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Momentum profits and time varying illiquidity effect

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Abstract

We study the variations in the US momentum returns using shocks to contemporaneous and lagged market illiquidity. We assert that the momentum strategy is hedged against systematic illiquidity risk. The impact of systematic illiquidity risk on momentum profits is shown to be distinctive from the effect of supplying liquidity. Our results show that the contemporaneous effect of systematic illiquidity dominates the opposite prediction of lagged systematic illiquidity and retains its significance even if variables capturing the time varying exposures of momentum returns to market risk are included in the analysis.

JEL Codes: G10, G12, G15

Keywords: momentum strategy, systematic illiquidity risk, supplying liquidity, time varying exposures

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1. Introduction

The technological developments in trading systems have reduced transaction costs and commissions and have contributed to an exponential increase in the trading volume of US stocks. Chordia, Subrahmanyam and Tong (2014) report that average returns on anomaly based trading strategies have decreased as the trading systems have become more advanced, which is consistent with limits to tradable arbitrage.¹ They report that an illiquidity based anomaly portfolio has 39% lower profits in the post-decimalization period than the pre-decimalization period. In itself this shows that the variability in profits is because of two distinctive liquidity attributes i.e. (i) supplying liquidity to facilitate trading and (ii) risk compensation for covariance between average returns and systematic market liquidity.²

Avramov, Cheng and Hameed (2015) report contrary empirical evidence specifically for momentum profits as market liquidity improves. They show that lagged market illiquidity predicts lower momentum returns and vice a versa. We argue that this effect is a conflation of the systematic liquidity effect and supplying trading liquidity. We hypothesize and show that ease in trading or supplying liquidity has not changed the systematic course of risk compensation of momentum profits. Furthermore, we argue that the negative relationship between momentum-liquidity available at previous period is consistent with risk averse tendencies of investors' ex-ante opting

¹ They report that, among other proxies for arbitrage activity, the decrease in the tick size due to decimalization has approximately halved the return on prominent anomalies based trading strategies when compared with their historical average returns. They analysed a range of anomalies including size, momentum, illiquidity, asset growth and operating profitability.

² Liquidity is a broad concept and in asset pricing literature has been studied: (i) to represent stock specific idiosyncratic liquidity (for example Amihud and Mendelson, 1986), (ii) to describe the systematic nature of market liquidity to influence stock returns (for example Pastor and Stambaugh, 2003) and (iii) availability of effective trading platforms to facilitate trading (Chordia et al., 2014 and references therein).

for safe (liquid) stocks compared to systematic bargains with high sensitivities to a liquidity risk factor.

In order to test our assertion, we study the liquidity-momentum relationship for the US stocks. To examine the momentum-liquidity contemporaneous relation, we partition the whole sample into five quintiles with respect to shocks to market illiquidity.³ The average returns across these five quintiles reveal that momentum profits are lowest when shocks to systematic liquidity improve market liquidity conditions and are highest when markets experience acute illiquidity shocks. Admittedly, momentum returns are hedged against shocks to systematic illiquidity.

Our direct tests show that illiquid shocks at the previous lag predict lower momentum returns but we find an even stronger reverse effect for the contemporaneous shocks to liquidity risk factor. In total, we posit a positive momentum-market liquidity relationship which is illustrated by the fact that the market clears risky claims for the expected returns with respect to their exposures to variations in systematic liquidity while holding others constant, i.e. as market illiquidity increases (decreases) momentum returns increase (decrease). We argue that as market liquidity conditions improve momentum returns are low for providing a hedge to illiquid systematic shocks: momentum profits are large when market liquidity witnesses acute illiquid shocks. Finally, the contemporaneous impact of shocks to market liquidity retains its significance even if we include the predictive variables proposed by Daniel and Moskowitz (2014) that capture time varying exposures of momentum returns to market risk.

³ We use shocks to market (il)liquidity and shocks to systematic (il)liquidity interchangeably to imply the same effect.

The rest of the paper is organized such that section two describes data and construction of liquidity risk factors. In section three we provide background evidence and testable hypotheses. Section four summaries key results and section five is reserved for conclusions.

2. Data and construction of aggregate liquidity series

The data for the momentum strategy i.e. winners⁴ (10th portfolio) minus losers⁵ (1st portfolio) is taken from Ken French's online database. In order to develop measures for market liquidity, we obtain stock prices, returns, traded volume and number of shares outstanding from the Center for Research in Security Prices (CRSP). We download the daily and monthly files for all common stocks with share code 10 or 11 listed on NYSE, AMEX and NASDAQ or the period of July 1963-December 2012. We retain common stocks with a share price greater (lesser) than or equal to 5 (1000) USD and remove monthly stock prices and returns from our dataset if the stock does not have 15 daily return and volume data points in a month. In order to make our analysis robust the aggregate market liquidity is estimated in three different ways, as proposed in Fong, Holden and Trzcinka (2014) (FHT onwards), Lesmond, Ogden and Trzcinka (1999) (Zero-returns onwards) and Amihud (2002) (Price-impact onwards). For details on the construction of these measures please refer to the respective articles.

Approximations to market liquidity are highly persistent (Amihud, 2002). Sadka (2006) stresses the use of innovations to systematic liquidity factor, presumably for the fact that unexpected changes to the aggregate liquidity can better explain cross-sectional variations to expected returns than the predictable changes to the systematic liquidity. Therefore we examine

⁴ Winners' portfolio is the 10th portfolio which is the collection of 13th month's returns for 10 percent of total stocks whose returns are the highest for the previous 11 months.

⁵ Losers' portfolio is the 1st portfolio which is the collection of 13th month's returns for 10 percent of total stocks whose returns are the minimum for the previous 11 months.

the relationship between time varying market illiquidity and momentum returns using shocks to market illiquidity⁶. The shocks to each market illiquidity series are the part left unexplained after fitting an AR (2) filter. The shocks to market illiquidity are easily interpretable in terms of the increase and decrease in market liquidity: negative shocks to systematic illiquidity represent improvements in market liquidity and positive shocks to market illiquidity displays worsening of market liquidity for the very fact how increases in the level of the approximated aggregate liquidity series showcase market is becoming illiquid.⁷

This strategy will help us to decipher the reduction in momentum gains when observing negative shocks to systematic illiquidity from the increase in momentum profits when positive shocks to market illiquidity makes trading difficult. Nonetheless, the reported results in section 4 are invariant to the use of market illiquidity or shocks to market illiquidity, a feature that is also noted in Avramov et al. (2015).⁸ Furthermore, our work studies the time series variations in the momentum returns with respect to contemporaneous changes to market liquidity and contrasts with the cross-sectional pricing of liquidity risk widely reported in the literature e.g. Pastor and Stambaugh (2003), Sadka (2006) and Asness, Moskowitz and Pedersen (2013) among others.⁹

3. Background studies and testable hypotheses

Reportedly, unexpected changes to systematic liquidity have larger effects on illiquid stocks than on liquid stocks (Amihud, 2002). Due to this a typical investor would prefer to hold stocks which have low return sensitivity to adverse shocks to systematic liquidity (Vayanos, 2004).

⁶ Jesper (2015) has tested the relationship between momentum profits and credit risk.

⁷ Sadka (2006 p-321) has given an alternate interpretations to shocks to systematic liquidity: he converted the measure of market illiquidity to a measure of liquidity by multiplying with minus one. For readers interested in drawing a relationship between shocks in market illiquidity and liquidity risk the section 2.1 is recommended.

⁸ See footnote 4 in their study: the negative relationship between momentum returns and an alternative measure – which captures innovations in aggregate market liquidity – persists.

⁹ We are appreciative of the comprehensive nature of comments provided by an anonymous referee for the clarity of description to show to which strand of literature our evidence is related to and in suggesting a robustness check of our main results which is reported in the section 4.4.

Perhaps the negative relationship between lagged market illiquidity and momentum that Avramov et al. (2015) found is driven by the ex-ante flight to liquidity (Pastor and Stambaugh, 2003 among others) which increases the prices of liquid stocks as equity markets witness illiquid shocks. Arguably, investors hold liquid stocks to not only hedge against adverse systematic liquidity shocks but also because they expect that the price rise may continue in the following period¹⁰. However, we argue that the contemporaneous relationship between momentum profits and systematic illiquidity is an equilibrium manifestation of reward-to-risk clearing: investors ask for a premium to hold a stock/portfolio which is sensitive to systematic illiquidity and vice a versa. Since the momentum strategy is long in winners which have better liquidity than the liquidity of its short portfolio i.e. losers, we expect a positive relationship between momentum and variations to systematic illiquidity¹¹. This relation makes the momentum strategy a candidate for liquidity risk hedging. That is, the momentum strategy provides high returns when positive shocks to market illiquidity are witnessed but as a tradeoff a lower return is accepted when systematic liquidity is favorable.

This expectation has two components. One, returns on the momentum strategy are driven by an insurance type feature to have a long position in the winner portfolio: the momentum strategy provides liquidity as required without large selling discounts and especially in periods which witness adverse shocks to market liquidity. Two, and more importantly, the momentum strategy is hedged against the loser portfolio's return sensitivity to systematic illiquid shocks. Therefore the momentum strategy yields high returns as adverse shocks to market liquidity can depress loser portfolio returns more than winner portfolio returns. In these scenarios the default short position

¹⁰ For the later part of the expectation of the investor, LeBaron (2003) argued the suboptimal financial forecasting strategies such as momentum can also sustain in market for some time.

¹¹ This is consistent with Avramov et al. (2015) that the losers are illiquid in comparison to the winners.

in the loser portfolio drives up the average momentum returns whereas the insurance feature, together with the hedge to liquidity risk, keeps momentum returns low in periods when shocks to liquidity ease trading.

This motivation positively links the time series variability in momentum returns to contemporaneous shocks to systematic liquidity. The proposed time series relation is consistent with the positive cross-sectional loading for momentum on liquidity risk reported in Asness et al. (2013) and fifty percent reduction in the cross-sectional alpha for momentum portfolios in Pastor and Stambaugh (2003) for including a liquidity risk factor in the test specification for US stock returns.

Furthermore, the attenuation in the average returns of anomaly based portfolios, because of the trade facilitation effect reported in Chordia et al. (2014), has added up to the known short-term over reaction in winners (Lehmann, 1990). We argue that the trade facilitation related attenuation in anomaly based expected returns is distinctive from the effect of systematic liquidity shocks on the momentum profits. If this was not the case then the depression in momentum profits in the post-decimalization period should result in a negative momentum-liquidity relationship. Overall, we expect the variability in the momentum profits to be positively linked to contemporaneous changes to market liquidity across periods regardless of how technological improvements have facilitated trading in the equity markets.

4. Market illiquidity and momentum profits

4.1 Momentum profits in relation to changing market illiquidity.

The variations in the average momentum returns for the full sample, across the five quintiles based on shocks to market liquidity, are reported in part I of table 1. The sample average returns using FHT show that momentum profits are at their minimum (a monthly average of -

0.227%) when the aggregate series witnesses a liquid shock and that momentum profits are highest (an average of 2.270%) as the market experiences acute illiquidity shocks. This pattern of low/high momentum profits, when shocks to aggregate liquidity are liquid/illiquid, are related to the performance of the loser portfolio whose returns decline as market liquidity witnesses illiquid shocks and vice versa¹².

For instance the full sample average excess returns on loser and winners are respectively - 0.275% and 1.081%, whereas the average excess return using the FHT measure in the L-1 quintile is 2.311% for the loser portfolio and 2.084% for the winner portfolio. The substantial increase in the loser portfolio's average return results in negative momentum profits (W-L). Unsurprisingly, the short position in the loser portfolio is a hedge to adverse market liquidity conditions and makes the momentum profits (W-L) positive when market liquidity experiences illiquid shocks despite the fact that winners display their insurance like features in L-5 quintile. That is the negative average return on winners in L-5 is outweighed by the drop in the loser portfolio return in the same quintile. Overall, the average return on momentum strategy in this quintile is positive and is driven for the short position in the loser portfolio with presumably high return sensitivity to systematic illiquidity shocks. The averages in panels B and C replicate the same patterns, however losers do not increase in the L-1 quintile to the extent noted with shocks to FHT based systematic liquidity. In total, the momentum profits are low (high) when shocks to aggregate liquidity are negative (positive).

The variations in momentum profits are large in the recent period of January 2001 to December 2012 (see Part II, panels A, B and C, of table 1). Nonetheless, the sample averages across the five quintiles follow the same pattern i.e. momentum profits are low as systematic

¹² Xiuqing Ji (2016) has shown that the longest series of momentum profits for Australian market behave differently, from the US market.

liquidity experiences liquid shocks and are high when systematic liquidity bears illiquid shocks. Essentially, average momentum profits are driven by the sensitivity of the loser portfolio's average return to illiquid systematic shocks. We argue that in a period when arbitrageurs can exploit arbitrage opportunities more easily, the contemporaneous momentum-liquidity relationship displays its distinctive effect instead of the potentially ex-ante loss aversion based investment preferences which results in the contrary momentum-liquidity relationship.

4.2 Contemporaneous and predictive effect of the market illiquidity

We compare the impact of shocks to contemporaneous and lagged systematic liquidity on the momentum returns using the following model:

$$R_{i,t} = \alpha + \beta_1 ILLQ_{m,t} + \beta_2 ILLQ_{m,t-1} + \varepsilon_{i,t} \quad (1),$$

where $R_{i,t}$ is the average return on momentum strategy, β_1 and β_2 are the exposures to the contemporaneous and lagged shocks to market illiquidity.

Table 2 shows that the contemporaneous effect of shocks to market illiquidity is positively significant for all three of our measures. The predictive effect of market illiquidity is always smaller than the size of the contemporaneous shocks to market liquidity and is significant for shocks to FHT and Zero-returns. To fully grasp the meaning of these results, we assess the economic impact of these shocks to contemporaneous and lagged market illiquidity. Using the Price-impact measure of Amihud (2002), also employed in Avramov et al. (2015), the coefficient on β_1 is 1.001 and β_2 is -0.078 for the momentum strategy. Given the standard deviation of 0.0098 for the shocks to the Price-impact measure, the contemporaneous economic impact of the shocks to market illiquidity on momentum profits is 0.98%. That is, a one standard deviation increase (decrease) in the shocks to market illiquidity drives momentum profits 0.98% higher (lower) than

the average momentum profits of 1.36% per month.¹³ The economic impact of the lagged shocks to market illiquidity is not economically meaningful with Price-impact.

Our results indicate that the economic impact of lagged market liquidity shocks is lower in magnitude than the economic impact of contemporaneous shocks to market liquidity and is always in reverse. The net effect of the positive contemporaneous effect and negative lagged prediction results in a positive momentum-liquidity relationship. Ignoring the depreciation/appreciation in momentum profits due to the ease/difficulty in arbitrage trading in liquid/illiquid market conditions, this result indicates two things. First, contemporaneous shocks to market liquidity dominate the predictive effect of shocks to market liquidity. Second, the momentum strategy is hedged against the adverse liquidity changes and has, on average, provided high returns when market liquidity has turned over itself – this puts momentum profits in a unique position among the asset pricing anomalies. We argue that this net effect displays the positive momentum-illiquidity relation over and above the ex-ante predictive effect of liquidity risk on the momentum profits.

4.3 Momentum profits as markets facilitate trading (2001-2012)

Chordia et al. (2014) reported that the depression in the returns on asset pricing anomalies is sizeable as trading is facilitated in equity markets. Following them, we replicate results in table 2 for the period of January 2001 to December 2012 and report them in table 3. Our results, reported in table 3, maintain the higher effect of the shocks to contemporaneous liquidity rather than the impact of lagged market liquidity risk as reported in table 2. The positive liquidity-momentum

¹³ These computations using FHT and Zero-returns measures translate into a contemporaneous increase/decrease in momentum profits by 0.80% and 0.63% when shocks to market illiquidity experiences rise/fall by a unit standard deviation. However the lagged effect predicts that momentum returns in the following month will be decreased/increased by 0.78% for FHT and 0.60% with Zero-returns, given one standard deviation rise/ fall for shocks to market illiquidity.

relationship in this period implies that even if reduced trading costs make it easier to exploit arbitrage opportunities the fluctuations in momentum profits for exposure to shocks to systematic liquidity remain intact.

4.4 Momentum profits and time varying market exposures

Daniel and Moskowitz (2014) report that large declines in momentum returns – momentum crashes – are partially predictable using down and up market state variables¹⁴. To this effect, we run regressions to test if the predictive variables proposed by Daniel and Moskowitz (2014) subsume the reported effect of shocks to contemporaneous market illiquidity in our study. Essentially, the contemporaneous shocks to aggregate illiquidity and shocks to lagged systematic illiquidity are taken along with the ex-ante and contemporaneous bear market and contemporaneous market dummy variables. The results for this analysis using the Price-impact measure, reported in table 4, clearly show that contemporaneous illiquidity risk as measured by β_1 is not subsumed by the momentum returns' time varying exposures to the market risk factor.¹⁵ The insignificance of the predictive effect of lagged market liquidity reported in Avramov et al (2015) is perhaps not driven by the ex-ante insurance like feature of liquid stocks but rather is better captured by the return sensitivity of momentum returns to contemporaneous shocks to market liquidity which provides a hedge against exposure to systematic illiquid shocks.

5. Conclusion

We show that momentum profits are positively linked with the systematic liquidity risk factor. Put simply, momentum profits compensate for adverse liquidity shocks: average returns on the loser

¹⁴ The construction of state variables and their subsequent interaction follows the procedure described in Daniel and Moskowitz (2014).

¹⁵ The results are available using the FHT and Zero-returns measures upon request and are not reported to conserve space. Even more importantly, the same effect using shocks to Price-impact measure in the sub-sample period of January 2001 to December 2012 – a period in which seven out of the fifteen worst momentum crashes have occurred (Daniel and Moskowitz, 2014) – is stronger than the full period when we repeat the regressions reported in table 4.

portfolio are large when the market is liquid and are low when an illiquid shock to market liquidity is witnessed. This effect makes the momentum strategy a hedge against adverse market conditions for having a short position in the loser portfolio. Our results show that the contemporaneous liquidity effect dominates the lagged liquidity effect on momentum returns and the trade facilitation effect has not changed the systematic positive momentum-liquidity relationship: momentum profits increase (decrease) as systematic liquidity risk factor increases (decreases). The contemporaneous impact of liquidity risk is robust to the inclusion of predictive variables capturing the time varying exposures of momentum returns to market factor.

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Table 1 Relationship between Momentum and change in market illiquidity

Table provides the average excess returns on Winner (W), Loser (L) and momentum strategy (W-L) across five quintiles using shocks to market illiquidity, using three measures of illiquidity, namely FHT, Zero-returns and Price-impact, see panels A, B and C respectively. Full sample average returns are provided in Part I and average returns for the period from January 2001 to December 2012 are reported in Part II of this table. The five illiquidity quintiles are increasing in market illiquidity such that L-1 is the quintile in which market liquidity observes liquid (negative) shocks whereas L-5 is the quintile in which market liquidity witnesses an illiquid (positive) shocks.

Part I - Full Sample period: July 1963-December 2012

Panel A: Average returns across FTH quintiles

	L-1	L-2	L-3	L-4	L-5
W	2.084	2.399	1.242	0.370	-0.687
L	2.311	0.934	-0.859	-0.810	-2.958
W-L	-0.227	1.465	2.101	1.180	2.270

Panel B: Average returns across Zero-returns quintiles

W	1.296	0.955	0.857	1.505	0.792
L	0.558	0.319	-0.165	-0.839	-1.248
W-L	0.738	0.636	1.022	2.344	2.040

Panel C: Average returns across Price-impact quintiles

W	3.507	1.746	-0.913	1.018	0.049
L	2.663	0.524	-2.468	-1.170	-0.934
W-L	0.844	1.221	1.555	2.187	0.983

Part II- Post Decimalization period: January 2001-December 2012

Panel A: Average returns across FTH quintiles

W	0.060	3.113	2.587	-1.302	-2.088
L	5.599	1.026	0.224	-2.163	-2.910
W-L	-5.539	2.087	2.364	0.861	0.822

Panel B: Average returns across Zero-returns quintiles

W	-0.721	0.276	-0.136	2.067	0.790
L	0.439	1.066	0.428	0.503	-0.652
W-L	-1.159	-0.790	-0.565	1.564	1.442

Panel C: Average returns across Price-impact quintiles

W	0.459	2.147	1.938	1.942	-1.027
L	0.356	5.931	0.877	1.370	-2.238
W-L	0.103	-3.784	1.061	0.571	1.212

Table 2 Relationship between Illiquidity and Momentum

Table shows the contemporaneous and lagged effects of time varying illiquidity on momentum profits (W-L). The following model is tested,

$$R_{i,t} = \alpha + \beta_1 ILLQ_{m,t} + \beta_2 ILLQ_{m,t-1} + \varepsilon_{i,t}$$

The contemporaneous and lagged shocks to market illiquidity are $ILLQ_{m,t}$ and $ILLQ_{m,t-1}$, respectively which are obtained by an autoregressive model of order two on the level series of FHT, Zero-returns and Price-impact measures. The coefficients on the contemporaneous effect of illiquidity and lagged effect of illiquidity are shown below for each measure of illiquidity and t-statistics are in parentheses.

W-L Strategy	FHT	Zero-Returns	Price-impact
	0.014	0.0136	0.013
α	(4.76)	(4.74)	(4.75)
	4.259	0.443	1.001
β_1	(2.76)	(2.21)	(3.36)
	-4.208	-0.415	-0.078
β_2	(-2.74)	(-2.07)	(-0.266)

Table 3 Relationship between Illiquidity and Momentum in Post Decimalization period (2001-2012)

Table shows the contemporaneous and lagged effects of time varying illiquidity on momentum profits (W-L). The following model is tested,

$$R_{i,t} = \alpha + \beta_1 ILLQ_{m,t} + \beta_2 ILLQ_{m,t-1} + \varepsilon_{i,t}$$

The contemporaneous and lagged shocks to market illiquidity are $ILLQ_{m,t}$ and $ILLQ_{m,t-1}$, respectively which are obtained by an autoregressive model of order two on the level series of FHT, Zero-returns and Price-impact measures. The coefficients on the contemporaneous effect of illiquidity and lagged effect of illiquidity are shown below for each measure of illiquidity and t-statistics are in parentheses.

W-L Strategy	FHT	Zero-returns	Price-impact
	-0.003	0.000	0.003
α	(-0.39)	(0.105)	(0.33)
	14.718	1.728	3.251
β_1	(1.98)	(0.97)	(4.611)
	-34.452	-1.719	-0.436
β_2	(-5.14)	(-0.97)	(-0.618)

Table 4: Bear Market Sates and Effect of Illiquidity Shocks with Price Impact Amihud (2002).

This table presents the coefficients estimated through four different regressions for the period of 1963:7 to 2012:12. The full estimated equation is as follows:

$$R_{i,t} = \alpha + \beta_0 R_t^{ex} + \beta_1 ILLQ_{m,t} + \beta_2 ILLQ_{m,t-1} + \beta_3 D_{t-1} + \beta_4 D_{t-1} \cdot R_t^{ex} + \beta_5 D_{t-1} \cdot U_t \cdot R_t^{ex} + \varepsilon_{i,t}.$$

Where $R_{i,t}$ is time series of momentum profits and R_t^{ex} is value weighted excess market returns, the contemporaneous and lagged shocks to market illiquidity are $ILLQ_{m,t}$ and $ILLQ_{m,t-1}$ respectively, which are obtained by an autoregressive model of order two on the level series of Price-impact measure. The bear market dummy is D_{t-1} , the interaction of market returns with bear market dummy is constructed by the $D_{t-1} \cdot R_t^{ex}$, the last interaction $D_{t-1} \cdot U_t \cdot R_t^{ex}$ shows the higher market returns in bear market state. The coefficients (t-stats) and adjusted r-squared for the four different specifications of the above equation are reported in columns of this table.

Coefficients	W-L Strategy	W-L Strategy	W-L Strategy	W-L Strategy
α	0.0146 (4.96)	0.0167 (5.46)	0.0168 (5.49)	0.0167 (5.61)
β_0	-0.229 (-3.52)	0.0498 (0.68)	0.0498 (0.69)	0.0502 (0.69)
β_1	0.835 (2.74)	0.620 (2.13)	0.683 (2.35)	0.686 (2.36)
β_2	-0.0231 (-0.08)	-0.0708 (-0.25)	-0.0174 (-0.06)	-0.0162 (-0.06)
β_3		-0.0260 (-3.38)	-0.0022 (-0.17)	
β_4		-1.031 (-7.64)	-0.593 (-2.51)	-0.566 (-3.24)
β_5			-0.928 (-2.26)	-0.984 (-4.08)
R_{adj}^2	0.035	0.137	0.143	0.144