly, the positivist epistemological position has inherent limitations in assuming a causal relationship between variables and the simplistic expression of this causality. In this study, 9 independent variables and 2 dependent variables were used. Whilst this has been guided by prior studies, the focus of the study on only these variables at the exclusion of others becomes a limitation. Further, bank performance has been captured by the ROE and ROA ratios. This might give an incomplete picture of the performance of the banks to reflect largely the profitability aspect of the banks at the expense of other performance measures such as cost efficiency or technological innovation.

In addition, other non-financial variables are essentially not captured in such a methodological approach as the approach focusses on the quantifiable variables only in seeking for the generalisability of results. Further, whilst 108 banks in 15 countries were investigated, the study was limited to data only available from Bankscope database and the World Bank Database.

Some banks, as a result, were not included in the sample due to data unavailability. In addition, whilst the ten-year period (2004 to 2014) was sufficient to address the research objectives, more years after 2014 could have been included. However, data availability was a constraint for the period after 2014. This made it impossible, among others, to undertake an out-of-sample testing that could examine the robustness of the statistical estimates.

Further, the study has covered 15 countries in the MENA region which makes a contribution to prior studies that were country specific or covered less countries. However, the MENA region comprises in total 22 countries and as such, the study has not covered all the banks in the region. Further, despite some similarities identifiable in the MENA region, there still exist some distinctive differences in the economic environments. The study has partly addressed this limitation in showing results for the GCC countries separately. However, the differences among the other countries in the region are observable which might influence the study's results.

7.7 Future Research

Building on this study's approach, results and limitations, some suggestions for future research can be made. Such future research could address the identified limitations above and also investigate further the findings in this study.

This research has used bank performance captured by ROE and ROA. Further research could incorporate other variables as the dependent variables such as net interest margin and return on deposits. Further studies could also investigate other aspect of performance such as productivity, liquidity, marketability and human resources with appropriate proxies for these performance aspects. In addition, more macroeconomic indicators could be incorporated in addition to GDP and inflation.

Future research could consider also increasing the study period. This research examined a 10-year period. A period long than 10 could be examined. As Lam (2004) argues, this could further increase the data results when applying the artificial neural network technique as there will be more data available for data processing. Similarly, a longer period with data availability could allow for additional validity or robustness checks, such as an out-of-sample testing which examines the strength of the statistical estimates. In addition, other statistical methods could be applied or compared with these non-linear (forecasting) models. The integration of time series

analysis, logistic regression and discriminant analysis could be employed together with the neural network technique.

This study was aimed at achieving generalisation by increasing the sample sizes. However, future research could focus on achieving a deeper understanding of internal factors that influence bank performance within a particular context. In this case, a different epistemological approach could be employed with a reduced number of banks to focus on. Consequently, this could involve employing research methods which capture primary data such as questionnaires or interviews.

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Appendix A: A review of some prior studies

Article	Country(ies)	Period	Methodology	Dependent variable	Independent variable	Main conclusions
Metwally (1997)	15 Isl. banks 15 conv. banks	1992–1994	Logit model Probit model Descriminant analysis		Liquidity: cash to deposits Leverage: deposits to assets; equity to assets Credit risk: funds channeled to direct investments to loanable funds; loans used to finance durable to total loans; personal loans to total loans Profitability: gross income to assets; average return on deposits Efficiency ratios: operating expenses to assets	The two groups of banks may be differentiated in terms of liquidity, leverage and credit risk, but not in terms of profitability and efficiency
Bashir (2001)	Bahrain, Egypt, Jordan, Kuwait, Qatar, Sudan, Turkey, UAE	1993-1998	Panel data methods and White (1980) Procedure	Non-interest margin Before-tax profit, ROA, ROE	Bank characteristic indicators, macroeconomic indicators, taxation and financial structure indicators	High leverage and large loans to asset ratios lead to higher profitability Implicit and explicit taxes affect the bank performance measures negatively. A positive relationship between GDP and bank profitability
Iqbal (2001)	12 conv. banks 12 Isl. banks	1990–1998	T-test for equality of means	Profitability: return on asset (ROA); return on equity (ROE)	Bank capital: capital to assets Liquidity: cash and accounts with banks to total deposits Deployment ratio: total investment to total equity and total deposits Efficiency: cost to income ratio	Islamic banks are better capitalized and more profitable than conventional banks
Hassan & Bashir (2003)	21 countries	1994-2001		Net non-interest margin,	Bank characteristics, macroeconomic indicators, taxation, financial structure	High capital and loan-to-asset ratios lead to higher profitability Implicit and explicit taxes negatively affect the bank

				Profit margin, ROA, ROE		performance. A strong positive correlation between profitability and overhead.
Haron &Wan (2004)	Bank Islam Malaysia Berhad, Islamic Bank of Bangladesh, Dubai Islamic Bank Jordan Islamic Bank, Albaraka Islamic Investment Bank	1984-2002	Cointegration and Error Correction Model	Total income/TA, Bank's portion of income/TA, Net profit after taxes (percentage of capital and reserves)	Internal variables External variables	A significant long run relationship between profitability and liquidity, deposits items, asset structure, inflation and money supply Islamic bank profitability does not respond speedily to changes occurring in explanatory variables at short run.
Asutay & Izhar(2007)	Bank Muamalat Indonesia	1996-2001	Least square method	ROA	Bank characteristic indicators Consumer price index	Bank profit is dominantly generated from financing activities. Service activities have not contributed significantly to the profitability. A positive relationship between inflation and profitability
Olson & Zoubi (2008)	28 conv. banks 16 Isl. banks GCC region	2000–2005	T-test for equality of means Logistic regression Neural networks k-means		Profitability: ROA; ROE; profit margin; return on deposits; return on shareholders' capital; net operating margin Efficiency: interest income to expenses; operating expense to asset; operating income to assets; operating expenses to revenue; asset	Accounting ratios are good discriminators between Islamic and conventional banks. Islamic banks are more profitable but less efficient than conventional banks

			nearest neighbors		turnover; net interest margin; net-non interest margin Asset quality: provision to earning assets; adequacy of provisions for loans; write off ratio; loan to assets; loans to deposits Liquidity: cash to assets; cash to deposits Risk: deposits to assets; equity multiplier; equity to deposits; total liabilities to equity; total liabilities to shareholder capital; retained earnings to assets	
Wasiuzzaman & Tarmizi (2010)	16 Islamic banks/windows (Malaysia)	2005-2008	Ordinary Least Squared	Average ROA	Internal variables GDP, inflation rate	Capital and asset quality have an inverse relationship with profitability. Liquidity and operational efficiency positively affect bank profitability. Inflation and GDP have a positive influence on bank profitability
Srairi (2010)	48 conv. banks 23 Isl. banks GCC region	1999–2007	stochastic frontier analysis T-test for equality of means		Profitability: net profit to average total assets Capital adequacy: equity to total assets Credit risk: loans to total assets Operation cost: cost to income Size: natural logarithm of total assets	Conventional banks are more efficient than Islamic banks
Olson & Zoubi (2011)	MENA region 83 different banks in 10 countries	2000–2008	Generalized least squares panel estimator, stochastic frontier analysis, distribution-free approach	ROE, ROA, Net operating profit, Cost	Bank internal characteristic, bank efficiency measures, bank risk measures External variables – GDP, inflation, concentration, ownership	MENA banks are slightly less cost efficient than European banks, but similar to banks in developing economies. However, MENA banks score well in terms of profit efficiency relative to banks world-wide. Finally, almost all banks in the MENA region are below optimal size.

Smaoui & Salah (2012)	44 GCC Islamic Banks	1995-2009	Prais–Winston estimation technique	ROE, ROA, Net noninterest margin	Bank characteristic indicators GDP growth rate Consumer price index	Higher capital, better asset quality, and larger size lead to higher profitability, Higher cost-to-income ratio leads to lower profitability. Favorable macroeconomic conditions positively affect the profitability.
Belanes & Hassiki (2012)	19 conv. banks 13 Isl. banks MENA region	2006–2009	Data envelopment analysis Wilcoxon rank-sum test	ROA; ROE; net Interest margin	Liquidity: short-term assets to short-term loans Risk: total debts to assets; reserves for losses on credits to total credits	There is no significant difference in the efficiency scores between these two types of banks
Al-Qudah and Jaradat (2013)	All Islamic Jordan Bank	2000-2011	Panel data methodology	ROA ROE	Internal variables External variables	Capital adequacy has a positive and significant impact on profitability. Leverage has a negative and significant impact on profitability. The liquidity has an inversely insignificant effect on ROA and negative significant impact on ROE. Macroeconomic factors are good determinants for profitability
Beck et al. (2013)	Sample of 510 banks across 22 countries	1995–2009	T-test for equality of means, regression		Business model: Fee income to operational income; non-deposit funding to total funding; loans to deposit Efficiency: cost to income ratio; overheads to assets Asset quality: loss reserves to gross loans; loan loss provisions to gross loans;	There are few significant differences in business models. Islamic banks are less efficient, but have higher intermediation ratios, have higher asset quality, and are better capitalized than conventional banks

					nonperforming loans to gross loans; Stability: Z-score; ROA; equity to assets; liquid assets to deposit	
Abedifar et al. (2013)	553 banks from 24 countries	1999–2009	T-test for equality of means, random effect regression		Credit risk: loan loss reserves to gross loans; impaired loans to gross loans; loan loss provision to average gross loans Insolvency risk: Z-score Bank interest rate: net interest margin; interest income rate; interest expense rate; loan rate; deposit rate Financial ratio: equity capital to asset ratio; ROA; ROE; net loans to total earning assets; cost to income ratio; total assets	Islamic banks are more capitalized and profitable than conventional banks. Islamic banks have lower credit risk than conventional banks, specifically small, leveraged, or those operating in countries with more than 90% Muslim populations. In terms of insolvency risk small Islamic banks are more stable than small conventional banks
Almazari (2014)	23 Saudi and Jordanian banks	2005-2011	Regression by enter method	ROA	Bank characteristic indicators	A significant positive correlation between ROA of Saudi banks with TEA, TIA and LQR variables, and negative correlation with NCA, CDR, CIR and SZE variables. A significant positive correlation between ROA of Jordanian banks with LQR, NCA, TEA and CDR variables, and a negative correlation of ROA with CIR, TIA and SZE
Johnes et al. (2014)	252 banks (207 conventional and 45 Islamic) across 18 countries	2004 - 2009	Data envelopment analysis (DEA) and meta-frontier analysis (MFA).	Bank efficiency	Bank characteristic indicators (Total assets, ratio of loan loss reserves to loans, ratio of total loans to total assets, banking environment – normalized Herfindahl index, degree of market capitalization, growth in real GDP and inflation, per capita GDP)	Study found that Islamic banks are typically on a par with conventional ones in terms of gross efficiency, significantly higher on net efficiency and significantly lower on type efficiency. Second stage analyses, which account for banking environment and bank level characteristics, confirm these results. The low type efficiency of Islamic banks could be

						attributed to lack of product standardization whereas high net efficiency reflects high managerial capability in Islamic banks. These findings are relevant to both policy-makers and regulators. In particular, Islamic banks should explore the benefits of moving to a more standardized system of banking, while the underperformance of conventional bank managers could be examined in the context of the on-going remuneration culture.
El Massah & Al-Sayed (2015)	11 CBs and 5 IBs The United Arab Emirates	2008-2014	Financial ratio analysis (FRA)			CBs are more solvent, liquid and profitable and less risky than IBs
Khediri et al. (2015)	GCC region	2003–2010	Parametric and non-parametric classification models (Linear discriminant analysis, Logistic regression, Tree of classification and Neural network)	Profitability ratios (ROA, and ROE)	Fourteen financial ratios: liquidity ratios (CTA, and CTD), credit risk (LLR, NPL,LTA, LTD), insolvency risk (ETA, DA, DTA, and DTE), and asset structure ratios (FAA, OBSIA).	Univariate results show that Islamic banks are, on average, more profitable, more liquid, better capitalized, and have lower credit risk than conventional banks. Study also found that Islamic banks are, on average, less involved in off-balance sheet activities and have more operating leverage than their conventional peers.

Ghosh (2016)	12 MENA countries 112 banks	2000-2012	Difference-in-differences analysis	ROA Net non-interest margin,	ROA: Size, Capital ratio (+), Ratio of liquid asset to total asset (-), Diversification. - NIM: Arab Spring period (-), Size, Capital ratio, Ratio of liquid asset to total asset, Diversification.	The analysis indicates that the Arab Spring lowered bank profitability by roughly 0.2% and raised bank risk by 0.4% points. As well, the evidence appears to suggest that there were no differential effect of the political conflict on the performance and stability of Islamic banks.
Ramlan & Adnan (2016)	Malaysia	2006-2011	T-test, regression and correlation	ROA; ROE	Total Equity to Total Assets Total Loans to Total Assets Deposits to Total Assets	This study finds that Islamic Banks are more profitable than Conventional Banks whereas Total Loan to Total Asset for Islamic bank is higher than Conventional bank. Based Regression test, for Conventional Banks, ROE is an influence profitability of Conventional Bank.and for Islamic Banks, ROA and ROE are significant factor that influence profitability. Based on Correlation test, ROE is an influence profitability of Conventional Bank and for Islamic Banks, ROA and ROE are significant relationship with independent variable which is Total Equity to Total Asset.
Zarrouk et al. (2016)	51 banks, Qatar, Turkey, UAE, Egypt, Kuwait, Yemen, Sudan, Bahrain, Saudi Arabia and Jordan	1994 - 2012	dynamic panel data model	ROA; ROE; net profit margin	Bank characteristic indicators - Liquidity - Risk and solvency - Efficicncy ratios - Asset quality - Capital - Operations - Annual stock data	The findings reveal that profitability is positively affected by banks' cost effectiveness, asset quality and level of capitalization. The results also indicate that non-financing activities allow Islamic banks to earn higher profits. Islamic banks perform better in environments where the gross domestic product and investment are high. There is evidence of several elements of similarities between determinants of the

					Macroeconomic indicators - Economic activity - Inflation	profitability for Islamic and conventional banks. The inflation rate, however, is negatively associated with Islamic bank profitability.
Caporale et al. (2017)	76 foreign and 46 domestic banks from the 17 MENA countries	2000–2012	OLS	return on average assets (ROAA) return on average equity (ROAE)	Bank characteristic indicators - Bank size (total assets), - Liquidity (loans to total assets), and - net interest revenues Macroeconomic indicators - Economic activity – GDP per capital growth - Inflation	The empirical findings suggest that during the crisis the domestic banks outperformed the foreign banks in that region. As for the determinants of profitability, size does not appear to play a role, whilst the liquidity ratio and net interest revenues seem to have a negative and positive effect respectively; GDP has a positive effect in the case of domestic banks.
Alexakis et al. (2018)	6 GCC 19 Islamic and 43 conventional banks	2006–2012	Financial ratio analysis & Meta-frontier Malmquist productivity index (MPI)	ROA ROE	Financial ratio analysis - cost performance; - revenue performance - profit performance Malmquist variables - Technical efficiency change - Technology change	Islamic banks exhibit worse cost and profit performance but are on a par with regards to revenue performance compared to the conventional ones. The components of the meta-frontier MPI suggest that the technology of conventional banks improves markedly in years leading to the financial crisis and declines thereafter. Islamic banks show a similar but more muted pattern. By contrast, the pronounced within-Islamic bank group variation in technical efficiency and technology suggests that Islamic banks are quite heterogeneous as a group. Overall, the MPI analysis suggests that the two bank types are more aligned following the global financial crisis. Policy makers should be wary of the important variations within the

						Islamic banking industry when implementing bank regulations
Hassan et al. (2019)	52 IBs and CBs, from selected Organization of Islamic Cooperation Countries	2007–2015	Linear regression	Credit risk (loan loss provision) and liquidity risk (deposits to total assets)	Bank stability variables - Z-score - Distance to default Control variables - Return on assets - Efficiency ratio - Loan growth - Asset growth - GDP	Credit risk and liquidity risk have negative relationship. The investigation of the relationship between liquidity risk and stability found a negative relationship just for IBs. Study showed that Islamic banks are better than conventional banks in managing risks.

Appendix B: Network Information for reduced number of independent variables

Network information for reduced number of independent variables

Input layer	Covariates*	1	Credit risk
		2	Capital risk
		3	Operating ratio
		4	Z-score
		5	Capital ratio
	Number of units*		5
	Rescaling method for covariates		Standardized
Hidden layer(s)	Number of hidden layers		1
	Number of units in hidden layer 1[a]		3
	Activation function		Sigmoid
Output Layer	Dependent variables	1	Return on equity*
	Number of units		1
	Rescaling method for scale dependents		Normalized
	Activation function		Sigmoid
	Error function		Sum of Squares

a. Excluding the bias unit

** Information that will be changing according to the test runs

Appendix C: Parameter estimates

Table C102: Parameter estimates for ROE in Islamic banking in the MENA countries

Predictor		Predicted							
		Hidden Layer 1							Output Layer
		H(1:1)	H(1:2)	H(1:3)	H(1:4)	H(1:5)	H(1:6)	H(1:7)	ROE
Input Layer	(Bias)	1.862	.131	-.749	.060	-.148	.163	-.398	
	Inflation	.266	-.048	.145	.385	-.012	-.094	.277	
	Log GDP	-1.117	-.193	.301	-.274	-.124	.643	-1.380	
	Capital ratio	-.413	-.064	.069	-.170	.194	-.186	-.620	
	Bank size	.142	-.224	-.490	-.480	.203	.635	-.728	
	Credit risk	-.026	-.468	.414	-.869	.097	.459	.030	
	Capital risk	-.899	-.397	.181	-.422	.566	-.544	.139	
	Loan intensity	-.333	.300	.299	.453	.124	-.451	.264	
	Financial lev.	.108	-.503	-.314	.408	.200	.128	.101	
	Operating ratio	-.178	.014	-.206	1.307	.500	.112	.172	
	Z-score	1.244	-.228	.202	-.952	.810	.305	-.566	
Hidden Layer 1	(Bias)								-.407
	H(1:1)								2.409
	H(1:2)								-.088
	H(1:3)								.193
	H(1:4)								.940
	H(1:5)								-.398
	H(1:6)								-.657
	H(1:7)								-1.453

Table C103: Parameter estimates for ROE in Islamic banks in the MENA countries

Predictor		Predicted			
		Hidden Layer 1			Output Layer
		H(1:1)	H(1:2)	H(1:3)	ROE
Input Layer	(Bias)	.393	-.279	-.256	
	Credit risk	-.431	-.780	-.440	
	Capital risk	-.903	-.238	-.602	
	Operating ratio	.041	.645	-.058	
	Z- score	.628	.301	.421	
	Capital risk	-.517	-.280	.156	
Hidden Layer 1	(Bias)				.201
	H(1:1)				.649
	H(1:2)				.260
	H(1:3)				.456

Table C104: Parameter estimates for ROA in Islamic banks in the MENA countries

Predictor		Predicted							
		Hidden Layer 1							Output Layer
		H(1:1)	H(1:2)	H(1:3)	H(1:4)	H(1:5)	H(1:6)	H(1:7)	ROA
Input Layer	(Bias)	.422	.107	.209	.135	.318	-.188	-.093	
	Inflation	-.246	-.241	.301	.022	-.086	.315	.268	
	Log GDP	.389	-.135	.392	.260	.413	.048	-.030	
	Capital ratio	.348	-.017	-.139	.431	-.052	-.063	-.291	
	Bank size	-.229	-.243	.260	-.078	-.190	.244	.395	
	Credit risk	-.082	.411	.234	.435	-.163	-.140	-.365	
	Capital risk	.378	-.239	-.305	.405	.184	.366	-.430	
	Loan intensity	-.217	.036	-.154	-.117	.023	-.034	-.094	
	Financial lev	-.372	-.140	-.284	-.160	-.326	-.158	-.119	
	Operating ratio	-.001	-.181	.391	.309	-.281	-.141	.079	
	Z-score	.055	-.275-	.080	-.416	.501	-.284-	-.019	
Hidden Layer 1	(Bias)								-.045
	H(1:1)								-.104
	H(1:2)								.143
	H(1:3)								.078
	H(1:4)								-.053
	H(1:5)								.718
	H(1:6)								.132
	H(1:7)								.332

Table C105: Parameter estimates for ROA in Islamic banks in the MENA countries

Predictor		Predicted			
		Hidden Layer 1			Output Layer
		H(1:1)	H(1:2)	H(1:3)	ROA
Input Layer	(Bias)	.164	.354	-.255	
	Capital ratio	-.436	-.479	-.190	
	Credit risk	.243	-.019	.330	
	Financial leverage	.272	-.061	-.314	
	Operating ratio	-.465	-.436	.139	
	Z-score	.096	.230	.241	
Hidden Layer 1	(Bias)				.559
	H(1:1)				-.145
	H(1:2)				.239
	H(1:3)				.072

Table C106: Parameter estimates for ROE in conventional banks in the MENA countries

Predictor		Predicted							
		Hidden Layer 1							Output Layer
		H(1:1)	H(1:2)	H(1:3)	H(1:4)	H(1:5)	H(1:6)	H(1:7)	ROE
Input Layer	(Bias)	.425	-.670	-.079	.524	-.340	-.022	.531	
	Inflation	-.148	-.220	.174	.333	.024	-.342	.555	
	Log GDP	.024	-.185	.277	-.597	-.112	.245	-.302	
	Capital ratio	-.058	-.007	.109	-.659	-.196	.094	-.367	
	Bank size	-.165	-.066	.317	-.650	-.259	.078	-.444	
	Credit risk	.217	.074	.424	-.052	-.240	.565	.360	
	Capital risk	.289	-.097	-.043	.426	-.295	.281	.351	
	Loan intensity	.191	-.168	-.315	.405	-.210	.075	.506	
	Financial lev	.294	.357	.637	.171	-.105	.288	-.335	
	Operating ratio	.090	-.099	-.233	-.047	.510	.040	.727	
	Z-score	-.119	-.384	.358	-.275	.405	.098	-.120	
Hidden Layer 1	(Bias)								.157
	H(1:1)								-.213
	H(1:2)								-.439
	H(1:3)								.287
	H(1:4)								.513
	H(1:5)								-.038
	H(1:6)								-.135
	H(1:7)								-.497

Table C107: Parameter estimates for ROE in conventional banks in the MENA countries

Predictor		Predicted			
		Hidden layer 1			Output layer
		H(1:1)	H(1:2)	H(1:3)	ROE
Input layer	(Bias)	.299	.169	.259	
	Inflation	-.150	.220	.298	
	Credit risk	-.530	-.134	.078	
	Operating ratio	-.151	-.320-	-.361	
	Z-score	-.235	.325	.457	
Hidden layer 1	(Bias)				-.065
	H(1:1)				.428
	H(1:2)				.477
	H(1:3)				.440

Table C108: Parameter estimates for ROA in conventional banks in the MENA countries

Predictor		Predicted							
		Hidden Layer 1							Output Layer
		H(1:1)	H(1:2)	H(1:3)	H(1:4)	H(1:5)	H(1:6)	H(1:7)	ROA
Input Layer	(Bias)	-.521	.225	.264	.121	.272	.382	-.346	
	Inflation	.488	-.033	.430	.284	-.164	.425	.002	
	Log GDP	.289	.085	.249	-.326	.173	-.311	-.367	
	Capital ratio	.200	.335	.141	.070	-.150	.055	-.673	
	Bank size	-.157	-.508	-.250	.225	-.226	.346	.290	
	Credit risk	.143	-.150	.074	-.286	-.069	-.481	.177	
	Capital risk	-.323	.479	.498	.611	.293	-.326	.131	
	Loan intensity	.261	.202	.435	.336	-.095	.205	.365	
	Financial lev.	.109	.355	.026	.148	.165	-.196	-.481	
	Operating ratio	.243	.472	-.570	-.047	-.189	.084	-.669	
	Z-score	-.378	.205	-.147	.425	.048	-.350	.526	
Hidden Layer 1	(Bias)								.090
	H(1:1)								-.510
	H(1:2)								-.154
	H(1:3)								.477
	H(1:4)								.583
	H(1:5)								.100
	H(1:6)								-.141
	H(1:7)								-.487

Table C109: Parameter estimates for ROA in conventional banks in the MENA countries

Predictor		Predicted			
		Hidden layer 1			Output layer
		H(1:1)	H(1:2)	H(1:3)	ROA
Input Layer	(Bias)	-.009	.204	.374	
	Credit risk	-.405	.102	-.279	
	Operating ratio	-.195	-.319	.072	
	Financial lev.	.261	-.314	.251	
	Capital risk	1.042	.361	.167	
Hidden Layer 1	(Bias)				.177
	H(1:1)				.972
	H(1:2)				.366
	H(1:3)				-.016

Table C110: Parameter estimates of Islamic banks in the GCC countries

Predictor		Predicted							
		Hidden layer 1							Output layer
		H(1:1)	H(1:2)	H(1:3)	H(1:4)	H(1:5)	H(1:6)	H(1:7)	ROE
Input layer	(Bias)	-.108	.553	.888	-.171	-.368	-.039	.110	
	Inflation	-.061-	-.283	.078	.522	-.156	.229	-.021	
	Log GDP	.839	.232	-.266	-.460	-.270	.198	-.219	
	Capital ratio	.185	.304	-.190	.161	.113	.246	.469	
	Bank size	-.408	-.050	.319	-.333	.378	-.362	-.363	
	Credit risk	.455	-.018	-.118-	.121	-.659	.075	-.127	
	Capital risk	.102	-.548	-.341	-.184-	-.512-	.290	.148	
	Loan intensity	-.069	-.140	-.241	.208	.187	-.154-	.431	
	Financial lev.	-.454	-.060	-.328	.104	-.030	.205	-.434	
	Operating ratio	-.038	-.192	-.089	-.388	.083	.141	-.047	
	Z-score	-.241-	.589	.806	.585	.098	.027	-.117	
Hidden layer 1	(Bias)								.305
	H(1:1)								-1.025
	H(1:2)								.480
	H(1:3)								1.014
	H(1:4)								.665
	H(1:5)								.522
	H(1:6)								-.209
	H(1:7)								-.397

Table C111: Parameter estimates for ROE in Islamic banks in the GCC countries

Predictor		Predicted			
		Hidden layer 1			Output layer
		H(1:1)	H(1:2)	H(1:3)	ROE
Input layer	(Bias)	-.371	2.683	.799	
	Log GDP	-.112	-.105	-1.453	
	Bank size	-.274	.279	.610	
	Credit risk	-.601	1.137	-1.279	
	Capital risk	.236	-5.039	-4.412	
	Z-score	-.555	.946	1.969	
Hidden Layer 1	(Bias)				.694
	H(1:1)				-.561
	H(1:2)				-2.345
	H(1:3)				2.996

Table C112: Parameter estimates of Islamic banks in the GCC countries

Predictor		Predicted							
		Hidden layer 1							Output Layer
		H(1:1)	H(1:2)	H(1:3)	H(1:4)	H(1:5)	H(1:6)	H(1:7)	ROA
Input layer	(Bias)	.196	-.454	-.365	.497	.182	-.278	-.383	
	Inflation	-.226	-.060	.290	.316	.097	-.155	.125	
	Log GDP	-.101	-.232	-.109	.200	.456	-.032	.271	
	Capital ratio	-.395	-.499	-.149	.372	-.265	-.340	.131	
	Bank size	.051	-.485	.132	-.166	-.330	.046	-.449	
	Credit risk	-.360	-.098	.150	.068	-.474	.282	-.314	
	Capital risk	.348	.231	.407	-.428	-.352	.080	-.325	
	Loan intensity	.145	.481	.150	-.440	.071	.062	.023	
	Financial lev.	.408	-.324	-.184	-.279	-.281	-.460	-.102	
	Operating ratio	.147	-.448	.301	-.325	-.212	.188	-.378	
	Z-score	.385	.054	-.209	-.217	.208	.057	.256	
Hidden layer 1	(Bias)								.153
	H(1:1)								.247
	H(1:2)								-.015
	H(1:3)								.129
	H(1:4)								-.227
	H(1:5)								.420
	H(1:6)								-.048
	H(1:7)								.429

Table C113: Parameter estimates in Islamic banks in the GCC countries

Predictor		Predicted			
		Hidden layer 1			Output layer
		H(1:1)	H(1:2)	H(1:3)	ROA
Input layer	(Bias)	.474	-.537	-.117	
	Capital ratio	.049	.577	.193	
	Bank size	.017	-.057	-.442	
	Credit risk	-.721	.195	.488	
	Z-score	.218	-.719	-.259	
Hidden layer 1	(Bias)				.940
	H(1:1)				.122
	H(1:2)				-.232
	H(1:3)				-.652

Table C114: Parameter estimates for ROE in conventional banks in the GCC countries

Predictor		Predicted							
		Hidden layer 1							Output layer
		H(1:1)	H(1:2)	H(1:3)	H(1:4)	H(1:5)	H(1:6)	H(1:7)	ROE
Input layer	(Bias)	.501	.104	-1.613	-.634	-.487	-.377	1.269	
	Inflation	.010	.260	-.050	.289	-.535	-.194	-.305	
	Log GDP	-.365	-.432	.017	.527	.000	-.342	.057	
	Capital ratio	.766	-.255	.195	-.979	.643	.344	.259	
	Bank size	-.277	-.222	.316	.652	-.534	-.306	-.266	
	Credit risk	.473	.297	.123	-.376	-.515	.135	-1.284	
	Capital risk	.089	.441	-.162	.012	.557	1.671	-.399	
	Loan intensity	-.500	.322	.079	-.507	-.311	.188	.298	
	Financial lev.	.308	.628	.345	.780	-1.039	.223	.199	
	Operating ratio	.665	.010	.326	-.458-	.102	.116	-.401	
	Z-score	-.819	.172	-.819	-.624-	.235	1.099	.150	
Hidden layer 1	(Bias)								-.232
	H(1:1)								.888
	H(1:2)								-.076
	H(1:3)								-1.565
	H(1:4)								.885
	H(1:5)								-.982
	H(1:6)								1.402
	H(1:7)								.785

Table C115: Parameter estimates for ROE in conventional banks in the GCC countries

Predictor		Predicted			
		Hidden layer 1			Output layer
		H(1:1)	H(1:2)	H(1:3)	ROE
Input layer	(Bias)	.077	4.316	-1.522	
	Capital risk	.365	.851	.055	
	Financial lev.	-.208	.567	1.132	
	Operating ratio	-.300	-.330	-1.379	
	Z-score	-.438	1.759	-1.205	
Hidden layer 1	(Bias)				-2.028
	H(1:1)				-.493
	H(1:2)				3.244
	H(1:3)				.659

Table C116: Parameter estimates for ROA in conventional banks in the GCC countries

Predictor		Predicted							
		Hidden layer 1							Output layer
		H(1:1)	H(1:2)	H(1:3)	H(1:4)	H(1:5)	H(1:6)	H(1:7)	ROA
Input Layer	(Bias)	-.695	.151	.294	.223	.282	.387	-.385	
	Inflation	.516	.006	.386	.249	-.178	.411	-.072	
	Log GDP	.223	.149	.212	-.391	.174	-.357	-.324	
	Capital Ratio	.238	.276	.001	.180	-.198	.030	-.653	
	Bank size	-.185	-.410	-.323	.205	-.237	.325	.294	
	Credit risk	.184	-.089-	.050	-.238	-.076	-.477	.261	
	Capital risk	-.372	.431	.553	.749	.259	-.360	.151	
	Loan intensity	.195	.234	.422	.261	-.059	.162	.460	
	Financial lev.	.057	.377	.098	.242	.186	-.199	-.456	
	Operating ratio	.216	.363	-.569	.119	-.240	.100	-.733	
	Z-score	-.434	.114	-.106	.561	.079	-.337	.586	
Hidden layer 1	(Bias)								.043
	H(1:1)								-.813
	H(1:2)								-.284
	H(1:3)								.604
	H(1:4)								.776
	H(1:5)								.241
	H(1:6)								-.167
	H(1:7)								-.569

Table C117: Parameter estimates for ROA in conventional banks in the GCC countries

Predictor		Predicted			
		Hidden layer 1			Output layer
		H(1:1)	H(1:2)	H(1:3)	ROA
Input layer	(Bias)	.241	-.297	.199	
	Credit risk	.368	.245	-.237	
	Capital risk	-.658	.156	.807	
	Financial lev.	-.485	-.416	-.201	
	Operating ratio	.353	-.230	-.023	
	Z-score	.321	.454	.660	
Hidden layer 1	(Bias)				.136
	H(1:1)				-.781
	H(1:2)				.096
	H(1:3)				.841