University of Strathclyde

Department of Accounting and Finance

The Time-Variation in Style Effects in the UK Stock Market

Hong Li

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Declaration of Authenticity and Author's Rights

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Abstract

The thesis extends most previous studies on static version of style effects in the overall period to their time-varying properties in the dynamic macroeconomic conditions and market states in the UK Stock Market. It deals with four research questions on style effects in the UK Stock Market in four empirical chapters, respectively. Firstly, the thesis uses two indicators, long/short return R_{lms} and style coefficient γ, to examine whether the time-variation in style effects with short-/medium-/long-term horizon exists in the UK Stock Market. The research finds stronger momentum effect with 6/12 months' formation horizon and 6/12 months' holding horizon from 1956 to 2008, but its volatile pattern over time with the strongest in the 1990s and the weakest in the 1970s. Empirical evidence presents no existence of significant size effect from 1979 to 2008 due to the rotation between (marginally) significant small-cap effect in the 1980s and marginally significant large-cap effect in the 1990s. It finds significant value effect, strengthening from 5 months' to 24 months' holding horizon, from 1980 to 2008 due to persistent outperformance of shares with low price-to-book ratio over time.

Secondly, the thesis applies time-series regression to investigate what factors can significantly explain time-varying style effects in the overall period from 1980 to 2008 and three subperiods. It finds that macroeconomic variables, such as annual change of GDP(GDP(Y)), unexpected annual change of TBILL(UEXTBILL(Y)), annual change of CPI(CPI(Y)), and lagged 8-year's market return (MR(-8)), can offer significant explanatory power for the time-variation in momentum effect (12/6,

12/12), size effect (12), and value effect (24) stronger than corresponding style effects with other holding horizons from 1980 to 2008. The decline in GDP(Y) and the increase in UEXTBILL(Y) imply strong momentum effect and large-cap effect. The decline in CPI(Y) and high MR(-8) means strong value effect. The sensitivity to the same economic forces can explain the findings on correlation among style effects. The thesis shows the variation in significant macroeconomic variables to explain style effects through holding horizons and over time.

Thirdly, the thesis discusses whether the dynamic style effects can be indeed predictable by using some lagged macroeconomic variables from 1980 to 2008. It uses statistics PIS, POOS, and PSS to test the performance of recursive in-sample regression model and out-of-sample forecasting model relative to sample mean model. With the model test, the research examines the reliability/or pitfall of in-sample predictability. Different from momentum effect (12/6, 12/12) and size effect (12), out-of-sample forecasting model for value effect (24) performs poorly relative to the historical mean model even though its in-sample regression model does better. The test shows that the recursive out-of-sample forecasting model offers successful signal to capture momentum effect (12/6, 12/12) in higher percentage of all observations, followed by size effect (12) and value effect (24).

Finally, the thesis explores whether active trading strategies with filter threshold and signal from out-of-sample forecasting model can capture style rotation from 1980 to 2008. Empirical work shows the significant gains to timing momentum effect. Active trading strategy on any equal-weighted decile momentum portfolio (12/6) and value-weighted Winner/Loser portfolio (12/6) significantly outperforms passive trading strategy which always hold Winner/Loser portfolio all the time. Although active trading strategy on size effect (12) improves passive strategy from negative average monthly excess return to positive one, it might becomes unprofitable after considering trading costs. Persistent performance of return spread between 'Low' and 'High' portfolios and poor performance of out-of-sample forecasting model lead to the failure of active trading strategy on value strategy.

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Dedication

In loving memory of my mother

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List of Abbreviations

R_{lms}: Long/short return, the return spread between top/bottom decile portfolios sorted by firms' characteristics.

R_{wml}: the return spread between 'Winner' portfolio and 'Loser' portfolio.

R_{sml}: the return spread between 'Small' portfolio and 'Large' portfolio

R_{lmh}: the return spread between 'Low' portfolio and 'High' portfolio.

γ: Style coefficient, the slope coefficient of the regression of decile portfolio returns in the holding horizon on their mean values of firms' characteristics in the formation horizon.

γ_{mom}: momentum coefficient, the slope coefficient of the regression of decile portfolios' holding returns on their formation returns;

γ_{mv}: size coefficient, the slope coefficient of the regression of decile portfolios' holding returns on their log mean market values at the formation time;

γ_{pb}: value coefficient, the slope coefficient of the regression of decile portfolios' holding returns on their price-to-book ratios at the formation time;

MEV: macroeconomic variable;

UEXMEV: unexpected macroeconomic variable;

GDP(Y): the previous annual change of GDP;

UEXGDP(Y): the unexpected annual change of GDP;

IP(i): the change of Industrial production over previous the i^{th} month;

UEXIP(i): the unexpected change of Industrial production over previous i months;

IPM(i): the change of Industrial Production Index – Manufacturing over previous the i^{th} month;

UEXIPM(i): the unexpected change of Industrial Production Index – Manufacturing over previous i months;

M0(i): the change of Money Supply M0 over previous the i^{th} month;

UEXM0(i): the unexpected change of Money Supply M0 over previous i months;

UNE(i): the change of Unemployment Rate over previous the i^{th} month;

UEXUNE(i): the unexpected change of Unemployment Rate over previous i months;

CPI(i): the change of Consumer Price Index over previous the i^{th} month;

UEXCPI(i): the unexpected change of Consumer Price Index over previous i months;

TBILL (i): the change of monthly return on a 90-day Treasury Bill over previous the i^{th} month;

UEXTBILL (i): the unexpected change of TBILL over previous i months;

TERM (i): the change of TERM over previous the i^{th} month. TERM: difference in the annualized yield on the long-term UK government bonds and the yield on the three-month Treasury Bill.

UEXTERM (i): the unexpected change of TERM over previous i months;

DY (i): the change of Dividend Yield over previous the i^{th} months. DY is estimated based on value-weighted market index of all companies;

UEXDY (i): the unexpected change of Dividend Yield over previous i months;

EMR/VMR(-y): equal-(value-) weighted y years' compounded return; y=1,2,…10;

PIS: the statistics to measure the performance of recursive in-sample regression model relative to sample mean model;

POOS: the statistics to measure the performance of recursive out-of-sample forecasting model relative to sample mean model;

PSS: the percentage having same sign between actual and predicted style coefficient γ (Long/Short return R_{lms}) , which is estimated from out-of-sample forecasting model.

Chapter 1 Introduction to the Research

Traditionally, technical analysis and fundamental analysis are two main investment strategies in the stock market. Technical analysis focuses on movements of share prices, and uses this data to forecast their movements in the future. It is based on the idea that share prices reflect all information in firms' fundamentals. On the other hand, fundamental analysis pays attention to economic factors in firms' financial statements to determine their intrinsic values. Long position is allocated to shares whose prices are below their intrinsic values, and short position is allocated to shares whose prices are above their intrinsic values.

Different from technical analysis and fundamental analysis, style investment in the stock market focuses on a particular class of stocks that share common characteristics， such as past return, market value, and price-to-book ratio. Dimson and Nagel (2001) propose that comovement of prices within a distinct group of stocks contributes to the definition of a style, and that a broad classification of shares with similar characteristics into styles may help investors to ease their burden in processing enormous information flow and simplify problems of choice. As Barberis and Shleifer (2003) argue, the grouping of shares into categories based on some similarity among them is called 'styles', and this process itself, namely allocating funds among styles rather than among individual shares, is known as 'style investing.' The categorization of style investing is attractive to institutional investors who follow fundamental rules of portfolio allocation in asset management.

Stocks can be classified into different categories, for example, winner versus loser, small versus large, value versus growth. Since the later 1970s some academic studies have focused on return difference between them, and found that stocks with high past 6/or 12 months' return outperform stocks with low past 6/or 12 months' return, small-cap stocks outperform large-cap stocks, and stocks with high book-to-market ratio outperform stocks with low book-to-market ratio. Cross-sectional variation in share returns based on these firm-specific characteristics is defined as return anomalies or style effects.

The thesis investigates the time-variation in style effects in the UK Stock Market, which include momentum, size, and value effect. Different from most previous studies on style effects, the thesis explores the dynamic pattern of cross-sectional variation in share returns in the UK Stock Market in terms of momentum, size, and value effect, and what factors drive this time-varying pattern. Furthermore, the thesis tests recursive in-sample regression and out-of-sample forecasting model, and explores the profitability of active trading strategy on style effects.

As the beginning part of the thesis, Chapter 1 consists of four sections, which introduces motivation for the research, research questions, structure of the thesis, and contributions and implications of the research, respectively.

1.1Motivation for the research

The research investigates the time-variation in style effects in the UK Stock Market due to three reasons, which are associated with research background, underlying empirical studies, and market characteristics. It is motivated by the gap between the academic derivation on consistent style effects in the long run in most existing studies and their dynamic patterns in the market. The research aims to provide insights into time-varying cross-sectional variation in share returns, examine explanatory factors for this dynamic patterns, test the reliability/or pitfall of in-sample predictability, and further explore how to develop active trading strategies to capture style rotation in the UK Stock Market.

1.1.1 Research background

As return anomalies in the stock market, cross-sectional variation in share returns has been eye-caught in the academic field since the later 1970s. The dispersion in specific firm characteristics, such as past share return, size, and book-to-market ratio, are associated with cross-sectional variation in share returns. The majority of studies focus on the static version of style effects in the overall period, but pay relatively little attention to time-varying property of style effects. These studies only investigate whether the sample mean of the variation in cross-sectional share returns is significantly different from zero in the overall period, but do not mention any time series properties of return anomalies other than the mean and t-ratio. They propose that at any time point there is a linear and positive (or negative) relationship between firms' specific characteristics and cross-sectional share returns. The static style effect is derived by examining return anomalies in only one period. In the view of the thesis, this is not a rational derivation. In the investing community, stocks live for many periods, which are associated with dynamic macroeconomic conditions and market states. Therefore, in the empirical examination of style effects, it is instructive to make certain assumption that style effects are volatile over time. The investigation on time-varying style effects can provide insights into dynamic characteristics of style effects and the practical implication for the adjustment of portfolio allocation over time.

In examining the source of value premium and its dynamics, Santos and Veronesi (2005) argue that quantitative conclusion on the cross-sectional pattern may be quite misleading if the explanation for cross-sectional share returns is independent of the time-series properties of the market portfolio. In reviewing methodologies and empirical evidence on cross-sectional variation in share returns, Goyal (2012) presents that there are relatively few literature for the case dealing with time-varying characteristics although firm characteristics that vary over time is always employed in practice. He argues that using time-varying characteristics in cross-sectional regression leads to biased and inconsistent estimators if the expected returns depend on average characteristics. Therefore, based on the rational derivation that style effects are always not in the time-invariant case, the thesis examines the time-variation in style effects in the UK Stock Market, and the conditions under which dynamic style effects arise or persist.

1.1.2 Underlying empirical studies

The research on time-varying style effects is based on underlying empirical studies on the source of the variation in cross-sectional share returns, time-varying firms' fundamentals, and time-varying risk preference. The interaction between cross-sectional dispersion in cash-flow risks of firms and time-varying firms' fundamentals/and risk preference contributes to the time-variation in style effects. Santos and Veronesi (2005) propose a theoretical model and empirical work and find that cross-sectional dispersion in cash-flow risk between value stocks and growth stocks is enough large to capture value premium, and that its interaction with series variation in risk preference leads to dynamic value premium.

The source of the variation in cross-sectional share returns

The present value model proposes that share prices reflect series present discounted expected future dividends, and that their movements reflect the change in expected dividends and discount rate. The change in expectations of dividends in the future is an important factor determining share returns. The present value model justifies that cross-sectional variation in share returns results from the difference in expected future dividends, which are associated with cash flow. Some papers document this rational intuition. For instance, Cohen, Polk, and Vuolteenaho (2003) decompose cross-sectional variance of book-to-market ratio (BE/ME) into three components: (a) covariance of future stock returns with past BE/ME ratios; (b) covariance of future profitability with past BE/ME ratios, and (c) persistence of BE/ME ratios. They find that about 20 to 25 percent of the value spread is explained by expected stock returns, and 75 to 80 percent of the value spread is explained by expected profitability (cash flows). Using cash flow risk measured by aggregate consumption and cash flow growth rates, Bansal, Dittmar, and Lundblad (2005) argue that cash flow risk is an important factor to capture the difference in risk premia across shares. They find that the risk measure can explain more than 60 percent of cross-sectional variation in mean returns of momentum, size, and value sorted portfolios. Hansen, Heaton, and Li (2008) show that value shares' cash flows positively covary in the long run with aggregate consumption growth more than growth shares, which implies that two kinds of shares are characterized by different cash flow risks due to dynamic macroeconomic growth. Campbell, Polk, and Vuolteenaho (2010) explore the economic origins of systematic risks for value shares and growth shares. They find that cash flows of value/growth shares are particularly sensitive to permanent/temporary movements, driven by shocks to aggregate cash flows/market discount rates.

Time-varying firms' fundamentals

The common expectation is that the fundamental variation in cyclical behaviour should exist across firms with specific characteristics through different stages in business cycle. The impacts of business expansion or contraction on small firms and large firms are not identical. Tamari (1984) uses three indicators, such as sales, profitability, and current liabilities, to examine the reaction of small firms and large firms to the change in US economic conditions. He finds that small firms are affected adversely to a greater degree than large firms in three recession periods from later 1950s to mid-1970s. Sales of small firms suffered more than large firms during periods of reduced demand, which was followed by the greater fall in their incomes and profits. Gertler and Gilchrist (1994) present empirical evidence on the cyclical behaviour of US small and large manufacturing firms, and on their differential response to monetary transmission. They argue that the rise in interest rate, due to tightening monetary policy, directly hits balance sheets by reducing cash flows and by lowering the value of collateral assets, which magnifies the effect of monetary policy on borrowers' costs. Using three variables, such as sales, inventories, and short-term debt, they find that small firms contracted much more than large firms after tightening monetary policy and during recessions from 1960 to 1991. Ehrmann (2000) finds the same asymmetric effect of tightening monetary policy on small and large firms in Germany. Grieb and Reyes (2002) find that information to UK Small-cap Index negatively impacts its next period correlation with UK Large-cap Index from 1955 to 1996, which reflects the difference in the sensitivity of small-cap and large-cap stock prices to the same macroeconomic variables. For example, small firms, as net importers, gain from the pound appreciation. Conversely, large firms, as net exporters, suffer from this movement in exchange rates.

Time-varying risk preference

It is widely accepted that the price of risk changes over time with business cycle. Fama and French (1989), Ferson and Harvey (1991) empirically document that equity risk premia exhibits countercyclical pattern, higher at business cycle troughs and lower at business cycle peak. With consumption-based asset pricing model, Campbell and Cochrane (1999), Lettau and Ludvigson (2001) present economic explanation for the fundamental source of the price of risk and its time-varying pattern. They argue that investors' risk preference (or aversion) is closely associated with their consumption habit. In Campbell and Cochrane (1999) slow-moving habit model, consumption booms exist in the period when consumption rises above habit, followed by the decline in risk aversion and in turn greater demand for risky assets. The consumption-wealth ratio in Lettau and Ludvigson (2001) is related to investors' risk preference. They analyze its economic intuition as: Investors increase (decrease) consumption out of asset wealth and labour income when they expect higher (lower) excess return in the future. In this way, they maintain a smooth consumption path over time and keep future consumption from the time-variation in expected returns. The process in which investors adjust consumption-wealth ratio to optimize consumption behaviour always precedes the movement in share returns, reflecting the existence of time-varying risk preference. Smith and Whitelaw (2009) find that risk premia varies counter-cyclically, and risk aversion increases on the course of economic contractions.

As these studies assume the change in consumption habit as the source of time-varying risk preference in the rational dimension of financial theory, others view psychological traits in investors as rational explanation for the variation. As a competing paradigm against the traditional financial theory, behavioural finance integrates insights from psychology with neo-classical financial theory. As Shleifer (2000) and Montier (2007) state, five psychological traits inherent in most investors, such as overoptimistic, overconfidence, conservatism bias, anchoring, and representativeness heuristic, influence investors' risk preference to both aggregate market and individual share. Investors become confident and overoptimistic in economic expansion and bull market, which leads to the increase in risk preference and the decline in risk premia. Conversely, investors become overpessimistic in economic contraction and bear market, which leads to the decline in risk preference and the increase in risk premia. Daniel, Hirshleifer, and Subrahmanyam (1998), Hong and Stein (1999) present that behavioural or cognitive biases can explain the variation in risk preference, and further momentum effect and reversal effect in share returns. Some studies document that irrational sentiment of investors may lead to common movement of share prices that is not related to firm fundamentals. Barberis, Shleifer, and Wurgler (2005) find that shares added to the S&P500 exhibit substantial and significant increase in their beta with the S&P500 and substantial and significant decrease in their betas with the rest of the market, and that the change in S&P betas was quantitatively larger after 1988. Greenwood (2005) presents similar results on the redefinition of the Nikkei 225 Index in Japan Stock Market.

1.1.3 Market characteristics

As academic research focused on cross-sectinal predictability, the rapid development of style investing in the market has driven the introduction of style index, such as small-/large-cap index and value/growth index. MSCI launched a series of international and regional Value/Growth Indices based on large-cap and mid-cap in December 1974. The value attribute for index construction is defined by three measures, such as book-to-price ratio, 12-months forward earnings to price ratio, and dividend yield. The growth attribute for index construction is defined by five measures, such as long-term forward earnings per share (EPS) growth rate, short-term forward EPS growth rate, current internal growth rate, long-term historical EPS growth trend, long-term historical sales per share growth trend. MSCI further introduced international and regional Value/Growth Indices based on large-cap, mid-cap, and small-cap, Large-cap/Small-cap Indices in December 1992, and Mid-cap Index in May 1994. Similarly, the FTSE indices series established FTSE UK Small-cap Index in 1986, and FTSE UK Value Index and Growth Index in 1993. The Russell indices introduced the full set of style indices, which represent the performance of value/growth shares in small-cap, mid-cap, and large-cap categories in 1986. Advanced Quantitative Research Capital Management introduced the AQR Momentum Index in 2009.

The performance of Value/Growth Index in US, UK, and Japan Stock Market

Style index uses clear and consistent sets of attributes and rigorous methodological framework to categorize shares. It can help us to observe dynamic performance of style effects over time. The research collects MSCI Value/Growth Indices (Large+Mid Cap) in US, UK, and Japan Stock Market from 1975 to 2009, which are plotted in Figure 1.1. The first row in Figure 1.1 clearly show outperformance of Value Index (solid line) over Growth Index (dotted line) in US Stock Market before 1990, and the opposite afterwards. The second and third row in Figure 1.1 shows that Value Index (solid line) always performs above Growth Index (dotted line) in UK and Japan Stock Market from 1975 to 2009.

[Figure 1.1]

Table 1.1 shows that from 1975 to 2009 US Growth Index outperforms US Value Index by 396 percent, UK Value Index outperforms UK Growth Index by 540 percent, and Japan Value Index dominantly outperforms Japan Growth Index by 2726 percent. If splitting the whole sample period into 7 five-year's subperiods, Value Index vs Growth Index is volatile over subperiods. Different from the pattern in overall period, Value Index outperforms Growth Index in the 1st, 2nd, and 6th subperiods in US Stock Market, Growth Index outperforms Value Index in the 2nd, 5th, and 7th subperiods in UK Stock Market, Growth Index outperforms Value Index in the 5th subperiods in Japan Stock Market. If we observe the return spread between Value Index and Growth Index each month as shown in Table 1.2, we can clearly find no obvious difference in the percentage having positive and negative monthly long/short return between two styles in US and UK Stock Market. In particular, the magnitude of average monthly negative return spread is slightly higher than positive one. Even though value effect dominates in Japan Stock Market, the return spread yields average negative return of 2.30 per month, slightly 14 basis points lower than positive return spread. Growth Index outperforms Value Index in 42.62 percent of 420 months.

[Table 1.1, 1.2]

The performance of Small-cap/Large-cap Index in US, UK, and Japan Stock Market

The research collects MSCI Small-cap/Large-cap indices for US, UK, and Japan Stock Market from May 1994 to December 2009, which is plotted in Figure 1.2. The first row in Figure 1.2 shows that Large-cap Index (dotted line) performs above

Small-cap Index (solid line) during 1994 to early 2000, and vice versa after then until 2009 in US Stock Market. The middle row shows that Small-cap Index (solid line) performs above Large-cap Index (dotted line) from early the 2000s until financial crisis happened in UK Stock Market. The bottom row shows that Large-cap Index (dotted line) performs above Small-cap Index (solid line) in most time of the period in Japan Stock Market.

[Figure 1.2]

When observing the holding return in Table 1.3, we find the difference in index return between overall period and 3 five-year's subperiods. In US Stock Market, although Small-cap Index yields return 124 percent higher than Large-cap Index from May 1994 to December 2009, its performance is poor relative to Large-cap Index by 128 percent from May 1994 to 1999. Similar pattern exist in UK Stock Market. Although in Japan Stock Market Large-cap Index outperforms Small-cap Index in the overall period, Small-cap Index performs well in the second subperiod from 2000 to 2004. Table 1.4 shows that if we observe the return spread of Small-cap Index and Large-cap Index each month, we can clearly find no obvious difference between two styles in US, UK and Japan Stock Market, with almost same percentage having positive and negative Small/Large return. Except for US Stock Market, the magnitude of average monthly positive and negative Small/Large return is almost the same in UK and Japan Stock Market.

[Table 1.3, 1.4]

The introduction of various style indices in the market further motivates academic research on style index. Using US Russell style indices, Kao and Shumaker (1999) show that from 1979 to 1997 Large-cap/Value Index outperformed the Growth Index in 62 percent of the time in US Stock Market. To construct style indices in UK Stock Market, Levis and Liodakis (1999) find that Small-cap Index performs well in 183 months (or 53% of the time), while Large-cap Index is better off the rest of the 348 months (or 47% of the time) from 1968 to 1997. Large-cap Index earns average annual return higher than Small-cap Index does from July 1988 to June 1997 after the small-cap premium during two decades. They conclude that the value/growth return spread is positive in 232 months (or 67% of the total period), and negative in 116 months (or 33% of the total period). Chan, Karceski, and Lakonishok (2000), Barberis and Shleifer (2003) come to similar conclusion in US Stock Market. Chen and De Bondt (2004) note that for large US companies in the S&P-500 Index between 1977 and 2000 investors could benefit from chasing style indices that were successful over the previous 3 to 12 months. Berger, Israel, and Moskowitz (2009) present that the AQR Momentum Index outperforms Value Index and Growth Index. By comparing style indices, they mention that momentum effect and growth effect are positively correlated, and that momentum effect and value effect are negatively correlated.

1.2 Research questions

The interaction of cross-sectional variation in cash-flow risk of firms and time-varying firms' fundamentals/and investors' risk preference leads to one implication that style effects reasonably depend on dynamic nature of business conditions and market states at any time point and thus vary over time. The thesis attempts to measure and interpret whether the time-variation in style effects based on past share return, market value, and price-to-book value relates to macroeconomic variables in the UK Stock Market. Another purpose is to investigate active trading strategy to time style rotation. The thesis specifically centres on following four issues, which are empirically analysed in Chapter 4 to Chapter 7:

Firstly, whether does the pattern of time-variation in style effects exist? The research examines momentum, size, and value effect with 3, 6, 12, 18, and 24 months' holding horizons, to deepen understanding of style effects with short-/medium-/long-term horizons. Furthermore, the research investigates the correlation among style effects given the assumption that some macroeconomic variables might have same impact on different style effects.

Secondly, what factors are associated with the time-variation in style effects and how they capture the dynamic properties in overall sample period and subperiods? The research examines the correlation between the time-variation in style effects and lagged macroeconomic variables given the previous empirical findings on time-varying firms' fundamentals and time-varying risk preference exposure to the volatility in economic conditions and market states, which drives the time-variation in style effects.

Thirdly, if some lagged macroeconomic variables can explain the time-variation in style effects, it is necessary to ask whether this dynamics can be indeed predictable by using recursive in-sample regression and out-of-sample forecasting model. Some studies find pitfalls of in-sample predictability of variables such as dividend yield, earning price ratio, book-to-market ratio, and short-term interest rate. Although in-sample predictability exists, out-of-sample forecasting model performs poorly. With out-of-sample forecasting model, the research tests explanatory power of macroeconomic variables on time-varying style effects over time. Meanwhile, recursive in-sample regression and out-of-sample forecasting model can help to find whether explanatory power and forecasting power of macroeconomic variables are stable or volatile. Furthermore, the test result based on recursive out-of-sample model can be applied in the foundation of exploring active trading strategy on style rotation.

Finally, how to establish recursive out-of-sample forecasting model to benefit a variety of active trading strategies on style effects in the market? Due to dynamic economic conditions and market states, time-varying style effects lead to the failure in traditional passive strategy on long/short return all the time. For example, many studies find that small-cap premium disappeared after the 1980s, and value effect underperformed growth effect in the later 1990s in some major stock markets. So, to establish forecasting model to time the significant period of individual style effect would be rather important in practical investment. It is instructive to examine whether investors can actually use forecasts of macroeconomic variables in making investment decision on style rotation.

1.3 Structure of the thesis

The thesis consists of eight chapters, with the first chapter on introduction and the final chapter on overall conclusion. The second and third chapters mainly offer description on literature review, data and portfolio formation, respectively. The following four chapters contain corresponding research methods and empirical analysis on four research questions, respectively, which are raised in the previous subsection.

Chapter 2 reviews previous studies on cross-sectional predictability, time-series return predictability, and the time-variation in cross-sectinal predictability, respectively. This chapter focuses on relevant studies on return anomalies in terms of momentum, size, and value effect, the correlation between aggregate market return and some macroeconomic variables, and the time-variation in return anomalies in the UK Stock Market as well as other international markets.

Chapter 3 describes data and portfolio formation in the research. It details data source, firm characteristics, holding portfolio returns, and approaches to construct momentum portfolio, size portfolio, and value portfolio.

Chapter 4 concentrates on the first research question on how momentum, size, and value effect perform in the UK Stock Market. Using two indicators, such as style coefficient γ and long/short return R_{lms}, it investigates time-varying characteristics of individual style effect with 3, 6, 12, 18, and 24 months' holding lengths in overall sample period and subperiods. Style coefficient γ is estimated by regressing style-sorted decile portfolio returns on the value of firm characteristics, and so includes the information of all shares' firm-specific characteristics and returns. Long/short return R_{lms} is estimated by the difference in top/bottom portfolio return. In addition, the research discusses the correlation among style effects.

Chapter 5 deals with the second research question on the correlation between time-varying style effects and lagged macroeconomic variables in overall sample period and subperiods. Using time-series regression, the research explores what lagged economic forces and market variables capture the variation in style coefficient γ and long/short return R_{lms}, and how they explain the volatility of style effects with 3, 6, 12, 18, and 24 months' holding horizons.

Chapter 6 discusses the third research question on whether the time-variation in style effects is indeed predictable by some lagged macroeconomic variables. It uses statistic indicators to test the performance of recursive in-sample regression and out-of-sample forecasting model on time-varying style effects. The empirical work only focuses on momentum effect with 12 months' formation length and 6/12 months' holding length, size effect with 12 months' holding length, and value effect with 24 months' holding length, the most strongest or stronger effect among the cases with five holding horizons as found in Chapter 4. Meanwhile, relative to style effects with other holding horizons, their time-varying properties are captured much more by macroeconomic variables as documented in Chapter 5.

Chapter 7 deals with the fourth research question on how to improve recursive out-of-sample forecasting model to benefit a variety of active trading strategies for timing style rotation. Following empirical findings in Chapter 6, it uses the signal from recursive out-of-sample forecasting model and filter thresholds, and explores the possibility of performance enhancement of active trading strategies relative to traditional passive trading strategies with long/short position all the time. This exploration on trading strategies is based on individual style effect and combined style effects.

1.4 Contributions and implications of the research

The thesis focuses on four research questions on the time-variation in style effects in the UK Stock Market. The empirical findings make contributions to studies on style effects, and offer implications for researchers in academic field and style-oriented investors in the market.

1.4.1 Contributions of the research

Firstly, although some existing studies have empirically examined the time-variation in style effects since the year 2000, they always focus on individual style effect, or two style effects with one certain holding horizon, such as 6 or 12 months. Because the thesis examines three style effects in one empirical research, it can help us to find the correlation between momentum effect and size effect, between momentum effect and vale effect, and between size effect and vale effect. In addition, because the thesis examines style effects with 3, 6, 12, 18, and 24 months' holding horizons, it can offer us one approach to observe the difference in style effects with short-/medium-/long-term horizon, and the variation in significant explanatory factors for style effects through holding horizons.

Secondly, besides traditional indicator long/short return R_{lms} in previous studies, the thesis uses style coefficient γ to investigate time-varying style effects. Different from long/short return R_{lms} based on top/bottom portfolios, style coefficient γ is estimated by cross-sectional regression of decile portfolios' returns in the holding period on their average values of firm characteristics in the formation period. It contains the information of all shares in decile portfolios in terms of share return and firm characteristics. So, style coefficient γ could capture much more information on the relation between share return and firm characteristics than long/short return R_{lms}. Meanwhile, the test on the impact of lagged macroeconomic variables on the time-variation in style coefficient γ helps us to diagnose the efficiency of active trading strategy which allocates long position and short position on any decile portfolio according to portfolio returns predicted from out-of-sample forecasting model.

Thirdly, all previous studies only investigate the time-variation in style effects and explain their dynamic property in the context of macroeconomic conditions and market states in the overall sample period. The thesis undertakes these studies in subperiods as well as the overall period. The empirical studies in subperiods help us to find the stability/or volatility of significant macroeconomic variables to explain the time-variation in style effects.

Fourthly, Goyal and Welch (2003, 2008) find that many predictor variables for aggregate market return perform poorly in out-of-sample test relative to the prevailing sample mean. Although some previous studies find significant explanatory power of macroeconomic factors for the time-variation in style effects, they do not undertake the test on out-of-sample forecasting model. The thesis uses statistic measures PIS, POOS, and PSS to test the recursive in-sample regression and out-of-sample forecasting model on style effects, and verify whether macroeconomic factors indeed offer predictive power for time-varying style effects. The test helps us to find the reliability/or pitfall of in-sample predictability on style effects.

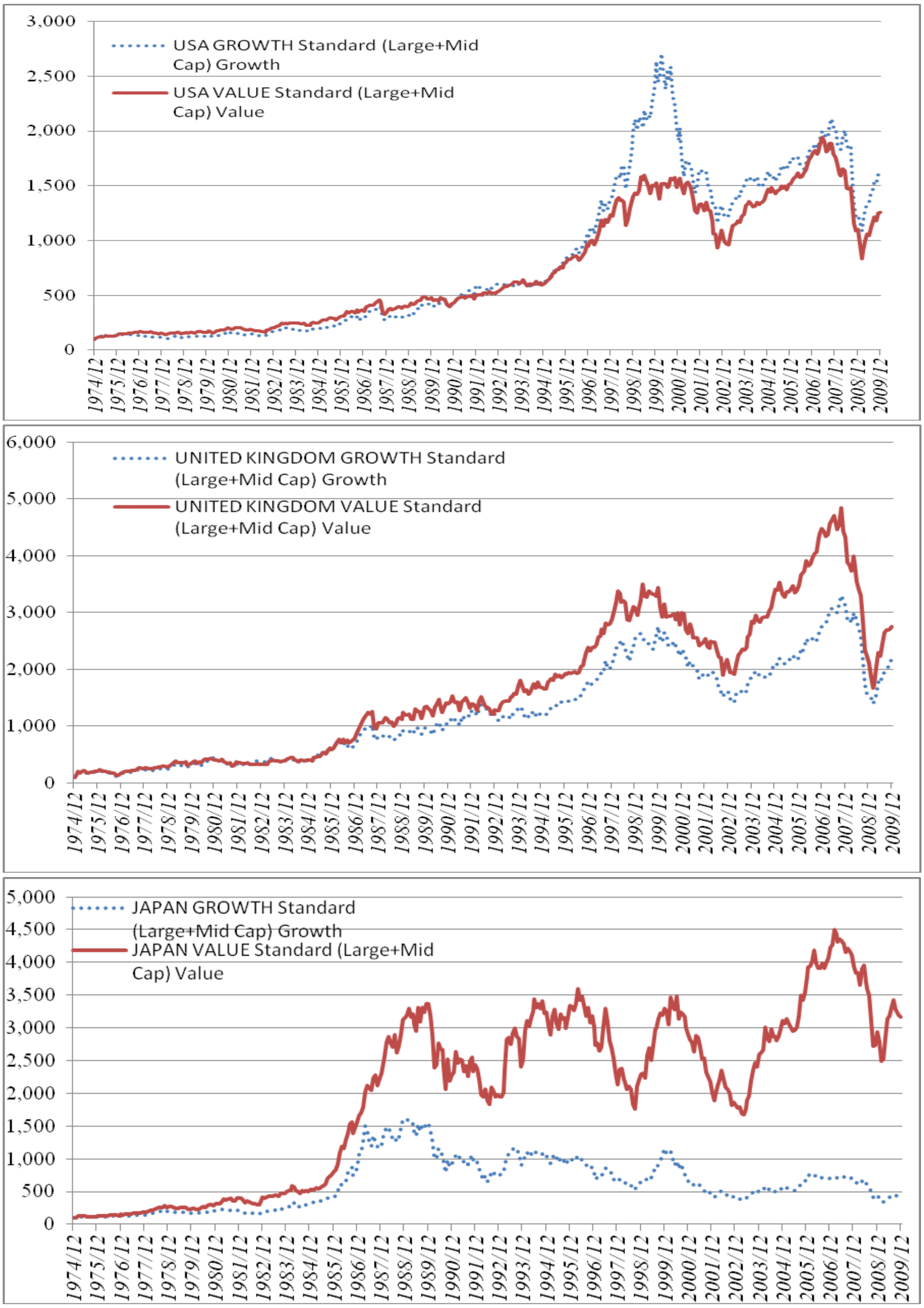
1.4.2 Implications of the research

Academics could benefit from the empirical findings in the thesis. The thesis finds the variation in significant macroeconomic variables for one style effect with different holding horizons and over time. This implies that researchers should examine empirical work over different holding horizons and subperiods when they undertake studies on series return predictability. In addition, the thesis finds that out-of-sample forecasting model on value effect (24) fails to outperform the sample mean model although its in-sample regression model has good performance. This means that it is necessary for researchers to conduct out-of-sample model test with two statistics, POOS and PSS, in order to examine the reliability/or pitfall in-sample predictability.

Empirical findings have implications for practitioners who favour style investing. Due to the existence of biased and inconsistent significant macroeconomic variables for the time-variation in style effects with short-/medium-/long-horizons and over time, style-oriented investors should be cautious to use forecasting variables to time style rotation according to their holding horizons and macroeconomic conditions. In addition, the thesis develops a variety of active trading strategies on long/short portfolio for individual style effect and combined style effects. Active trading strategy with either any equal-weighted decile momentum portfolio (12/6) or value-weighted Winner/Loser portfolio (12/6) seems to be one good choice for style-oriented investors in the UK Stock Market.

Appendix: tables and figures in Chapter 1

Figure 1.1 MSCI Value Index and Growth Index (Large+Mid Cap) in US, UK, and Japan Stock Market from 1975 to 2009



Note: The figure is plotted by series monthly MSCI Value Index and Growth Index from the MSCI Global Equity Indices.

Table 1.1 The holding return of MSCI Value Index and Growth Index in US, UK, and Japan Stock Market in subperiods and overall period from 1975 to 2009 (100/%)

	US		UK		Japan	
Subperiod	Value	Growth	Value	Growth	Value	Growth
1975-1979	0.6352	0.3210	2.3564	1.8887	1.3784	0.7446
1980-1984	0.5475	0.4665	0.1836	0.4193	1.2114	0.8554
1985-1989	0.8959	1.2359	2.3633	1.3479	5.3946	3.7740
1990-1994	0.2450	0.4121	0.2592	0.2527	-0.0369	-0.3274
1995-1999	1.5551	3.3143	1.0471	1.2839	0.0183	0.1135
2000-2004	-0.0351	-0.3805	-0.0102	-0.2346	-0.0567	-0.5113
2005-2009	-0.1464	0.0111	-0.1922	0.0500	0.0176	-0.2214
Overall period:1975-2009	11.5699	15.5291	26.5378	21.1339	30.6621	3.4037

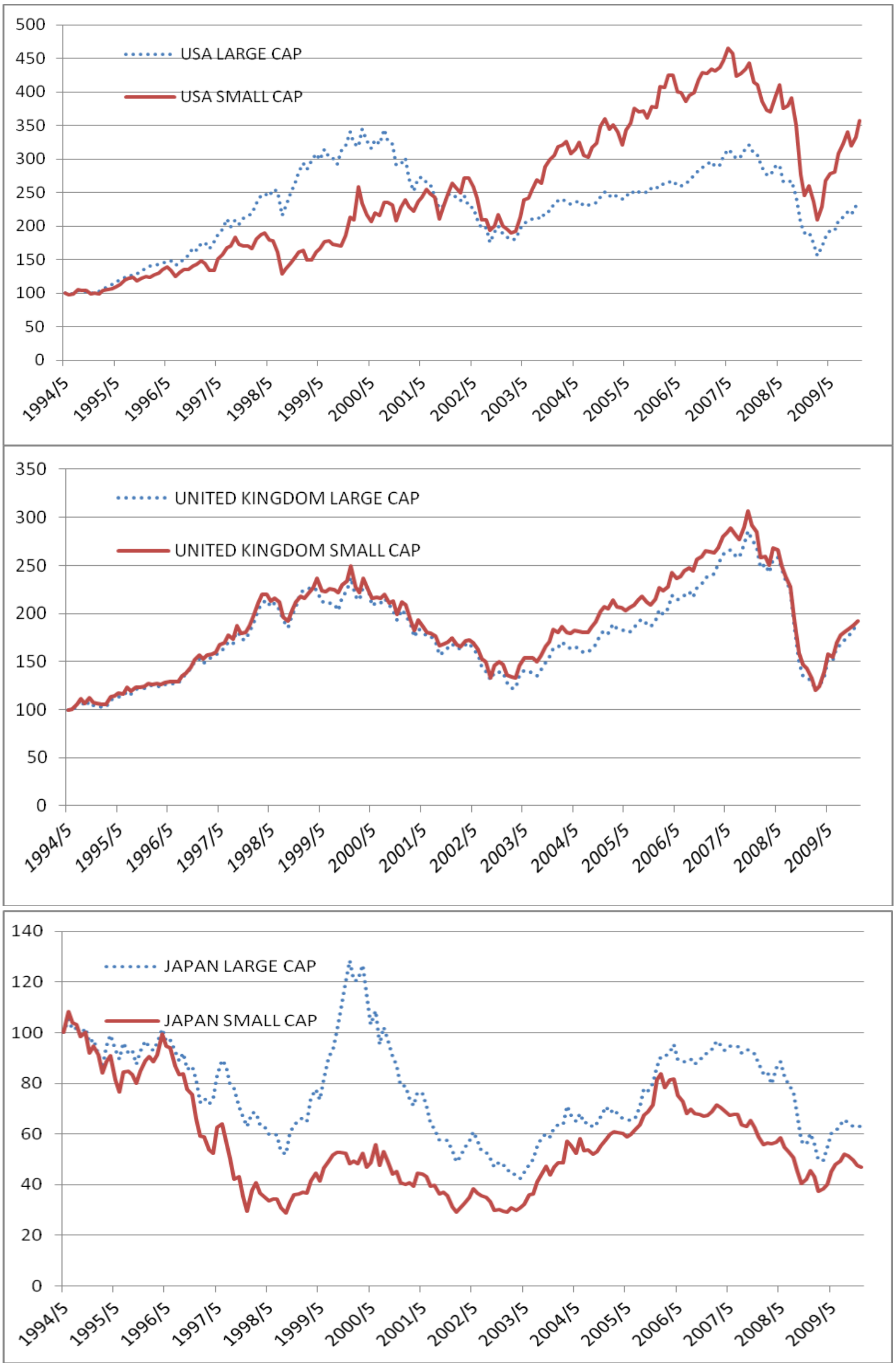
Note: The holding return over 5-year's subperiods and overall period is the percentage by which the value of Value/Growth Index has grown for a particular period. Series monthly MSCI Value Index and Growth Index in US, UK, and Japan Stock Market is collected from the MSCI Global Equity Indices.

Table 1.2 The average monthly return spread of MSCI Value Index and Growth Index in US, UK, and Japan Stock Market from 1975 to 2009

	Return spread	Number	Percentage (%)	Average monthly return (%)
US	+	210	50.00	1.87
	-	210	50.00	-2.06
UK	+	217	51.67	2.11
	-	203	48.33	-2.14
Japan	+	241	57.38	2.44
	-	179	42.62	-2.30

Note: The average monthly return spread of MSCI Value Index and Growth Index in US, UK, and Japan Stock Market is estimated by data from the MSCI Global Equity Indices.

Figure 1.2 MSCI Small-cap Index and Large-cap Index in US, UK, and Japan Stock Market from May 1994 to December 2009



Note: The figure is plotted by series monthly MSCI Small Index and Large Index from the MSCI Global Equity Indices.

Table 1.3 The holding return of MSCI Small-cap Index and Large-cap Index in US, UK, and Japan Stock Market in subperiods and overall period from May 1994 to 2009 (100/%)

	US		UK		Japan	
Subperiod	Small-cap	Large-cap	Small-cap	Large-cap	Small-cap	Large-cap
1994/5-1999	1.1299	2.4088	0.6106	1.4904	-0.5158	0.2853
2000-2004	0.6911	-0.2648	0.3149	-0.1680	0.1975	-0.4496
2005-2009	-0.0094	-0.0710	-0.0299	-0.0708	-0.1924	-0.1064
Overall period: 1994/5-2009	2.5681	1.3281	1.0544	0.9253	-0.5318	-0.3679

Note: The holding return over 5-year's subperiods and overall period is the percentage by which the value of Small-cap/Large-cap Index has grown for a particular period. Series monthly MSCI Small-cap Index and Large-cap Index in US, UK, and Japan Stock Market is collected from the MSCI Global Equity Indices.

Table 1.4 The average monthly return performance of MSCI Small-cap Index minus Large-cap Index in US, UK, and Japan Stock Market from May 1994 to December 2009

	Return spread	Number	Percentage (%)	Average monthly return (%)
US	+	94	50.27	3.12
	-	93	49.73	-2.53
UK	+	92	49.20	1.18
	-	95	50.80	-1.14
Japan	+	92	49.20	3.11
	-	95	50.80	-3.17

Note: The average monthly return spread of MSCI Small-cap Index and Large-cap Index in US, UK, and Japan Stock Market is estimated by data from the MSCI Global Equity Indices.

Chapter 2 Literature Review

The Capital Asset Pricing Model of Sharpe (1964), Lintner (1965), and Black (1972) has long shaped the way that academics and practitioners think about average share returns and risk. The central argument of the model is that invested market portfolio is mean-variance efficient. The efficiency of market portfolio implies that expected security return is a positive linear function of its market beta (the slope in the regression of the security return on the market return), and market beta suffices to describe the cross-sectional variation in share returns. The theory of CAPM identifies market portfolio return as the only important factor in the pricing of risky assets, and assumes that betas remain constant over time.

Since the Efficient Market Hypothesis (EMH) was introduced in Fama (1970), many studies on the EMH has often used the CAPM to test market efficiency. As further and deep academic discussion on EMH, more and more research work has cast doubt on the capability of Sharpe-Lintner-Black (SLB) model to explain cross-sectional variation in share returns. Fama and French (1992) investigate the static pattern of CAPM and find flat relation between market beta and average return. Fama and French (1992), Jagannathan and Wang (1996) present evidence that the static CAPM fails to explain cross-sectional share returns based on size/beta portfolios. Santos and Veronesi (2005) find the failure of the CAPM to generate cross-sectional variation in their risk estimators across book-to-market sorted decile portfolios. Other empirical studies find that the source of risk in CAPM does not completely account for the cross-sectional expected returns, and present that one or more additional factors may capture the performance of expected returns. They show that average returns on common stocks are correlated to firm characteristics and financial ratios, such as share size, earnings/price, cash flow/price, book-to-market equity, past sales growth, long-(short-) term past return. Because these patterns in average returns apparently are not explained by the CAPM, they are called ‘return anomalies’.

Early in the past century, statisticians noticed that the change in stock prices seems to follow a fair game pattern. In 1900, French mathematician Louis Bachelier proposed the Random Walk Hypothesis (RWH) in his PhD thesis, which states that the movement in stock prices is random, like the steps taken by a drunk, and therefore is unpredictable. Similar to the idea of the RWH, the Efficient Market Hypothesis (EMH) in Fama (1970) seeks to explain the random walk hypothesis by positing that only new information will move stock prices significantly, and since new information is presently unknown and occurs at random, future movements in stock prices are also unknown and thus move randomly. The EMH states that financial markets are efficient, and that share prices already reflect all known information in the market or rapidly adjust to any new information. Hence, the EMH implies that share prices must follow a random walk, and that it is impossible to outperform the market by picking undervalued and overvalued stocks in the efficient market. However, two hypothetical theories of RWH and EMH have been challenged by many empirical findings since the early 1980s that share prices seem not to completely reflect all known information in the market, and that their movements seem not to be unpredictable. For example, stocks with low price to earnings, cash flow, or book value outpeform the others. More studies of linking economic variables to aggregate stock market return have been motivated after Ross (1976) introduced the Arbitrage Pricing Theory (APT). As an alternative to the CAPM, APT is more general than CAPM and allows multiple risk factors to capture asset returns besides market portfolio. The change in economic forces could be viewed as one underlying risk factor for stock market return. Some economic and market indicators, such as industrial production, inflation, interest rate, and dividend yield, are significantly correlated to forthcoming aggregate stock return.

Obviously, in the context of classical finance theories, such as CAPM, RWH, and EMH, stocks always move at their fair price, neither undervalued nor overvalued. It should be impossible for any professional investment to perform well than the aggregate market by using stock selection and market timing. This inference has been contradicted and challenged by empirical work on return predictability in terms of cross-sectional and time-series dimensions. The research on cross-sectional return predictability is concerned about return anomalies in terms of momentum, size, and value effect, and tests of conditional CAPM to capture cross-sectional variation in share returns. The research on time-series return predictability focuses on the forecasting power of macroeconomic variables and market variables on subsequent aggregate market return. Therefore, the developing process of modern finance theory sheds some light on return predictability in the market.

2.1 Cross-sectional return predictability

The research on examination of cross-sectinal return predictability stems from academic tests of CAPM. Since the later 1970s, a large amount of studies have found cross-sectional return predictability in documenting the shortcomings of SLB model and EMH. They argue that cross-sectional share returns could be associated with some firms' specific characteristics.

2.1.1 Cross-sectional return predictability in the US Stock Market

Many empirical papers have documented the existence of cross-sectinal return predictability in the US Stock Market. They conduct cross-sectional research with regarding to the prediction of firm-specific characteristics on expected returns. For example, Basu (1977) shows that price/earnings ratio (P/E) has explanatory power on the cross-sectional variation in share returns during the period of April 1957 to March 1971. The low P/E portfolio earned higher absolute and risk-adjusted return than the high P/E portfolio. Basu (1983) further supports the P/E effect after controlling the difference in firm size from 1963 to 1979. It is found in Banz (1981) that small firms had significantly larger risk-adjusted returns than large firms from 1926-1975. Rosenberg, Reid, and Lanstein (1985) present that the return of strategy, which buys stocks with high book-to-market ratio and sells ones with low ratio, is significantly positive from 1973 to 1984. Fama and French (1993) find that size and BE/ME capture the cross-sectional variation in average stock returns associated with other variables such as earnings/price, cash flow/price, and sales growth from 1963 to 1991. They present that cross-sectional return variance could be captured by a three-factor model of market return, the spread in the returns on portfolios of small stocks and large stocks, and the spread in the returns on portfolios of high BE/ME stocks and low BE/ME stocks. Fama and French (1996) further show that the three-factor model captures long-term return reversal. Asness (1997) proposes that value variables, such as book-to-market ratio and dividend-price ratio are positively associated with future expected returns. Consistent with findings on 25 size/value sorted portfolios by Fama and French (1993), Hodrick and Zhang (2001) presents a monotonic increase in average returns as book-to-market ratio increases within a size quintile, and the average return on the smallest firms higher than the average return on the largest firms within a book-to-market quintile, except for the lowest book-to-market one, from 1952 to 1997. Goyal (2012) finds up-to-date evidence of positive but statistically unsignficant small-cap premium, and positive and statistically significant value premium over the sample period of 1946 to 2010.

Other empirical studies focus on return anomalies based on share price levels in different horizons. De Bondt and Thaler (1985, 1987) state that prior "losers" in past three to five years are found to outperform prior "winners". Jegadeesh (1990) documents that monthly returns on individual stocks exhibit significantly positive serial correlation at three-month, six-month, and one-year lags, which is designated as momentum effect. Jegadeesh and Titman (1993，2001), Chan, Jegadeesh, and Lakonishok (1996), and Asness (1997) further document return momentum. Figelman (2007a, 2007b), Goyal (2012) systematically offer the existence of short-term reversal effect, intermediate-term momentum effect, and long-term reversal effect. It is found in Heston and Sadka (2008) that positive return of winner/loser strategy with one-year's holding horizon is concentrated around financial announcements by firms.

2.1.2 Cross-sectional return predictability in the international and UK Stock Market

Besides in the US Stock Market, the cross-sectional variation in share returns has been found in other stock markets. Chan, Hamao, and Lakonishok (1991) find that book-to-market ratio and cash flow yield have significantly positive impact on expected returns in the Japan Stock Market. Brouwer, Put, and Veld (1996) conclude that in France, Germany, the Netherlands and the UK Stock Market among four value variables such as earnings-to-price (E/P) ratio, cash-flow-to-price (CF/P) ratio, book-to-market (B/M) ratio, and dividend yield, the remarkable force to drive the cross-sectional variation in share returns stems from the CF/P ratio. Fama and French (1992, 1996, 1998), Lakonishok, Shleifer, and Vishny (1994), Davis, Fama, and French (2000）further test the relation between expected returns and book-to-market ratio, and find value premium in other major markets. Asness, Moskowitz, and Pedersen (2009), Chui, Titman, and Wei (2010) show positive momentum returns in 37 share markets. Fama and French (2011) present significant value premium in Europe, Japan, and Asia Pacific, and significant momentum premium in North America, Europe, and Asia Pacific. Asness (2011) finds significant value long/short return in the UK and Japan Stock Market and significant momentum long/short return in the UK and Europe Stock Market from 1981 to 2010. Hou, Karolyi, and

Kho (2011) find that the cross-sectional variation in share returns across 49 markets might be explained by firm characteristics, such as size, dividend yield, earnings yield, book-to-market equity, cash flow-to-price, and share returns.

There is similar empirical research on cross-sectional return predictability in the UK Stock Market. Poon and Taylor (1991) report average annual return premium of 6.5 percent for smaller firms from 1958 to 1982. But Clare and Thomas (1994) find that large firms outperform small firms from 1983 to 1990. Levis and Liodakis (1999) show that average equal-(value-) weighted annual return of value portfolio is 23.58% (22.31%), over 11 percentage points higher than the return of growth portfolio from 1968 to 1997. After classifying companies whose market values make up the bottom 10% (the top 80%) of the total equity capitalization into the small-cap (large-cap) portfolio, they find that average equal-(value-) weighted annual return of small-cap portfolio is 17.51% (15.63%), 83 (77) basis points higher (lower) than the return of large-cap portfolio. In Dimson and Marsh (2001), the micro-cap, low-cap, and high-cap indices cover 1%, 9%, and 90% of the total equity capitalization, respectively. They come to the similar conclusion that although micro-cap premium and low-cap premium from 1955 to 1989 exist, they go into reverse from 1989 to 1999. To examine naive extrapolation hypothesis in the behavioural finance, Levis and Liodakis (2001) find the superior performance of value strategies, based on book-to-price, earnings-to-price, cash-flow-to-price, and three years' past EPS growth, from 1968 to 1997. Ahmed, Lockwood, and Nanda (2002) present that average annual value/growth return spread based on earnings-to-price ratio is 4.03 percent， and small-/large-cap return spread is -0.57 percent from 1981 to 1997. Antoniou, Galariotis, and Spyrou (2003) indicate that short-term contrarian strategies are profitable and more pronounced for extreme market capitalization stocks. Dimson, Nagel, and Quigley (2003) document the value (measured by BE/ME and dividend yield) premium among small-capitalization and large-capitalization stocks from 1955 to 2001. It is found in Siganos (2004) that momentum profits are significant in London Stock Exchange. Antonious, Lam, and Paudyal (2007) present momentum effect from 1977 to 2002. Fletcher (2007) shows significantly positive excess returns on HML (high B/M minus low B/M) and WML (winner minus loser) factors from 1979 to 2005. Fletcher (2011) finds size effect and value effect based on DY from 1957 to 2009.

2.1.3 Theoretical arguments for return anomalies (correction 7, 8)

There has been discussion about the underlying reasons behind return anomalies. Academics offer either risk-based or behavioural-based explanations for anomalies. The argument in some studies, that return anomalies are reward for risk, is based on the present value model. As Goyal (2012) presents, the common denominator in market capitalization and book-to-market ratio is the use of market price, which is associated with expected future cash flows and discount rates, thus reveals the difference in expected returns. Campbell and Vuolteenaho (2004) argue that risk factor can be decomposed into two components: cash flow and discount rate. They find that risk component from cash flows is priced in the cross-section of size and book-to-market sorted portfolio returns, and that return premium on value shares and small-cap shares is due to their higher cash–flow betas than growth shares and large-cap shares. Bansal, Dittmar, and Lundblad (2005) find that cash-flow risk can capture more than 60 percent of cross-sectional variation in momentum, size, and value sorted portfolio returns. Santos and Veronesi (2005) find that the difference in cash-flow risk between value shares and growth shares can explain value premium. In another rational perspective derived from cash-flow risk, return anomalies are priced in macroeconomic conditions. Chordia and Shivakumar (2002) propose that momentum profit can be explained by business cycles. Petkova (2006) shows that a factor model, including term structure and default spread, captures returns of 25 size and book/market sorted portfolios in Fama and French (1993). Liu and Zhang (2008) find that a factor measured by growth rate of industrial production captures more than half momentum premium.

An alternative argument is based on the role of behavioural bias in explaining return anomalies. In contrast to risk-based argument, behavioural theories attribute return anomalies to mispricing due to behavioural bias. DeBondt and Thaler (1985) argue that reversal premium comes from mispricing when contrarian investors make profits by buying value shares that naïve investors overreact due to misplaced pessimism and by shorting growth shares that are in-favour. Return reversal is a reflection of the cognitive bias of investors' overreaction. Jegadeesh and Titman (1993) claims that positive autocorrelation in share returns is caused by investors' delayed reaction to firm-specific information. Lakonishok, Shleifer, Vishny (1994) argue that investors' overreaction can explain value effect. When shares with high B/M ratios generally fall in tough time, investors irrationally extrapolate their worse performance, which leads to value shares undervalued and value premium. Daniel, Hirshleifer, and

Subrahmanyam (1998) propose a theory with two psychological biased traits: investor overconfidence in the precision of their private information and self-attribution bias of investment outcomes. This implies that investors overreact to private information and underreact to public information. They show that short-term momentum can be a result of continuing overreaction, and followed by long-term reversal. Barberis, Shleifer, and Vishny (1998) use other two psychological traits, such as conservatism and representative heuristic, to offer an alternative explanation for behavioural characteristics in financial markets. Investors change their belief too slowly and underreact to news, which leads to momentum effect. On the other hand, they overweight recent experience or data and overreact to consistent good or bad news, which leads to reversal effect.

The debate between risk-based and behavioural-based argument for return anomalies comes from the test of value effect in the recession periods. Lakonishok, Shleifer, and Vishny (1994) present that if value shares are fundamentally riskier, they must underperform growth shares in some 'bad' sates of world where the marginal utility of wealth is high, making value shares unattractive to risk-averse investors. However, they find the opposite evidence that value shares outperform growth shares in economic recessions and downward markets. Using stochastic dominance approach, Abhyankar, Ho, and Zhao (2008) find the same evidence that contradicts the risk-based explanations for value premium in recession periods. They argue that value premium may reflect the missing behavioural components from value investors. These findings cast doubt on risk-based explanations that value effect simply results from risk factors in asset pricing models.

2.2 Time-series return predictability

Different from the research on cross-sectional return predictability, a number of academic studies investigate the relation between macroeconomic variables and aggregate market return. With the present value model, stock prices can be estimated as the sum of present discounted expected future dividend flows. Clearly, macroeconomic forces influence firms' cash flows, dividend payouts, and discount rates, which further affect the movement in stock prices. Using the Arbitrage Pricing Theory (APT) model in Ross (1976), Chen, Roll, and Ross (1986) measure risk factors associated to various macroeconomic indicators to capture stock market returns, and offer the foundation for the belief on the relation between share returns and macroeconomic forces. Some papers examine the impact of business cycle on stock returns in the US Stock Market. Keim and Stambaugh (1986), Campbell and Shiller (1988), Fama and French (1988a, 1988b, 1989), and Hodrick (1992) document that expected stock returns are driven by four risk factors, such as the dividend–price ratio, the short-term interest rate, the term spread, and the credit spread. In addition, other studies centre on the impact of market conditions on expected aggregate market performance. For example, Keim and Stambaugh (1986), Campbell, Grossman, and Wang (1993) explore the correlation between lagged share prices, trading volume and their subsequent movements.

2.2.1 Time-series return predictability in the US Stock Market

- *Forecasting economic variables*

It is well known that expected excess returns on common stocks vary countercyclically in the US Stock Market, and that risk premia are higher in recessions but lower in expansions. Fama and French (1989), Ferson and Harvey (1991) plot fitted values of the expected risk premium on the aggregate stock market and find that it increases during economic contractions and peaks near business cycle troughs. Harrison and Zhang (1999), Campbell and Diebold (2009) come to the same conclusion on the countercyclical pattern of expected share returns. Cochrane (2011) makes a summary that expected returns are low and prices are high in 'good times' when consumption, output, and investment are strong, unemployment is low, and interest rates are high, and vice versa.

A more direct way of testing the time-variation in share returns is to explicitly forecast excess returns with predetermined conditioning variables. The empirical asset pricing studies have focused on the relation between series share returns and macroeconomic information, such as money supply, inflation, the levels of short-term and long-term interest rates measured by short-term interest rates and term spreads, default spreads, industrial production, and proxies for the consumption-wealth ratio (CAY). The relevant literature on predictive economic variables for expected return is summarized as below:

Money supply: Brunner (1961), Friedman and Schwartz (1963) establish the relation between the change in money supply and the change in asset prices. It is generally concluded that the increase or decrease in the growth of money supply leads to the adjustment for the proportion of money and other assets in investors' portfolios, and further the change in asset prices. Cooper (1974) shows significant relation between Standard and Poor 500 Index and money supply at lagged eight months from 1947 to 1970. However, Rozeff (1974) finds that share returns are unrelated to past change in money supply, and do not include information on money supply.

Inflation and Short interest rate: An increase in expected inflation rate is likely to lead to tightening economic policies, and further negatively influence firm fundamentals. Meanwhile, the rising inflation pushes up the nominal risk-free rate and the discount rate in the present value model. Fama and Schwert (1977) argue that unlike government bonds and real estate, stocks were not hedges against inflation. Fama (1981) notes that one important determinant of stock returns stems from real activity. When nominal quantity of money in the market does not move sufficiently with real activity, a negative relation exists between inflation and real activity. The same conclusion on the relation between inflation and share returns is drawn by Chen, Roll, and Ross (1986). In the present value model, real interest rate that investors use to discount future dividends is negatively associated with stock prices. Chen (1989) presents negative relation between expected share returns and TBILL rate. Chen (1991) further finds that the forecasting power of TBILL is limited to the next quarter. Hodrick (1992), Lettau and Ludvigson (2001) conclude that short-term interest rates, often measured as a 'relative TBILL rate' (e.g., the 30-day Treasury-bill rate minus its 12-month moving average) predicts share returns.

Term spread and default spread: Kessel (1965) presents that yields on long-term Treasury bonds rise less during business expansions and fall less during business contractions than yields on short-term bills. Thus the yield spread of long-term Treasury bonds over short-term Treasury bills has a clear countercyclical pattern. Keim and Stambaugh (1986) find weaker forecasting power of term spread, defined as the difference between yields on long-term under-BAA-rated corporate bonds and short-term one month U.S. Treasury bill, on monthly risk premiums. The t-statistics on term structure are typically less than conventional significance level in the first subperiod from 1928 to 1952, and the estimates themselves are sometimes negative in the second subperiod from 1953 to 1978. Fama and French (1988a) study the forecasting power for share returns with the 10-year Treasury bond yield minus the one-year Treasury bond yield (a measure of the term spread) and the BAA corporate bond yield minus the AAA corporate bond yield (a measure of the default spread). Fama and French (1989) extend the test of Keim and Stambaugh (1986) on monthly returns to longer horizon returns, and present that predictable variation in common stock returns is tracked by the default spread and term spread in bond returns. The default spread as well as dividend yields seem to be related to long-term business episodes that span several business cycles. They forecast high returns when business conditions are weak and low returns when business conditions are strong. The term spread is more closely related to the short-term business cycles, performing with low around measured business cycle peaks and high near troughs. It is shown in Chen

(1991) that the default spread has forecasting power for real and excess market returns and its power starts to fade beyond the first year, and term structure only offers forecasting power less than 3 quarters.

Industrial production: Chen, Roll, and Ross (1986) show that from 1958 to 1984 monthly growth rate in industrial production with positive risk coefficient, combining with unanticipated change in the default premium and term structure, is significant in explaining expected stock returns. Hodrick and Zhang (2001) present that industrial production has significant predictive power for expected monthly return, but explains 1% of return variation from 1952 to 1997. Humpe and Macmillan (2007) find significantly positive and negative influence of industrial production and inflation, respectively, on US stock prices from 1965 to 2005.

Consumption-wealth ratio (CAY): Lettau and Ludvigson (2001) use a log-linear approximation of a representative investor's consumption-wealth ratio (CAY) as one variable and show that the deviation from a cointegrating relation for log consumption c_t, log asset wealth a_t, and log labor income y_t, is a potential predictor of real and excess stock market returns. Hodrick and Zhang (2001) show that CAY has significant predictive power for expected quarterly return, and explains 11% of return variation from 1952 to 1997. It is found in Lettau and Ludvigson (2010) that over one-quarter horizon, the 'CAY' and the relative-bill rate have statistically significant predictive power for excess returns from 1952 to 2000 when dividend-price ratio, term spread, default spread, and one lag of the market return have little forecasting power for quarterly excess returns. This single variable is capable of predicting 34% of the variability in three-year's excess return. When sample data after 1995 are included, dividend-price ratio has no ability to forecast excess stock returns at horizons ranging from 1 to 24 quarters. The second half of the 1990s saw an extraordinary surge in stock prices relative to dividends, weakening the tight link between the dividend-yield and future returns that has been found in early sample period. However, the forecasting power of the 'CAY' seems to have been less affected by this episode. The consumption-wealth ratio (CAY) should have more stable forecasting power for common share returns in changing macroeconomic risk than other macroeconomic variables.

- *Forecasting market variables*

Other studies investigate the impact of market indicators on expected share returns. The empirical asset pricing literature has focused on the relation between series variation in share returns and stock market valuation ratios, such as price-dividend and price-earnings ratios, dividend-payment ratio, and book-market ratio. Fama and French (1988a), Campbell and Shiller (1988), and Hodrick (1992) find that the ratio of price to dividend or earnings has predictive power for excess returns. Fama and French (1988a) show that the explanatory power of dividend yield on returns strengthens as the horizon extends longer. Dividend yield typically explains less than 5% of monthly or quarterly return variations, but often explains more than 25 % of two- to four-year's return variations from 1927 to 1986. Similarly, using Standard and Poor Composite Index, Campbell and Shiller (1988) present that 3.9% of one-year's real return variations is explained by the log dividend-price ratio from 1871 to

1987. As return horizon extends to 3 and 10 years, the fraction of the variation explained by the log dividend-price ratio increases to 11.0% and 26.6%. Fama and French (1989) conclude that although D/P and E/P capture similar components of expected returns, t-stats and regression R-square suggest that D/P makes better forecasts of stock returns. Chen (1991) finds that the dividend yield D/P forecasts real and excess market returns over the next 2 years and its forecasting power diminishes toward the end of the second year. Cochrane (2008, 2011) draw the same conclusion on explanatory power of dividend yield for share returns over horizons.

Price and volume are simultaneously determined in equilibrium. The investors' trading process generates volatility in both price and volume. The real investing market might contain some information which is not included in macroeconomic variables. Chen, Roll, and Ross (1986) find that stock market index, although explaining a significant portion in time-series volatility of share returns, has an unsignificant influence on expected returns when it is combined with macroeconomic variables such as industrial production growth, the default premium, and the term structure in the model. But, Keim and Stambaugh (1986) find that when the seasonality is taken into account, the level of stock prices contains ex post information about the change in expected risk premia. Campbell and Hamao (1992) use lagged excess market return as well as macroeconomic variables, such as dividend-price ratio, relative short rate, and long-short yield spread, to investigate predictable stock returns in US and Japan Stock Market.

Return momentum and reversal show the existence of series autocorrelation in share prices, and imply the impact of lagged share return performance in different horizons on their subsequent returns. Daniel, Hirshleifer, and Subrahmanyam (1998), Hong and Stein (1999) apply investors' behavioural or cognitive biases to explain short-term price momentum in Jegadeesh and Titman (1993) and long-term price reversal in DeBondt and Thaler (1985, 1987). Daniel, Hirshleifer, and Subrahmanyam (1998) show that investors' unrational emotional movement leads to price momentum and reversal. Hong and Stein (1999) conclude that investors' initial underreaction and subsequent overreaction to information contribute to price momentum and reversal. Investors become overconfidence and overoptimistic in the rising market, which further drive common stock prices in the rising direction, vice versa.

In addition, at least two theoretical papers suggest that past trading volume may provide valuable information about the movement in share prices. Campbell, Grossman, and Wang (1993) present a model in which trading volume proxies for the aggregate demand of liquidity traders, and that price changes accompanied by high volume will tend to be reversed. Blume, David, and Maureen (1994) establish a model in which traders can learn valuable information about a security by observing both past price and past volume information, and conclude that volumes offer information that can not be deduced from the price performance. Empirical research supports the relation between trading volume and expected returns. Datar, Naik and Radcliffe (1998) show that shares with low (high) volume earn higher (lower) future returns. Lee and Swaminathan (2000) present that the interaction between past returns and trading volume can predict both the magnitude and the persistence of future price momentum.

2.2.2 Time-series return predictability in the international and UK Stock Market

Time series return predictability in other stock markets has been studied since the later 1980s. Campbell and Hamao (1992) find positive and negative impact of dividend-price ratio and the relative short interest rate (the difference between the current short interest rate and its one year backward moving average) on excess stock return in the Japan Stock Market from 1971 to 1990. Mukherjee and Naka (1995) use vector error correction model (VECM) to find a cointegrating relation between Tokyo Stock Exchange Index and six Japanese macroeconomic variables, such as exchange rate, money supply, inflation, industrial production, long-term government bond rate, and call money rate from 1971 to 1990. Nasseh and Strauss (2000) show significant long-run correlation between stock prices and domestic macroeconomic activity in six Europe countries, such as France, Italy, Netherlands, Switzerland, Germany, and UK. Domestic macroeconomic variables, including short-term interest rates, long-term interest rates, consumer prices, manufacturing orders, and real industrial production, can forecast 37% to 82% of the variation in four-year's share returns in these markets. Maysami and Koh (2000) find significant relation between the change in interest rate, exchange rate, and stock market level in the Singapore Stock Market. Bordo and Wheelock (2006) point out that most booms in ten developed stock markets were procyclical in the 20th century. The booms took place during the period of above-average GDP growth and below-average or falling inflation, and ended in the period of rising inflation and tightening monetary policy. Humpe and Macmillan (2007) present that Japan stock prices are positively associated to industrial production but negatively to money supply from 1965 to 2005. The unexpected money supply forecasts may be explained by Keynesian liquidity trap during the late 1990s and early 2000s, the period when increasing money supply and falling interest rates failed to boost Japanese economy and prevent its stock market from the decline.

Beenstock and Chan (1988) find that four risk factors, such as treasury bill rate, money supply, fuel and material costs, and inflation, significantly explain about 33% of the variation in expected share returns in the UK Stock Market from 1977 to 1983. Clare and Thomas (1994) show corporate default and retail price index are priced in the UK Stock Market from 1983 to 1990 when beta-sorted portfolios and size-sorted portfolios are tested by the model of Chen, Roll and Ross (1986). They find that market return contains information, which is not included in two macroeconomic forces, and captures significant risk premium in the size-sorted portfolios. In the test of CAPM and APT, Soufian (2001) finds that the explanatory power of market portfolio becomes unsignificant when some economic variables are regarded as risk factors, and that the change in yearly industrial production and unexpected inflation have significant impact on expected return in the overall period from 1980 to 1997 and two subperiods. Fletcher (2002) shows that the performance of the CAPM improves sharply when a proxy for labour income growth is added to the stock market index from 1975 to 2000. Fletcher and Hillier (2002) present that the combination of market index and other factors, such as term structure, monthly percentage change in industrial production and inflation, and the difference between risk-free return and inflation, can offer good predictability on UK stock returns. Gunsel and Cukur (2007) find that seven economic variables, such as term structure, unanticipated inflation, unanticipated industrial production, risk premium, exchange rate, money supply, unanticipated dividend yield, explain 28% to 79% of the variation in portfolio returns of 10 UK industries from 1980 to 2003.

2.3 The time-variation in return anomalies

Some studies argue that time-varying betas exist in the explanation of size effect and value effect. Jagannathan and Wang (1996), Lettau and Ludvigson (2001), Santos and Veronesi (2005) show that the betas of small-cap stocks and value stocks vary over business cycle. Brandt, Clara, and Valkanov (2009) note that the relation between firm characteristics (such as market capitalization, book-to-market ratio, lagged twelve-month return) and the joint distribution of returns is time-variant in estimating the coefficients of portfolio policy.

2.3.1 The time variation in return anomalies in the US Stock Market

By extending longer sample period and investigating pattern in subperiods, some empirical papers show that return anomalies are volatile, rather than stable, over time in the US Stock Market. Banz (1981) shows that size effect was not very stable through time, stronger from 1936 to 1945 and weaker from 1946 to 1955. Fraser (1995) further shows that prior to mid-1989 smaller companies consistently outperformed market portfolio but since then to October 1991 small-cap premium disappeared. The volatility also exists in value effect. It is found in Asness, Friedman, Krail, and Liew (2000) that value stocks sustain periods of poor performance although they on average beat growth stocks. Since 1982 there have been three major bear markets for value stocks: 1989-1990, 1995-1996, and 1998-1999. Ahmed, Lockwood, and Nanda (2002), Lucas, Dijk, and Kloek (2002) present that the impact of firm-specific characteristics like size and book-to-price on stock returns varies considerably over time. Teo and Woo (2004) find strong evidence for reversal and momentum at the style level in terms of large value and small growth. Cooper, Gulen and Rau (2005) point out that the variation in style effects over time is one important reason for style-originated investors to allocate risky assets into styles based on their past performance.

Since small-cap premium, value premium, and momentum premium were found in the later 1970s to the early 1990s, some studies have begun to link dynamic performance of return anomalies to different macroeconomic backgrounds and market conditions. Fama and French (1993) present that distressed firms, based on size and book-to-market ratio, may be more sensitive to certain business cycle factors. It is found in Jensen, Johnson, and Mercer (1998) that small-cap premium and value premium are stronger in expansionary monetary periods, but weak or negative in tightening ones. Coggin (1998) finds that it is possible to predict style index returns by conditioning such predictions on some outside macroeconomic information besides monthly returns. Perez-Quiros and Timmermann (2000) test the impact of macroeconomic variables, such as short interest rate, default spread, and money growth, on decile-sized portfolios, and conclude that excess return on the smallest portfolio is most strongly related with these variables. Lucas, Dijk, and Kloek (2002) show that investment styles have different performance in economic recession and expansion, and that over recessions investors load less on momentum stocks and more on small-cap stocks. Chordia and Shivakumar (2002) document that momentum payoffs are negative during recessions and positive during expansions, and that macroeconomic variables such as lagged dividend yield, default preimium, term structure, and three-month T-bill yield can explain momentum profit. However, with the decomposed buy-and-hold method, Liu and Strong (2008) replicate the research by Chordia and Shivakumar (2002), and find the difference in momentum payoffs between expansionary and contractionary periods is insiginificant (0.774%, t=1.05). Cohen, Polk and Vuolteenaho (2003) present that the expected value-minus-growth return is high when the value spread is wide. Vassalou (2003) comes to the conclusion that the mimicking portfolio related to future GDP growth is an important factor for explaining the cross-sectional returns of book-to-market and size portfolio. Asness, Moskowitz, and Pedersen (2009) report that value premium and momentum premium are both positively related to long-run consumption growth and both negatively related to recessions. Liu and Zhang (2008) document that the value spread (the log book-to-market of value stocks minus the log book-to-market of growth stocks) negatively correlates with default premium (-0.41) and short-term T-bill rate (-0.51).

Cooper, Gutierrez, and Hameed (2004) show that momentum profits depend on the lagged state of the market in the US Stock Market from 1929 to 1995, the significant positive (negative) profit following positive (negative) market return in past one to three years. Avramov and Chordia (2006), Avramov, Chordia, Jostova, and Philipov (2007) come to the same conclusion. L'Her, Mouakhar, and Roberge (2007) compare the predictive power of three approaches, which are recursive partitioning (RP), neural networks (NN), and genetic algorithm (GA), to correctly time the size premium, and find that with RP approach the most important variable (the first split criterion) in timing small-cap premium is the US Conference Board Coincident

Economic Indicators Index (COIN), and the second important factors (the next split criterion) are Dividend Yield of the S&P500 (DIV) and Six-Month momentum of the S&P500 (MOM). COIN and MOM are also the factors in NN approach that play the most important role in timing small-cap premium. L'Her, Mouakhar, and Roberge (2007) present that some information on market states, such as six-month index performance and one-month volume change in NYSE, can offer prediction on shifting time between large-cap stocks and small-cap ones.

2.3.2 The time variation in return anomalies in the international and UK Stock Market

Bird and Whitaker (2004) examine value and momentum effects in major European markets from 1990 to 2002, and find their large upward movement followed by a significant correction. They find that momentum effect occurred during the 1990s' running up market, and value effect was confined in the correction period. This shows pro-cyclical momentum effect and counter-cyclical value effect. Using 59 MSCI industry indices for the UK like the US and Japan, Babameto and Harris (2008) note that term spread significantly predicts the variation in momentum portfolio returns with a negative coefficient, the aggregate book-to-market ratio offers statistically significant explanatory power for the performance in value strategy with a positive coefficient. Hou, Karolyi, and Kho (2011) find that book-to-market effect in shares across 27 emerging countries is weaker in the period from 1992 to 2003 than the period from 1981 to 1992, and the opposite pattern for effects in terms of cash flow-to-price (C/P), dividend yield (D/P), and earnings yield (E/P).

The time-variation in return anomalies also exists in the UK Stock Market. As shown in Levis and Liodakis (1999), no obvious small-cap premium in the whole sample period from 1968 to 1997 results from quite different return performance of small-cap shares over periods. As opposite performance in the previous period, the large-cap portfolio yielded an average equal- (value-) weighted return of 13.28% (14.35%), 4.30 (6.30) percentage points higher than the return of the small-cap portfolio in the period from 1988 to 1997. Similarly, Dimson and Marsh (2001) show that although micro-cap equities had highest return in the UK from 1955 to 1999, the percentage of years in which large-cap equities outperformed micro-cap equities and small-cap equities is 22 percent, and small-cap premium disappeared from the 1980s to the 1990s. It is found in Dimson, Nagel, and Quigley (2003) that annual premium returns on the SMB (small minus big) and the HML (high BE/ME minus low BE/ME) zero-investment portfolio in the UK Stock Market have been volatile from 1955 to 2001.

The similar research investigates the relation between macroeconomic variables and time-varying return anomalies in the UK Stock Market. Fraser (1995) points out that the disappearance of small-cap premium in the London Stock Market in the early 1990s might be caused by UK economy's deep recession in this period. Levis and Liodakis (1999) show that small-cap stocks benefit from lower inflation rate and high dividend yield ratio, and that value stocks benefit from lower inflation rate and a fall in the monthly £/$ exchange rate from 1968 to 1997. One-month lagged value/growth return spread and monthly change in consumer price index are two significant variables on annual value/growth spread in the UK from 1968 to 1999.

Dimson and Marsh (2001) find that dividend yield and dividend growth explain the time-variation in size effect. Small-cap shares' higher dividend yield and dividend growth in 1955 to 1988 drive their return premium. In the following decade small-cap shares' declining dividend yield and dividend growth lead to the disappearance of small-cap effect. Fletcher (2001) examines the impact of lagged market performance and macroeconomic variables on decile size portfolio returns, and finds that lagged one month excess return of the Financial Times All Share Index and lagged one month risk-free return have statistically positive and negative significance impact on smaller-cap portfolio return more than large-cap portfolio return from 1955 to 1995. Although lagged dividend yield on the Financial Times All Share Index is generally unsignificant in 9 out of 10 portfolios, it has increasingly positive impact on the return from the first (the smallest market capitalization) portfolio to the tenth (the largest market capitalization) portfolio. The lagged FTA excess return has significantly positive impact on smaller-cap portfolio return more than large-cap portfolio return. Levis and Tessaromatis (2004) investigate the role of macroeconomic variables in growth-value spread based on FTSE100 and FTSE250 indices from 1987 to 2001, and document negative relation between default premium, term structure and growth-value return spread, and positive relation between dividend yield and the return spread. Dimson, Nagel, Quigley (2003) find that correlation in annual return between HML (high minus low BE/ME) portfolios and IMC (high minus low dividend yield) portfolios from 1956 to 2001 is 0.82. The reason for this high correlation is that although dividend yield in the UK Stock Market has declined since the mid-1980s, about 75 percent of listed shares still paid dividends in 2001. The market value of shares with dividend payment made up 95 percent of total market capitalization. Dividend yield explains the time-variation in cross-sectional return of HML. Zhang, Hopkins, Satchell, and Schwob (2009) offer the existence of positive relationship between SMB/HML and unexpected higher GDP, short term interest rates, and term spread, and negative (positive) relationship between SMB (HML) and unexpected inflation.

2.4 Concluding remarks

There was the voluminous research on the pattern of share prices in past one century. The early work based on the Random Walk Hypothesis (RWH), the Efficient Market Hypothesis (EMH), and the Capital Asset Pricing Model (CAPM) before the 1980s argues that the movement in share prices can not be predicted, and that it is impossible to outperform the aggregate market by picking stocks in cross-sectional dimension and time-taking in time-series dimension.

The theories of RWH, EMH, and CAPM have begun to face challenge from large number of empirical findings and the tests of CAPM since the later 1970s. Many studies have found the existence of return anomalies, such as momentum effect, size effect, and value effect in the US Stock Market and other markets. This means that cross-sectional share returns are related to firms' characteristics, and that investors could earn return premium by allocating positions on shares with specific characteristics.

In another dimension of share prices, empirical work in the 1960s and 1970s found the relation between money supply, inflation and aggregate market return. With the introduction of the Arbitrage Pricing Theory (APT) model in 1976, more studies have focused on the impact of macroeconomic forces on series share returns. This offers the possibility in time-taking by using macroeconomic variables associated with business cycles.

Since the mid-1990s, empirical work has found the unstable pattern of return anomalies as the sample period extends longer. Small-cap premium disappeared after the 1980s, and value stocks underperformed growth stocks in the later 1990s. In this context, it is accepted that small-cap premium and value premium is not invariant all the time. Since the 2000, some studies have begun to investigate time-varying style effects, and explored what factors lead to the variation. This drives the research on the combination of cross-sectional and series properties of expected returns.

Chapter 3 Data and Portfolio Formation

The research consists of four aspects of empirical work, that is to investigate the time-variation in relation between share returns and firm characteristics in the UK Stock Market, the impact of lagged macroeconomic variables on the variation, the performance of recursive in-sample regression model and out-of-sample forecasting model, and the application of active trading strategy on style effects. Followed by next four chapters on empirical analysis, this chapter introduces data description and portfolio formation used in the empirical work. The relevant data on macroeconomic variables is described in Chapter 5. The remainder of the chapter proceeds as followings. Section 3.1 is concerned on data, which describes data source, firm characteristics, and holding portfolio returns. Section 3.2 introduces portfolio formation for momentum effect, size effect, and value effect.

3.1Data

3.1.1 Data source

The research investigates time-varying style effects in the UK Stock Market. As other studies, the research classifies style effects into momentum effect, size effect, and value effect, which are relation between share returns and firm characteristics, such as lagged share return, market value, and price-to-book ratio. In practical application, some database, such as MSCI, FTSE, Russell, and Datastream, have published value/growth index and small/large index since the 1970s. A series of style-originated mutual funds in terms of small-/mid-/large-cap, value/growth have been launched. As a long-known style, momentum index has been edited and published by AQR Capital Management since 2009. Although a large number of funds based on value/growth and small/large-cap effects have been established for a long period, the first momentum fund was launched by AQR Capital Management in 2009.

The research uses the London Share Price Database (LSPD) to collect shares' monthly returns, share prices, share capitals, monthly market values, and delisting and suspended information. LSPD, which is maintained by the Institute of Finance and Accounting at London Business School, covers 9412 listed stocks in the UK Stock Market from 1955 to 2008. The return is adjusted for the change in capital structure and dividends. The research uses Datastream to collect shares' price-to-book values. Datastream is compiled by Thomson Financial Limited, and covers UK companies since 1965.

With LSPD, the research collects 9412 shares' monthly returns since 1955 to form decile momentum portfolios, and monthly market values of all shares after January 1979 onwards to form decile size portfolios. With Datastream, the research collects companies' price-to-book ratios to form decile value portfolios. LSPD and Datastream have different identification approaches for companies quoted on London Stock Exchange. LSPD allocates a unique identification number in a sequence from

1 for them since 1955. Datastream allocates a unique identification code with 6 characters for them since 1965. The research matches all companies' names in LSPD with ones in Datastream by hand. (10) After January 1980 onwards, 92.8 percent of company names in LSPD could be matched with ones in Datastream. Few companies in LSPD has corresponding price-to-book ratio in Datastream prior to January 1980. Therefore, in order to include shares as much as possible in the empirical analysis, the research investigates value effect at the beginning of the 1980.

The research splits the whole sample period from January 1955 to December 2008 into three subperiods, and establishes decile momentum portfolios according to relevant criteria in three subperiods. Dimson, Nagel, and Quigley (2003) note that in the first subperiod before 1975 the LSPD does not have full coverage of all companies, so the research uses random one-in-three of companies to form the portfolios prior to 1975. In the second subperiod from 1975 to 1979 and the third subperiod from 1980 to 2008, portfolio formation is based on the complete sample. In three subperiods, investment trusts are excluded to avoid double counting and ensure a purer measure on return performance in UK equities because investment trusts invest in other equities and other assets. In the third subperiod, three kinds of shares, which are secondary shares, odd foreign mining and banking shares, Irish, Scottish, and odd companies, are excluded by using data in LSPD archive file.

3.1.2 Firm characteristics

The research uses firm characteristics in terms of lagged share return, market value, and price-to-book ratio to construct decile style portfolios, and examines the relation between firm characteristics and share returns in holding horizons.

- lagged share return in momentum portfolios

The research examines momentum effect, which is measured by share returns in past 6/12 months and their subsequent holding returns. Lehmann (1990) and Jegadeesh (1990) examine the performance of trading strategies based on one week and one month return, respectively, and find that these short horizon strategies yield contrarian profits over the next one week and one month. The research uses two approaches, namely unskipping one month and skipping one month between the formation period and the holding period, to construct momentum portfolios, and to observe the impact of monthly price reversal on momentum effect as robustness test. In the case of unskipping one month, the research uses equation (3.1) and (3.2) to calculate all shares' compounded return $r_{-1\sim-6}$ in the month t-1 to the month t-6, and compounded return $r_{-1\sim-12}$ in the month t-1 to the month t-12 to form decile momentum portfolios. In the case of skipping one month, the research uses equation (3.1') and (3.2') to calculate all shares' compounded return $r_{-2\sim-6}$ in the month t-2 to the month t-6, and compounded return $r_{-2\sim-12}$ in the month t-2 to the month t-12 to form decile momentum portfolios.

$$r_{i,-1\sim-6} = \prod_{t=-1}^{-6}(1+r_{i,t})-1 \quad (3.1)$$

$$r_{i,-2\sim-6} = \prod_{t=-2}^{-6}(1+r_{i,t})-1 \quad (3.1')$$

$$r_{i,-1\sim-12} = \prod_{t=-1}^{-12}(1+r_{i,t})-1 \quad (3.2)$$

$$r_{i,-2\sim-12} = \prod_{t=-2}^{-12}(1+r_{i,t})-1 \quad (3.2')$$

The research conducts empirical work on momentum effect with 6/12 months' formation return and five holding horizons. It compares the performance of average monthly Winner/Loser return R_{wml} between skipping and unskipping one month in the formation period. Table 3.1 and Table 3.2 show that over five holding horizons, Winner/Loser return R_{wml} based on the approach of skipping one month in portfolio formation is higher than one without skipping one month, and that the percentage of observations with positive Winner/Loser return R_{wml} in the skipping case is higher than one in the unskipping case. The difference in Winner/Loser return R_{wml} and the percentage of $R_{wml}>0$ between the skipping case and the unskipping case becomes small as holding length extends from 3 months to 24 months. The impact by skipping one month in momentum formation declines when the holding length becomes longer. In addition, in Chapter 4 the research finds high correlation in empirical result between the skipping approach and the unskipping approach, with more than 0.92 for most ‘Winner’ return and ‘Loser’ return, more than 0.82 for most Winner/Loser Return R_{wml}, and more than 0.87 for most momentum coefficient γ_{mom}, as shown in Table 4.8. Therefore, in order to obtain conservative estimation on momentum effect, the research does not skipping one month between the formation period and the holding period to construct momentum portfolios in the empirical analysis in the following chapters.

[Table 3.1, 3.2]

- Market value in size effect and value-weighted portfolios

The research uses the archive of monthly share market capitalization in LSPD database to form decile size portfolios after January 1979 onwards, and to examine monthly-by-monthly size effect. In addition, shares’ market values are used to construct value-weighted momentum portfolios, size portfolios, and value portfolios from January 1979 to December 2008.

- Price-to-book ratio in value effect

The research collects all shares’ price-to-book ratios from Datastream to investigate value effect after January 1980 onwards. Because of different share codes for

Datastream and LSPD, the research matches all shares' names in two databases. After the year of 1980, 92.8 percent of shares in LSPD could be matched in Datastream. The research excludes shares with negative price-to-book ratio in empirical work.

3.1.3 Holding portfolio returns

The research makes two corrections to shares' missing monthly returns in LSPD. Firstly, Shumway (1997) finds that most of missing delisting returns in CRSP database correspond to surprise delists due to bankruptcy and other negative reasons. They are often worthless when they delist, and yield average delisting return of -30 percent in actual US Share Market. He documents that introducing -1 to missing delisting returns leads to the large decline in the return of small-cap portfolio in declie size portfolios and loser portfolio in decile momentum portfolios. This implies that empirical results on size effect and momentum effect might be biased if missing delisting returns are omitted. Following the approach in Dimson, Nagel, and Quigley (2003), the research uses an upper bound for the delisting bias to assign -1 for missing delisting returns in LSPD at the death event date where the LSPD code indicates valueless death. Secondly, except shares with missing return due to valueless death, some shares have missing returns with death or a temporary suspension. Following the approach of Liu and Strong (2008), the research assigns a zero value for these shares returns when they have missing return observation.

With two reasons, the research investigates the relation between firm characteristics and share returns in five holding horizons, such as 3, 6, 12, 18, and 24 months. Firstly, style-originated investors in the market always have a preference for different holding horizons, including short-/medium-/long-term, because of the variation in their trading psychology and behaviour, risk exposure, and asset patterns. It is rational to explore the variation in style effects with different holding horizons. Secondly, the forecasting power of lagged informative variables for share returns with different holding horizons is not invariant. For example, some macroeconomic variables, such as the dividend yield and the term structure, have stronger explanatory power in longer holding period than in shorter one because they are largely measures of long-term business cycles. Fama and French (1989) find that the R-square for regression of expected stock returns on the dividend yield and the default spread tends to increase with longer holding period. It is typically less than 0.1 for monthly and quarterly returns, but is often greater than 0.3 for one- to four-year's return. Cochrane (2008, 2011) further supports the same conclusion on the dividend yield. With the equation (3.3), the research calculates shares' compounded buying-and-holding returns in five holding horizons.

$$r_{i,1\sim 3(6,12,18,24)} = \prod_{t=1}^{3(6,12,18,24)} (1 + r_{i,t}) - 1 \qquad (3.3)$$

The research calculates equal-weighted portfolio holding returns and value-weighted portfolio holding returns, respectively. Equal-weighted portfolio returns are weighted toward small shares, and value-weighted ones are affected more by large shares. Two kinds of holding returns offer a better way to examine the performance of share returns as a function of share size, especially in momentum effect and value effect. With monthly market value since 1979 from LSPD archive, the research calculates all shares' value weighting to examine value-weighted momentum, size, and value effect January 1979 afterwards.

The investigation on value-weighted momentum effect from 1955 to 1978 is limited by the collection of monthly share market value. LSPD database offers the archive of annual market value of all shares. Market values of many shares in this archive are set to be 0 or 1 because of rounding off and the expression with million. This leads to the same market values for some shares, and makes impossible to form value-weighted decile momentum portfolios by number of shares. For example, at the end of 1955, among 1073 shares, 564 shares have market value of 0, and 252 shares have market value of 1. To deal with this issue, the research multiplies annual share capital by monthly share price in LSPD as monthly market value. This approach ignores the capital change of some shares during one year, so the result on value-weighted momentum effect prior to 1979 might be biased.

3.2 Portfolio formation

The research examines the time-variation in style effects based on firm characteristics in the UK Stock Market. The research uses shares' individual firm characteristics to establish decile portfolios, and then examines the variation in relation between firm characteristics and equal/value-weighted holding portfolio returns with five holding horizons of 3, 6, 12, 18, and 24 months.

3.2.1 Momentum portfolio formation

LSPD offer monthly share returns after January 1955 onwards, the research investigates monthly-on-monthly momentum effect with 6 and 12 months' formation lengths, respectively, in the UK Stock Market from 1955 to 2008. For momentum effect with 6 months' formation length, depending on magnitudes of their lagged 6 months' compounded returns in the formation period, all shares are ranked from the lowest to the highest each month, and then decile momentum portfolios with the same number of shares are formed. The first portfolio contains shares with lowest formation return, and is designated as 'Loser' portfolio. The tenth portfolio contains shares with highest formation return, and is designated as 'Winner' portfolio. Similar approach is used to form decile momentum portfolios based on lagged 12 months' compounded share returns.

In the overall sample period, there are 648 months from January 1955 to December 2008. After excluding the first month with no share returns, the research uses 6 months from February 1955 to July 1955 to form the first decile momentum portfolios in the sample period. It rolls this portfolio formation forward each month, and uses last 3, 6, 12, 18, and 24 months as five holding horizons for the last decile momentum portfolios at the end of the sample period. The research has 639, 636, 630, 624, and 618 overlapping sample observations for momentum effect with 6 months' formation length and 3, 6, 12, 18, and 24 months' holding horizon, respectively, until the end of 2008. When momentum portfolios are based on lagged 12 months' shares returns, the first decile momentum portfolios are formed in January 1956, and there are 633, 630, 624, 618, and 612 overlapping sample observations for momentum effect with 12 months' formation length and five holding horizons, respectively. Table 3.3 shows that there are an average 1662 to 1682 (1615 to 1638) shares to construct equal-(value-) weighted momentum portfolios based on lagged 6 months' share returns and five holding horizons, and an average 1572 to 1587 (1540 to 1558) shares to construct equal-(value-) weighted momentum portfolios based on lagged 12 months' share returns and five holding horizons.

[Table 3.3]

3.2.2 Size portfolio formation

LSPD offers the archive of monthly market values of all shares after January 1979 onwards, so the research examines size effect monthly-on-monthly from 1979 to 2008. Each month all shares are ranked from the lowest to the highest according to their market values. The first and tenth portfolios include the smallest companies and the largest companies, and are designated as 'Small' portfolio and 'Large' portfolio, respectively. The first decile size portfolios are formed in the end of January 1979, and there are 357, 354, 348, 342, and 336 overlapping sample observations for size effect with five holding horizons of 3, 6, 12, 18, and 24 months until the end of 2008. Table 3.3 shows that there are an average 1785 to 1822 shares to construct equal- (value-) weighted size portfolios with five holding horizons.

- Two approaches to form decile size portfolios

In academic and practical field, there are two approaches to establish decile size portfolios on number of shares and market capitalization, respectively. After ranking all shares' market values from the lowest to the highest, CRSP (Center for Research in Security Prices) defines decile portfolios with same number of shares. Similarly, Ibbotson Associtres uses the number of shares to construct a set of size indices. The breakpoints for size portfolios are defined by grouping the largest 20 percent shares for large-cap index, the next 30 percent for mid-cap index, the next 30 percent for small-cap index, and the smallest 20 percent for micro-cap index. In contrast, Dimson and Marsh (2001) apply market capitalization deciles to establish micro-cap, small-cap, and large-cap indices.

With Dimson and Marsh (2001) approach, the research establishes decile size portfolios based on cumulative market capitalization, rather than number of shares, for three reasons. Firstly, FTSE small-cap index is based on the bottom 10% by market capitalization of each market. To construct decile size portfolios on market capitalization, the research maximizes its comparability with FTSE cap indices. Secondly, because empirical data shows that most companies in the UK Stock Market have low market value, it is necessary to apply the approach of market capitalization decile to classify small companies into the 1st and the 2nd portfolios, which captures small-cap effect. Thirdly, it is found in Table 3.4 that decile size portfolios constructed by equal number of shares leads to dynamic distribution in the market value between the 1st (small-cap) portfolio and the 10th (large-cap) portfolio. Especially, the 2nd and 11th columns in Table 3.4 show that the percentage of small-cap portfolio among overall market capitalization increases from 0.034% in 1969 to 0.158% in 1989, and that the percentage of large-cap portfolio among overall market capitalization declines from 86.93% to 79.01%. After 1989, they have opposite variation over time. Figure 3.1 and Figure 3.2 reflect the opposite trendline in the distribution of small-cap portfolio and large-cap portfolio among overall market capitalization in the period of 1969 to 1989 and afterwards. The unstable distribution in market value of small-cap portfolio and large-cap portfolio over time might lead to biased empirical result on size effect if same number of shares is allocated in decile size portfolios.

[Table 3.4]

[Figure 3.1, 3.2]

With Dimson and Marsh (2001) approach, decile size portfolios are constructed according to the fixed % market value banding after ranking all shares' market values from the lowest to the highest each month. The fixed % market value banding for the 1st, 2nd, 3rd through 8th, 9th and 10th portfolios are 1%, 9%, 10%, 15% and 15%, respectively.

- Adjusted Dimson and Marsh (2001) approach to form decile size portfolios

However, Dimson and Marsh (2001) approach raises another issue, that is not enough number of shares in some portfolios. Table 3.5 shows that there are less than 10 shares in the 5th to 10th portfolios in some years. Especially, there are only 1 or 2 shares in the 8th, 9th, and 10th portfolios. In order to overcome this limitation, the research adjusts Dimson and Marsh (2001) approach to ensure each formation: at least 10 large shares and more in the 8th, 9th, and 10th portfolio; small-cap shares in the 1st and the 2nd portfolios with fixed market value banding. Because the 8th, 9th, and 10th portfolio must include at least 10 large shares, it has flexible market value banding over time. Therefore, with adjusted Dimson and Marsh (2001) approach, the research constructs decile size portfolios with fixed and flexible % market value banding from the 1st portfolio to the 10th portfolio.

[Table 3.5]

As shown in Table 3.6, when 10 large shares are allocated in the 8th, 9th, and 10th portfolio, its average % market value banding is 7.3%, 11.5%, 37.5%, respectively. If the fixed % market value banding for the 1st and 2nd portfolio is 1% and 9% as ones in Dimson and Marsh (2001), the 1st, 2nd, 8th, 9th and 10th portfolios account for 66.3 percent of overall market capitalization. Then only 33.7 percent of overall market capitalization is allocated to the 3rd to 7th portfolio, average 6.7% market value banding for them. This leads to % market value banding of the 2nd portfolio higher than the 3rd to 7th portfolio. Therefore, the research further reduces % market value banding of the 2nd portfolio from 9% to 4%, and allocates 38.7 percent of overall market capitalization to the 3rd to 7th portfolio, average 7.7% market value banding for them.

Table 3.6 shows the comparison in % market value banding between Dimson and Marsh (2001) approach and adjusted Dimson and Marsh (2001) approach. Dimson and Marsh (2001) approach applies the fixed 10% and 15% market value banding to form the 3rd to 10th portfolio, which leads to 1 or 2 shares in the 8th, 9th, and 10th portfolio. To adjust Dimson and Marsh (2001) approach, the research increases average % market value banding of the 10th (large-cap) portfolio and decrease average % market value banding of the 2nd to 9th portfolio in order to ensure at least 10 shares in the 8th, 9th, and 10th portfolio each month. Because the percentage of the 8th, 9th, and 10th portfolio among overall market capitalization volatiles over time, % market value banding of the 3rd to 7th portfolio is flexible in the allocation of at least

10 shares in the 8th, 9th, and 10th portfolio. Therefore, decile size portfolios with adjusted Dimson and Marsh (2001) approach consists of the 1st and 2nd portfolio with fixed 1% and 4% market value banding, and the 3rd to 10th portfolio with flexible % market value banding.

[Table 3.6]

As shown in Table 3.7, decile size portfolios with adjusted Dimson and Marsh (2001) approach are summarized as following criteria:

- fixed 1% and 4% market value banding in the 1st and the 2nd portfolio each month; average 41.3% of all shares included in the 1st portfolio and average 29.8% of all shares included in the 2nd portfolio, which reflects that most shares in the UK Stock Market have low market value;
- average 7.3% to 8.1% flexible market value banding in the 3rd through the 8th portfolio (similar to 10% market value banding in the 3rd through the 8th portfolio in Dimson and Marsh (2001) approach) , minimum % market value banding between 4.3% to 4.7% and maximum % market value banding between 10.1% to 11.5%;
- average 11.5% and 37.5% flexible market value banding in the 9th and 10th portfolio to ensure at least 10 large shares in the 8th, 9th, and 10th portfolio each portfolio formation. 10 largest shares in the 10th portfolio account for 22.9 to 56.7 percent of overall market capitalization over time.

[Table 3.7]

3.2.3 Value portfolio formation

The research collects shares' price-to-book ratio (pb) from Datastream. Because there are few companies with price-to-book ratio prior to January 1980, the research explores monthly-on-monthly value effect in the UK Stock Market from 1980 to 2008. It excludes shares with negative pb. After ranking all shares' price-to-book ratios according to ascending order at the end of months, the research establishes decile value portfolios with same number of shares. The shares on the binding between two portfolios, especially for 1st to 3rd portfolios with lower price-to-book ratios, have the same pb. The research assigns the share with the same pb in the i^{th} portfolio into the $(i-1)^{th}$ portfolio on the binding between two portfolios, which leads to slight difference in number of shares each value portfolio. For instance, Table 3.8 shows monthly distribution in the number of shares for decile value portfolios with 12 months' holding horizon when the first (last) decile portfolios are constructed in January 1980 (December 2007). The table presents slightly different number of shares from the 1st portfolio to the 10th portfolio each month. The first portfolio with low price-to-book ratio is designed as 'Low' portfolio. Conversely, the tenth portfolio with high price-to-book ratio is designed as 'High' portfolio.

[Table 3.8]

There are 348 months in the overall sample period from January 1980 to December 2008. The first decile value portfolio is formed in the end of December 1979. The research rolls decile value portfolio formation forward each month, and uses last 3, 6, 12, 18, and 24 months as five holding horizons for the last decile value portfolios until the end of 2008. The research has 345, 342, 336, 330, and 324 overlapping sample observations for value effect with 3, 6, 12, 18, and 24 months' holding horizon, respectively. Table 3.3 shows that there are an average 1528 to 1647 (1148 to 1191) shares to construct equal-(value-) weighted value portfolios with five holding horizons.

Appendix: tables and figures in Chapter 3

Table 3.1 The performance of average monthly Winner/Loser return R_{wml} based on lagged 6 months' formation: skipping one month (i-2 to i-6) and unskipping one month (i-1 to i-6)

Panel A Equal-weighted

	R_{wml} (%)			% R_{wml} >0		
Holding months	Skipping	Unskipping	Difference	Skipping	Unskipping	Difference
3	0.80	0.02	0.78	66.7	53.4	13.3
6	0.93	0.54	0.39	73.0	64.0	9.0
12	0.73	0.56	0.17	75.7	70.2	5.5
18	0.39	0.21	0.18	67.3	62.0	5.3
24	0.31	0.12	0.19	62.9	57.6	5.3

Panel B Value-weighted

	R_{wml} (%)			% R_{wml} >0		
Holding months	Skipping	Unskipping	Difference	Skipping	Unskipping	Difference
3	1.27	0.76	0.51	65.6	59.9	5.7
6	1.18	0.94	0.24	71.1	64.0	7.1
12	0.93	0.82	0.11	72.1	70.8	1.3
18	0.46	0.34	0.12	63.6	62.2	1.4
24	0.41	0.41	0.00	62.9	61.3	1.6

Note: The table reports the the performance of average monthly Winner/Loser return R_{wml} with lagged 6 months' share returns: skipping one month and unskipping one month between the formation period and the holding period. Winner/Loser return R_{wml} is estimated by the return spread between 'Winner' portfolio and 'Loser' portfolio. '% R_{wml} >0' denotes the percentage having positive Winner/Loser return R_{wml} in all observations.

Table 3.2 The performance of average monthly Winner/Loser return R_{wml} based on lagged 12 months' formation: skipping one month (i-2 to i-12) and unskipping one month (i-1 to i-12)

Panel A Equal-weighted

	R_{wml} (%)			% R_{wml} >0		
Holding months	Skipping	Unskipping	Difference	Skipping	Unskipping	Difference
3	1.06	0.51	0.55	70.6	61.9	8.7
6	1.01	0.74	0.27	74.9	70.5	4.4
12	0.50	0.40	0.10	70.2	67.5	2.7
18	0.26	0.16	0.10	64.1	62.8	1.3
24	0.03	-0.09	0.12	56.7	54.6	2.1

Panel B Value-weighted

	R_{wml} (%)			% R_{wml} >0		
Holding months	Skipping	Unskipping	Difference	Skipping	Unskipping	Difference
3	1.33	0.97	0.36	67.6	61.1	6.5
6	1.16	0.98	0.18	71.7	66.3	5.4
12	0.57	0.55	0.02	66.3	66.2	0.1
18	0.28	0.23	0.05	61.7	62.0	-0.3
24	0.12	0.11	0.01	55.2	56.7	-1.5

Note: The table reports the the performance of average monthly Winner/Loser return R_{wml} with lagged 12 months' share returns: skipping one month and unskipping one month between the formation period and the holding period. Winner/Loser return R_{wml} is estimated by the return spread between 'Winner' portfolio and 'Loser' portfolio. '% R_{wml} >0' denotes the percentage having positive Winner/Loser return R_{wml} in all observations.

Table 3.3 The average number of shares in the sample period in the investigation of momentum, size, and value effect

	Momentum effect (6)		Momentum effect (12)		Size effect		Value effect	
Holding months	EW	VW	EW	VW	EW	VW	EW	VW
3	1682	1638	1587	1558	1822	1822	1647	1191
6	1680	1635	1584	1555	1817	1817	1630	1186
12	1673	1628	1579	1549	1807	1807	1597	1175
18	1668	1621	1575	1544	1795	1795	1563	1161
24	1662	1615	1572	1540	1785	1785	1528	1148

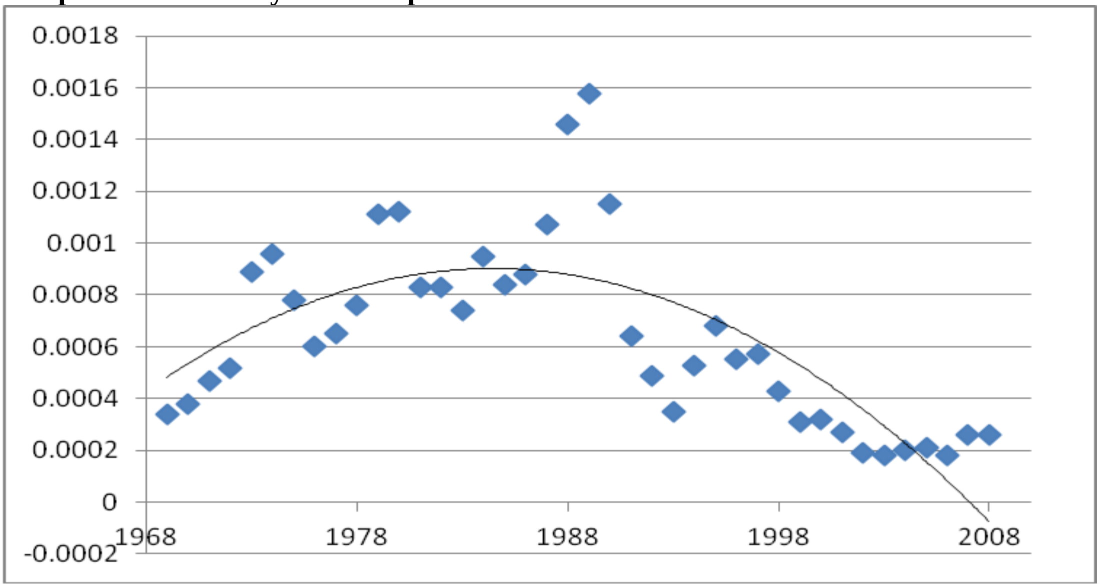
Note: The table reports the average number of shares in the sample period in the investigation of momentum, size, and value effect with five holding horizons. Momentum effect(6) and Momentum effect(12) stand for momentum portfolios based on shares' returns in lagged 6 and 12 months, respectively. EW and VW stands for equal-weighed portfolio and value-weighted portfolio, respectively.

Table 3.4 The percentage of decile size portfolios based on number of shares in overall market capitalization

Year	Small	2nd	3rd	4th	5th	6th	7th	8th	9th	Large
1956	0.00086	0.00207	0.00369	0.00618	0.00924	0.01385	0.02226	0.03807	0.07696	0.82683
1957	0.00088	0.00203	0.00349	0.00551	0.00808	0.01168	0.01957	0.03391	0.07043	0.84443
1958	0.00088	0.00225	0.00375	0.00602	0.00846	0.01236	0.02014	0.03535	0.07024	0.84055
1959	0.00066	0.00177	0.00321	0.00524	0.00817	0.01224	0.02074	0.03627	0.07837	0.83333
1960	0.00063	0.00182	0.00343	0.00561	0.00866	0.01341	0.02164	0.03664	0.07835	0.82981
1961	0.00079	0.00203	0.00395	0.00630	0.00955	0.01462	0.02309	0.03952	0.08112	0.81905
1962	0.00063	0.00191	0.00381	0.00585	0.00928	0.01395	0.02228	0.03803	0.08060	0.82368
1963	0.00062	0.00191	0.00390	0.00614	0.00985	0.01528	0.02369	0.04040	0.08067	0.81754
1964	0.00066	0.00214	0.00438	0.00711	0.01069	0.01664	0.02599	0.04264	0.07625	0.81350
1965	0.00068	0.00248	0.00481	0.00749	0.01097	0.01701	0.02648	0.04208	0.07566	0.81235
1966	0.00070	0.00224	0.00446	0.00704	0.01046	0.01599	0.02516	0.04089	0.07466	0.81840
1967	0.00056	0.00188	0.00376	0.00598	0.00898	0.01431	0.02210	0.03571	0.06659	0.84013
1968	0.00048	0.00157	0.00317	0.00513	0.00773	0.01229	0.02000	0.03318	0.06392	0.85253
1969	0.00034	0.00131	0.00267	0.00446	0.00677	0.01054	0.01752	0.02859	0.05850	0.86932
1970	0.00038	0.00140	0.00275	0.00429	0.00630	0.01046	0.01705	0.02894	0.06164	0.86678
1971	0.00047	0.00157	0.00288	0.00429	0.00643	0.01019	0.01646	0.02880	0.06337	0.86554
1972	0.00052	0.00181	0.00347	0.00545	0.00841	0.01291	0.02043	0.03506	0.07270	0.83924
1973	0.00089	0.00229	0.00393	0.00602	0.00860	0.01309	0.01998	0.03436	0.07055	0.84028
1974	0.00096	0.00257	0.00427	0.00628	0.00885	0.01313	0.01999	0.03311	0.07230	0.83854
1975	0.00078	0.00196	0.00338	0.00503	0.00764	0.01106	0.01621	0.02649	0.06715	0.86031
1976	0.00060	0.00168	0.00298	0.00480	0.00730	0.01158	0.01900	0.03459	0.08364	0.83384
1977	0.00065	0.00163	0.00276	0.00444	0.00707	0.01136	0.01742	0.03126	0.07892	0.84449
1978	0.00076	0.00193	0.00347	0.00580	0.00936	0.01475	0.02296	0.04193	0.10395	0.79510
1979	0.00111	0.00268	0.00435	0.00689	0.01085	0.01655	0.02437	0.04344	0.10112	0.78866
1980	0.00112	0.00251	0.00419	0.00675	0.01049	0.01538	0.02383	0.04199	0.09599	0.79777
1981	0.00083	0.00191	0.00328	0.00521	0.00809	0.01281	0.02088	0.04035	0.09662	0.81005
1982	0.00083	0.00195	0.00336	0.00527	0.00839	0.01329	0.02203	0.04266	0.10347	0.79876
1983	0.00074	0.00170	0.00295	0.00468	0.00713	0.01178	0.02009	0.03770	0.09938	0.81385
1984	0.00095	0.00209	0.00360	0.00554	0.00848	0.01279	0.02041	0.04074	0.09979	0.80561
1985	0.00084	0.00194	0.00330	0.00535	0.00799	0.01227	0.01980	0.03906	0.09493	0.81452
1986	0.00088	0.00206	0.00343	0.00533	0.00780	0.01236	0.01983	0.03649	0.09624	0.81559
1987	0.00107	0.00238	0.00379	0.00559	0.00815	0.01255	0.02129	0.03882	0.09282	0.81354
1988	0.00146	0.00305	0.00463	0.00669	0.00986	0.01487	0.02445	0.04305	0.09848	0.79347
1989	0.00158	0.00323	0.00499	0.00720	0.01056	0.01640	0.02522	0.04310	0.09757	0.79016
1990	0.00115	0.00235	0.00359	0.00548	0.00783	0.01191	0.01953	0.03539	0.09049	0.82228
1991	0.00064	0.00144	0.00233	0.00368	0.00573	0.00879	0.01536	0.03146	0.08359	0.84698
1992	0.00049	0.00114	0.00202	0.00342	0.00546	0.00886	0.01733	0.03520	0.09567	0.83041
1993	0.00035	0.00081	0.00155	0.00270	0.00439	0.00774	0.01532	0.03300	0.09474	0.83940
1994	0.00053	0.00123	0.00234	0.00406	0.00649	0.01064	0.01876	0.03575	0.09880	0.82141
1995	0.00068	0.00163	0.00294	0.00483	0.00764	0.01227	0.01959	0.03756	0.09798	0.81487
1996	0.00055	0.00133	0.00253	0.00429	0.00686	0.01134	0.01882	0.03501	0.09196	0.82731
1997	0.00057	0.00136	0.00251	0.00421	0.00656	0.01085	0.01788	0.03419	0.08570	0.83618
1998	0.00043	0.00104	0.00195	0.00330	0.00512	0.00856	0.01499	0.02823	0.07176	0.86463
1999	0.00031	0.00074	0.00135	0.00220	0.00348	0.00616	0.01147	0.02153	0.05211	0.90066
2000	0.00032	0.00076	0.00133	0.00229	0.00389	0.00717	0.01295	0.02439	0.06052	0.88639
2001	0.00027	0.00065	0.00115	0.00202	0.00332	0.00613	0.01119	0.02216	0.05463	0.89849
2002	0.00019	0.00050	0.00093	0.00151	0.00264	0.00449	0.00929	0.01922	0.05157	0.90967
2003	0.00018	0.00049	0.00089	0.00144	0.00247	0.00465	0.00900	0.01981	0.05296	0.90811
2004	0.00020	0.00056	0.00111	0.00197	0.00336	0.00590	0.01156	0.02430	0.06383	0.88720
2005	0.00021	0.00061	0.00116	0.00206	0.00350	0.00617	0.01141	0.02252	0.06349	0.88887
2006	0.00018	0.00051	0.00110	0.00195	0.00311	0.00539	0.01000	0.01980	0.05701	0.90094
2007	0.00026	0.00076	0.00140	0.00234	0.00391	0.00674	0.01199	0.02246	0.06292	0.88723
2008	0.00026	0.00070	0.00133	0.00237	0.00385	0.00629	0.01135	0.02128	0.05414	0.89843
Average	0.00065	0.00167	0.00298	0.00474	0.00725	0.01139	0.01868	0.03371	0.07862	0.84032

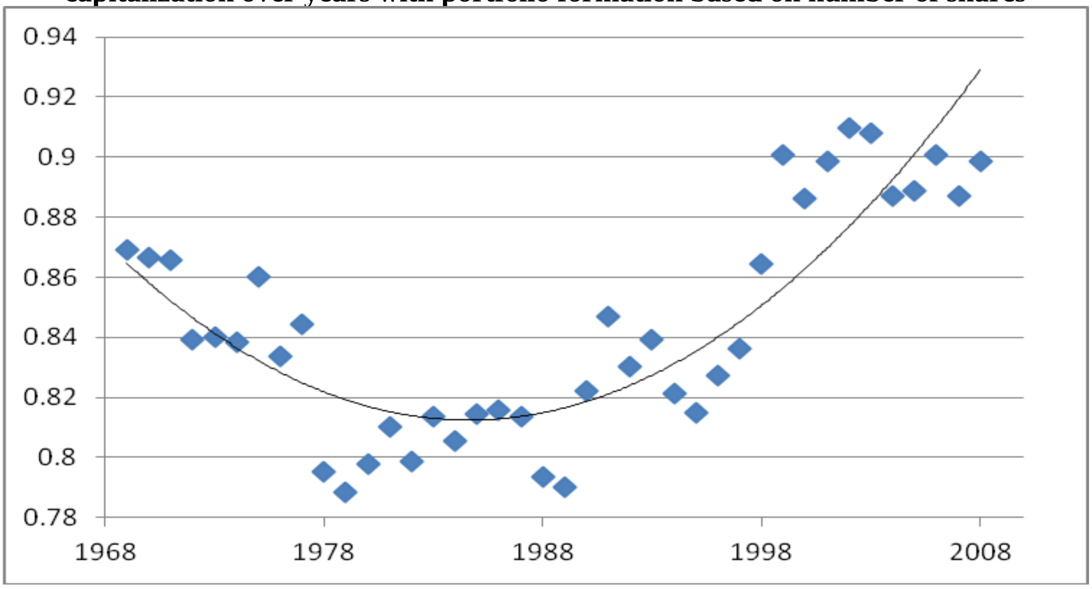
Note: At the end of each year decile size portfolios are formed with the same number of shares after ranking all shares' market values from the smallest to the largest

Figure 3.1 The percentage of the 1st (small-cap) portfolio among overall market capitalization over years with portfolio formation based on number of shares



Note: The figure plots annual percentage of the 1st (small-cap) portfolio among overall market capitalization from 1968 to 2008. At the end of each year decile size portfolios are formed with the same number of shares after ranking all shares' market values from the lowest to the highest.

Figure 3.2 The percentage of the 10th (large-cap) portfolio among overall market capitalization over years with portfolio formation based on number of shares



Note: The figure plots annual percentage of the 10th (large-cap) portfolio among overall market capitalization from 1968 to 2008. At the end of each year decile size portfolios are formed with the same number of shares after ranking all shares' market values from the lowest to the highest.

Table 3.5 The number of shares in decile size portfolios with Dimson and Marsh (2001) approach

Year	Small	2nd	3rd	4th	5th	6th	7th	8th	9th	Large
1956	855	118	48	25	9	5	1	1	1	1
1957	879	108	43	17	8	3	1	0	1	1
1958	846	112	43	20	9	5	1	1	1	1
1959	829	101	41	22	9	4	2	1	1	1
1960	808	101	41	23	10	5	2	1	1	2
1961	768	107	42	23	12	6	4	2	1	1
1962	783	105	39	21	13	7	4	2	1	2
1963	772	112	40	21	12	7	3	2	1	1
1964	748	126	45	22	12	8	3	2	1	1
1965	760	131	48	22	12	7	4	1	1	1
1966	762	124	44	20	12	7	3	2	1	1
1967	773	109	34	17	9	5	3	1	1	1
1968	769	91	30	15	8	5	3	1	1	1
1969	757	73	26	11	6	3	2	0	1	1
1970	719	72	25	12	7	4	1	1	1	1
1971	694	67	21	12	7	5	1	1	1	1
1972	633	80	26	15	9	5	3	2	1	1
1973	608	78	25	13	7	5	3	1	1	1
1974	583	73	25	13	9	5	4	2	1	1
1975	591	54	20	12	6	4	2	2	1	1
1976	1854	196	76	41	26	17	10	7	4	2
1977	1761	173	69	37	23	16	9	5	2	2
1978	1580	196	82	47	30	19	12	8	4	2
1979	1501	213	87	49	31	19	11	7	4	3
1980	1452	201	81	44	30	17	11	7	3	2
1981	1361	160	68	39	23	16	11	7	2	2
1982	1365	163	72	40	24	17	11	8	4	2
1983	1389	145	65	37	22	15	10	6	3	3
1984	1374	161	69	40	24	15	11	7	4	3
1985	1411	160	64	37	24	16	10	6	4	2
1986	1442	157	65	34	23	16	11	6	5	3
1987	1435	172	67	36	24	17	11	6	4	3
1988	1421	201	76	42	26	19	13	9	5	3
1989	1430	214	81	41	27	20	14	9	5	3
1990	1480	162	63	35	23	17	10	7	5	3
1991	1438	124	51	28	19	14	9	6	4	3
1992	1320	116	53	30	20	11	8	5	4	3
1993	1276	102	49	30	17	11	8	6	4	3
1994	1258	117	51	32	21	14	9	6	5	3
1995	1315	136	57	35	23	14	10	7	5	4
1996	1432	139	58	32	21	14	9	7	5	3
1997	1515	148	59	31	21	15	9	7	4	3
1998	1588	133	47	28	19	13	8	5	3	3
1999	1585	87	36	21	15	9	7	3	3	2
2000	1453	101	37	22	15	9	5	3	2	2
2001	1554	93	38	20	12	7	4	2	1	2
2002	1535	84	35	19	11	5	3	2	1	2
2003	1478	82	31	16	9	6	3	2	1	2
2004	1411	95	38	20	11	6	4	2	1	2
2005	1591	105	43	22	12	7	4	3	1	2
2006	1846	112	44	23	11	7	4	3	2	2
2007	1935	134	51	27	14	8	6	3	3	2
2008	1985	133	48	23	9	7	5	4	2	2

Note: With Dimson and Marsh (2001) approach, decile size portfolios are formed according to the fixed % market value banding after ranking all shares' market values from the lowest to the highest each year. The fixed % market value banding for the 1st, 2nd, 3rd through 8th, 9th and 10th portfolios are 1%, 9%, 10%, 15% and 15%, respectively.

Table 3.6 The comparison in % market value banding between Dimson and Marsh (2001) approach and adjusted Dimson and Marsh (2001) approach.

Portfolio	DM(2001) approach	adjusted DM(2001) approach
Small-cap	1.0	1.0
2nd	9.0	4.0
3rd	10.0	7.7
4th	10.0	7.7
5th	10.0	7.7
6th	10.0	7.7
7th	10.0	8.1
8th	10.0	7.3
9th	15.0	11.5
Large-cap	15.0	37.5

Note: With Dimson and Marsh (2001) approach, decile size portfolios are formed according to the fixed % market value banding after ranking all shares' market values from the lowest to the highest each month. The fixed % market value banding for the 1st, 2nd, 3rd through 8th, 9th and 10th portfolios are 1%, 9%, 10%, 15% and 15%, respectively. With adjusted Dimson and Marsh (2001) approach, the fixed % market value banding for the 1st and 2nd is 1% and 4%, average 7.3 to 8.1 % flexible market value banding is arranged for the 3rd through the 8th portfolios. 10 companies are arranged in the 8th, 9th, and 10th portfolios with flexible market value banding.

Table 3.7 The summary statistics on average number of shares(%) and % market value (MV) banding for decile size portfolios by adjusted Dimson and Marsh (2001) approach

Portfolio	Average number of shares (%)	Average % MV banding	Max % MV banding	Min % MV banding
Small-cap	617 (41.3)	1.0	1.0	1.0
2nd	432 (29.8)	4.0	4.0	4.0
3rd	225 (15.3)	7.7	11.0	4.3
4th	78 (5.6)	7.7	10.9	4.3
5th	39 (2.8)	7.7	11.0	4.4
6th	24 (1.7)	7.7	10.9	4.3
7th	17 (1.2)	8.1	11.5	4.7
8th	10 (0.8)	7.3	10.1	4.6
9th	10 (0.8)	11.5	16.1	8.8
Large-cap	10 (0.8)	37.5	56.7	22.9

Note: With adjusted Dimson and Marsh (2001) approach, decile size portfolios are formed by market capitalization after ranking all shares' market values from the lowest to the highest each month. The fixed % market value banding for the 1st and 2nd portfolios is 1% and 4%. Average 7.3% to 8.1 % flexible market value banding is arranged for the 3rd through the 8th portfolio. 10 shares are arranged in the 8th, 9th, and 10th portfolios with flexible market value banding.

Table 3.8 The number of shares of decile value portfolios each month from 1980 to 2007 (12 months' holding horizon)

Date	Low	2^{nd}	3^{rd}	4^{th}	5^{th}	6^{th}	7^{th}	8^{th}	9^{th}	High
1980/1	25	26	24	21	25	23	26	22	24	29
1980/2	24	27	22	26	21	27	21	24	24	30
1980/3	27	23	24	22	24	27	21	24	24	31
1980/4	25	27	20	28	23	24	21	24	24	31
1980/5	26	23	23	24	24	28	20	24	24	31
1980/6	24	24	25	25	23	23	24	24	25	30
1980/7	25	25	23	23	25	24	23	24	24	32
1980/8	26	23	24	24	27	22	22	24	25	31
1980/9	24	24	25	25	26	21	23	24	24	32
1980/10	26	22	26	24	25	21	24	24	24	32
1980/11	24	25	23	24	25	23	25	23	24	32
1980/12	30	22	26	22	25	27	23	26	24	25
1981/1	27	25	24	26	23	25	25	25	25	30
1981/2	26	27	22	28	22	25	26	24	25	31
1981/3	25	25	26	29	21	25	24	26	24	31
1981/4	26	26	24	24	26	25	24	25	25	31
1981/5	26	25	25	24	25	25	27	23	25	32
1981/6	25	25	25	26	25	26	23	25	25	32
1981/7	27	27	23	29	19	25	25	26	24	33
1981/8	27	25	23	25	27	26	23	24	25	33
1981/9	25	29	21	27	24	24	25	26	24	33
1981/10	29	21	27	24	24	27	23	25	25	34
1981/11	26	26	28	26	24	27	25	26	26	28
1981/12	28	26	25	25	26	29	23	27	25	28
………	………	………	………	………	………	………	………	………	………	………
2006/1	292	294	295	286	287	289	291	287	289	293
2006/2	294	298	288	291	292	294	291	288	293	299
2006/3	296	300	300	294	293	297	298	291	295	304
2006/4	303	295	310	288	308	293	301	294	299	300
2006/5	304	302	309	290	301	302	301	301	299	305
2006/6	311	307	295	306	306	299	305	304	305	304
2006/7	311	310	302	301	311	304	305	306	305	312
2006/8	311	308	308	305	303	308	306	309	307	313
2006/9	311	308	317	300	315	303	315	305	307	314
2006/10	319	316	295	315	306	312	310	311	306	318
2006/11	312	320	305	313	317	307	310	312	312	320
2006/12	320	313	317	317	311	313	314	315	315	319
2007/1	322	321	322	324	318	321	324	318	319	325
2007/2	331	317	324	327	320	325	318	322	323	328
2007/3	336	331	311	329	331	318	329	325	324	328
2007/4	335	326	329	323	335	325	326	325	329	328
2007/5	332	330	330	332	327	331	326	324	330	334
2007/6	338	324	332	333	334	331	326	331	330	333
2007/7	338	330	337	326	329	332	332	332	334	337
2007/8	334	350	317	343	322	332	339	331	329	341
2007/9	337	340	330	343	331	339	326	334	337	335
2007/10	341	344	331	337	337	335	335	338	335	338
2007/11	342	334	344	339	333	341	337	334	338	339
2007/12	340	338	346	343	330	337	339	339	339	347

Note: After ranking all shares' price to book values (pb) according to ascending order at the end of months, decile value portfolios with 12 months' holding horizon are formed. The research assigns the share with the same pb in the i^{th} portfolio into the $(i-1)^{th}$ portfolio on the binding between two portfolios. 'Low' portfolio includes shares with low price-to-book ratio. 'High' portfolio includes shares with high price-to-book ratio.

Chapter 4 The Time-variation in Style Effects

As the beginning of empirical analysis, this chapter mainly focuses on the first research question in the thesis of how the time-variation in style effects in the UK Stock Market exists. The research classifies firm characteristics into three kinds in terms of lagged share return, market value, and price-to-book ratio, and examines the time-variation in their impact on cross-sectional share returns, respectively. The remainder of the chapter proceeds as followings. Section 4.1 describes research methods for investigating the performance of time-varying style effects. Section 4.2 details data analysis on the time-variation in momentum effect with 6 and 12 months' formation lengths, respectively. Section 4.3 and Section 4.4 report data analysis on the time-variation in size effect and value effect, respectively. Section 4.5 analyzes the correlation between style effects. Section 4.6 discusses the correlation between Long/Short return R_{lms} and style coefficient γ. Section 4.7 presents style effects in business cycles and market conditions. The last section comes to conclusion with a summary of results. The empirical analysis is based on the examination of equal- (value-) weighted style effects with 3, 6, 12, 18, and 24 months' holding horizons.

4.1 Research Methods

The research uses two indicators, long/short return R_{lms} and style coefficient γ, to measure time-varying style effects. Besides traditional indicator long/short return

R_{lms} in the majority of literature on style effects, the research uses style coefficient γ to investigate time-varying style effects. Two indicators are estimated after decile portfolios are constructed by firms' characteristics, such as lagged share returns, market value, and price-to-book ratio. Long/short return R_{lms} is return spread between top/bottom portfolios. It contains the information of shares in top and bottom portfolios in terms of firm characteristics and share return, and causes a loss of relevant information of shares in the 2^{nd} to 9^{th} portfolio. Style coefficient γ is the slope coefficient of cross-sectional regression of decile portfolios' returns in the holding period on their average values of firm characteristics in the formation period. It contains the information of all shares across decile portfolios. So, it is expected that style coefficient γ could capture much more information on the relation between share return and firm characteristics than long/short return R_{lms}.

Style coefficient γ has two implications in the empirical work. Firstly, Chapter 5 focuses on the impact of lagged macroeconomic variables on time-varying style effects. Because some macroeconomic variables might explain cross-sectional variation in returns of all shares, the research expects that they would have explanatory power for style coefficient γ stronger than long/short return $R_{lms.}$ Secondly, the test on the impact of lagged macroeconomic variables on the time-variation in style coefficient γ helps to diagnose the efficiency of active trading strategy on any decile portfolio, which is discussed in Chapter 6 and Chapter 7. Besides passive and active trading strategies on top and bottom portfolios, the research explores the profitability of active trading strategy on any decile portfolios. The investigation on the relation between macroeconomic variables and style coefficient γ offers analysis on the return forecast of any decile portfolio, and the profitability of holding long/short any decile portfolio.

4.1.1 The estimation of style coefficient γ

The research uses Fama-Macbeth (1973) approach to estimate series average style coefficient γ of momentum, size, and value effect in terms of short-/medium-/long-term of 3, 6, 12, 18, and 24 months in the UK Stock Market, and then to examine their time-varying pattern.

Firstly, at the end of each month the research ranks all shares by firm characteristics in terms of past share return, market value, price-to-book ratio, individually, from the lowest to the highest, and classifies them into decile portfolios. The relevant portfolio formation is described in Chapter 3.

Secondly, the research treats mean lagged 6/12 months' compounded returns, log mean market values, mean price-to-book ratios of decile portfolios in the formation period t-1 as independent variables, and equal-(value-) weighted portfolio returns in following holding period as dependent variables. With equation (4.1), the research applies univarite ordinary least squares regression to estimate style coefficient γ each month.

$$R_{p,t} = \gamma_{0,t} + \gamma_{1,t} * FC_{p,t-1} + \varepsilon_{p,t} \tag{4.1}$$

t = 1, 2, …, N, p = 1, 2, …, 10,

where $R_{p,t}$ is equal-(value-) weighted decile portfolio returns in the holding period t , $FC_{p,t-1}$ is the mean value of firm characteristics, such as lagged share return, market value, price-to-book ratio, individually, of decile portfolios in the formation period t-1. $\gamma_{1,t}$ is the regression coefficient, measuring the impact of portfolios' firm characteristics in the formation period t-1 on portfolio returns in the holding period t, which is defined as style coefficient γ. To repeat this step each month, the research estimates series style coefficient γ in the sample period.

Thirdly, the research uses Fama-MacBeth (1973) approach to control unreliable regression statistics OLS standard errors due to cross-sectional correlation. It regards 24 months as one testing period to average 24 style coefficient γ. To repeat this step each month, the research collects series mean γ over the whole sample period.

Fourthly, Fama-MacBeth (1973) approach assumes no series autocorrelation, which leads to undervalued standard deviation in the parameter test and over-rejection of the null hypothesis of mean γ =0. To adjust underestimated standard errors due to series autocorrelation, the research uses a finite period adjustment through Newey-West (1987) approach. Newey-West (1987) suggests the estimation of the variance by using a long-run variance matrix instead of the standard deviation of series cross-sectional regression coefficients in Fama-MacBeth (1973) approach. This approach includes the estimation of series covariance across time. With Newey-West adjustment approach, the research calculates series t-statistics for mean γ in one testing period monthly by monthly.

How wide a window k should be used in the Newer-West estimator? The window k is "..too short values of k, that is significantly autocorrelated, and you do not correct for correlation that might be there in the errors. Too long a value of k, together with a series that does not have much autocorrelation, and the performance of the estimate and test deteriorates." (Cochrane, 2001, p.222). In addition, too long window in the research might highlight long-term overall pattern in style effect but smooth out its short/medium-term fluctuations. It might not reflect actual timing-varying characteristics in style coefficient γ. Therefore, the research repeats above process monthly by monthly to estimate series 24-month's average style coefficient γ and their series t-statistics, and then to examine time-varying style effects.

4.1.2 The estimation of long/short return R_{lms}

Following other studies, the research constructs zero-investment portfolio to estimate long/short return R_{lms}, that goes long/short position in top/bottom portfolio. After ranking all shares with their lagged share return, market value, and price-to-market (PB) ratio, to form decile portfolios, the research estimates monthly-by-monthly return spread between 'Winner' portfolio and 'Loser' portfolio, between 'Small' portfolio and 'Large' portfolio, and between 'Low' portfolio and 'High' portfolio, respectively. The variation through time of three kinds of series return spreads represents for the dynamitic performance of momentum, size, and value effect. The research regards the performance of long/short return R_{lms} as the second indicator to investigate the time-variation in style effects.

4.2 Momentum effect

This section focuses on the investigation of the time-variation in momentum effect in the UK Stock Market from 1956 to 2008. As mentioned in Chapter 3, the empirical analysis on momentum effect in two subsections is based on shares' past 6 and 12 months' share returns and following 3, 6, 12, 18, and 24 months' holding returns, respectively. In the third subsection, the research compares the result in two approaches of skipping/unskipping one month between the formation period and the holding period to construct momentum portfolios as robustness test.

4.2.1 Momentum effect based on 6 months' formation length

In this subsection, the research examines the relation between shares' lagged 6 months' formation returns and following 3, 6, 12, 18, and 24 months' holding returns, respectively, in the UK Stock Market from 1955 to 2008. It presents empirical analysis on time-varying momentum effect in different holding horizons in terms of the performance of decile momentum portfolio returns, Winner/Loser return R_{wml}, and momentum coefficient γ_{mom}.

Decile momentum portfolio returns

The research investigates the performance of decile momentum portfolios in terms of average monthly excess return and the percentage of one portfolio with highest and lowest return among decile portfolios over the whole sample period. Monthly excess return of decile portfolios is the difference between monthly portfolio return and monthly risk-free interest rate, measured by 90-day Treasury Bill (TBILL). TBILL is collected from LSPD. Portfolio P1 consists of stocks with the lowest ranking lagged 6 months' formation returns and is represented as 'Loser' portfolio. Portfolio P10 consists of stocks with the highest ranking lagged 6 months' formation returns and is represented as 'Winner' portfolio. To investigate six-month's reversal effect in some time points, the research estimates the percentage of one portfolio with highest monthly excess return to reflect the percentage of 'Loser' portfolio outperforming other decile portfolios in the whole sample period. Conversely, the research estimates the percentage of one portfolio with lowest monthly excess return to reflect the percentage of 'Winner' portfolio underperforming other decile portfolios.

[Table 4.1]

The performance of momentum portfolios' excess returns reflects the existence of momentum effect based on lagged 6 months' share returns in the UK Stock Market. Panel A1 (B1) of Table 4.1 presents the performance of decile portfolios' returns and standard deviations over different holding horizon. It shows when equal-(value-) weighted decile portfolios are established according to lagged 6 months' share returns and hold for following 3, 6, 12, 18, 24 months, 'Winner' portfolio yields the highest (the second highest for value-weighted 'Winner' portfolio based on 24 months' holding horizon) average monthly excess return. Conversely, equal-weighted 2nd portfolio with the second lowest lagged 6 months' share returns underperforms other portfolios, and value-weighted 'Loser' portfolio exhibits worst performance among decile portfolios. For the case of five holding horizons, the standard deviation of 'Loser' portfolio return is highest, which means the volatility in 'Loser' portfolio return. The standard deviation of decile portfolio returns exhibit U pattern through the 1^{st} to 10^{th} portfolio. The standard deviation of 'Winner' portfolio return and 'Loser' portfolio return monotonically falls as holding horizon grows.

'Winner' ('Loser') portfolio's excess return over five holding horizons indicates the strongest (or stronger) momentum effect with 12 months' holding period. Panel A1 (B1) of Table 4.1 shows equal-(value-) weighted 'Winner' portfolio with 12 months' holding horizon yields 1.50% (0.97%) average monthly excess return, the highest among the cases with five holding horizons. 'Loser' portfolio with 12 months' holding horizon yields 0.94% (0.15%) of excess return per month, the (second) third lowest return among the case with five holding horizons. For different holding horizons, the power of 'Winner'('Loser') portfolio based on 12 months' holding horizon to maintain their previous return performance is the strongest (stronger). 'Winner' portfolio return rises over 3 to 12 months' holding horizon and then falls over 18 and 24 months' holding horizon. 'Loser' portfolio return becomes higher from 6 months' to 24 months' holding horizon.

'Winner' ('Loser') portfolio's high (low) holding returns are supported by its percentage with highest and lowest return among decile portfolios in all observations. Panel A2 and A3 (Panel B2 and B3) of Table 4.1 show that the percentage of each portfolio wtih highest and lowest monthly excess return among decile portfolios over the whole sample period exhibits the U-pattern. Firstly,

although it outperforms other portfolios, it is more likely for 'Winner' portfolio to have the poor performance, following 'Loser' portfolio and the 2nd portfolio. Similarly, although its return is lower or lowest among decile portfolios for all holding horizons, it is more likely for 'Loser' portfolio to yield the highest portfolio return than the 2nd to 9th portfolio. This reflects the existence of 6-month's price reversal in some time points. Secondly, equal-weighted 'Winner' portfolio has highest percentage of all observations to yield the highest excess return over decile portfolios, much higher than the percentage of all observation to yield the lowest excess return. This leads to 'Winner' portfolio's superior performance. Conversely, although equal-weighted 'Loser' portfolio with five holding horizons yields the highest excess return in 16.0 to 26.9 percentage of all observations, following the percentage of 'Winner' portfolio, it is more likely to earn the lowest return. Panel A3 shows that equal-weighted 'Loser' portfolio with five holding horizons has worst return performance among decile portfolios in 20.2 to 35.7 percentage of all observations, which counterbalances its higher return in good time. Thirdly, when equal-weighted 'Winner' portfolio is hold for 12 months, it yields the highest monthly excess return in decile portfolios in 31.3 percentage of all observations, but the lowest excess return in 6.7 percentage of all observation. This big spread in percentage between highest and lowest excess return plays role in its good return performance of 1.5% per month. Conversely, When equal-weighted 'Loser' portfolio is hold for 12 months, its percentage having highest return among decile portfolios is 16.0 percent in all observations, much lower than 35.7 percentage with lowest return. The big spread in percentage between lowest and highest excess return makes

‘Loser’ return down to 0.94% per month. The same pattern is for value-weighted case.

Winner/Loser return R_{wml}

The research designates Winner/Loser return R_{wml} as the difference in average monthly excess return between the top (P10) and bottom (P1) portfolios, and investigates the performance of Winner/Loser return R_{wml} for five holding horizons in the overall sample period and subperiods.

[Table 4.2]

Winner/Loser return R_{wml} based on 6 and 12 months’ holding period is higher. Panel A1 (B1) of Table 4.2 indicates that t-statistics of equal-weighted Winner/Loser return R_{wml} is 2.97 and 3.17 when momentum long/short portfolio is hold for 6 and 12 months, and t-statistics of value-weighted Winner/Loser return R_{wml} ranges 2.12 to 4.19 when momentum long/short portfolio is hold for five horizons, which means existence of Winner/Loser return R_{wml} reliably different from zero. Equal-(value-) weighted Winner/Loser return R_{wml}, when long/short position is hold for 6 and 12 months, is 0.54 and 0.56 (0.94 and 0.82) percent per month, which is higher than ones with other three horizons. Their outperformance is supported by the percentage of positive/negative Winner/Loser return R_{wml} in the sample period. As shown in Panel A2 (B2), equal-(value-) weighted Winner/Loser position with 6 and 12 months’ holding horizon yields positive return in 64.0 and 70.2 (64.0 and 70.8) percentage of all observations, higher than ones with other three holding horizons.

Winner/Loser return R_{wml} exhibits the variation over time. Although Winner/Loser position with 6 and 12 months yields higher return, it exhibits the variation over subperiods. For example, as shown in Panel A1 of Table 4.2, when equal-weighted Winner/Loser position is hold for 6 months, it yields significant positive return after 1980, but (marginally) significant negative return from sample beginning time to 1959 and in the 1970s. The variation in Winner/Loser return R_{wml} over time is reflected in the variation in the percentage of positive Winner/Loser return R_{wml} over subperiods. Panel A2 shows that Winner/Loser position with 6 months' holding horizon yields positive return in more than 71.7 percentage of all observations since 1980, but only 27.1 percent from sample beginning time to 1959 and 44.2 percent in the 1970s. Similarly, Panel B1 shows that when value-weighted Winner/Loser position is hold for 6 months, it earns significant positive return in the 1960s and afterwards 1980, but unsignificant positive return from sample beginning time to 1959 and in the 1970s. This return variation is consistent with the variation in the percentage of positive Winner/Loser return R_{wml} as shown in Panel B2.

Winner/Loser return R_{wml} is highest in the 1990s, but lowest in the 1970s. Panel A1 (B1) of Table 4.2 shows that equal-(value-) weighted zero-investment momentum portfolios based on all holding horizons yield significant positive return in the 1990s, more than 1.02(0.84) % per month and higher than corresponding return in most other subperiods. This can be reflected in Panel A2 (B2) that more than 70.8 (63.3) percentage of observations earns positive Winner/Loser return R_{wml} in the 1990s. Conversely, in the 1970s equal-weighted Winner/Loser return R_{wml} with five horizons is negative due to more than 44 percentage of observations with negative return as shown in Panel A3, and value-weighted Winner/Loser return R_{wml} is negative or less than 0.09 due to low percentage of positive Winner/Loser return R_{wml} as shown in Panel B2.

Momentum coefficient γ_{mom}

With the equation (4.1), the research conducts monthly-on-monthly regression of equal-(value-) weighted decile portfolios' holding returns on their formation returns, applies Fama-Macbeth (1973) approach to adjust cross-sectional correlation, and Newey-West(1987) approach to adjust standard errors due to serial correlation from overlapping data in examination of momentum effect. With Fama-Macbeth (1973) approach, the research averages 24 regression coefficient γ_{mom} as one testing period, uses Newey-West (1987) approach to adjust standard errors and estimates t-statistics, and finds number (percentage) of significant momentum/short reversal effect among all observations. Confidence level for t-test is 95%. Different from long-term return reversal with three to five years' formation and holding horizons in De Bondt and Thaler (1985, 1987), the research examines return reversal based on lagged 6 months' share returns.

[Table 4.3]

Monthly-on-monthly cross-sectional regression of portfolios' holding returns on their 6 months' formation returns reflects the strong momentum effect with 6 and 12 months' holding horizon. Panel A1 and A2 (Panel B1 and B2) of Table 4.3 show that equal-(value-) weighted portfolios based on 6 and 12 months' holding horizon have 35.4 and 43.7 (42.6 and 43.2) percentage of observations with significantly positive mean momentum coefficient γ_{mom} in the overall sample period, which are higher than ones with other three holding horizons, and only 2.9 and 2.6 (0 and 0.2) percentage of observations with significantly negative mean momentum coefficient γ_{mom}, the lowest among cases with five holding horizons.

Momentum coefficient γ_{mom} exhibits the variation over time. When observing the performance of momentum coefficient γ_{mom} in subperiods, except the 1950s due to limited observations after averaging 24 regression coefficient γ_{mom} as one test, it is found in Panel A1 (B1) of Table 4.3 that equal-(value-) weighted momentum coefficient γ_{mom} is significant positive in more than 64.2 (30.0) percentage of all observations in the 1990s, higher than ones in other subperiods for corresponding holding horizons. But the corresponding percentage is no more than 12.5 (30.0) percent in the 1970s, lower than one in other subperiods. This pattern is consistent with findings on Winner/Loser return R_{wml}.

In short, the return performance of momentum portfolios, Winner/Loser return R_{wml}, and momentum coefficient γ_{mom} reflect the existence of momentum effect based on lagged 6 months' formation in the UK Stock Market from 1956 to 2008. The performance of 'Winner', 'Loser' (or second 'Loser') and 'Winner/Loser' portfolios in five holding horizons confirms UK momentum effect in Antonious, Lam, and Paudyal (2007), Fletcher (2007) and Asness (2011). It is found that momentum effect on 6 and 12 months' holding horizon is stronger than ones with other holding horizons, and that momentum effect becomes weaker as holding horizon extends longer. Momentum effect exhibits the variation over time, strongest in the 1990s, but weakest in the 1970s. Following 'Winner' ('Loser') portfolio, 'Loser' ('Winner') portfolio yields the highest (lowest) return among decile portfolios more often than other eight portfolios.

4.2.2 Momentum effect based on 12 months' formation length

In this subsection, the research examines the impact of lagged 12 months' share returns on following 3, 6, 12, 18, and 24 months' returns, respectively, in the UK Stock Market from 1955 to 2008. As the previous subsection, the research presents empirical analysis on time-varying momentum effect in terms of return performance of decile momentum portfolios, Winner/Loser return R_{wml}, and momentum coefficient γ_{mom}.

Decile momentum portfolio returns

The research investigates the performance of decile momentum portfolios in terms of average monthly excess return and the percentage of one portfolio with highest and lowest return among decile portfolios over the whole sample period. Portfolio P1 includes shares with the lowest ranking 12 months' formation returns and is designated as 'Loser' portfolio. Portfolio P10 includes shares with the highest ranking 12 months' formation returns and is designated as 'Winner' portfolio. To investigate twelve-month's reversal effect in some time points, the research estimates the percentage of one portfolio with highest monthly excess return to reflect the percentage of 'Loser' portfolio outperforming other decile portfolios in the whole sample period. Conversely, the research estimates the percentage of one portfolio with lowest monthly excess return to reflect the percentage of 'Winner' portfolio underperforming other decile portfolios.

[Table 4.4]

The performance of momentum portfolios' excess returns reflects the existence of momentum effect based on lagged 12 months' share returns in the UK Stock Market. Panel A1 (B1) of Table 4.4 presents the performance of decile momentum portfolios' returns and their standard deviation over different holding horizons. It shows when equal-(value-) weighted decile portfolios are formed according to previous 12 months' share returns and hold for next 3, 6, 12, and 18 months (3, 6, and 12 months), 'Winner' portfolio has the highest average monthly excess return among decile portfolios. When value-weighted portfolio is hold for next 18 or 24 months, the 9th portfolio with second highest lagged 12 months' share returns outperforms other portfolios. Conversely, 'Loser' portfolio exhibits poor return performance. Especially value-weighted 'Loser' portfolio yields the lowest average monthly excess return among decile portfolios, except for the case with 3 months' holding horizon. When equal-weighted portfolio is hold for 24 months, 'Loser' portfolio yields the highest average monthly excess return over decile portfolios, meaning that one-year's return reversal might take place when holding horizon extends to a certain extent. As momentum portfolios with 6 months' formation length, return on 'Loser' portfolio has the highest standard deviation, followed by the 2nd portfolio or 'Winner' portfolio. The volatility of decile portfolio returns exhibit U pattern through the 1st to 10th portfolio. The standard deviation of 'Winner' portfolio return and 'Loser' portfolio return monotonically falls as holding horizon extends.

'Winner' ('Loser') portfolio's return over five holding horizons indicates strong momentum effect with 6 and 12 months' holding horizon. Panel A1 (B1) of Table 4.4 shows that average monthly excess return on equal-(value-) weighted 'Winner' portfolio monotonically falls from 1.52% to 1.30% (0.96% to 0.74%) when holding horizon is from 6 months to 24 months, and 'Loser' portfolio return monotonically increases from 0.78% to 1.39% (-0.02% to 0.63%). The opposite variation over holding horizons means that 'Winner' and 'Loser' portfolios based on 6 and 12 months' holding horizon have the strong power to maintain their previous 12 months' return performance, and that momentum effect becomes weaker as holding horizon extends.

'Winner' ('Loser') portfolio's high (low) holding returns is supported by its percentage of highest (lowest) return among decile portfolios in all observations. Panel A2 (B2) of Table 4.4 tabulates the percentage of observations where each portfolio yields the highest monthly excess return among decile portfolios over all observations, and indicates that equal-(value-) weighted 'Winner' portfolio based on 3 to 18 months' holding horizon takes up 23.5 to 35.4 (17.2 to 22.1) percent among all observations with highest monthly return, higher than other nine portfolios. When equal-(value-) weighted 'Winner' portfolio is hold for 6 and 12 months, its

percentage having highest return among decile portfolios is 35.4 and 29.8 (22.1 and 20.5) in all observations, the highest or higher among five holding horizons. As indicated in Panel A3 (B3), equal-(value-) weighted ‘Winner’ portfolio with 6 and 12 months’ holding horizon yields lowest return among decile portfolios in 6.7 and 8.5 (8.9 and 10.6) percentage of observations, the lowest and the second lowest among the cases with five horizons. The big spread between the percentage with highest return and the percentage with lowest return contributes to high return on ‘Winner’ portfolio. Conversely, When equal-(value-) weighted ‘Loser’ portfolio is hold for 6 and 12 months, its percentage having highest return among decile portfolios is 17.9 and 17.3 (13.2 and 14.4) in all observations, the lowest or second lowest among five holding horizons. It earns lowest return among decile portfolios in 33.0 and 37.3 (32.5 and 31.3) percentage of observations, the highest or higher among the cases with five horizons. The large spread between the percentage with lowest return and the percentage with highest return contributes to low return on ‘Loser’ portfolio.

The percentage of decile momentum portfolios’ highest monthly return over the whole sample period exhibits the U-pattern. Panel A2 (B2) of Table 4.4 shows that although ‘Loser’ portfolio return is lower or lowest among decile momentum portfolios for all holding horizons, it yields the highest portfolio return more often than the 2nd to 9th portfolio. Equal-(value-) weighted ‘Loser’ portfolio with highest monthly return has 17.3 to 24.0 (13.2 to 16.8) percentage of all observations for five holding horizons, following corresponding percentage of ‘Winner’ portfolio. This means the existence of twelve-month’s reversal effect in ‘Loser’ portfolio in some time points.

Winner/Loser return R_{wml}

The research designates Winner/Loser return R_{wml} as the spread in average monthly excess return between the top (P10) and bottom (P1) portfolios, and investigates the performance of Winner/Loser return R_{wml} in the overall sample period and subperiods for five holding horizons. Panel A1 (B1) of Table 4.5 shows that equal-(value-) weighted Winner/Loser return R_{wml} in the overall sample period is from 0.41 to 0.74 (0.55 to 0.98) per month when long/short position is hold for 3 to 12 months. Its adjusted t-stats by Newey-West (1987) approach is more than 2.04, which means that Winner/Loser return R_{wml} is reliably different from zero. When Winner/Loser portfolio is hold for 18 and 24 months, the return spread is unsignificant positive or negative.

[Table 4.5]

Winner/Loser return R_{wml} based on 6 months' holding period is highest. Panel A1 (B1) of Table 4.4 indicates that as holding horizon extends, equal-(value-) weighted 'Winner' portfolio's average monthly excess return monotonically descends from 1.52% (0.96%) for 6 months' holding horizon to 1.30% (0.74%) for 24 months' holding horizon. Conversely, 'Loser' portfolio return monotonically ascends from 0.78 to 1.39 (-0.02 to 0.63). 'Winner' and 'Loser' portfolio returns' converse variation over holding horizons leads to the highest Winner/Loser return R_{wml} for the case with 6 months' holding period, and the declining pattern of Winner/Loser return R_{wml} over holding horizons. The converse variation is consistent with the performance of their percentage having highest and lowest returns as indicated in Panel A2 and A3 (Panel B2 and B3) of Table 4.4.

The declining pattern of Winner/Loser return R_{wml} over holding horizons is mainly caused by 'Loser' portfolio return. Panel A1 (B1) of Table 4.4 shows that equal-(value-) weighted 'Winner' portfolio's average monthly return over 6 to 24 months' holding horizon falls by 0.22 from 1.52 to 1.30 (0.22 from 0.96 to 0.74), the amount less than the rising magnitude of 'Loser' portfolio return, which is 0.61 from 0.78 to 1.39 (0.65 from -0.02 to 0.63). This result is different from the findings by Jegadeesh and Titman (2001) that both winners and losers contribute about equally to Winner/Loser return R_{wml} in the US Stock Market.

As Winner/Loser return R_{wml} performs, Panel A2 (B2) of Table 4.5 shows that the percentage of positive equal-(value-) weighted Winner/Loser return R_{wml} among all observations monotonically declines from 70.5 to 54.6 (66.3 to 56.7) percentage over 6 to 24 months' holding horizon. In addition, equal-(value-) weighted zero-investment portfolio based on 6 months' holding horizon yields positive Winner/Loser return R_{wml} in more than 59.2 (60.8) percentage of observations each subperiod. Conversely, equal-(value-) weighted zero-investment portfolios based on 24 months' holding horizon takes up below 55 percentage of observations with having positive Winner/Loser return R_{wml} in most subperiods. Panel A3 (B3) shows that in the 1960s, 1970s, 1980s, and 2000s the percentage of observations with negative equal- (value-) weighted Winner/Loser return R_{wml} ranges from 45.4 to 70.8

(38.3 to 49.2), almost the same or higher than the percentage with positive Winner/Loser return R_{wml}.

Momentum effect is strongest in the 1990s, and weakest in the 1970s. Panel A1 (B1) of Table 4.5 shows that equal-(value-) weighted zero-investment portfolios based on all holding horizons yield positive Winner/Loser average monthly return in the 1990s, which are more than 0.85% (0.66%) per month and reliably different from zero. In the 1970s equal-weighted Winner/Loser return R_{wml} with almost all holding horizons is negative, and the lowest among all subperiods. Similarly, in the 1970s value-weighted Winner/Loser return R_{wml} with all holding horizons is unsignificant positive except for the case with 18 months' holding horizon, and the lowest or lower among all subperiods.

Momentum coefficient γ_{mom}

With equation (4.1), the research conducts monthly-on-monthly regression of equal-(value-) weighted decile portfolios' holding returns on their lagged 12 months' formation returns. With Fama-Macbeth (1973) approach, the research averages 24 regression coefficient γ_{mom} as one testing period. Then, using Newey-West (1987) approach to adjust standard errors and estimate t-statistics, the research finds the number of observations with significant momentum/short reversal effect and corresponding percentages among all observations. Confidence level for t-test is 95%.

[Table 4.6]

The performance of momentum coefficient γ_{mom} in overall period and subperiods supports the stronger momentum effect when portfolios are hold for 6 and 12 months. Panel A1 (B1) of Table 4.6 shows that equal-(value-) weighted portfolios based on 6 and 12 months' holding period have 42.5 and 39.9 (35.3 and 33.4) percentage of observations with significantly positive mean momentum coefficient γ_{mom}, the highest percentage among five holding horizons. As shown in Panel A2 (B2), they have only 0.8 and 4.0 (0.0 and 3.3) percentage of observations with significantly negative mean momentum coefficient γ_{mom}, the lowest or lower percentage among five holding horizon. As the holding horizon extends from 6 months to 24 months, the percentage of observation with significantly positive mean momentum coefficient γ_{mom} monotonically declines from 42.5 to 22.6 (35.3 to 18.3), the percentage of observation with significantly negative mean momentum coefficient γ_{mom} rises from 0.8 to 18.5 (0 to 13.9). The similar varying pattern over holding horizons is in most subperiods. This indicates that the longer is holding horizon, the weaker is momentum effect. Especially, when portfolios are hold for 18 and 24 months, equal-weighted portfolios yield significantly negative mean momentum coefficient γ_{mom} in 31.7 and 58.3 percentage of observations in the 1970s, which is consistent with the performance of significant negative Winner/Loser return R_{wml} in Panel A1 of Table 4.5.

In summary, there are same findings on the performance of series share returns between two momentum portfolios based on 6 and 12 months' formation length. The return performance of momentum portfolios, Winner/Loser return R_{wml}, and momentum coefficient γ_{mom} reflects the existence of momentum effect based on lagged 12 months' formation in the UK Stock Market from 1956 to 2008. It is found that momentum effect with 6 and 12 months' holding horizon is stronger than ones with other holding horizons, and that momentum effect declines as holding horizon extends. Momentum effect exhibits the variation over time, strongest in the 1990s, but weakest in the 1970s. Following 'Winner' ('Loser') portfolio, 'Loser' ('Winner') portfolio yields the highest (lowest) return among decile portfolios more often than other eight portfolios.

4.2.3 Robustness test on momentum effect

To avoid the effect of short-term reversal effect documented in Lehmann (1990) and Jegadeesh (1990), the research uses the approach with skipping one month between the formation period and the holding period to construct momentum portfolios, and compares empirical results with the findings in previous two subsections in which momentum portfolios are constructed without skipping one month. Momentum portfolios with skipping one month are constructed in the month t according to share returns in the months from t-2 to t-6, and t-2 to t-12. Table 4.7 presents the difference in average monthly return of 'Winner' portfolio, 'Loser' portfolio, and 'Winner/Loser' portfolio, respectively, between skipping one month approach and unskipping one month approach in the case of 6 months' and 12 months' formation lengths and corresponding five holding horizons. This return difference is denoted as 'R_s-R_{us}'.

[Table 4.7]

As shown in the 4th and 7th columns of Panel A and Panel B, Winner/Loser R_s-R_{us} is positive over five holding horizons, which reflects that Winner/Loser return R_{wml} based on the approach with skipping one month in portfolio formation is higher than the approach without skipping one month; In the same holding horizon, the difference for the formation with lagged 6 months' share return is larger than the formation with lagged 12 months' share return; In the same formation length and holding horizon, the difference for equal-weigthed portfolio is larger than value-weigthed portfolio.

This difference in the performance of Winner/Loser return R_{wml} between two approaches of skipping and unskipping one-month in momentum formation becomes small as holding horizon extends from 3 months to 24 months. The difference is obvious in short-term holding case. For example, when equal-(value-) weighted Winner/Loser portfolio is constructed according to lagged 6 months' share returns and is hold for 3 and 6 month, average monthly holding return in the formation approach with skipping one month is 0.77 and 0.39 (0.51 and 0.24) larger than one in the formation approach without skipping one month. The corresponding difference for momentum effect with 12 months' formation period is 0.56 and 0.27 (0.36 and 0.18). The effect of skipping one month in formation declines or even disappears when the holding horizon becomes longer. For example, the difference is no more than 0.20 when Winner/Loser portfolio is hold for 12, 18, and 24 months.

The difference in Winner/Loser return R_{wml} between two approaches of skipping and unskipping one month in momentum formation is mainly caused by 'Loser' portfolio. For example, the 2^{nd} and 5^{th} columns in Panel A show that equal-(value-) weighted 'Winner' portfolio with skipping one month in lagged 6 months' formation length yields average monthly return 0.15 and 0.08 (0.08 and 0.04) higher than one with unskipping pattern when 'Winner' portfolio is hold for 3 and 6 months. The 3^{rd} and 6^{th} columns show that equal-(value-) weighted 'Loser' portfolio with skipping one month in the formation yields average monthly return 0.62 and 0.31 (0.43 and 0.20) lower than one with unskipping pattern. The monthly price reversal in 'Loser' portfolio is stronger than one in 'Winner' portfolio, which mainly contributes to the difference in Winner/Loser return R_{wml} between two approaches. The similar result is for the case of 12 months' formation in Panel B.

Table 4.8 reports the correlation coefficient of time series 'Winner' return, 'Loser' return, 'Winner/Loser' return R_{wml}, and momentum coefficient γ_{mom} between two approaches of skipping and unskipping one month in momentum portfolio formation. For 'Winner' return and 'Loser' return with five holding horizons, most correlation coefficients are higher than 0.92. For 'Winner/Loser' portfolio return R_{wml}, most correlation coefficients are higher than 0.82. For momentum coefficient γ_{mom}, most correlation coefficients are higher than 0.87.

[Table 4.8]

In summary, as robustness test, the research investigates momentum effect based on formation approach with skipping one month between the formation period and the holding period. It finds the existence of one-month's price reversal, which is mainly caused by 'Loser' portfolio. Empirical comparison shows high correlation coefficient in series 'Winner' return, 'Loser' return, 'Winner/Loser' return R_{wml}, and momentum coefficient γ_{mom} between two formation approaches with skipping and unskipping one month. To obtain conservative estimation on momentum effect, the research uses momentum indicators from formation approach with unskipping one month to conduct empirical analysis in following chapters.

4.3 Size Effect

This section concentrates on the relation between shares' market values and their returns with five holding horizons, such as 3, 6, 12, 18, and 24 months, in the UK Stock Market from 1979 to 2008. It presents empirical analysis on time-varying size effect over different holding horizons in terms of decile size portfolio returns, Small/Large return R_{sml}, and size coefficient γ_{mv}.

Decile Size Portfolio returns

The research investigates the performance of decile size portfolios in terms of average monthly excess return and the percentage of one portfolio with highest/lowest return among decile portfolios from 1979 to 2008. It uses fixed % and flexible % market value banding in adjusted Dimson and Marsh (2001) approach to form decile size portfolios, which is described in Chapter 3. Portfolio P1 includes shares with the smallest ranking market value at the end of each month, and is defined as 'Small' portfolio. Portfolio P10 includes shares with the largest ranking market value at the end of each month, and is defined as 'Large' portfolio. Because small-cap effect and large-cap effect may exist when they outperform/or underperform other portfolios, the research estimates the percentage of one portfolio with highest and lowest monthly return to examine the percentage of small-cap premium and large-cap premium in the whole sample period.

[Table 4.9]

The return performance of equal-weighted size portfolios reflects existence of small-cap premium in the UK Stock Market. Panel A1 (B1) of Table 4.9 presents the performance of equal-(value-) decile size portfolios' average monthly excess returns and standard deviations over different holding horizons. It shows when equal-weighted size portfolios are formed, 'Small' portfolio has the highest average monthly excess return among portfolios for five holding horizons. Value-weighted 'Small' portfolio return performs in the second highest position when it is hold for 12 to 24 months. 'Small' portfolio return over five holding horizons indicates that the portfolio based on 24 months' holding period exhibits the strongest small-cap premium. Panel A1 (B1) shows that equal-(value-) weighted 'Small' portfolio return monotonically increases from 0.56% to 1.13% (0.35% to 0.92%) as holding horizon extends from 3 months to 24 months, but its standard deviation monotonically decreases. The standard deviation of portfolio returns monotonically declines through the 1st to the 10th portfolio. 'Small' portfolio return is more volatile than other portfolios, and has highest standard deviation. The return on the 8th, 9th, and 'Large' portfolio, which include the largest and larger shares, perform steadily than other seven portfolios, and have lower standard deviation.

Because small-cap shares always have wider bid-ask spread as well as low trading volume, they might not actually reflect market trading prices. If the research compares portfolio return among 2nd to 10th ('Large-cap') portfolio, it is found that equal-(value-) weighted 2nd portfolio with the second smallest market share yields the lowest or second lowest average monthly return, and that equal-(value-) weighted 8th portfolio earns the highest or second highest return. This means the existence of medium-cap effect, rather than small-cap effect and large-cap effect, in the UK Stock Market.

Higher 'Small' portfolio return is supported by its percentage of highest return among decile portfolios in all observations. Panel A2 (B2) of Table 4.9 offers the percentage of one portfolio yielding the highest monthly excess return among decile size portfolios over all observations, and indicates that equal-(value-) weighted 'Small' portfolio based on five holding horizon yields the highest monthly excess return in 22.7 to 37.5 (19.3 to 36.3) percentage of all observations, the highest among decile portfolios, except for value-weighted 'Small' portfolio with 3 months' holding horizon. This percentage exhibits monotonic increase as holding horizon extends from 3 months to 24 months. When equal-(value-) weighted 'Small' portfolio is hold for 24 months, its percentage having highest return among decile portfolios is 37.5 (36.3) in all observations, the highest among five holding horizons. Given bid-ask spread and low trading volume in small-cap shares discussed above, the research observes the percentage of 2nd to 10th portfolio with highest return among all observations, and finds that equal-(value-) weighted 8th portfolio with five holding horizons earns the highest return in 14.1 to 21.7 (14.6 to 21.7) percentage of observations, more than most other portfolios. This provides explanation for the outperformance of the 8th portfolio return.

The volatility of 'Small' portfolio return is supported by its percentage of highest and lowest return among decile portfolios in all observations. Although 'Small' portfolio yields the highest or higher average monthly excess return, and has the highest percentage with highest return among decile size portfolios over the sample period, it is likely to exhibit the worst return performance in some periods. Panel A3(B3) indicates that equal-(value-) weighted 'Small' portfolio yields the lowest return in 16.1 to 23.2 (17.9 to 24.3) percentage of all observations, higher than or almost same with the corresponding percentage for 'Large' portfolio. Especially, for equal-(value-) weighted 'Small' portfolio with 3 to 6 months' holding horizon, the percentages of observation with highest and lowest return are almost same. This could offer explanation for high standard deviation of 'Small' portfolio return.

Similarly, 'Large' portfolio exhibits higher frequency in the best and worst return performance among decile portfolios. As indicated in Panel A2 (B2), equal-(value-) weighted 'Large' portfolio yields the highest return among decile portfolios in 10.4 to 17.6 (10.7 to 20.2) percentage of all observations, following 'Small' portfolio, the 8^{th} and 9^{th} portfolios. Panel A3 (B3) shows that 'Large' portfolio yields the lowest return in 15.8 to 19.0 (18.2 to 25.7) percentage of all observations, following/or heading 'Small' portfolio. The extreme performance in return of 'Small' and 'Large' portfolio means the rotation between small-cap effect and large-cap effect.

Small/Large return R_{sml}

The research designates Small/Large return R_{sml} as the difference in average monthly excess return between the bottom ('Small') and top ('Large') portfolios, and investigates the performance of Small/Large return R_{sml} with five holding horizons in the overall sample period from 1979 to 2008 and three subperiods. Table 4.10 Panel A1(B1) shows that equal-(value-) weighted Small/Large return R_{sml} in overall sample period is from 0.10 to 0.44 (-0.06 to 0.30) per month when Small/Large position is hold for five horizons. Its adjusted t-stats by Newey-West (1987) approach is less than 1.15, which means that Small/Large return R_{sml} is unreliably different from zero.

[Table 4.10]

Small/Large return R_{sml} based on 24 months' holding period is highest. Panel A1(B1) of Table 4.9 indicates that as holding horizon extends, average monthly return on equal-(value-) weighted 'Small' portfolio monotonically increases from 0.56% (0.35%) for 3 months' holding horizon to 1.13% (0.92%) for 24 months' holding horizon. 'Large' portfolio return becomes higher from 0.46% to 0.69% (0.41% to 0.62%). Although two portfolio returns rise as holding horizon extends, 'Small' portfolio return has the rising magnitude of 0.57% (0.57%) per month, more than 'Large' portfolio's corresponding magnitude of 0.23% (0.21%). This leads to the highest Small/Large return R_{sml} when long/short position is hold for 24 months. The rising pattern of Small/Large return R_{sml} over holding horizons is mainly caused by 'Small' portfolio return.

Panel A2 (B2) of Table 4.10 shows that the percentage of positive equal-(value-) weighted Small/Large return R_{sml} in all observations rise from 45.8 to 61.3 (44.8 to 61.0) as holding horizon extends from 3 months to 24 months, which is consistent with rising Small/Large return R_{sml} over holding horizons. In the 1980s and the 2000s the percentage exhibits monotonically rise over holding horizons. Panel A3

(B3) presents that equal-(value-) weighted ‘Small/Large’ portfolio with five holding horizons yields negative average monthly return from 38.7 to 54.2 (39.0 to 55.2) percentage of observation. No obvious difference in the percentage of zero-investment portfolio having positive and negative Small/Large return R_{sml} leads to unsignificant positive return spread in the overall sample period.

Small/Large return R_{sml} rotates over three subperiods. Panel A1(B1) of Table 4.10 indicates that during the 1980s, equal-(value-) weighted Small/Large return R_{sml} is (marginally) positive with rising magnitude over holding horizons. Its strong performance is supported by more than 59.7% (52.7%) of observations having positive zero-investment return in the 1980s. In the 1990s Small/Large return R_{sml} is marginally negative and rises as holding horizon grows. It yields negative return in more than 60 percentage of observations. In the 2000s ‘Small/Large’ return R_{sml} is (marginally) significantly positive in 18 and 24 holding horizon.

Size coefficient γ_{mv}

With equation (4.1), the research conducts monthly-on-monthly regression of equal-(value-) weighted decile portfolio returns on log mean portfolios’ market values at the end of formation month. Due to ascending order of share market values in portfolio formation, negative regression coefficient γ_{mv} means that small-cap shares outperform large-cap shares, and vice versa. (In order to be consistent with the sign of Small/Large return R_{sml}, the research takes negative size coefficient γ_{mv} as dependent variable in series regression in following chapters.) With Fama-Macbeth (1973) approach, the research averages 24 regression coefficient γ_{mv} as one testing period. Then, using Newey-West (1987) approach to adjust standard errors and to calculate t-statistics, the research estimates the number of observations (percentages) with significant small-cap/large-cap effect among all observations. Confidence level for t-test is 95%.

[Table 4.11]

Monthly-on-monthly cross-sectional regression of portfolio holding returns on their log mean market values indicates strong rotation between small-cap/large-cap effect when holding horizon is 18 and 24 months. Panel A1 and A2 (Panel B1 and B2) of Table 4.11 shows that the percentage of equal-(value-) weighted portfolios with significant negative and positive average slope coefficient γ_{mv} rises over holding horizons. For the case of 3, 6, 12 months' holding horizon, the percentage of significant negative average size coefficient γ_{mv} is lower than the positive one. The portfolios based on 18 and 24 months' holding horizons have 45.8 and 41.2 (46.7 and 39.9) percentage of observations with significant negative average size coefficient γ_{mv}, and 35.4 and 35.1 (33.9 and 30.4) percentage of observations with significant positive average size coefficient γ_{mv}. The difference in the percentage between significant negative and positive γ_{mv} is not so large that Small/Large return R_{sml} is unsignfiicant in the overall sample period as shown in Table 4.10.

In the 1980s equal-(value-) weighted portfolios based on 18 and 24 months' holding horizon have significant negative average size coefficient γ_{mv} in more than 61.2 percentage of observations, and significant positive average γ_{mv} in less than 18.8

percentage of observations. The large difference in percentage with significant negative and positive average γ_{mv} leads to significant 'Small/Large' return R_{sml} in the period, as showing in Panel A1 (B1) of Table 4.10. The same condition exists in the 2000s. Conversely, in the 1990s equal-(value-) weighted portfolios obtain 38.3 to 62.5 percentage of observations having significant positive average size coefficient γ_{mv} over five holding horizon, and less than 17.5 percentage of observations having significant negative average $\gamma_{mv.}$ This large difference causes marginally negative 'Small/Large' return R_{sml} in the period as indicated in Table 4.10 Panel A1 (B1).

In brief, the performance of decile size portfolio returns, Small/Large return R_{sml}, and size coefficient γ_{size} reflects no existence of obvious size effect in the UK Stock Market from 1979 to 2008. This pattern is mainly caused by the rotation in return premium between small-cap and large-cap portfolio over subperiods. It is consistent with the findings of Levis and Liodakis (1999) that size spread is unconsistent across different subperiods in the UK Stock Market from 1968 to 1997, and that the average annual return for small-cap index performs higher than one for large-cap index before 1988, but conversely thereafter. Similarly, Fama and French (2011) present no size effect in four regions of North America, Europe, Japan, and Asia Pacific from 1991 to 2011. After excluding 'Small' portfolio due to the possibility of its wider bid-ask spread and low trading volume, the research finds the equal-(value-) weighted 2^{nd} portfolio with the second smallest market value yields the lowest or second lowest average monthly return, and that equal-(value-) weighted 8^{th} portfolio earns the highest or second highest return.

4.4 Value Effect

In this section, the research investigates the relation between shares' price-to-book ratios (PB) at the end of formation month and share returns in following 3, 6, 12, 18, and 24 months, respectively, in the UK Stock Market from 1980 to 2008. It presents empirical analysis on time-varying value effect in different holding horizons in terms of decile portfolio returns, Low/High return R_{lmh}, and value coefficient γ_{pb}.

Decile value portfolio returns

The research examines the performance of decile value portfolios in terms of average monthly excess return and the percentage of one portfolio with highest/lowest return among decile portfolios from 1980 to 2008. Portfolio P1 includes shares with the lowest ranking price-to-book ratio (PB) at the end of formation month, and is defined as 'Low' portfolio. Portfolio P10 includes shares with the highest ranking PB at the end of formation month, and is defined as 'High' portfolio. In order to observe the possibility of 'High' portfolio to outperform other portfolios, the research estimates the percentage of one portfolio with highest monthly excess return among decile value portfolios to examine the percentage of high PB premium (growth effect). Similarly, the research estimates the percentage of one portfolio with lowest monthly excess return to find out the underperformance of low PB portfolio over others.

[Table 4.12]

The return performance of value decile portfolios reflects the existence of low PB premium (value effect) in the UK Stock Market. Panel A1 (B1) of Table 4.12 presents the performance of decile value portfolios' average monthly excess returns and standard deviations when portfolios are hold for five holding horizons. It shows that 'Low' portfolio yields the highest average monthly excess return, and 'High' portfolio yields the lowest or second/third lowest return among decile portfolios over different holding horizon. Decile portfolio returns exhibit declining pattern from 'Low' portfolio to 'High' portfolio in which price-to-book ratio increases through portfolios. Average monthly excess return on equal-(value-) weighted 'Low' portfolio increases from 1.17% to 1.35% (1.24% to 1.50%) as holding horizon extends from 3 months to 24 months. This indicates 'Low' portfolio based on 24 months' holding horizon exhibits the strongest low PB premium. With higher standard deviation, 'Low' portfolio return is more volatile than most other portfolios. Its volatility, like other portfolios, becomes lower as holding horizon extends from short-term to long-term.

The return performance of 'Low' and 'High' portfolios is supported by its percentage of highest and lowest return among decile portfolios in all observations. Panel A2 (B2) of Table 4.12 shows that equal-(value-) weighted 'Low' portfolio with five holding horizons yields the highest return in 32.8 to 37.1 (26.4 to 37.0) percentage of all observations, the highest percentage among decile portfolios. Panel A3 (B3) indicates that equal-(value-) weighted 'Low' portfolio with five holding horizons yields the lowest return in 5.9 to 9.4 (6.5 to 13.2) percentage of all observations. The large spread between two percentages of 'Low' portfolio contributes to its return premium. Conversely, equal-(value-) weighted 'High' portfolio with five holding horizons earns highest return in only 3.7 to 9.0 (7.9 to 11.9) percentage of all observations, much lower than the percentage of 39.4 to 45.2 (15.2 to 26.9) with lowest return. This causes the worst return performance of 'High' portfolio.

Low/High return R_{lmh}

The research designates Low/High return R_{lmh} as the difference in average monthly excess return between the bottom (low price-to-book ratio) and top (high price-to-book ratio) portfolios, and investigates its performance in the overall sample period and subperiods for five holding horizons. Panel A1(B1) of Table 4.13 shows that equal-(value-) weighted Low/High return R_{lmh} in the overall sample period is from 0.97 to 1.25 (0.93 to 1.04) per month when Low/High position is hold for five horizons. Its adjusted t-stats by Newey-West (1987) approach is more than 2.86, which means that Low/High return R_{lmh} is reliably different from zero.

[Table 4.13]

Equal-(value-) weighted Low/High return R_{lmh} descends (ascends) over holding horizons. Panel A1 (B1) of Table 4.13 indicates the descending equal-weighted Low/High return R_{lmh} from 1.25% to 0.97% per month, but the ascending value-weighted Low/High return R_{lmh} from 0.93% to 1.04% per month as holding horizon grows from 3 months to 18 months. This difference is caused by the performance of the return on 'Low' portfolio and 'High' portfolio through holding horizon. For the equal-weighted case, Panel A1 of Table 4.12 shows that the return on 'Low' portfolio increases less than the return on 'High' portfolio as holding horizon extends from 3 months to 18 months, which leads to the descending return spread between equal-weighted 'Low' portfolio and 'High' portfolio through holding horizon. Conversely, for the value-weighted case, Panel B1 of Table 4.12 shows that the return on 'Low' portfolio increases more than the return on 'High' portfolio as holding horizon grows from 3 months to 18 months, which leads to the ascending return spread between value-weighted 'Low' portfolio and 'High' portfolio through holding horizon.

Low/High return R_{lmh} keeps positive over subperiods. Panel A1 (B1) indicates that Low/High returns R_{lmh} with five holding horizon are significantly positive in overall sample period. What is more striking is that positive Low/High return R_{lmh} is consistent in three subperiods. Equal-weighted Low/High return R_{lmh} is (marginally) significantly positive in the 1980s and the 1990s over five holding horizons and in the 2000s over 3 to 12 months' holding horizon. Value-weighted Low/High return R_{lmh} is significantly positive in the 1980s and the 2000s over all holding horizons, and positive but unreliably different from zero in the 1990s. The persistent good performance of Low/High return R_{lmh} is supported by the percentage of its positive return in the whole sample period and subperiods. A2 (B2) of Table 4.13 shows that equal-(value-) weighted Low/high return R_{lmh} is positive in more than 75.2 (60.6) percentage of observations in overall sample period and 64.2 (50.0) in three subperiods.

Value coefficient γ_{pb}

With equation (4.1), the research conducts monthly-on-monthly regression of equal-(value-) weighted value portfolio returns on mean portfolios' price-to-book values at the end of formation month. Due to ascending order of share's price-to-book ratio in portfolio formation, negative regression coefficient γ_{pb} means that low price-to-book shares outperform high ones, and vice versa. (In order to be consistent with the sign of Low/High return R_{lmh}, the research takes negative γ_{pb} as dependent variable in series regression in following chapters.) With Fama-Macbeth (1973) approach, the research averages 24 regression coefficient γ_{pb} as one testing period, uses Newey-West (1987) approach to adjust standard errors and estimates t-statistics, and further finds the number of significant value effect/growth effect and corresponding percentages among all observations. Confidence level for t-test is 95%.

[Table 4.14]

The monthly-on-monthly cross-sectional regression of portfolio holding returns on their mean price-to-book ratios indicates strong value effect when value portfolios are hold for 24 months. Panel A1 and A2 (Panel B1 and B2) of Table 4.14 shows that the percentage of equal-(value-) weighted portfolios with significantly negative average value coefficient γ_{pb} rises from 59.3 (40.4) to 74.1 (57.1) over five holding horizons in the overall period, and that the percentage having significantly positive γ_{pb} is below 6.5 (13.3). This means that the value effect becomes stronger as holding horizon grows from 3 to 24 months, which explains rising 'Low' portfolio return shown in Table 4.12 Panel A1 (B1).

For equal-weighted value portfolios, the percentage with significantly negative γ_{pb} is high in three subperiods, most of them higher than 50 percent. For valuel-weighted value portfolios, this percentage is higher than 50 percent in the 1980 and in the 2000s, but low in the 1990s. Their patterns are consistent with the performance in corresponding Low/High return R_{lmh} over three subperiods. Most equal-weighted Low/High returns are significant in three subperiods, and value-weighted ones are significant in the 1980s and 2000s.

In short, the performance of decile value portfolio returns, Low/High return R_{lmh}, and value coefficient γ_{pb} reflects strong value effect in the UK Stock Market from 1979 to 2008. Low price-to-book premium rises as holding horizon extends from 3 months to 24 months. The similarly rising pattern is for the percentage of observations with significantly negative value coefficient γ_{pb}. Value effect is significant in three subperiods, except for value-weighted one in the 1990s. This finding is consistent with other studies on value effect in the UK Stock Market. For example, Levis and Liodakis (1999) explores the value/growth performance in the UK Stock Market from 1968 to 1997, and find that positive value/growth return spread persisted for all three subperiods. Fletcher (2007) shows significantly positive excess return spread between high B/M and low B/M portfolios from 1979 to 2005.

4.5 The correlation between style effects

Style effects in stock market are not necessarily independent with each other. It is reasonable to consider that some economic factors might lead to the existence of two significant style effects in the market at the same time point/or period, which will be examined in detail in next chapter. Asness (1997) shows that value variable ((BV/MV)) and momentum variable (PAST(2,12)) are positively associated with future expected returns but negatively associated with each other. Value strategy is significantly stronger over loser shares than over winner shares. Momentum strategy is significantly stronger over expensive shares than over cheap shares. Asness (2011) finds negative correlation between momentum effect and value effect in USA, Europe, and Japan Stock Market. In this section, the investigation of the correlation between two style effects is based on two measures, namely Long/Short return R_{lms} and style coefficient γ estimated in previous three sections. Momentum effect is based on lagged 12 months' share returns.

Table 4.15 reports correlation coefficient among style effects in terms of Long/Short return R_{lms} in overall sample period and three subperiods. Panel A shows negative correlation in Long/Short return R_{lms} between momentum effect and size effect, negative correlation in Long/Short return R_{lms} between momentum effect and value effect, and positive correlation in Long/Short return R_{lms} between size effect and value effect from 1980 to 2008. This reflects that it is likely momentum effect, large-cap effect, and growth effect to take place in the same period. As shown in Panel B, C, D in Table 4.15, correlation coefficients between momentum effect and size effect, and between momentum effect and value effect are negative in three subperiods of the 1980s, the 1990s, and the 2000s.

However, Table 4.15 shows the variation in correlation between size effect and value effect over three subperiods. Particularly, correlation coefficients in the equal-weighted case with five horizons change from more than positive 0.54 in the 1980s to less than negative 0.36 in the 2000s. This reflects that positive correlation between size effect and value effect is strong in the 1980s, 1990s, but disappears after the 2000. This variation is mainly caused by high-tech bubble that emerged in the market from 1997 to 2000. Figure 4.1 plots the performance of monthly Small/Large return R_{sml} and Low/High return R_{lmh} from 1981 to 2008 when long/short return is hold for 12 months. It is found that small effect is strong during four periods, such as 1983 to 1988, 1993 to 1994, 1999 to 2000, and 2003 to 2004. Small effect and value effect cover three periods except for the third period. Small-cap shares yielded return premium during 1999 to 2000 when growth shares significantly outperformed value shares due to crazy speculation in technology stocks. If the research excludes the period of 1999 to 2002 when small effect and growth effect simultaneously happened, correlation coefficient between equal-weighted R_{sml} and R_{lmh} rises from 0.23 to 0.46 in the 1990s, and -0.56 to 0.33 in the 2000s.

The same pattern is found in the correlation in style coefficient γ between two style effects, which is shown in Table 4.16.

[Table 4.15, 4.16], [Figure 4.1]

4.6 Long/Short return R_{lms} and style coefficient γ

Table 4.17 reports summary statistics on series Long/Short return R_{lms} and style coefficient γ for three style effects, such as momentum effect, size effect, and value effect. It shows the decline in standard deviation of series Long/Short return R_{lms} and the increase in standard deviation of style coefficient γ for three style effects as holding horizon grows from 3 months to 24 months. The value of maximum and/or minimum Long/Short return R_{lms} declines as holding horizon grows, which leads to its lower volatility. The value of maximum and/or minimum style coefficient γ increases as holding horizon grows, which leads to its higher volatility.

[Table 4.17]

Panel A, B, and C in Table 4.17 show that Long/Short return R_{lms} and style coefficient γ of momentum effect and size effect have high correlation coefficient over five holding horizons, ranging from 0.84 to 0.92 and from 0.94 to 0.98, respectively. This means that two indicators could explain similar pattern on the relation between share returns and lagged price performance, market value, respectively. However, Panel D shows that correlation coefficient of Low/High return R_{lmh} and value coefficient γ_{pb} over five holding horizons is lower, ranging from 0.63 to 0.81. This reflects the difference in two indicators to measure value effect, which could be explained by the percentage of observations for each portfolio with highest and lowest return among decile value portfolios. Table 4.12 shows that the 2nd, 3rd, and 4th portfolio, besides 'Low' portfolio, yields highest return in higher percentage of observations, and that the 7th, 8th, and 9th portfolio, besides the 'High' portfolio, yields lowest return in higher percentage of observations. Low/High return R_{lmh} is return spread between the 1st and the 10th portfolio. It only captures the distribution in highest/lowest return of two portfolios, but ignores its distribution of the 2nd to 9th portfolio. Correspondingly, value coefficient γ_{pb} is the slope coefficient of cross-sectional regression of value decile portfolios' returns in the holding period on their average values of price-to-book ratio in the formation period. It includes the information of all shares in decile value portfolios, and can capture the distribution in highest/lowest return through them.

4.7 Style effects in business cycles and market conditions

In Section 4.2, 4.3, and 4.4, the research finds the time-variation in style effects in the UK Stock Market, measured by Long/Short return R_{lms} and style coefficient γ. In this section, the research further investigates the performance of style effects in business cycles and market conditions from 1980 to 2008. Because the previous section shows high or higher correlation between two indicators, the research observes the performance of Long/Short return R_{lms} in economic expansionary and contractionary periods, and upward and downward markets, respectively. The investigation is based on momentum effect with 12 month's formation horizon, size effect, and value effect when long/short portfolio is hold for 12 months, which is indicated as momentum effect (12/12), size effect (12), and value effect (12).

4.7.1 Long/Short return R_{lms} in business cycles

Time-varying cross-sectional risk premium in momentum, size, and value sorted portfolios might be exposure to business cycles, such as economic expansionary and contractionary periods. The research uses equation (4.2) to calculate the previous annual change of GDP as an indicator of the current economic condition, which is denoted as GDP(Y):

$$GDP(Y)_{t-L} = GDP_{t-L} / GDP_{t-L-4} - 1 \qquad (4.2)$$

where GDP_{t-L} is the level of GDP for quarter t-L. 'L' stands for lag length of two quarters to ensure GDP known as economic indicator in advance in the decision-making on allocation in Winner/Loser, Small/Large-cap, and Low/High portfolios. GDP is collected from ESDS IFS (The Economic and Social Data Service, International Financial Statistics). The research classifies series GDP(Y) into positive and negative groups, and regards them as economic expansionary and contractionary periods, respectively.

[Table 4.18]

Table 4.18 shows the performance of Long/Short return R_{lms} of style effects in the period with positive and negative GDP(Y) from 1980 to 2008. For momentum effect (12/12), average Winner/Loser return R_{wml} is negative 0.11% (0.14%) per month and positive in 60.9 (54.2) percent of observations in the period with positive GDP(Y) when equal-(value-) weighted Winner/Loser portfolio is hold for 12 months. Average R_{wml} is significantly positive 1.40% (1.23%) per month and positive in 87.7 (76.7) percent of observations in the period with negative GDP(Y), which are obviously higher than corresponding values in the period with positive GDP(Y). This means that momentum effect is significant and stronger in the declining annual change of GDP, but disappears in the increasing annual change of GDP.

For size effect (12), average Small/Large return R_{sml} is significantly positive 0.68% (0.52%) per month and positive in 52.5 (56.9) percent of observations in the period with positive GDP(Y), but negative 0.07% (0.14%) per month and positive in 41.8

(42.4) percent of observations in the period with negative GDP(Y) when equal-(value-) weighted Small/Large portfolio is hold for 12 months. This reflects significant small-cap effect in the increasing annual change of GDP, but no size effect in the declining annual change of GDP.

For value effect (12), there is no obvious difference in the performance of Low/High return R_{lmh} in the period with positive and negative GDP(Y) when Low/High portfolio is hold for 12 months. Equal-(value-) weighted Low/High portfolio yields significantly positive monthly R_{lmh} with small difference of 0.18% (0.24%) no matter GDP(Y) rises or falls. R_{lmh} is positive in almost same percentage of observations in two economic conditions.

In summary, momentum effect and size effect have different performance in business cycles as measured by GDP(Y). Small-cap (Loser) shares outperform large-cap (Winner) shares in economic expansionary period, and vice versa. However, value effect seems not to be associated with economic conditions.

4.7.2 Long/Short return R_{lms} in market conditions

The time-variation in style effects might be associated with dynamic market states. The research groups one-year's market return into positive and negative category, and observes the performance of Long/Short return R_{lms} of style effects with 12 months' holding horizon in lagged upward market and downward market from 1980 to 2008. Table 4.19 reports the performance of Long/Short return R_{lms} of style effects in the period with positive and negative lagged one-year's market return, which is denoted as MR(-1). MR(-1) is calculated by monthly FTSE ALL SHARE PRICE from LSPD.

[Table 4.19]

When Long/Short portfolio is hold for 12 months, average monthly Winner/Loser return R_{wml} and Small/Large return R_{sml} are positive in lagged one-year's upward market and downward market. Equal-(Value-) weighted Winner/Loser return R_{wml} is average 0.10% (0.30%) per month in the rising market lower than in the declining market, and positive in almost same percentage of the observations in two market conditions. Small/Large return R_{wml} has similar pattern no matter whether the market rises or falls in past one year. For value effect (12), equal-(value-) weighted Low/High portfolio yields significantly positive Low/High return R_{lmh} in either upward or downward market in past one year. It earns average monthly return of 0.35% (0.46%) in upward market lower than in downward market, but has almost same percentage of observations with positive return in two market conditions.

In summary, momentum effect, size effect, and value effect seems not to be related to lagged short-term market conditions. Long/Short return R_{lms} of three style effects do not have obvious difference in either magnitude or the percentage of observations with positive return when the market rises or falls in past one year.

4.8 Conclusion

In this chapter, the research uses two indicators, such as long/short return R_{lms} and style coefficient γ, to investigate the performance of time-varying style effects in the UK Stock Market. It classifies firm characteristics into lagged share return, market value, and price-to-book ratio, and examines the relation between three firm characteristics and share returns with 3, 6, 12, 18, and 24 months' holding horizon, respectively, in the overall sample period and subperiods.

- Momentum effect

When momentum portfolios are formed on lagged 6 and 12 months' share returns and hold for five holding horizons with 3, 6, 12, 18, and 24 months, there are common patterns in holding returns. Firstly, the performance of decile momentum portfolios' average monthly excess returns, Winner/Loser return R_{wml}, and momentum coefficient γ_{mom} reflects the existence of momentum effect in the UK Stock Market from 1956 to 2008. Secondly, when portfolios are hold for 6 and 12 months, Winner/Loser return R_{wml} are highest or second/third highest among the cases with five holding horizons, and are positive in the highest or second highest percentage of all observations. Meanwhile, their momentum coefficient γ_{mom}, which reflects information of decile momentum portfolios, is significantly positive in the highest and second highest percentage of all observations. These reflect that momentum effect based on 6 and 12 months' holding horizons is strong. As holding horizon grows more than 12 months, momentum effect becomes weaker and unsignificant. Thirdly, Winner/Loser return R_{wml} and momentum coefficient γ_{mom}

exhibit the variation over time. Their patterns show that momentum effect is strongest in the 1990s, but weakest in the 1970s. Fourthly, following ‘Winner’ portfolio, ‘Loser’ portfolio has higher percentage to yield highest return among decile momentum portfolio. It is not the case that ‘Winner/Loser’ return R_{wml} is nearly always positive. It is positive in 53-71 percent and negative in 29-47 percent of observations with five holding horizons. This pattern motivates the investigation on what factors lead to the time-varying momentum effect, and the exploration to capture the rotation between ‘Winner’ and ‘Loser’ portfolios by using forecasting model, which is detailed in next chapters.

- Size Effect

The empirical work indicates no existence of obvious size effect in the UK Stock Market from 1979 to 2008 due to size rotation in three subperiods. Firstly, ‘Small’ portfolio yields lowest return among decile size portfolios in higher percentage of all observations while it outperforms other portfolios in high percentage. Its high volatility leads to no obvious small-cap premium in the overall sample period. The similar pattern exists in ‘Large’ portfolio. Secondly, there is rotation between small-cap effect and large-cap effect over three subperiods. Small/Large return R_{sml} is (marginally) significant positive in the 1980s, and marginally significant negative in the 1990s, and positive afterwards. Thirdly, this size rotation is consistent with the performance of the variation in the percentage of observations with significantly positive and negative size coefficient γ_{mv} over three subperiods. Given higher volatility in return of ‘Small’ and ‘Large’ portfolio, it is instructive to examine what factors explain the volatility, and whether the forecasting model times the rotation in size effect, which is analyzed in next chapters.

- Value Effect

The empirical work on value effect with the measurement of shares' price-to-book ratios in the UK Stock Market from 1980 to 2008 indicates, firstly, 'Low' portfolio and 'High' portfolio are much likely to yield highest return and lowest return than other portfolios, respectively. Their opposite pattern supports significantly positive Low/High return R_{lmh} as well as low price-to-book return premium. Secondly, value effect based on 24 months' holding horizon is the strongest as compared to ones with short or medium horizons, which is supported by highest return of 'Low' portfolio and highest percentage of observations with significantly negative value coefficient γ_{pb}. Thirdly, the performance of Low/High return R_{lmh} and value coefficient γ_{pb} reflects persistent value effect in three subperiods. Given invariant value effect over time as well as high (low) percentage of 'Low' portfolio with highest (lowest) return among decele portfolios, it is less likely to succeed to time the rotation in value effect by using forecasting model, which is discussed in Chapter 7.

- The correlation between two style effects

The empirical work finds negative correlation between momentum effect and size effect, between momentum effect and value effect from 1980 to 2008 as well as three subperiods of the 1980s, the 1990s, and the 2000 afterwards. There exists the variation in correlation between size effect and value effect over time. Strong positive correlation in the 1980s, but disappears after the 2000, namely strong negative in the equal-weighted case and weak positive in the value-weighted case due to high-tech bubble from 1997 to 2000 when small-cap effect and growth effect emerged.

- Style effects in business cycles and market conditions

Momentum effect and size effect have different performance in business cycles as measured by GDP(Y), annul change of GDP. Small-cap (Loser) shares outperform large-cap (Winner) shares when economic expansion accelerates or economic contraction slows down, and vice versa. However, value shares and growth shares have the same return performance no matter how economic conditions change. Meanwhile, it is found that three style effects seem not to be related to lagged one-year's market performance.

Appendix: tables and figures in Chapter 4

Table 4.1 Statistics on decile momentum portfolios based on 6 months' formation length

Panel A Equal-weighted portfolio

A1 Average monthly excess return and standard deviation

Holding months	Loser	P2	P3	P4	P5	P6	P7	P8	P9	Winner	R_{wml}
3	1.17	0.62	0.62	0.63	0.71	0.76	0.82	0.88	1.00	1.19	0.02
	(4.99)	(4.17)	(3.80)	(3.60)	(3.46)	(3.34)	(3.30)	(3.31)	(3.47)	(4.05)	(3.51)
6	0.82	0.63	0.73	0.76	0.83	0.90	0.98	1.02	1.15	1.36	0.54
	(3.91)	(3.28)	(3.03)	(2.85)	(2.77)	(2.68)	(2.63)	(2.67)	(2.78)	(3.21)	(2.35)
12	0.94	0.83	0.87	0.92	1.00	1.04	1.09	1.15	1.28	1.50	0.56
	(3.29)	(2.63)	(2.43)	(2.29)	(2.20)	(2.12)	(2.06)	(2.12)	(2.20)	(2.45)	(1.83)
18	1.21	1.09	1.10	1.12	1.14	1.15	1.18	1.20	1.27	1.41	0.20
	(2.76)	(2.31)	(2.17)	(2.05)	(1.93)	(1.87)	(1.86)	(1.90)	(1.93)	(2.16)	(1.62)
24	1.31	1.19	1.18	1.25	1.25	1.21	1.26	1.26	1.31	1.43	0.12
	(2.43)	(2.18)	(1.90)	(1.90)	(1.87)	(1.70)	(1.73)	(1.76)	(1.77)	(1.99)	(1.59)

A2 Percentage of observations for each portfolio with highest return

Holding months	Loser	P2	P3	P4	P5	P6	P7	P8	P9	Winner
3	26.9	8.8	5.6	4.5	3.6	3.3	7.5	8.5	10.6	20.7
6	20.9	5.8	5.2	4.7	4.7	4.2	7.1	8.6	13.5	25.2
12	16.0	6.3	5.1	4.1	5.4	4.8	6.3	7.1	13.5	31.3
18	19.4	6.3	7.4	5.8	7.5	5.4	6.9	7.5	12.0	21.8
24	22.7	6.1	7.8	6.0	8.1	6.0	6.3	6.6	11.8	18.6

A3 Percentage of observations for each portfolio with lowest return

Holding months	Loser	P2	P3	P4	P5	P6	P7	P8	P9	Winner
3	20.2	16.4	11.0	8.9	6.6	7.0	6.3	4.5	8.0	11.1
6	32.1	14.5	9.3	7.9	6.1	6.8	4.6	4.9	5.2	8.8
12	35.7	14.0	9.7	7.5	6.7	5.1	4.9	5.6	4.3	6.7
18	31.3	13.3	8.8	6.9	5.9	6.6	5.3	5.4	5.4	11.1
24	29.8	13.8	7.1	6.1	6.5	6.3	6.1	6.3	6.0	12.0

Panel B Value-weighted portfolio

B1 Average monthly excess return and standard deviation

Holding months	Loser	P2	P3	P4	P5	P6	P7	P8	P9	Winner	R_{wml}
3	0.08	0.25	0.37	0.40	0.48	0.53	0.60	0.66	0.69	0.84	0.76
	(5.57)	(4.67)	(4.12)	(3.91)	(3.76)	(3.51)	(3.46)	(3.62)	(3.57)	(3.82)	(4.87)
6	-0.04	0.26	0.44	0.48	0.50	0.62	0.66	0.69	0.79	0.90	0.94
	(3.89)	(3.25)	(3.02)	(2.81)	(2.76)	(2.60)	(2.65)	(2.64)	(2.67)	(2.84)	(3.19)
12	0.15	0.35	0.49	0.53	0.56	0.66	0.74	0.73	0.89	0.97	0.82
	(2.86)	(2.35)	(2.21)	(2.11)	(1.94)	(1.95)	(1.94)	(1.89)	(1.94)	(2.12)	(2.35)
18	0.49	0.58	0.67	0.68	0.65	0.71	0.76	0.77	0.83	0.83	0.34
	(2.32)	(1.92)	(1.80)	(1.67)	(1.61)	(1.62)	(1.65)	(1.64)	(1.64)	(1.83)	(1.98)
24	0.54	0.65	0.71	0.73	0.68	0.74	0.81	0.80	0.87	0.85	0.31
	(1.85)	(1.55)	(1.47)	(1.45)	(1.40)	(1.40)	(1.45)	(1.44)	(1.49)	(1.62)	(1.64)

B2 Percentage of observations for each portfolio with highest return

Holding months	Loser	P2	P3	P4	P5	P6	P7	P8	P9	Winner
3	17.8	11.3	8.6	6.6	6.4	6.4	6.3	6.6	12.2	17.8
6	14.2	8.8	7.4	7.7	5.0	6.9	7.9	7.5	12.9	21.7
12	12.5	6.5	7.0	5.4	5.2	7.0	8.1	7.1	17.1	24.0
18	15.1	8.5	8.0	5.1	6.1	6.4	8.8	8.7	14.7	18.6
24	14.7	9.2	8.4	6.5	5.0	6.8	7.9	8.1	16.2	17.2

B3 Percentage of observations for each portfolio with lowest return

Holding months	Loser	P2	P3	P4	P5	P6	P7	P8	P9	Winner
3	27.2	10.6	8.9	6.9	6.7	6.4	6.3	7.2	8.1	11.6
6	31.8	12.7	7.4	7.2	6.1	6.0	6.0	5.7	5.5	11.6
12	36.8	11.1	7.6	5.9	6.5	5.9	6.0	5.2	6.3	8.6
18	30.9	11.4	8.3	3.0	6.7	5.9	6.9	6.4	7.5	12.8
24	29.6	9.9	8.9	4.7	7.0	7.4	6.0	5.8	8.6	12.1

Note: The table reports statistics on decile momentum portfolios based on ranking lagged 6 months' share returns from the lowest to the highest and 3, 6, 12, 18, and 24 months' holding horizons from 1956 to 2008. The research designates 'Winner' and 'Loser' as the top (P10) and bottom (P1) portfolios. Winner/Loser return R_{wml} is estimated by the spread in average monthly excess return between 'Winner' portfolio and 'Loser' portfolio. Panel A1 shows equal-weighted decile momentum portfolios' average monthly excess returns, with standard deviation in parenthesis. Panel A2 and A3 show the percentage of equal-weighted portfolio with highest return and lowest return among decile portfolios, respectively, over the sample period. Panel B shows the corresponding statistics on value-weighted decile momentum portfolios.

Table 4.2 Statistics on Winner/Loser return R_{wml} based on 6 months' formation length

Panel A Equal-weighted portfolio

A1 Average monthly Winner/Loser return R_{wml} and t-stats

Holding months	Observation Number	Sample beginning -1959	1960s	1970s	1980s	1990s	2000-2008	Overall period
3	639	-1.33	-0.51	-1.58	0.59	1.11	1.21	0.02
		(-4.87)	(-2.37)	(-2.92)	(1.70)	(2.53)	(1.78)	(0.12)
6	636	-0.66	0.15	-0.65	0.90	1.53	1.34	0.54
		(-2.72)	(0.77)	(-1.65)	(2.69)	(3.94)	(2.32)	(2.97)
12	630	-0.05	0.33	-0.11	0.61	1.46	0.73	0.56
		(-0.22)	(1.30)	(-0.36)	(1.65)	(4.50)	(1.24)	(3.17)
18	624	0.19	-0.04	-0.31	0.07	1.02	0.31	0.20
		(1.16)	(-0.12)	(-1.23)	(0.22)	(3.25)	(0.69)	(1.32)
24	612	0.79	-0.26	-0.65	0.08	1.24	0.24	0.12
		(4.33)	(-1.16)	(-2.59)	(0.24)	(4.05)	(0.52)	(0.89)

A2 The number (percentage) of positive average monthly Winner/Loser return R_{wml} (momentum effect)

Holding months	Observation Number	Sample beginning -1959	1960s	1970s	1980s	1990s	2000-2008	Overall period
3	639	13	48	44	76	85	75	341
		(25.5)	(40.0)	(36.7)	(63.3)	(70.8)	(69.4)	(53.4)
6	636	13	71	53	86	103	81	407
		(27.1)	(59.2)	(44.2)	(71.7)	(85.8)	(75.0)	(64.0)
12	630	24	77	67	85	106	83	442
		(57.1)	(64.2)	(55.8)	(70.8)	(88.3)	(76.9)	(70.2)
18	624	22	57	53	76	108	71	387
		(61.1)	(47.5)	(44.2)	(63.3)	(90.0)	(65.7)	(62.0)
24	618	25	53	44	66	108	66	362
		(83.3)	(44.2)	(36.7)	(55.0)	(90.0)	(61.1)	(58.6)

A3 The number (percentage) of negative average monthly Winner/Loser return R_{wml} (reversal effect)

Holding months	Observation Number	Sample beginning -1959	1960s	1970s	1980s	1990s	2000-2008	Overall period
3	639	38	72	76	44	35	33	298
		(74.5)	(60.0)	(63.3)	(36.7)	(29.2)	(30.6)	(46.6)
6	636	35	49	67	34	17	27	229
		(72.9)	(40.8)	(55.8)	(28.3)	(14.2)	(25.0)	(36.0)
12	630	18	43	53	35	14	25	188
		(42.9)	(35.8)	(44.2)	(29.2)	(11.7)	(23.1)	(29.8)
18	624	14	63	67	44	12	37	237
		(38.9)	(52.5)	(55.8)	(36.7)	(10.0)	(34.3)	(38.0)
24	612	5	67	76	54	12	42	256
		(16.7)	(55.8)	(63.3)	(45.0)	(10.0)	(38.9)	(41.4)

Panel B Value-weighted portfolio

B1 Average monthly Winner/Loser return R_{wml} and t-stats

Holding months	Observation Number	Sample beginning -1959	1960s	1970s	1980s	1990s	2000-2008	Overall period
3	639	-0.28	0.31	-0.71	0.85	1.41	2.56	0.76
		(-0.58)	(1.12)	(-1.04)	(1.96)	(2.21)	(2.75)	(2.82)
6	636	0.14	0.69	0.03	0.94	1.68	1.78	0.94
		(0.33)	(2.64)	(0.06)	(2.60)	(2.86)	(2.21)	(4.17)
12	630	1.26	0.88	0.08	0.73	1.38	0.90	0.82
		(2.53)	(3.33)	(0.23)	(2.35)	(3.72)	(1.14)	(4.19)
18	624	1.16	0.16	0.01	0.17	0.84	0.29	0.34
		(1.81)	(0.75)	(0.05)	(0.55)	(2.31)	(0.49)	(2.12)
24	618	0.72	0.29	0.04	0.21	1.02	0.42	0.31
		(1.19)	(1.50)	(0.11)	(0.59)	(2.75)	(0.70)	(2.31)

Continued

B2 The number (percentage) of positive average monthly Winner/Loser return R_{wml} (momentum effect)

Holding months	Observation Number	Sample beginning -1959	1960s	1970s	1980s	1990s	2000-2008	Overall period
3	639	26	65	68	75	76	73	383
		(5.1)	(54.2)	(56.7)	(62.5)	(63.3)	(67.6)	(59.9)
6	636	22	77	65	79	86	78	407
		(45.8)	(64.2)	(54.2)	(65.8)	(71.7)	(72.2)	(64.0)
12	630	28	86	76	85	93	78	446
		(66.7)	(71.7)	(63.3)	(70.8)	(77.5)	(72.2)	(70.8)
18	624	27	66	65	76	87	67	388
		(75.0)	(55.0)	(54.2)	(63.3)	(72.5)	(62.0)	(62.2)
24	618	20	66	66	66	92	69	379
		(66.7)	(55.0)	(55.0)	(55.0)	(76.7)	(63.9)	(61.3)

B3 The number (percentage) of negative average monthly Winner/Loser return R_{wml} (reversal effect)

Holding months	Observation Number	Sample beginning -1959	1960s	1970s	1980s	1990s	2000-2008	Overall period
3	639	25	55	52	45	44	35	256
		(49.0)	(45.8)	(43.3)	(37.5)	(36.7)	(32.4)	(40.1)
6	630	26	43	55	41	34	30	229
		(54.2)	(35.8)	(45.8)	(34.2)	(28.3)	(27.8)	(36.0)
12	630	14	34	44	35	27	30	184
		(33.3)	(28.3)	(36.7)	(29.2)	(22.5)	(27.8)	(29.2)
18	624	9	54	55	44	33	41	236
		(25.0)	(45.0)	(45.8)	(36.7)	(27.5)	(38.0)	(37.8)
24	618	10	54	54	54	28	39	239
		(33.3)	(45.0)	(45.0)	(45.0)	(23.3)	(36.1)	(38.7)

Note: The table reports statistics on Winner/Loser return R_{wml}, the spread in average monthly excess return between top and bottom momentum portfolios which are formed on previous 6 months' share returns and hold for 3, 6, 12, 18, and 24 months from 1956 to 2008. Panel A1 shows equal-weighted Winner/Loser return R_{wml} and its t-statistics in parenthesis in overall period and subperiods. t-statistics is adjusted by Newey-West (1987) approach. Lag length is holding horizon minus one. Panel A2 and A3 show the number (percentage) of positive and negative equal-weighted Winner/Loser return R_{wml}, respectively, in overall period and subperiods. Panel B shows the corresponding statistics on value-weighted Winner/Loser return R_{wml}.

Table 4.3 Statistics on momentum coefficient γ_{mom} based on 6 months' formation length

Panel A Equal-weighted portfolio

A1 The number (percentage) of significant positive momentum coefficient γ_{mom}

Holding months	Observation Number	Sample beginning -1959	1960s	1970s	1980s	1990s	2000-2008	Overall period
3	616	0	0	0	42	81	66	189
		(0.0)	(0.0)	(0.0)	(35.0)	(67.5)	(61.1)	(30.7)
6	613	0	7	5	57	85	63	217
		(0.0)	(5.8)	(4.2)	(47.5)	(70.8)	(58.4)	(35.4)
12	607	0	57	15	60	88	45	265
		(0.0)	(47.5)	(12.5)	(50.0)	(73.3)	(41.7)	(43.7)
18	601	3	21	10	55	81	41	211
		(23.1)	(17.5)	(8.3)	(45.8)	(67.5)	(38.0)	(35.1)
24	595	7	21	4	38	77	45	192
		(100.0)	(17.5)	(3.3)	(31.7)	(64.2)	(41.7)	(32.3)

A2 The number (percentage) of significant negative momentum coefficient γ_{mom}

Holding months	Observation Number	Sample beginning -1959	1960s	1970s	1980s	1990s	2000-2008	Overall period
3	616	26	23	6	0	0	0	55
		(92.9)	(19.2)	(5.0)	(0.0)	(0.0)	(0.0)	(8.9)
6	613	1	0	17	0	0	0	18
		(4.0)	(0.0)	(13.3)	(0.0)	(0.0)	(0.0)	(2.9)
12	607	0	0	16	0	0	0	16
		(0.0)	(0.0)	(14.2)	(0.0)	(0.0)	(0.0)	(2.6)
18	601	0	2	39	8	0	4	53
		(0.0)	(1.7)	(32.5)	(6.7)	(0.0)	(3.7)	(8.8)
24	595	0	10	49	6	1	9	75
		(0.0)	(8.3)	(40.8)	(5.0)	(0.8)	(8.3)	(12.6)

Panel B Value-weighted portfolio

B1 The number (percentage) of significant positive momentum coefficient γ_{mom}

Holding months	Observation Number	Sample beginning -1959	1960s	1970s	1980s	1990s	2000-2008	Overall period
3	616	0	25	12	34	36	39	146
		(0.0)	(20.8)	(10.0)	(28.3)	(30.0)	(36.1)	(23.7)
6	613	2	67	29	53	65	45	261
		(8.0)	(55.8)	(24.2)	(44.2)	(54.2)	(41.7)	(42.6)
12	607	1	58	36	56	69	42	262
		(5.3)	(48.3)	(30.0)	(46.7)	(57.5)	(38.9)	(43.2)
18	601	0	61	36	28	63	39	227
		(0.0)	(50.8)	(30.0)	(23.3)	(52.5)	(36.1)	(37.8)
24	595	0	53	22	33	68	45	221
		(0.0)	(44.2)	(18.3)	(27.5)	(56.7)	(41.7)	(37.1)

B2 The number (percentage) of significant negative momentum coefficient γ_{mom}

Holding months	Observation Number	Sample beginning -1959	1960s	1970s	1980s	1990s	2000-2008	Overall period
3	616	0	0	1	0	0	0	1
		(0.0)	(0.0)	(0.8)	(0.0)	(0.0)	(0.0)	(0.2)
6	613	0	0	0	0	0	0	0
		(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
12	607	0	0	0	0	0	1	1
		(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.9)	(0.2)
18	601	0	0	10	2	11	6	29
		(0.0)	(0.0)	(8.3)	(1.7)	(9.2)	(5.6)	(4.8)
24	595	0	0	20	11	8	10	49
		(0.0)	(0.0)	(16.7)	(9.2)	(6.7)	(9.3)	(8.2)

Note: The table reports statistics on momentum coefficient γ_{mom}, estimated by regressing decile momentum portfolios' holding returns on their formation returns. Decile momentum portfolios are formed on previous 6 months' shares returns and hold for 3, 6, 12, 18, and 24 months from 1956 to 2008. The research averages 24 regression coefficient γ_{mom} as one testing period, uses Newey-West (1987) approach to adjust standard errors and estimates t-statistics. Lag length is holding horizon minus one. The confidence level for t-test is 95%. Panel A1 and A2 show number (percentage) of significant positive and negative momentum coefficient γ_{mom} for equal-weighted momentum portfolios in overall sample period and subperiods. Panel B shows the corresponding statistics on value-weighted momentum coefficient γ_{mom}..

Table 4.4 Statistics on decile momentum portfolios based on 12 months' formation length

Panel A Equal-weighted portfolio

A1 Average monthly excess return and standard deviation

Holding months	Loser	P2	P3	P4	P5	P6	P7	P8	P9	Winner	R_{wml}
3	0.97	0.52	0.56	0.60	0.72	0.75	0.89	0.98	1.13	1.48	0.51
	(4.80)	(4.15)	(3.88)	(3.58)	(3.47)	(3.37)	(3.34)	(3.26)	(3.43)	(3.92)	(3.23)
6	0.78	0.67	0.69	0.73	0.84	0.88	1.00	1.07	1.21	1.52	0.74
	(3.90)	(3.32)	(3.01)	(2.84)	(2.74)	(2.66)	(2.63)	(2.6)	(2.71)	(3.11)	(2.31)
12	1.03	0.96	0.97	0.93	1.02	1.05	1.09	1.17	1.21	1.43	0.40
	(3.24)	(2.69)	(2.49)	(2.25)	(2.17)	(2.14)	(2.06)	(2.12)	(2.16)	(2.51)	(1.91)
18	1.22	1.17	1.16	1.12	1.17	1.17	1.19	1.23	1.25	1.37	0.16
	(2.70)	(2.29)	(2.19)	(2.00)	(1.96)	(1.91)	(1.83)	(1.90)	(1.95)	(2.21)	(1.68)
24	1.39	1.30	1.28	1.29	1.26	1.24	1.24	1.26	1.26	1.30	-0.09
	(2.52)	(2.01)	(1.95)	(2.03)	(1.77)	(1.73)	(1.70)	(1.77)	(1.78)	(2.00)	(1.83)

A2 Percentage of observations for each portfolio with highest return

Holding months	Loser	P2	P3	P4	P5	P6	P7	P8	P9	Winner
3	24.0	6.0	3.9	2.8	4.9	3.5	5.2	7.0	12.3	30.3
6	17.9	4.9	3.8	3.5	3.8	3.5	5.9	8.4	12.9	35.4
12	17.3	5.6	4.2	4.3	5.4	4.3	7.5	9.5	12.0	29.8
18	19.3	8.1	5.8	6.6	6.0	5.2	7.3	8.6	9.7	23.5
24	22.7	10.3	6.4	5.9	8.3	7.8	6.9	8.2	9.5	14.1

A3 Percentage of observations for each portfolio with lowest return

Holding months	Loser	P2	P3	P4	P5	P6	P7	P8	P9	Winner
3	23.9	16.7	11.7	8.8	9.0	6.8	5.1	4.6	6.5	7.0
6	33.0	15.6	9.2	7.5	6.3	6.7	5.2	4.6	5.2	6.7
12	37.3	13.8	8.2	7.1	6.1	4.8	4.6	3.2	6.4	8.5
18	33.2	9.5	8.9	6.6	6.8	4.5	6.0	5.7	6.0	12.8
24	31.2	7.2	7.4	6.9	6.5	5.7	7.2	5.9	6.5	15.5

Panel B Value-weighted portfolio

B1 Average monthly excess return and standard deviation

Holding months	Loser	P2	P3	P4	P5	P6	P7	P8	P9	Winner	R_{wml}
3	0.03	-0.11	0.22	0.20	0.56	0.58	0.68	0.77	0.84	1.00	0.97
	(5.81)	(4.72)	(4.24)	(3.99)	(3.80)	(3.64)	(3.58)	(3.52)	(3.64)	(4.08)	(5.15)
6	-0.02	0.06	0.35	0.40	0.56	0.63	0.72	0.78	0.88	0.96	0.98
	(4.14)	(3.34)	(3.03)	(2.97)	(2.78)	(2.67)	(2.69)	(2.66)	(2.74)	(2.99)	(3.42)
12	0.33	0.34	0.57	0.59	0.68	0.66	0.70	0.77	0.85	0.88	0.55
	(3.04)	(2.37)	(2.16)	(2.07)	(1.98)	(1.93)	(1.94)	(2.05)	(2.04)	(2.26)	(2.55)
18	0.56	0.56	0.70	0.66	0.74	0.71	0.76	0.77	0.85	0.79	0.23
	(2.66)	(1.84)	(1.78)	(1.64)	(1.65)	(1.65)	(1.69)	(1.81)	(1.83)	(1.93)	(2.41)
24	0.63	0.71	0.77	0.76	0.80	0.78	0.77	0.77	0.88	0.74	0.11
	(1.92)	(1.49)	(1.46)	(1.41)	(1.42)	(1.43)	(1.49)	(1.61)	(1.61)	(1.67)	(1.80)

B2 Percentage of observations for each portfolio with highest return

Holding months	Loser	P2	P3	P4	P5	P6	P7	P8	P9	Winner
3	15.3	7.0	7.9	5.4	7.4	6.0	8.5	10.6	12.5	19.4
6	13.2	7.0	7.9	6.3	6.8	5.9	7.3	8.4	15.1	22.1
12	14.4	6.1	6.9	5.6	7.5	7.5	7.2	9.8	14.4	20.5
18	15.7	7.8	7.3	5.8	7.9	8.4	7.3	8.6	14.1	17.2
24	16.8	10.9	8.2	8.3	7.7	8.5	6.4	8.2	11.6	13.4

B2 Percentage of observations for each portfolio with lowest return

Holding months	Loser	P2	P3	P4	P5	P6	P7	P8	P9	Winner
3	25.4	17.2	11.5	9.0	5.5	3.6	4.6	5.4	6.8	10.9
6	32.5	17.3	8.3	7.3	4.9	4.9	5.4	5.7	4.8	8.9
12	31.3	15.1	8.5	5.4	5.1	6.3	6.3	5.0	6.6	10.6
18	28.3	12.9	8.4	6.5	5.7	6.6	6.1	6.6	6.8	12.0
24	27.1	11.4	7.5	7.2	4.4	6.5	6.4	7.4	6.7	15.4

Note: The table reports statistics on decile momentum portfolios based on ranking lagged 12 months' share returns from the lowest to the highest and 3, 6, 12, 18, and 24 months' holding horizons from 1956 to 2008. The research designates 'Winner' and 'Loser' as the top (P10) and bottom (P1) portfolios. Winner/Loser return R_{wml} is estimated by the spread in average monthly excess return between 'Winner' portfolio and 'Loser' portfolio. Panel A1 shows equal-weighted decile momentum portfolios' average monthly excess returns, with standard deviation in parenthesis. Panel A2 and A3 show the percentage of equal-weighted portfolio with highest return and lowest return among decile portfolios, respectively, over the sample period. Panel B shows the corresponding statistics on value-weighted decile momentum portfolios.

Table 4.5 Statistics on Winner/Loser return R_{wml} based on 12 months' formation length

Panel A Equal-weighted portfolio

A1 Average monthly Winner/Loser return R_{wml} and t-stats

Holding months	Observation Number	Sample beginning -1959	1960s	1970s	1980s	1990s	2000-2008	Overall period
3	633	-0.18	-0.20	-0.67	1.00	1.57	1.15	0.51
		(-0.43)	(-0.91)	(-1.41)	(2.55)	(3.84)	(1.89)	(2.65)
6	630	0.29	0.27	-0.04	0.90	1.82	0.94	0.74
		(1.02)	(0.99)	(-0.10)	(2.21)	(4.64)	(1.49)	(4.11)
12	624	0.47	0.10	0.03	0.30	1.33	0.23	0.41
		(2.02)	(0.30)	(0.13)	(0.66)	(3.46)	(0.32)	(2.04)
18	618	0.79	-0.14	-0.29	0.06	1.05	-0.08	0.16
		(4.27)	(-0.43)	(-1.75)	(0.17)	(3.08)	(-0.13)	(0.86)
24	612	1.04	-0.47	-0.66	(-0.13)	0.85	-0.27	-0.09
		(10.16)	(-1.81)	(-3.82)	(-0.55)	(3.44)	(-0.57)	(-0.53)

A2 The number (percentage) of positive average monthly Winner/Loser return R_{wml} (momentum effect)

Holding months	Observation Number	Sample beginning -1959	1960s	1970s	1980s	1990s	2000-2008	Overall period
3	633	23	61	65	76	93	74	392
		(51.1)	(50.8)	(54.2)	(63.3)	(77.5)	(68.5)	(61.9)
6	630	25	83	71	82	104	79	444
		(59.5)	(69.2)	(59.2)	(68.3)	(86.7)	(73.1)	(70.5)
12	624	28	66	68	84	103	72	421
		(77.8)	(55.0)	(56.7)	(70.0)	(85.8)	(66.7)	(67.5)
18	618	28	57	50	76	109	68	388
		(93.3)	(47.5)	(41.7)	(63.3)	(90.8)	(63.0)	(62.8)
24	612	24	51	35	61	104	59	334
		(100)	(42.5)	(29.2)	(50.8)	(86.7)	(54.6)	(54.6)

A3 The number (percentage) of negative average monthly Winner/Loser return R_{wml} (reversal effect)

Holding months	Observation Number	Sample beginning -1959	1960s	1970s	1980s	1990s	2000-2008	Overall period
3	633	22	59	55	44	27	34	241
		(48.9)	(49.2)	(45.8)	(36.7)	(22.5)	(31.5)	(38.1)
6	630	17	37	49	38	16	29	186
		(40.5)	(30.8)	(40.8)	(31.7)	(13.3)	(26.9)	(29.5)
12	624	8	54	52	36	17	36	203
		(22.2)	(45.0)	(43.3)	(30.0)	(14.2)	(33.3)	(32.5)
18	618	2	63	70	44	11	40	230
		(6.7)	(52.5)	(58.3)	(36.7)	(9.2)	(37.0)	(37.2)
24	612	0	69	85	59	16	49	278
		(0.0)	(57.5)	(70.8)	(49.2)	(13.3)	(45.4)	(45.4)

Panel B Value-weighted portfolio

B1 Average monthly Winner/Loser return R_{wml} and t-stats

Holding months	Observation Number	Sample beginning -1959	1960s	1970s	1980s	1990s	2000-2008	Overall period
3	633	0.23	0.69	0.05	0.96	1.61	1.92	0.97
		(0.16)	(1.87)	(0.09)	(1.99)	(2.51)	(1.80)	(3.34)
6	630	0.59	1.08	0.33	0.77	1.67	1.23	0.98
		(0.67)	(2.97)	(1.25)	(1.86)	(2.84)	(1.13)	(3.81)
12	624	1.55	0.63	0.28	0.26	1.13	0.07	0.55
		(2.00)	(2.07)	(1.32)	(0.57)	(2.43)	(0.07)	(2.27)
18	618	1.10	-0.12	0.35	-0.07	0.91	-0.18	0.23
		(1.04)	(-0.28)	(2.44)	(-0.16)	(2.23)	(-0.25)	(1.15)
24	612	-0.16	0.21	0.11	-0.18	0.66	-0.23	0.11
		(-0.27)	(0.81)	(0.78)	(-0.51)	(2.12)	(-0.39)	(0.69)

Continued

B2 The number (percentage) of positive average monthly Winner/Loser return R_{wml} (momentum effect)

Holding months	Observation Number	Sample beginning -1959	1960s	1970s	1980s	1990s	2000-2008	Overall period
3	633	25	70	70	74	78	70	387
		(55.6)	(58.3)	(58.3)	(61.7)	(65.0)	(64.8)	(61.1)
6	630	26	78	73	75	93	73	418
		(61.9)	(65.0)	(60.8)	(62.5)	(77.5)	(67.6)	(66.3)
12	624	25	80	81	71	85	71	413
		(69.4)	(66.7)	(67.5)	(59.2)	(70.8)	(65.7)	(66.2)
18	618	15	73	77	63	91	64	383
		(50.0)	(60.8)	(64.2)	(52.5)	(75.8)	(59.3)	(62.0)
24	612	6	74	66	61	83	57	347
		(25.0)	(61.7)	(55.0)	(50.8)	(69.2)	(52.8)	(56.7)

B3 The number (percentage) of negative average monthly Winner/Loser return R_{wml} (reversal effect)

Holding months	Observation Number	Sample beginning -1959	1960s	1970s	1980s	1990s	2000-2008	Overall period
3	633	20	50	50	46	42	38	246
		(44.4)	(41.7)	(41.7)	(38.3)	(35.0)	(35.2)	(38.9)
6	630	16	42	47	45	27	35	212
		(38.1)	(35.0)	(39.2)	(37.5)	(22.5)	(32.4)	(33.7)
12	624	11	40	39	49	35	37	211
		(30.6)	(33.3)	(32.5)	(40.8)	(29.2)	(34.3)	(33.8)
18	618	15	47	43	57	29	44	235
		(50.0)	(39.2)	(35.8)	(47.5)	(24.2)	(40.7)	(38.0)
24	612	18	46	54	59	37	51	265
		(75.0)	(38.3)	(45.0)	(49.2)	(30.8)	(47.2)	(43.3)

Note: The table reports statistics on Winner/Loser return R_{wml}, the spread in average monthly excess return between top and bottom momentum portfolios which are formed on previous 12 months' share returns and hold for 3, 6, 12, 18, and 24 months from 1956 to 2008. Panel A1 shows equal-weighted Winner/Loser return R_{wml} and its t-statistics in parenthesis in overall period and subperiods. t-statistics is adjusted by Newey-West (1987) approach. Lag length is holding horizon minus one. Panel A2 and A3 show the number (percentage) of positive and negative equal-weighted Winner/Loser return R_{wml}, respectively, in overall period and subperiods. Panel B shows the corresponding statistics on value-weighted Winner/Loser return R_{wml}.

Table 4.6 Statistics on momentum coefficient γ_{mom} based on 12 months' formation length

Panel A Equal-weighted portfolio

A1 The number (percentage) of significant positive momentum coefficient γ_{mom}

Holding months	Observation Number	Sample beginning -1959	1960s	1970s	1980s	1990s	2000-2008	Overall period
3	610	0	4	7	57	85	53	206
		(0.0)	(3.3)	(5.8)	(47.5)	(70.8)	(49.1)	(33.8)
6	607	5	44	11	59	89	50	258
		(26.3)	(36.7)	(9.2)	(49.2)	(74.2)	(46.3)	(42.5)
12	601	9	38	11	50	80	52	240
		(69.2)	(31.7)	(9.2)	(41.7)	(66.7)	(48.1)	(39.9)
18	595	7	17	0	36	74	46	180
		(100.0)	(14.2)	(0.0)	(30.0)	(61.7)	(42.6)	(30.3)
24	589	1	8	0	31	70	23	133
		(100.0)	(6.7)	(0.0)	(25.8)	(58.3)	(21.3)	(22.6)

A2 The number (percentage) of significant negative momentum coefficient γ_{mom}

Holding months	Observation Number	Sample beginning -1959	1960s	1970s	1980s	1990s	2000-2008	Overall period
3	610	0	0	6	0	0	0	6
		(0.0)	(0.0)	(5.0)	(0.0)	(0.0)	(0.0)	(1.0)
6	607	0	0	5	0	0	0	5
		(0.0)	(0.0)	(4.2)	(0.0)	(0.0)	(0.0)	(0.8)
12	601	0	0	19	5	0	0	24
		(0.0)	(0.0)	(15.8)	(4.2)	(0.0)	(0.0)	(4.0)
18	595	0	10	38	26	2	5	81
		(0.0)	(8.3)	(31.7)	(21.7)	(1.7)	(4.6)	(13.6)
24	589	0	10	70	12	4	13	109
		(0.0)	(8.3)	(58.3)	(10.0)	(3.3)	(12.0)	(18.5)

Panel B Value-weighted portfolio

B1 The number (percentage) of significant positive momentum coefficient γ_{mom}

Holding months	Observation Number	Sample beginning -1959	1960s	1970s	1980s	1990s	2000-2008	Overall period
3	610	5	20	26	27	57	49	184
		(22.7)	(16.7)	(21.7)	(22.5)	(47.5)	(45.4)	(30.2)
6	607	6	36	21	44	67	40	214
		(31.6)	(30.0)	(17.5)	(36.7)	(55.8)	(37.0)	(35.3)
12	601	0	43	38	29	60	31	201
		(0.0)	(35.8)	(31.7)	(24.2)	(50.0)	(28.7)	(33.4)
18	595	0	29	21	23	55	29	157
		(0.0)	(24.2)	(17.5)	(19.2)	(45.8)	(26.9)	(26.4)
24	589	0	14	2	23	47	22	108
		(0.0)	(11.7)	(1.7)	(19.2)	(39.2)	(20.4)	(18.3)

B2 The number (percentage) of significant negative momentum coefficient γ_{mom}

Holding months	Observation Number	Sample beginning -1959	1960s	1970s	1980s	1990s	2000-2008	Overall period
3	610	0	0	0	0	0	0	0
		(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
6	607	0	0	0	0	0	0	0
		(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
12	601	0	0	7	9	0	4	20
		(0.0)	(0.0)	(5.8)	(7.5)	(0.0)	(3.7)	(3.3)
18	595	0	0	13	17	5	6	41
		(0.0)	(0.0)	(10.8)	(14.2)	(4.2)	(5.6)	(6.9)
24	589	0	19	14	14	12	23	82
		(0.0)	(15.8)	(11.7)	(11.7)	(10.0)	(21.3)	(13.9)

Note: The table reports statistics on momentum coefficient γ_{mom}, estimated by regressing decile momentum portfolios' holding returns on their formation returns. Decile momentum portfolios are formed on previous 12 months' share returns and hold for 3, 6, 12, 18, and 24 months from 1956 to 2008, respectively. The research averages 24 regression coefficient γ_{mom} as one testing period, uses Newey-West (1987) approach to adjust standard errors and estimates t-statistics. Lag length is holding horizon minus one. The confidence level for t-test is 95%. Panel A1 and A2 show number (percentage) of significant positive and negative momentum coefficient γ_{mom} for equal-weighted momentum portfolios in overall sample period and subperiods. Panel B shows the corresponding statistics on value-weighted momentum coefficient γ_{mom}..

Table 4.7 The diference in average monthly return of 'Winner', 'Loser', and 'Winner/Loser' portfolio between two approaches of skipping and unskipping one month in momentum portfolio formation (R_s-R_{us})

Panel A Momentum formation with lagged 6 months' share returns						
	Equal-weighted			Value-weighted		
	Winner	Loser	Winner/Loser	Winner	Loser	Winner/Loser
Holding months	R_s-R_{us}	R_s-R_{us}	R_s-R_{us}	R_s-R_{us}	R_s-R_{us}	R_s-R_{us}
3	0.15	-0.62	0.77	0.08	-0.43	0.51
6	0.08	-0.31	0.39	0.04	-0.20	0.24
12	0.02	-0.16	0.18	0.02	-0.09	0.11
18	0.04	-0.14	0.18	0.03	-0.08	0.11
24	0.06	-0.13	0.19	0.05	-0.06	0.11

Panel B Momentum formation with lagged 12 months' share returns						
	Equal-weighted			Value-weighted		
	Winner	Loser	Winner/Loser	Winner	Loser	Winner/Loser
Holding months	R_s-R_{us}	R_s-R_{us}	R_s-R_{us}	R_s-R_{us}	R_s-R_{us}	R_s-R_{us}
3	0.10	-0.46	0.56	0.06	-0.30	0.36
6	0.04	-0.23	0.27	0.05	-0.13	0.18
12	-0.01	-0.10	0.11	0.01	-0.01	0.02
18	0.00	-0.10	0.10	0.02	-0.03	0.05
24	0.01	-0.11	0.12	0.01	0.00	0.01

Note: The table reports the difference in average monthly return of 'Winner', 'Loser', and 'Winner/Loser' portfolio between two approaches of skipping and unskipping one month in momentum portfolio formation from 1956 to 2008, which are denoted as 'Winner R_s-R_{us}', 'Loser R_s-R_{us}', and 'Winner/Loser R_s-R_{us}'

Table 4.8 The correlation in series return of 'Winner', 'Loser', 'Winner/Loser' portfolio, and momentum coefficient γ between two approaches of skipping and unskipping one month in momentum portfolio formation

Panel A Momentum formation with lagged 6 months' share returns								
	Equal-weighted				Value-weighted			
Holding months	Winner	Loser	Winner/Loser	γ_{mom}	Winner	Loser	Winner/Loser	γ_{mom}
3	0.9805	0.9833	0.9192	0.9533	0.9288	0.9317	0.8518	0.9078
6	0.9859	0.9871	0.9203	0.9476	0.9308	0.9409	0.8983	0.9010
12	0.9855	0.9877	0.9195	0.9417	0.9375	0.9446	0.8714	0.9062
18	0.9807	0.9722	0.8639	0.9230	0.9326	0.9168	0.8270	0.8834
24	0.9232	0.9047	0.6503	0.7250	0.9348	0.9237	0.8290	0.8749

Panel B Momentum formation with lagged 12 months' share returns								
	Equal-weighted				Value-weighted			
Holding months	Winner	Loser	Winner/Loser	γ_{mom}	Winner	Loser	Winner/Loser	γ_{mom}
3	0.9880	0.9873	0.9432	0.9710	0.9528	0.9549	0.9085	0.9361
6	0.9898	0.9907	0.9468	0.9681	0.9679	0.9643	0.9212	0.9510
12	0.9903	0.9903	0.8476	0.9654	0.9599	0.9634	0.9175	0.9391
18	0.9873	0.9799	0.9204	0.9379	0.9572	0.9619	0.9235	0.9233
24	0.9726	0.8772	0.7063	0.6909	0.9593	0.9409	0.8929	0.9201

Note: The table reports correlation coefficients of series return of 'Winner', 'Loser', and 'Winner/Loser' portfolio, and momentum coefficient γ_{mom} between two approaches of skipping and unskipping one month in momentum portfolio formation from 1956 to 2008.

Table 4.9 Statistics on decile size portfolios

Panel A Equal-weighted portfolio

A1 Average monthly excess return and standard deviation

Holding months	Small	P2	P3	P4	P5	P6	P7	P8	P9	Large	R_{sml}
3	0.56	0.21	0.35	0.43	0.37	0.48	0.46	0.48	0.49	0.46	0.10
	(3.80)	(3.53)	(3.35)	(3.16)	(3.09)	(2.84)	(2.91)	(2.90)	(2.85)	(2.85)	(3.50)
6	0.66	0.29	0.39	0.46	0.42	0.48	0.50	0.51	0.53	0.48	0.18
	(3.21)	(2.62)	(2.38)	(2.16)	(2.13)	(1.96)	(1.99)	(1.96)	(1.91)	(2.00)	(2.78)
12	0.88	0.43	0.48	0.55	0.52	0.60	0.53	0.71	0.62	0.57	0.31
	(2.64)	(1.84)	(1.61)	(1.47)	(1.50)	(1.39)	(1.40)	(1.37)	(1.36)	(1.44)	(2.33)
18	1.04	0.55	0.55	0.64	0.62	0.68	0.58	0.84	0.72	0.64	0.41
	(2.24)	(1.53)	(1.33)	(1.23)	(1.24)	(1.21)	(1.18)	(1.23)	(1.13)	(1.19)	(1.95)
24	1.13	0.64	0.60	0.70	0.69	0.72	0.64	0.96	0.79	0.69	0.44
	(2.04)	(1.32)	(1.15)	(1.08)	(1.11)	(1.08)	(1.04)	(1.11)	(1.06)	(1.08)	(1.78)

A2 Percentage of observations for each portfolio with highest return

Holding months	Small	P2	P3	P4	P5	P6	P7	P8	P9	Large
3	22.7	3.9	5.0	4.5	5.9	7.6	6.2	14.8	11.8	17.6
6	25.4	3.7	3.1	2.5	5.9	7.9	7.9	14.1	15.3	14.1
12	29.9	2.0	0.6	3.4	6.3	7.2	5.7	16.7	13.5	14.7
18	35.1	1.2	0.3	5.0	4.4	8.2	2.6	19.3	13.5	10.5
24	37.5	0	0.3	4.5	1.5	2.7	4.8	21.7	16.7	10.4

A3 Percentage of observations for each portfolio with lowest return

Holding months	Small	P2	P3	P4	P5	P6	P7	P8	P9	Large
3	21.0	10.9	6.2	3.4	8.4	6.4	6.2	12.0	8.1	17.4
6	23.2	13.8	5.4	3.4	5.9	4.8	5.1	11.9	10.2	16.4
12	22.7	13.5	3.2	2.9	4.0	6.9	7.2	12.1	9.5	18.1
18	18.1	15.8	4.1	4.1	2.6	7.9	7.3	10.8	10.2	19.0
24	16.1	15.8	5.1	4.5	2.4	8.6	10.4	8.3	13.1	15.8

Panel B Value-weighted portfolio

B1 Average monthly excess return and standard deviation

Holding months	Small	P2	P3	P4	P5	P6	P7	P8	P9	Large	R_{sml}
3	0.35	0.23	0.36	0.43	0.36	0.47	0.47	0.47	0.46	0.41	-0.06
	(3.68)	(3.51)	(3.34)	(3.15)	(3.09)	(2.83)	(2.90)	(2.90)	(2.86)	(2.78)	(3.24)
6	0.48	0.30	0.40	0.46	0.41	0.47	0.51	0.51	0.50	0.42	0.06
	(3.02)	(2.60)	(2.36)	(2.15)	(2.12)	(1.96)	(1.98)	(1.97)	(1.89)	(1.94)	(2.54)
12	0.69	0.43	0.49	0.56	0.51	0.59	0.54	0.71	0.60	0.49	0.20
	(2.37)	(1.80)	(1.58)	(1.46)	(1.49)	(1.39)	(1.40)	(1.38)	(1.34)	(1.41)	(2.05)
18	0.84	0.55	0.56	0.64	0.60	0.67	0.59	0.85	0.69	0.56	0.28
	(1.97)	(1.51)	(1.31)	(1.22)	(1.24)	(1.21)	(1.18)	(1.24)	(1.12)	(1.17)	(1.71)
24	0.92	0.63	0.62	0.70	0.68	0.71	0.64	0.98	0.77	0.62	0.30
	(1.77)	(1.30)	(1.13)	(1.07)	(1.11)	(1.08)	(1.03)	(1.13)	(1.05)	(1.07)	(1.55)

B2 Percentage of observations for each portfolio with highest return

Holding months	Small	P2	P3	P4	P5	P6	P7	P8	P9	Large
3	19.3	4.8	5.6	3.9	6.2	7.0	6.7	14.6	11.8	20.2
6	24.3	3.4	3.4	4.5	5.1	8.2	8.5	15.3	14.4	13.0
12	28.2	1.4	1.1	4.6	5.7	8.9	6.0	17.5	12.9	13.5
18	32.5	0.9	0.3	5.6	4.7	7.3	3.5	19.6	12.9	12.9
24	36.3	0	0	5.7	1.8	2.1	5.4	21.7	16.4	10.7

B3 Percentage of observations for each portfolio with lowest return

Holding months	Small	P2	P3	P4	P5	P6	P7	P8	P9	Large
3	23.2	8.1	5.9	3.1	8.1	6.7	5.0	11.2	7.8	20.7
6	24.3	9.6	4.2	3.1	6.8	5.9	4.5	11.3	10.7	19.5
12	23.3	10.6	3.7	2.6	3.2	6.0	6.0	11.2	10.9	22.4
18	18.7	11.7	3.5	5.0	2.6	6.7	5.3	10.2	10.5	25.7
24	17.9	11.9	4.5	3.9	2.4	9.8	8.3	7.1	16.1	18.2

Note: The table reports statistics on decile size portfolios based on ranking shares' market values from the lowest to the highest at the end of formation time and 3, 6, 12, 18, and 24 months' holding horizons from 1979 to 2008. The research designates 'Small' and 'Large' as the bottom (P1) and the top (P10) portfolios. Small/Large return R_{sml} is estimated by the spread in average monthly excess return between 'Small' portfolio and 'Large' portfolio. Panel A1 shows equal-weighted decile size portfolios' average monthly excess returns, with standard deviation in parenthesis. Panel A2 and A3 show the percentage of equal-weighted portfolio with highest return and lowest return among decile portfolios, respectively, over the sample period. Panel B shows the corresponding statistics on value-weighted decile size portfolios.

Table 4.10 Statistics on Small/Large return R_{sml}

Panel A Equal-weighted portfolio

A1 Average monthly Small/Large return R_{sml} and t-stats

Holding months	Observation Number	Sample beginning -1989	1990s	2000-2008	Overall period
3	357	0.79	-0.62	0.06	0.10
		(1.76)	(-1.34)	(0.13)	(0.33)
6	354	0.90	-0.68	0.28	0.18
		(1.77)	(-1.40)	(0.55)	(0.56)
12	348	1.10	-0.75	0.63	0.31
		(1.88)	(-1.38)	(1.20)	(0.88)
18	342	1.35	-0.72	0.67	0.41
		(2.29)	(-1.26)	(1.62)	(1.10)
24	336	1.53	-0.74	0.66	0.44
		(2.46)	(-1.32)	(2.22)	(1.15)

A2 The number (percentage) of positive average monthly Small/Large return R_{sml} (small-cap effect)

Holding months	Observation Number	Sample beginning -1989	1990s	2000-2008	Overall period
3	357	77	47	47	171
		(59.7)	(39.2)	(43.5)	(47.9)
6	354	79	41	42	162
		(62.7)	(34.2)	(38.9)	(45.8)
12	348	79	39	48	166
		(65.8)	(32.5)	(44.4)	(47.7)
18	342	89	44	65	198
		(78.1)	(36.7)	(60.2)	(57.9)
24	336	87	44	75	206
		(80.6)	(36.7)	(69.4)	(61.3)

A3 The number (percentage) of negative average monthly Small/Large return R_{sml} (large-cap effect)

Holding months	Observation Number	Sample beginning -1989	1990s	2000-2008	Overall period
3	357	52	73	61	186
		(40.3)	(60.8)	(56.5)	(52.1)
6	354	47	79	66	192
		(37.3)	(65.8)	(61.1)	(54.2)
12	348	41	81	60	182
		(34.2)	(67.5)	(55.6)	(52.3)
18	342	25	76	43	144
		(21.9)	(63.3)	(39.8)	(42.1)
24	336	21	76	33	130
		(19.4)	(63.3)	(30.6)	(38.7)

Panel B Value-weighted portfolio

B1 Average monthly Small/Large return R_{sml} and t-stats

Holding months	Observation Number	Sample beginning -1989	1990s	2000-2008	Overall period
3	357	0.48	-0.68	-0.02	-0.06
		(1.17)	(-1.52)	(-0.04)	(-0.23)
6	354	0.63	-0.74	0.28	0.06
		(1.42)	(-1.55)	(0.61)	(0.20)
12	348	0.81	-0.82	0.65	0.20
		(1.79)	(-1.58)	(1.43)	(0.63)
18	342	1.03	-0.84	0.72	0.28
		(2.46)	(-1.54)	(1.96)	(0.85)
24	336	1.21	-0.86	0.68	0.30
		(2.85)	(-1.61)	(2.56)	(0.89)

Continued

B2 The number (percentage) of positive average monthly Small/Large return R_{sml} (small-cap effect)

Holding months	Observation Number	Sample beginning -1989	1990s	2000-2008	Overall period
3	357	68	45	47	160
		(52.7)	(37.5)	(43.5)	(44.8)
6	354	76	39	49	164
		(60.3)	(32.5)	(45.4)	(46.3)
12	348	79	36	59	174
		(65.8)	(30.0)	(54.6)	(50.0)
18	342	85	40	77	202
		(74.6)	(33.3)	(71.3)	(59.1)
24	336	91	35	79	205
		(84.3)	(29.2)	(73.1)	(61.0)

B2 The number (percentage) of negative average monthly Small/Large return R_{sml} (large-cap effect)

Holding months	Observation Number	Sample beginning -1989	1990s	2000-2008	Overall period
3	357	61	75	61	197
		(47.3)	(62.5)	(56.5)	(55.2)
6	354	50	81	59	190
		(39.7)	(67.5)	(54.6)	(53.7)
12	348	41	84	49	174
		(34.2)	(70.0)	(45.4)	(50.0)
18	342	29	80	31	140
		(25.4)	(66.7)	(28.7)	(40.9)
24	336	17	85	29	131
		(15.7)	(70.8)	(26.9)	(39.0)

Note: The table reports statistics on Small/Large return R_{sml}, the spread in average monthly excess return between bottom ('Small') and top ('Large') size portfolios which are formed on shares' market value at the end of formation time and hold for 3, 6, 12, 18, and 24 months from 1979 to 2008. Panel A1 shows equal-weighted Small/Large return R_{sml} and its t-statistic in parenthesis in overall period and subperiods. t-statistics is adjusted by Newey-West (1987) approach. Lag length is holding horizon minus one. Panel A2 and A3 show the number (percentage) of positive and negative equal-weighted Small/Large return R_{sml}, respectively, in overall period and subperiods. Panel B shows the corresponding statistics on value-weighted Small/Large return R_{sml}.

Table 4.11 Statistics on size coefficient γ_{mv}

Panel A Equal-weighted portfolio

A1 The number (percentage) of significant negative size coefficient γ_{mv} (Small-cap effect)

Holding months	Observation Number	Sample beginning -1989	1990s	2000-2008	Overall period
3	334	28	0	0	28
		(26.4)	(0.0)	(0.0)	(8.4)
6	331	29	2	0	31
		(28.2)	(1.7)	(0.0)	(9.4)
12	325	51	6	12	69
		(52.6)	(5.0)	(11.1)	(21.2)
18	319	67	21	58	146
		(73.6)	(17.5)	(53.7)	(45.8)
24	313	55	13	61	129
		(64.7)	(10.8)	(56.5)	(41.2)

A2 The number (percentage) of significant positive size coefficient γ_{mv} (Large-cap effect)

Holding months	Observation Number	Sample beginning -1989	1990s	2000-2008	Overall period
3	334	0	46	21	67
		(0.0)	(38.3)	(19.4)	(20.1)
6	331	0	49	37	86
		(0.0)	(40.8)	(34.3)	(26.0)
12	325	0	52	32	84
		(0.0)	(43.3)	(29.6)	(25.8)
18	319	8	75	30	113
		(8.8)	(62.5)	(27.8)	(35.4)
24	313	16	72	22	110
		(18.8)	(60.0)	(20.4)	(35.1)

Panel B Value-weighted portfolio

B1 The number (percentage) of significant negative size coefficient γ_{mv} (Small-cap effect)

Holding months	Observation Number	Sample beginning -1989	1990s	2000-2008	Overall period
3	334	25	0	2	27
		(23.6)	(0.0)	(1.9)	(8.1)
6	331	29	0	0	29
		(28.2)	(0.0)	(0.0)	(8.8)
12	325	50	6	16	72
		(51.5)	(5.0)	(14.8)	(22.2)
18	319	67	21	58	149
		(73.6)	(17.5)	(53.7)	(46.7)
24	313	52	12	61	125
		(61.2)	(10.0)	(56.5)	(39.9)

B2 The number (percentage) of significant positive size coefficient γ_{mv} (Large-cap effect)

Holding months	Observation Number	Sample beginning -1989	1990s	2000-2008	Overall period
3	334	0	46	9	55
		(0.0)	(38.3)	(8.3)	(16.5)
6	331	0	48	16	64
		(0.0)	(40.0)	(14.8)	(19.3)
12	325	0	54	28	82
		(0.0)	(45.0)	(25.9)	(25.2)
18	319	8	75	30	108
		(8.8)	(62.5)	(27.8)	(33.9)
24	313	0	73	22	95
		(0.0)	(60.8)	(20.4)	(30.4)

Note: The table reports statistics on size coefficient γ_{mv}, estimated by regressing decile size portfolios' holding returns on their log mean market values at the formation time. Decile size portfolios are formed on shares' market values at the end of formation time and hold for 3, 6, 12, 18, and 24 months from 1979 to 2008. The research averages 24 regression coefficient γ_{mv} as one testing period, uses Newey-West (1987) approach to adjust standard errors and estimates t-statistics. Lag length is holding horizon minus one. The confidence level for t-test is 95%. Panel A1 and A2 show number (percentage) of significant negative and positive size coefficient γ_{mv} for equal-weighted size portfolios in overall sample period and subperiods. Panel B shows the corresponding statistics on value-weighted size coefficient γ_{mv}..

Table 4.12 Statistics on decile value portfolios

Panel A Equal-weighted portfolio

A1 Average monthly excess return and standard deviation

Holding months	Low	P2	P3	P4	P5	P6	P7	P8	P9	High	R_{lmh}
3	1.17	0.90	0.71	0.60	0.49	0.41	0.28	0.23	0.20	-0.09	1.26
	(3.26)	(3.00)	(3.07)	(2.97)	(2.88)	(2.92)	(2.81)	(2.94)	(3.24)	(3.48)	(2.64)
6	1.15	0.96	0.80	0.68	0.54	0.47	0.37	0.31	0.23	0.03	1.12
	(2.59)	(2.31)	(2.37)	(2.29)	(2.15)	(2.15)	(2.19)	(2.26)	(2.44)	(2.75)	(2.18)
12	1.16	1.07	0.90	0.77	0.66	0.59	0.45	0.39	0.27	0.18	0.98
	(2.14)	(1.85)	(1.79)	(1.76)	(1.68)	(1.66)	(1.60)	(1.71)	(1.73)	(2.05)	(1.86)
18	1.28	1.14	1.02	0.87	0.75	0.71	0.49	0.41	0.31	0.31	0.97
	(2.07)	(1.66)	(1.70)	(1.53)	(1.46)	(1.51)	(1.36)	(1.37)	(1.41)	(1.74)	(1.77)
24	1.35	1.20	1.06	0.94	0.89	0.76	0.57	0.46	0.35	0.37	0.99
	(2.04)	(1.56)	(1.46)	(1.43)	(1.46)	(1.36)	(1.26)	(1.21)	(1.22)	(1.50)	(1.55)

A2 Percentage of observations for each portfolio with highest return

Holding months	Low	P2	P3	P4	P5	P6	P7	P8	P9	High
3	32.8	18.3	7.8	5.5	6.4	4.6	4.1	4.1	7.5	9.0
6	37.1	19.0	7.0	6.4	4.4	4.1	4.7	4.4	5.6	7.3
12	34.5	17.9	8.3	7.1	5.4	5.7	4.5	4.2	4.5	8.0
18	35.8	16.4	8.2	7.9	7.3	6.1	3.0	3.6	3.0	8.8
24	34.9	17.0	10.8	7.4	7.7	6.2	2.5	5.2	4.6	3.7

A3 Percentage of observations for each portfolio with lowest return

Holding months	Low	P2	P3	P4	P5	P6	P7	P8	P9	High
3	8.7	4.9	6.7	4.6	4.6	5.8	4.1	6.1	15.1	39.4
6	9.4	4.4	3.8	4.4	4.1	4.4	7.0	5.6	13.7	43.3
12	9.2	2.4	3.9	3.6	5.4	2.1	4.8	7.7	15.8	45.2
18	9.4	1.2	3.6	2.7	3.3	3.0	6.1	8.8	18.8	43.0
24	5.9	0.6	1.9	2.8	3.1	5.9	3.7	10.5	22.2	43.5

Panel B Value-weighted portfolio

B1 Average monthly excess return and standard deviation

Holding months	Low	P2	P3	P4	P5	P6	P7	P8	P9	High	R_{lmh}
3	1.24	0.78	0.69	0.66	0.46	0.40	0.28	0.31	0.29	0.31	0.93
	(4.05)	(3.42)	(3.38)	(3.31)	(3.14)	(2.98)	(3.00)	(2.82)	(3.02)	(2.86)	(3.69)
6	1.31	0.77	0.82	0.66	0.52	0.44	0.34	0.37	0.33	0.35	0.96
	(3.00)	(2.37)	(2.55)	(2.37)	(2.19)	(2.14)	(2.00)	(1.93)	(2.13)	(1.99)	(2.79)
12	1.36	0.83	0.91	0.68	0.60	0.55	0.42	0.44	0.37	0.35	1.01
	(2.29)	(1.72)	(1.86)	(1.70)	(1.58)	(1.52)	(1.30)	(1.33)	(1.42)	(1.40)	(2.16)
18	1.45	0.90	1.01	0.78	0.71	0.63	0.49	0.51	0.40	0.41	1.04
	(1.95)	(1.28)	(1.61)	(1.45)	(1.38)	(1.31)	(1.11)	(1.17)	(1.15)	(1.21)	(1.90)
24	1.50	0.95	1.10	0.91	0.85	0.72	0.55	0.56	0.49	0.47	1.03
	(1.75)	(1.10)	(1.44)	(1.37)	(1.24)	(1.13)	(1.01)	(1.01)	(1.07)	(1.13)	(1.73)

B2 Percentage of observations for each portfolio with highest return

Holding months	Low	P2	P3	P4	P5	P6	P7	P8	P9	High
3	26.4	12.5	9.0	9.0	7.0	7.0	4.1	6.1	7.2	11.9
6	32.5	13.5	9.9	7.6	3.2	3.5	3.2	8.8	6.7	11.1
12	32.4	14.0	12.2	7.4	3.3	6.3	3.0	6.3	6.0	9.2
18	37.0	13.6	10.0	9.4	2.4	5.2	3.9	6.1	4.5	7.9
24	36.4	14.2	11.7	9.3	4.0	2.8	1.9	5.9	3.4	10.5

B3 Percentage of observations for each portfolio with lowest return

Holding months	Low	P2	P3	P4	P5	P6	P7	P8	P9	High
3	9.9	10.4	8.7	7.2	6.4	11.0	9.0	8.7	10.4	18.3
6	13.2	9.1	9.4	4.7	5.8	10.2	9.9	8.8	13.7	15.2
12	9.8	8.6	7.7	4.2	6.5	8.9	10.1	9.2	14.3	20.5
18	10.0	5.8	7.3	6.4	5.5	9.7	10.9	10.9	12.7	20.9
24	6.5	7.4	9.3	6.8	5.2	7.1	10.5	11.4	9.0	26.9

Note: The table reports statistics on decile value portfolios based on ranking shares' price-to-book ratios (PB) from the lowest to the highest at the end of formation time and 3, 6, 12, 18, and 24 months' holding horizons from 1980 to 2008. The research designates 'Low' and 'High' as the bottom (P1) and top (P10) portfolios. Low/High return R_{lmh} is estimated by the spread in average monthly excess return between 'Low' portfolio and 'High' portfolio. Panel A1 shows equal-weighted value decile portfolios' average monthly excess returns, with standard deviation in parenthesis. Panel A2 and A3 show the percentage of equal-weighted portfolio with highest return and lowest return among decile portfolios, respectively, over the sample period. Panel B shows the corresponding statistics on value-weighted decile value portfolios.

Table 4.13 Statistics on Low/High return R_{lmh}

Panel A Equal-weighted portfolio

A1 Average monthly Low/High return R_{lmh} and t-stats

Holding months	Observation Number	Sample beginning -1989	1990s	2000-2008	Overall period
3	345	1.32	0.90	1.57	1.25
		(3.53)	(2.83)	(4.03)	(5.78)
6	342	1.27	0.76	1.36	1.12
		(3.29)	(2.12)	(3.21)	(4.68)
12	336	1.35	0.65	0.98	0.98
		(2.89)	(1.58)	(2.04)	(3.48)
18	330	1.71	0.63	0.65	0.97
		(3.15)	(1.61)	(1.25)	(3.10)
24	324	1.88	0.60	0.62	0.99
		(2.80)	(1.83)	(1.44)	(3.01)

A2 The number (percentage) of positive average monthly Low/High return R_{lmh} (value effect)

Holding months	Observation Number	Sample beginning -1989	1990s	2000-2008	Overall period
3	345	88	80	92	260
		(75.2)	(66.7)	(85.2)	(75.4)
6	342	89	77	96	262
		(78.1)	(64.2)	(88.9)	(76.6)
12	336	84	87	95	266
		(77.8)	(72.5)	(88.0)	(79.2)
18	330	78	80	90	248
		(76.5)	(66.7)	(83.3)	(75.2)
24	324	73	96	95	264
		(76.0)	(80.0)	(88.0)	(81.5)

A3 The number (percentage) of negative average monthly Low/High return R_{lmh} (growth effect)

Holding months	Observation Number	Sample beginning -1989	1990s	2000-2008	Overall period
3	345	29	40	16	85
		(24.8)	(33.3)	(14.8)	(24.6)
6	342	25	43	12	80
		(21.9)	(35.8)	(11.1)	(23.4)
12	336	24	33	13	70
		(22.2)	(27.5)	(12.0)	(20.8)
18	330	24	40	18	82
		(23.5)	(33.3)	(16.7)	(24.8)
24	324	23	24	13	60
		(24.0)	(20.0)	(12.0)	(18.5)

Panel B Value-weighted portfolio

B1 Average monthly Low/High return R_{lmh} and t-stats

Holding months	Observation Number	Sample beginning -1989	1990s	2000-2008	Overall period
3	345	1.14	0.39	1.29	0.93
		(2.92)	(0.86)	(1.99)	(3.16)
6	342	1.14	0.45	1.34	0.96
		(2.89)	(0.92)	(2.10)	(3.17)
12	336	1.25	0.38	1.47	1.01
		(2.86)	(0.72)	(2.33)	(3.11)
18	330	1.42	0.29	1.52	1.04
		(2.57)	(0.58)	(2.86)	(3.07)
24	324	1.54	0.25	1.45	1.03
		(2.24)	(0.64)	(2.69)	(2.86)

Continued

B2 The number (percentage) of positive average monthly Low/High return R_{lmh} (value effect)

Holding months	Observation Number	Sample beginning -1989	1990s	2000-2008	Overall period
3	345	75	63	71	209
		(64.1)	(52.5)	(65.7)	(60.6)
6	342	82	60	70	212
		(71.9)	(50.0)	(64.8)	(62.0)
12	336	89	66	74	229
		(82.4)	(55.0)	(68.5)	(68.2)
18	330	85	65	80	230
		(83.3)	(54.2)	(74.1)	(69.7)
24	324	75	67	87	229
		(78.1)	(55.8)	(80.6)	(70.7)

B3 The number (percentage) of negative average monthly Low/high return R_{lmh} (growth effect)

Holding months	Observation Number	Sample beginning -1989	1990s	2000-2008	Overall period
3	345	42	57	37	136
		(35.9)	(47.5)	(34.3)	(49.4)
6	342	32	60	38	130
		(28.1)	(50.0)	(35.2)	(38.0)
12	336	19	54	34	107
		(17.6)	(45.0)	(31.5)	(31.8)
18	330	17	55	28	100
		(16.7)	(45.8)	(25.9)	(30.3)
24	324	21	53	21	95
		(21.9)	(44.2)	(19.4)	(29.3)

Note: The table reports statistics on Low/High return R_{lmh}, the spread in average monthly excess return between bottom and top value portfolios which are formed on shares' price-to-market ratios at the end of formation time and hold for 3, 6, 12, 18, and 24 months from 1980 to 2008. Panel A1 shows equal-weighted Low/High return R_{lmh} and its t-statistic in parenthesis in overall period and subperiods. t-statistics is adjusted by Newey-West (1987) approach. Lag length is holding horizon minus one. Panel A2 and A3 show the number (percentage) of positive and negative equal-weighted Low/High return R_{lmh}, respectively, in overall period and subperiods. Panel B shows the corresponding statistics on value-weighted Low/High return R_{lmh}

Table 4.14 Statistics on value coefficient γ_{pb}

Panel A Equal-weighted portfolio

A1 The number (percentage) of significant negative value coefficient γ_{pb} (Value effect)

Holding months	Observation Number	Sample beginning -1989	1990s	2000-2008	Overall period
3	322	54	54	83	191
		(57.4)	(45.0)	(76.9)	(59.3)
6	319	48	56	82	186
		(52.7)	(46.7)	(75.9)	(58.3)
12	313	56	69	78	203
		(65.9)	(57.5)	(72.2)	(64.9)
18	307	59	76	75	210
		(74.7)	(63.3)	(69.4)	(68.4)
24	301	56	92	75	223
		(76.7)	(76.7)	(69.4)	(74.1)

A2 The number (percentage) of significant positive value coefficient γ_{pb} (Growth effect)

Holding months	Observation Number	Sample beginning -1989	1990s	2000-2008	Overall period
3	322	0	0	0	0
		(0.0)	(0.0)	(0.0)	(0.0)
6	319	0	0	0	0
		(0.0)	(0.0)	(0.0)	(0.0)
12	313	0	0	1	1
		(0.0)	(0.0)	(0.9)	(0.3)
18	307	8	3	9	20
		(10.1)	(2.5)	(8.3)	(6.5)
24	301	4	2	13	19
		(5.5)	(1.7)	(12.0)	(6.3)

Panel B Value-weighted portfolio

B1 The number (percentage) of significant negative value coefficient γ_{pb} (Value effect)

Holding months	Observation Number	Sample beginning -1989	1990s	2000-2008	Overall period
3	322	52	17	61	130
		(55.3)	(14.2)	(56.5)	(40.4)
6	319	58	13	62	133
		(63.7)	(10.8)	(57.4)	(41.7)
12	313	61	23	59	143
		(71.8)	(19.2)	(54.6)	(45.7)
18	307	57	40	66	163
		(72.2)	(33.3)	(61.1)	(53.1)
24	301	54	44	74	172
		(74.0)	(36.7)	(68.5)	(57.1)

B2 The number (percentage) of significant positive value coefficient γ_{pb} (Growth effect)

Holding months	Observation Number	Sample beginning -1989	1990s	2000-2008	Overall period
3	322	0	0	3	3
		(0.0)	(0.0)	(2.8)	(0.9)
6	319	0	12	1	13
		(0.0)	(10.0)	(0.9)	(4.1)
12	313	0	14	13	27
		(0.0)	(11.7)	(12.0)	(8.6)
18	307	4	13	17	34
		(5.1)	(10.8)	(15.7)	(11.1)
24	301	8	15	17	40
		(11.0)	(12.5)	(15.7)	(13.3)

Note: The table reports statistics on value coefficient γ_{pb}, estimated by regressing decile value portfolios' holding returns on their price-to-book ratios at the formation time. Decile value portfolios are formed on shares' price-to-book ratios at the end of formation time and hold for 3, 6, 12, 18, and 24 months from 1980 to 2008. The research averages 24 regression coefficient γ_{pb} as one testing period, uses Newey-West (1987) approach to adjust standard errors and estimates t-statistics. Lag length is holding horizon minus one. The confidence level for t-test is 95%. Panel A1 and A2 show number (percentage) of significant negative and positive value coefficient γ_{pb} for equal-weighted value portfolios in overall sample period and subperiods. Panel B shows the corresponding statistics on value-weighted value coefficient γ_{pb}..

Table 4.15 Correlation coefficient among style effects in terms of Long/Short return R_{lms}

Panel A Overall period from 1980 to 2008						
	Equal-weighted			Value-weighted		
Holding months	Mom/Size	Mom/Value	Size/Value	Mom/Size	Mom/Value	Size/Value
3	-0.4843	-0.1768	0.0002	-0.2158	-0.5019	0.3401
6	-0.3860	-0.4426	0.0574	-0.3264	-0.5121	0.3580
12	-0.5147	-0.4529	0.1560	-0.4687	-0.5893	0.4500
18	-0.4728	-0.4172	0.2808	-0.4545	-0.5294	0.5035
24	-0.4485	-0.3927	0.4516	-0.3803	-0.4293	0.4949

Panel B January 1980-December 1989						
	Equal-weighted			Value-weighted		
Holding months	Mom/Size	Mom/Value	Size/Value	Mom/Size	Mom/Value	Size/Value
3	-0.4178	-0.3094	0.5414	-0.1962	-0.3167	0.4459
6	-0.4518	-0.5334	0.6090	-0.2641	-0.4210	0.5902
12	-0.6370	-0.5477	0.6734	-0.5478	-0.5476	0.6179
18	-0.3810	-0.4971	0.5790	-0.4924	-0.4419	0.5659
24	-0.2854	-0.4444	0.6343	-0.1888	-0.2789	0.4839

Panel C January 1990-December 1999						
	Equal-weighted			Value-weighted		
Holding months	Mom/Size	Mom/Value	Size/Value	Mom/Size	Mom/Value	Size/Value
3	-0.5897	-0.3940	0.0673	-0.2758	-0.4732	0.2748
6	-0.5606	-0.5094	0.1034	-0.4968	-0.5554	0.3131
12	-0.7107	-0.4314	0.2344	-0.5175	-0.4752	0.4247
18	-0.6649	-0.6432	0.5149	-0.4339	-0.4599	0.4662
24	-0.5113	-0.5095	0.5237	-0.3981	-0.3695	0.4045

Panel D January 2000-December 2008						
	Equal-weighted			Value-weighted		
Holding months	Mom/Size	Mom/Value	Size/Value	Mom/Size	Mom/Value	Size/Value
3	-0.4741	0.0796	-0.6227	-0.1935	-0.5889	0.3193
6	-0.1768	-0.3312	-0.6004	-0.2417	-0.5200	0.2070
12	-0.2585	-0.3894	-0.5674	-0.3897	-0.6571	0.2651
18	-0.3267	-0.2623	-0.5746	-0.3777	-0.5607	0.2931
24	-0.4416	-0.3058	-0.3675	-0.4229	-0.4618	0.3044

Note: The table reports correlation coefficient among style effects in terms of long/short return R_{lms} from 1980 to 2008, and three subperiods. Long/short return R_{lms} are estimated from return spread of top/bottom decile portfolios in terms of momentum, size, and value effect.

Table 4.16 Correlation coefficient among style effects in terms of style coefficient γ

Panel A Overall period from 1980 to 2008						
	Equal-weighted			Value-weighted		
Holding months	Mom/Size	Mom/Value	Size/Value	Mom/Size	Mom/Value	Size/Value
3	-0.3661	-0.3074	0.2065	-0.3729	-0.3269	0.3405
6	-0.4498	-0.3238	0.2384	-0.4183	-0.3445	0.3710
12	-0.5175	-0.3648	0.2461	-0.5139	-0.3832	0.4163
18	-0.5263	-0.3656	03594	-0.5256	-0.3809	0.4941
24	-0.5364	-0.3545	0.4457	-0.4555	-0.2475	0.5429

Panel B January 1980-December 1989						
	Equal-weighted			Value-weighted		
Holding months	Mom/Size	Mom/Value	Size/Value	Mom/Size	Mom/Value	Size/Value
3	-0.3844	-0.5327	0.5162	-0.2734	-0.4630	0.4976
6	-0.4314	-0.6249	0.5677	-0.2732	-0.5422	0.5424
12	-0.5173	-0.6465	0.5489	-0.3993	-0.4922	0.5292
18	-0.3605	-0.5633	0.5507	-0.3736	-0.3638	0.5725
24	-0.3148	-0.5457	0.5247	-0.1701	-0.0982	0.5648

Panel C January 1990-December 1999						
	Equal-weighted			Value-weighted		
Holding months	Mom/Size	Mom/Value	Size/Value	Mom/Size	Mom/Value	Size/Value
3	-0.5122	-0.3417	0.0456	-0.4729	-0.3611	0.3018
6	-0.6050	-0.2403	0.0297	-0.5893	-0.4600	0.3765
12	-0.6203	-0.2430	0.1704	-0.6384	-0.4437	0.4759
18	-0.6202	-0.3861	0.4320	-0.5544	-0.5839	0.5485
24	-0.4943	-0.3129	0.4190	-0.4096	-0.4759	0.5159

Panel D January 2000-December 2008						
	Equal-weighted			Value-weighted		
Holding months	Mom/Size	Mom/Value	Size/Value	Mom/Size	Mom/Value	Size/Value
3	-0.2013	-0.2600	-0.4876	-0.3626	-0.5817	0.1084
6	-0.2870	-0.2459	-0.4516	-0.3443	-0.4870	-0.0080
12	-0.3489	-0.2446	-0.4785	-0.4218	-0.5282	0.0847
18	-0.3640	-0.1227	-0.4599	-0.4475	-0.3979	0.1842
24	-0.5091	-0.0727	-0.1949	-0.5409	-0.2225	0.3435

Note: The table reports correlation coefficient among style effects in terms of style coefficient γ from 1980 to 2008, and three subperiods. Style coefficients are estimated from monthly-on-monthly cross-sectional regression of decile portfolio returns on firm characteristics such as lagged 12 months' share return, market value, and price-to-book ratio.

Table 4.17 Statistics on Long/Short return R_{lms} and style coefficient γ

Panel A Momentum effect (6 months' formation length)

A1 Equal-weighted

Holding months	Winner/Loser Return R_{wml}				Momentum coefficient γ_{mom}				Correlation coefficient
	Mean	Std	Max	Min	Mean	Std	Max	Min	
3	0.02	3.51	24.43	-22.86	0.0089	0.0629	0.4055	-0.9246	0.9034
6	0.54	2.35	14.47	-10.85	0.0415	0.0785	0.6707	-1.1212	0.9209
12	0.56	1.83	5.14	-7.81	0.0844	0.1985	0.5865	-1.2591	0.9093
18	0.20	1.62	7.10	-7.60	0.0581	0.2690	1.4133	-1.4823	0.9091
24	0.12	1.59	7.64	-17.69	0.0505	0.3392	2.0411	-2.8178	0.8944

A2 Value-weighted

Holding months	Winner/Loser Return R_{wml}				Momentum coefficient γ_{mom}				Correlation coefficient
	Mean	Std	Max	Min	Mean	Std	Max	Min	
3	0.76	4.87	17.68	-24.45	0.0208	0.1375	0.4913	-1.2283	0.9062
6	0.94	3.19	11.95	-17.03	0.0512	0.1777	0.6194	-1.1378	0.9063
12	0.82	2.35	7.02	-13.45	0.1026	0.2637	0.7737	-1.4299	0.8949
18	0.34	1.98	7.91	-10.18	0.0775	0.3207	1.6109	-1.4482	0.8808
24	0.31	1.63	7.95	-7.36	0.0890	0.3551	2.0833	-1.2139	0.8783

Panel B Momentum effect (12 months' formation length)

B1 Equal-weighted

Holding months	Winner/Loser Return R_{wml}				Momentum coefficient γ_{mom}				Correlation coefficient
	Mean	Std	Max	Min	Mean	Std	Max	Min	
3	0.51	3.23	15.35	-18.80	0.0159	0.0708	0.1908	-0.7627	0.8778
6	0.74	2.31	7.22	-11.33	0.0366	0.0993	0.3016	-0.8494	0.8982
12	0.41	1.91	4.78	-8.31	0.0443	0.1482	0.4528	-1.0752	0.8834
18	0.16	1.68	7.98	-9.64	0.0285	0.1986	1.1202	-1.1304	0.8940
24	-0.09	1.83	10.55	-18.01	-0.0062	0.2774	2.0580	-2.8956	0.9244

B2 Value-weighted

Holding months	Winner/Loser Return R_{wml}				Momentum coefficient γ_{mom}				Correlation coefficient
	Mean	Std	Max	Min	Mean	Std	Max	Min	
3	0.97	5.15	20.71	-24.88	0.0224	0.0982	0.4729	-0.7601	0.8914
6	0.98	3.42	10.55	-16.20	0.0433	0.1239	0.4010	-0.6086	0.9053
12	0.55	2.55	7.06	-13.53	0.0547	0.1803	0.5590	-0.8794	0.8848
18	0.23	2.41	6.70	-25.33	0.0447	0.2218	0.9478	-1.4038	0.8538
24	0.11	1.80	5.23	-13.35	0.0341	0.2461	1.1327	-0.9351	0.8426

Continued

Panel C Size effect

C1 Equal-weighted

Holding months	Small/Large Return R_{sml} Mean	Std	Max	Min	Size coefficient γ_{mv} Mean	Std	Max	Min	Correlation coefficient
3	0.10	3.49	20.15	-8.65	0.0003	0.0137	0.0314	-0.0629	0.9511
6	0.18	2.78	12.39	-5.86	0.0001	0.0218	0.0495	-0.0928	0.9577
12	0.31	2.33	10.53	-3.97	0.0015	0.0359	0.0670	-0.1539	0.9719
18	0.41	1.94	7.85	-4.00	0.0036	0.0459	0.0869	-0.1739	0.9788
24	0.44	1.78	7.96	-3.08	0.0052	0.0548	0.1073	-0.2126	0.9802

C2 Value-weighted

Holding months	Small/Large Return R_{sml} Mean	Std	Max	Min	Size coefficient γ_{mv} Mean	Std	Max	Min	Correlation coefficient
3	-0.06	3.24	12.54	-8.82	0.0006	0.0129	0.0324	-0.0487	0.9465
6	0.06	2.54	9.38	-5.65	0.0006	0.0203	0.0507	-0.0799	0.9543
12	0.20	2.05	8.62	-4.12	0.0001	0.0326	0.0673	-0.1311	0.9683
18	0.28	1.71	5.23	-3.59	0.0013	0.0415	0.0856	-0.1310	0.9750
24	0.30	1.55	5.79	-3.05	0.0018	0.0495	0.1071	-0.1604	0.9788

Panel D Value effect

D1 Equal-weighted

Holding months	Low/High Return R_{lmh} Mean	Std	Max	Min	Value coefficient γ_{pb} Mean	Std	Max	Min	Correlation coefficient
3	1.25	2.64	12.44	-12.39	0.0015	0.0069	0.0348	-0.0350	0.7922
6	1.12	2.17	6.46	-12.38	0.0028	0.0112	0.0575	-0.0331	0.7724
12	0.98	1.86	7.66	-7.61	0.0062	0.0168	0.0782	-0.0788	0.8038
18	0.97	1.77	7.33	-7.84	0.0103	0.0229	0.0860	-0.0881	0.8059
24	0.99	1.55	6.31	-4.23	0.0156	0.0303	0.0708	-0.1399	0.8089

D2 Value-weighted

Holding months	Low/High Return R_{lmh} Mean	Std	Max	Min	Value coefficient γ_{pb} Mean	Std	Max	Min	Correlation coefficient
3	0.93	3.69	12.27	-11.71	0.0011	0.0072	0.0409	-0.0361	0.6529
6	0.96	2.78	8.99	-6.89	0.0021	0.0126	0.0706	-0.0463	0.6303
12	1.01	2.16	10.05	-4.61	0.0054	0.0166	0.0742	-0.0583	0.6802
18	1.04	1.90	6.62	-3.33	0.0092	0.0223	0.0650	-0.0888	0.7158
24	1.03	1.72	6.44	-2.40	0.0134	0.0282	0.0438	-0.1191	0.7562

Note: The table reports statistics on Long/Short return R_{lms} and style coefficient γ of three style effects with 3, 6, 12, 18, and 24 months' holding horizons. Long/Short return R_{lms} is return spread between top/bottom portfolios sorted by lagged 6 and 12 months' return, market value, and price-to-book ratio. Style coefficient γ is the slope coefficient of cross-sectional regression of decile portfolios' returns in the holding period on their average values of firm characteristics in the formation period. Correlation coefficient is estimated by series Long/Short return R_{lms} and style coefficient γ.

Table 4.18 The performance of monthly Long/Short return R_{lms} in positive and negative annual change of GDP from 1980 to 2008

	Equal-weighted					
		+GDP(Y)			-GDP(Y)	
	Mean (%)	t-stat	+%	Mean (%)	t-stat	+%
Momentum effect (12/12)	-0.11	-0.54	60.9	1.40	3.39	87.7
Size effect(12)	0.68	3.86	52.5	-0.07	-0.38	41.8
Value effect(12)	1.09	2.99	79.3	0.91	3.15	80.7

	Value-weighted					
		+GDP(Y)			-GDP(Y)	
	Mean (%)	t-stat	+%	Mean (%)	t-stat	+%
Momentum effect (12/12)	-0.14	-0.63	54.2	1.23	2.65	76.7
Size effect(12)	0.52	3.46	56.9	-0.14	-0.80	42.4
Value effect(12)	1.13	3.18	68.2	0.89	2.98	67.6

Note: The table reports average monthly Long/Short return R_{lms}, t-statistics, and the percentage of observations with positive return in positive and negative annual change of GDP from 1980 to 2008. Long/Short return R_{lms} is return spread between top/bottom portfolios sorted by lagged 12 months' return, market value, and price-to-book ratio when long/short portfolio is hold for 12 months.

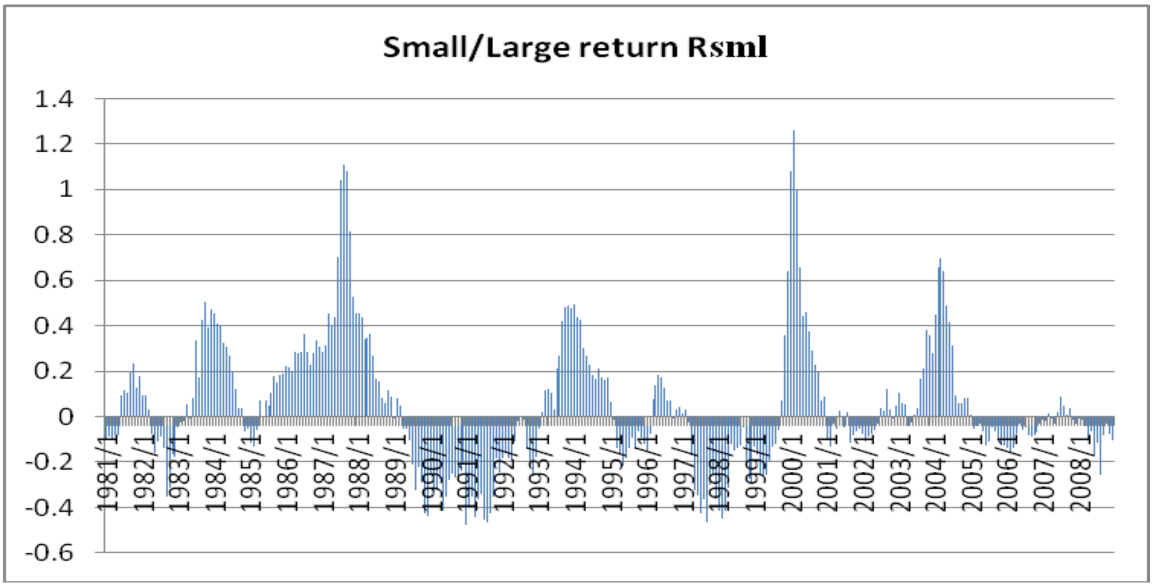
Table 4.19 The performance of monthly Long/Short return R_{lms} in positive and negative lagged one-year's market return from 1980 to 2008

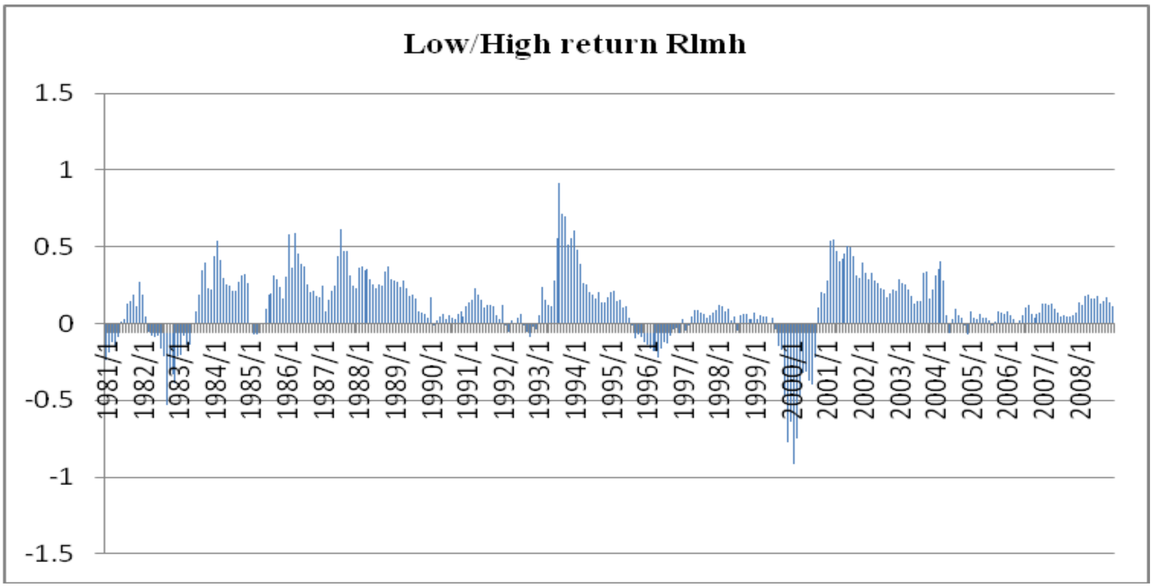
	Equal-weighted					
		+MR(-1)			-MR(-1)	
	Mean (%)	t-stat	+%	Mean (%)	t-stat	+%
Momentum effect (12/12)	0.58	1.38	73.4	0.68	1.85	73.9
Size effect(12)	0.30	1.21	52.1	0.35	1.38	47.2
Value effect(12)	0.91	3.01	79.4	1.26	3.58	78.3

	Value-weighted					
		+MR(-1)			-MR(-1)	
	Mean (%)	t-stat	+%	Mean (%)	t-stat	+%
Momentum effect (12/12)	0.22	0.40	63.8	0.52	1.78	64.0
Size effect(12)	0.19	1.52	49.4	0.43	1.81	57.9
Value effect(12)	0.92	3.56	67.8	1.38	3.19	69.6

Note: The table reports average monthly Long/Short return R_{lms}, t-statistics, and the percentage of observations with positive return in lagged one-year's upward market and downward market from 1980 to 2008. Long/Short return R_{lms} is return spread between top/bottom portfolios sorted by lagged 12 months' return, market value, and price-to-book ratio when long/short portfolio is hold for 12 months. One-year's market return is calculated by monthly FTSE ALL SHARE PRICE from LSPD.

Figure 4.1 Equal-weighted monthly Small/Large return R_{sml} and Low/High return R_{lmh} with 12 months holding horizon from 1980 to 2008





Note: The figure plots series equal-weighted monthly Small/Large return R_{sml} and Low/High return R_{lmh} from 1980 to 2008, which is estimated by the spread in 12 months' holding return between 'Small-cap' portfolio and 'Large-cap' portfolio, between 'Low' portfolio and 'High' portfolio.

Chapter 5 The Impact of Macroeconomic variables on the Time-Variation in Style Effects

Based on decile momentum portfolios, decile size portfolios, and decile value portfolios, the previous chapter uses two measures, long/short return R_{lms} and style coefficients γ, to find time-varying momentum effect, size effect, and value effect in the UK Stock Market. This chapter mainly investigates what factors lead to the time-variation in style effects, and how they can capture these dynamic properties. It explores in more depth macroeconomic conditions and market states under which dynamic style effects occur over time in the UK Stock Market. The remainder of this chapter is structured as followings. Section 5.1 offers the description on macroeconomic variables, which are assumed to have influence on time-varying style effects in the UK Stock Market. Section 5.2 reviews research methods. Section 5.3, 5.4, and 5.5 presents data analysis on the impact of macroeconomic variables on the time-variation in momentum effect, size effect, and value effect, respectively. Section 5.6 concludes empirical work.

5.1 Macroeconomic variables

As reviewed in Chapter 2, some previous researchers pay attention to the different performance of firms/ and shares with specific characteristics in business cycle. For example, Tamari (1984), Gertler and Gilchrist (1994) find that small firms contracts much more than large firms in economic recessions and tightening monetary policy. Jensen, Johnson, and Mercer (1998) find stronger (weaker) small-cap premium and value premium due to expansionary (tightening) monetary policy. Chordia and Shivakumar (2002), Antonious, Lam, and Paudyal (2007) conclude positive momentum payoffs during economic expansions and negative ones during economic recessions. Cooper, Gutierrez, and Hameed (2004), Avramov and Chordia (2006) present the positive relation between momentum profits and market return in lagged one to three years. Asness, Moskowitz, and Pedersen (2009) show value premium and momentum premium are positively linked to long-run consumption growth and negatively linked to economic recessions. In Chapter 4, the research finds the different performance in Winner/Loser return R_{wml} and Small/Large return R_{sml} between positive and negative annual change of GDP when long/short position is hold for 12 months These findings suggest that cross-sectional risk premium in momentum, size, and value sorted portfolios are exposure to business cycle.

The research assumes that time-varying style effects may be captured by some macroeconomic variables, which are associated with economic conditions and market states. They are measured by Growth of Domestic Production (GDP), Industrial Production/Manufacturing (IP/IPM), Money Supply (M0), Unemployment Rate (UNE), Inflation Rate (CPI), 3-month Short-term Rate (TBILL), Term Structure (TERM), Dividend Yield (DY), and Market Return (MR). The rationale for using these macroeconomic variables to capture the time-variation in style effects is that they are quantitative indicators straightforwardly measuring economic conditions and market states. Based on the findings in previous studies, the research hypothesizes the relation between macroeconomic variables and the time-variation in style effects in the UK Stock Market, which is shown in Panel B of Table 5.1. The time-variation in momentum effect is hypothesized to have positive relation to GDP, IP, IPM, and MR(-y). The time-variation in size effect and value effect is hypothesized to have positive relation to GDP, IP, IPM and M0, and negative relation to CPI and TBILL.

The research collects series GDP and Term Structure (TERM) from ESDS IFS (The Economic and Social Data Service, International Financial Statistics), series Industrial Production (IP) and Industrial Production Index – Manufacturing (IPM), Money Supply (M0), Unemployment Rate (UNE), and CPI from Datastream. Because the research investigates the impact of macroeconomic variables on time-varying style effects at the beginning of January 1980 and Datastream offers data on money supply M1 and M2 since September 1986 and June 1982, it collects M0 as an indicator of money supply. The correlation between M0 and M1 (M2) is 0.9932 (0.9940) since September 1986, so M0 can reflect the pattern of money supply M1 and M2. 3-month Short-term Interest Rate (TBILL) and Dividend Yield (DY) are available from LSPD. Market Return (MR) in the previous horizons from one year to eight years is calculated by monthly FTSE ALL SHARE PRICE from LSPD.

When the research investigates the impact of macroeconomic variables on time-varying style effects, it collects them in corresponding lag length in order to ensure the publication of their data be available in advance when portfolios are established. The lag length for GDP is two quarters, for M0, CPI, TBILL, TERM, DY, and EMR/VMR is one month, for IP, IPM, and UNE is two months. Panel A of Table 5.1

summaries the description on macroeconomic variables, their lagged length, and data sources.

[Table 5.1]

5.1.1 Derived primary macroeconomic variables

There are two reasons to derive innovations in primary macroeconomic variables in terms of their previous change and unexpected change over different horizons when the research investigates the impact of macroeconomic variables on the time-variation in style effects.

Firstly, Ferson, Sarkissian, and Simin (2003) point out that some standard economic variables, such as dividend yield, short-term interest rate, term structure, and default spread, behave as persistent or highly autocorrelated time series. Highly persistent series are more likely to be found significant in the search for predictor variables. They cast doubt on the significance of term spread in Fama and French (1989) on the basis of either t-stats or R-square of the regression, the significance of short-term interest rate in Fama and Schwert(1977), and the significance of dividend yield in Fama and French (1988b) on the basis of one but not both statistics. The simulation by Ferson, Sarkissian, and Simin (2003, 2006) shows that many regressions in the literature may be spurious due to individual predictor variable with highly-autocorrelation. They find that the extent of the spurious regression bias depends on the parameters of the first-order autocorrelation. Therefore, the research uses differenced data of macroeconomic variables to avoid the complications associated with spurious regressions.

Panel A of Table 5.2 shows the first to tenth order autocorrelation of primary macroeconomic variables in the research, which include GDP, Industrial Production/Manufacturing (IP/IPM), Money Supply (M0), Unemployment Rate (UNE), Inflation Rate (CPI), Short-term Rate (TBILL), Term Structure (TERM), and Dividend Yield (DY). All of these macroeconomic variables have first order autocorrelations of 0.95 or higher, suggesting a high degree of persistence. In order to lower the risk of a spurious regression caused by highly autocorrelated macroeconomic variables, the research uses previous change and unexpected change of these primary macroeconomic variables over different horizons.

[Table 5.2]

With the Augmented Dickey-Fuller (ADF) test, Panel B of Table 5.2 reports the unit root statistics for primary macroeconomic variables. The ADF statistics for macroeconomic variables, except for CPI, are below the 5% critical value. The ADF test fails to reject the null hypothesis of unit root in the levels for most macroeconomic variables. It rejects the null hypothesis of non-stationary in the levels for CPI. The unit root test presents that most primary macroeconomic variables are I (1) process.

Secondly, it is rational to examine the relation between the innovations in primary macroeconomic variables and the time-variation in style effects. Because the research investigates the reason for time-varying style effects with different holding horizons, such as 3, 6, 12, 18, and 24 months, it is rational to assume that the previous change or unexpected change of macroeconomic variables over different horizons have different explanatory power for style coefficient γ and style long/short return R_{lms} with different holding horizons. For example, if expected annual change of TBILL might offer significant impact on time-varying size effect with 24 months' holding length, it might not have the same explanatory power for size effect with 3 and 6 months' holding period.

The research uses the differenced natural logarithms in equation (5.1) or equation (5.1') to calculate the previous change of primary macroeconomic variables (MEV) over past the 1st, 3rd, 6th, and 12th month as an indicator of the current economic condition and market state:

$$MEV(i)_{t-L} = \log\left[MEV_{t-L} / MEV_{t-L-i}\right] \qquad (5.1)$$

or

$$MEV(i)_{t-L} = MEV_{t-L} / MEV_{t-L-i} - 1 \qquad (5.1')$$

where MEV(i) is the change of macroeconomic variable over past i months. MEV_{t-L} is the level of primary macroeconomic variables for month t-L (quarter t-L for GDP). 'L' stands for lag length of macroeconomic variables to ensure them known as explanatory variables in advance in the forecasting model. Except for lag length of 2 for GDP, IP, IPM, and UNE, lag length for other variables is set to 1. ‘i’ stands for 1, 3, 6, and 12 months. The research uses equation (5.1) to estimate the change of macroeconomic variables over time, except for GDP and TERM. Because the value of GDP and TERM is negative at some time points, the research uses equation (5.1') to estimate their change over time. For instance, in the sample period from 1980 to 2008, UK economy experienced two periods of negative growth from the 4th quarter in 1980 to the 1st quarter in 1982, and from the 2nd quarter in 1991 to the 4th quarter 1992. Term Structure is negative in five periods, including 1980, March 1985 to September 1986, September 1988 to October 1992, November 1997 to June 2001, and February 2005 to December 2008.

The test on monthly data by Fama and Gibbons (1984) indicates that expected real return on one-month treasury bill is estimated as its simple average of the twelve most recent realized real returns. The research follows Fama and Gibbons (1984) methodology, which is used in Chen, Roll, and Ross (1986), Hamao (1988), Zhang, Hopkins, Satchell, and Schwob (2009), to derive unexpected macroeconomic variables. It uses equation (5.2) to estimate the difference between macroeconomic variable (MEV) at month t-L and its moving average in past 3, 6, and 12 months (4 quarters for GDP), and regards it as a proxy for the unexpected macroeconomic variables (UEXMEV).

$$UEXMEV(i)_{t-L} = MEV_{t-L} - (\sum_{j=1}^{N} MEV_{t-L-j})/N \qquad (5.2)$$

where UEXMEV(i) is unexpected macroeconomic variables with i months. N stands for 3, 6, and 12 months (4 quarters for GDP). 'L' is lag length described as in equation (5.1).

5.1.2 Three kinds of macroeconomic variables

The research assumes that three kinds of macroeconomic variables might drive the time-variation in momentum, size, and value effect in the UK Stock Market. They are associated with economic states, the bond market, and the stock market, respectively.

- (Unexpected) change of macroeconomic variables associated with economic states

Some studies focus on relation between economic forces and stock returns based on one special firm characteristics. Jensen, Johnson, and Mercer (1998) show that premiums of small-cap stocks and value stocks are closely dependent to the monetary environment. Perez-Quiros and Timmermann (2000) find that the return on small-cap portfolio is most strongly associated with economic variables, such as short interest rate, default premium, and money growth, among decile-sized portfolios. Asness, Moskowitz, and Pedersen (2008) examine different performance of momentum strategy and value strategy in business cycle. Levis and Liodakis(1999) find the impact of inflation level on small-cap stocks and value stocks.

Based on the findings of previous studies, the research assumes the link between the time-variation in style effects and some derived primary economic variables. They include GDP(Y) (the annual previous change of GDP), UEXGDP(Y) (unexpected annual change of GDP), IP(i) (the change of Index of all Industrial production over previous the i^{th} month), UEXIP(i) (unexpected change of IP over previous i months), IPM(i) (the change of Industrial Production Index – Manufacturing over previous the i^{th} month), UEXIPM(i) (unexpected change of IPM over previous i months), M0(i) (the change of M0 over previous the i^{th} month), UEXM0(i) (unexpected change of M0 over previous i months), UNE(i) (the change of Unemployment Rate over previous the i^{th} months), UEXUNE(i) (unexpected change of UNE over previous i months), CPI(i) (the change of Consumer Price Index over previous the i^{th} month), and UEXCPI(i) (unexpected change of CPI over previous i months). They are regarded as the first kind of macroeconomic variables which mainly reflects current and unexpected change of economic conditions.

- (Unexpected) change of macroeconomic variables associated with the bond market

Fama and French (1989) finds that term spread always exhibits low around business-cycle peaks and high near troughs, and that its explanatory power for stock returns tends to increase with the return horizon out to one or two years. Chen (1991) finds that short-term interest rates and term structure are associated with the quarterly growth rate of GNP in the next 4 and 5 quarters, respectively, and further have explanatory power for the next 1 and 2 quarterly stock returns.

Based on these findings, the research assumes that time-varying style effects might be influenced by the second kind of macroeconomic variables, which are associated with the bond market. They consists of TBILL(i) (the change of TBILL over previous the i^{th} month), UEXTBILL(i) (unexpected change of TBILL over previous i months), TERM(i) (the change of TERM over pervious the i^{th} month), and UEXTERM(i) (the unexpected change of TERM over previous i months). Term structure (TERM) is the difference in the annualized yield on the long-term UK government bonds and the yield on the three-month Treasury TBILL.

- (Unexpected) change of macroeconomic variables associated with the stock market

Fama and French (1988a, 1989) find dividend yield is related to long-term business episodes that span several measured business cycles. Chen ((1991) shows the relation between dividend yield and the next quarterly growth of GNP, and further presents the explanatory power of dividend yield for following expected return in different horizons. So, the research assumes the impact of dividend yield, which is based on value-weighted market index of all companies, on the time-variation in style effects. It classifies DY(i) (the change of DY over pervious the i^{th} month), and UEXDY(i) (unexpected change of DY over previous i months) into the third kind of macroeconomic variables, which are associated with the stock market.

Keim and Stambaugh (1986) concludes that although security returns are significantly impacted by a number of economic factors, the market return remains the dominant factor and plays a major role in pricing the US and UK Stock Market. The market return seems to incorporate most of information in the underlying factors. Levis and Liodakis(1999), Fletcher (2001) use lagged market excess return to test expected returns. Cooper, Gutierrez, and Hameed (2004) find that six-month momentum profit is positively related to the lagged market return at its low level, and this relation diminishes at its high level. In addition, cognitive biases inherent in investors implies that risk preference is volatile in the changing aggregate stock market, high in upward price trend but low in downward price trend. As Chapter 1 mentions, the interaction of cross-sectional variation in cash-flow risks of firms and time-varying risk preference leads to dynamic style effects. Therefore, the research uses EMR/VMR (equal/value-weighted market return) to reflect the present price level of aggregate stock market relative to its past level in different horizons. It uses monthly share returns from LSPD to estimate equal-(value-) weighted n months' compounded return (n=12, 24, 36, 48, 60, 72, 84, 96, 108, and 120) as EMR(-y)/VMR(-y) in different horizons, where y denotes the number of year. The correlation coefficients between monthly EMR, VMR and monthly return of FTSE ALL SHARE, which is estimated with series values of FTSE ALL SHARE in LSPD, are 0.78 and 0.99, respectively.

Simulation results in Ferson, Sarkissian, and Simin (2003) find that spurious regression bias does not arise to any serious degree if first autocorrelation is 0.90 or less. Table 5.3 shows that after excluding variables with UNE, 85 percent of (unexpected) change of macroeconomic variables have the first-order autocorrelation below 0.90 or lower. After using (unexpected) change of macroeconomic variables, the research lowers the first-order autocorrelation of explanatory variables in the regression on time-varying style effects, and the risk of spurious regression.

[Table 5.3]

Table 5.4 reports correlation of annual (unexpected) change of macroeconomic variables from 1980 to 2008.

[Table 5.4]

5.2 Research methods

Maddala (1977) presents one case of varying-parameter models that explanatory variables for changes in the parameters are known. He argues that in actual practice if z_t is a policy variable and if a relation like (5.3) is obtained by the maximization behaviour of firms or individuals, then z_t should not enter equation (5.3) additively. It should be entering as a determining variable for the parameters as in equation (5.4).

$$y_t = \beta_t * x_t + u_t \tag{5.3}$$

$$\beta_t = \alpha + \delta * z_t + \upsilon_t \tag{5.4}$$

Similar to the spirit in Maddala (1977), other studies investigate time-varying regression parameter alpha or beta in conditional asset pricing model. Shanken (1990) specifies the relation between market beta(β_m) and short-term rate(TB), its volatility(TBV), and a dummy variable with $\beta_m = c_0 + c_1 * TB + c_2 * TBV + c_3 * JAN$. Ferson and Schadt (1996) use the model $\beta_{pm}(Z_t) = b_{0p} + b_p * Z_t$ to measure fund strategy and performance in changing economic conditions, where β_{pm} is portfolio beta, and b_p are the response coefficients of the conditional beta with respect to the macroeconomic variables Z_t. Jagannathan and Wang (1996) investigates the time-variation in betas to explain the cross-sectional returns, and find that size effect and statistical rejection of CAPM model specifications become weaker. Christopherson, Ferson, and Glassman (1998) use time-varying intercept or conditional alpha, which is a function of public macroeconomic variables Z as $\alpha_t = d_0 + d_{1*}Z_t$, to measure abnormal performance of mutual funds.

In real investing field, style-oriented investors are indeed maximizing the profitability of their portfolios by using public macroeconomic variables in their decisions of which kind of stocks with specific firm characteristics are included in their portfolios. Macroeconomic variables should be entering the model not in an additive fashion but as determinants of time-varying style effects in the model (5.4). Thus, the research explores the relation between some macroeconomic variables and time-varying style effects in the UK Stock Market.

5.2.1 Univariate regression to extract explanatory variables

In pervious chapter, the research estimates style coefficient γ and long/short return R_{lms} to measure the time-variation in style effects in the UK Stock Market. In this chapter, the research assumes that a set of (unexpected) change of lagged macroeconomic variables might have explanatory power for time-varying style effects. Because 68 innovations with different horizons are estimated from 10 primary macroeconomic variables, it is rational to use univariate regression to screen some most significant innovations for the time-variation in style effects. Univariable regression is used to measure the relation between style coefficient γ, long/short return R_{lms} and each (unexpected) change of lagged macroeconomic variable. The research uses the innovations screened in univariate regression as explanatory variables in the following multiple regression for γ and R_{lms}. These explanatory variables can be assumed to capture the common movements in prices of shares with similar firm characteristics. The research uses univariate regression model (5.5) and (5.5') to extract most important explanatory factors for time-varying style coefficient γ and long/short return R_{lms} from January 1980 to December 2008.

$$\gamma_t = \lambda_0 + \lambda_{IV} * MEV(i)_{t-L} + e_t \quad (5.5)$$

$$\gamma_t = \lambda_0 + \lambda_{IV} * UEXMEV(i)_{t-L} + e_t$$

and

$$R_{lms,t} = \lambda_0 + \lambda_{IV} * MEV(i)_{t-L} + e_t \quad (5.5')$$

$$R_{lms,t} = \lambda_0 + \lambda_{IV} * UEXMEV(i)_{t-L} + e_t$$

t = 1, 2, …, n

where γ_t is style coefficient from monthly-by-monthly cross-sectional regression of portfolios' holding returns on their average value of firm characteristics in the formation period, in terms of lagged share return, market value, and price-to-book ratio, respectively. R_{lms} is the difference in return between 'Winner' portfolio and 'Loser' portfolio, between 'Small' portfolio and 'Large' portfolio, and between 'Low' portfolio and 'High' portfolio. They are estimated in Chapter 4. MEV(i) and UEXMEV(i) are the previous change and unexpected change of primary macroeconomic variable at monthly, quarterly, half-yearly, and annual horizons, which are related to macroeconomic conditions, the bond market, and the stock market. 'L' denotes lag length for macroeconomic variables available in advance when portfolios are constructed. Primary macroeconomic variables include GDP, IP(Index of all Industrial production), IPM(Industrial Production Index – Manufacturing), M0(Money Supply), UNE (Unemployment Rate), CPI(Consumer Price Index), TBILL(monthly 3 months' interest rate), TERM(Term Structure), DY(Dividend Yield), and EMR/VMR(equal-/value-weighted market return). The estimation of (unexpected) change of primary macroeconomic variables at different horizons and corresponding lag length is described in the section 5.1 and Table 5.1. 'n' denotes corresponding the number of observations for style effect with five holding horizons from 1980 to 2008. The research uses the sample period from 1980 to 2008 because value effect is examined at the beginning of 1980, and all macroeconomic variables are available after 1980.

The research uses t-stats to judge which (unexpected) change of macroeconomic variable is statistically significant to explain the time-variation in style coefficient γ and long/short return R_{lms}. T-stats is adjusted by Newey-West (1987) approach for heteroscedasticity and autocorrelation. In addition, following Granger and Newbold (1974), Ferson, Sarkissian, and Simin (2003, 2006) interpret a spurious regression as one in which the 't-ratios' in the regression is likely to indicate a significant relation when the variables are really independent. The problem may come from the denominator, the standard error, of the t-ratio. Because the spurious regression problem is driven by biased estimates of the standard error, the choice of standard error estimator is crucial. The research uses the method of automatic lag selection in Ferson, Sarkissian, and Simin (2003) to estimate an efficient unbiased estimator of standard error. The number of lags is chosen by computing the autocorrelations of the estimated residuals and truncating the lag length when the sample autocorrelations become insignificant at longer lags. Specifically, the research calculates autocorrelations of the estimated residuals and compares the value with a cutoff at two approximate standard errors: $2/T^{0.5}$, where T is the sample size.

The volatility in explanatory power of forecasting variables is documented in Welch and Goyal (2008). It is in one case that the lower value of t-stats and adjusted R^2 in overall period is caused by higher value in one subperiod and lower value in other subperiods. In another case, although macroeconomic variable is significant in two subperiods, the sign of its regression coefficient is opposite, which leads to lower value of t-stats and adjusted R^2 in overall period. To control biased and inconsistent estimator in series regression model, the research uses the absolute magnitude of t-stats and adjusted R^2 in the univariate regression to extract (unexpected) change of macroeconomic variables to (marginally) significantly explain time-varying style effects. In the process of screening macroeconomic variables, the research sets up two conditions to select same significant macroeconomic variables for equal-(value-) weighted style coefficient γ and long/short return R_{lms} with five holding horizons in order to simplify data analysis in the multivariate regression. Firstly, when slope coefficient of one macroeconomic variable at different time horizons has significant t-stats, the research selects one with the highest or higher adjusted R^2 because t-stats might be biased due to its adjustment. Secondly, the research tests the significance of macroeconomic variables for the time-variation in style effects, measured by equal-(value-) weighted long/short return R_{lms} and style coefficient γ, to identify significant ones and use them in the multiple regression. It might be the case when one macroeconomic variable is significant at 5% or 10% significant level for one of two indicators in one style effect. To keep the same macroeconomic variable tested in the multiple regression of two equal-(value-) weighted style indicators, the research regards one macroeconomic variable with the value of t-stats more than 1.2 for one style indicator in univariate regression as one forecasting variable in multiple regression when it is significant for another style indicator at 5% or 10% significant level.

5.2.2 Multiple regression

After extracting explanatory variables MEV(i) and UEXMEV(i) from univariate regression, the research uses multiple regression (5.6) and (5.6') to investigate the relation between style coefficient γ, long/short return R_{lms} and the combination of these variables, respectively, and judge how well the combination of macroeconomic variables can explain time-varying style effects in overall sample period and subperiods. It uses t-stats to evaluate which (unexpected) change of macroeconomic variable is statistically significant to explain the time-variation in γ and R_{lms}. T-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003).

$$\gamma_t = \lambda_0 + \lambda_{EV} * EV_{t-L} + e_t \qquad (5.6)$$

and

$$R_{lms,t} = \lambda_0 + \lambda_{EV} * EV_{t-L} + e_t \qquad (5.6')$$

t = 1, 2, …, n

where γ_t and R_{lms} is style coefficient and long/short return in the holding period t, EV_{t-L} is a (n*1) vector representing (unexpected) change of lagged macroeconomic variables MEV(i) and UEXMEV(i) which are statistically significant in univariate regression. 'L' denotes lag length for macroeconomic variables available in advance when portfolios are established. 'n' denotes corresponding the number of observations for style effect with five holding horizons from 1980 to 2008.

5.3 The impact of macroeconomic variables on the time-variation in momentum effect

This section investigates the impact of macroeconomic variables on time-varying momentum effect based on 6 and 12 months' formation lengths in the UK Stock Market from 1980 to 2008, respectively. It finds what macroeconomic variables have significant explanatory power for time-varying momentum effect, and how they explain the variation when momentum portfolios are based on share returns in past 6 and 12 months, and then hold for 3, 6, 12, 18, and 24 months, respectively. Time-varying momentum effect is measured by two indicators: momentum coefficient γ_{mom} and Winner/Loser return R_{wml}, which are estimated in Chapter 4. The first momentum coefficient γ_{mom} and Winner/Loser return R_{wml} with 6 and 12 months' formation length and 3, 6, 12, 18, and 24 months' holding lengths are estimated in April 1980, July 1980, January 1981, July 1981, and January 1982, respectively. There are 345, 342, 336, 330, and 324 observations for momentum effect with five holding horizons.

5.3.1 Momentum effect based on 6 months' formation length

In this subsection, the research investigates the impact of macroeconomic variables on time-variation in momentum effect based on 6 months' formation length and 3, 6, 12, 18, and 24 months' holding lengths.

A. Univariate regression to extract explanatory variables

With the model 5.5 and 5.5', the research regresses equal-(value-) weighted momentum coefficient γ_{mom} and Winner/Loser return R_{wml} on 68 lagged (unexpected) change of macroeconomic variables, individually, for momentum portfolios with 3, 6, 12, 18, and 24 months' holding lengths from 1980 to 2008. Table 5.5, 5.6, 5.7, 5.8, and 5.9 report slope coefficient λ, t-stats, and adjusted R^2 from the univariate regression in the case of five holding horizons, respectively. Panel A and B report corresponding parameters for equal-(value-) weighted momentum coefficient γ_{mom} and Winner/Loser return $R_{wml,}$ respectively.

[Table 5.5, 5.6, 5.7, 5.8, 5.9]

As Table 5.5 and 5.6 present, when equal-(value-) weighted momentum portfolios are hold for 3 and 6 months, UEXTBILL(Y), DY(H), and CPI(Q) have significant explanatory power for the time-variation in momentum coefficient γ_{mom} and Winner/Loser return R_{wml}. Table 5.7, 5.8, and 5.9 show when momentum portfolios are hold for 12, 18, and 24 months, GDP(Y) and UEXTBILL(Y) are significant explanatory variables for the time-variation in momentum effect. Different from the findings in the US Stock Market by Cooper, Gutierrez, and Hameed (2004), the research finds no significant link between lagged 1 to 10 years' market return and momentum effect with 6 months' formation length in the UK Stock Market.

B. Multivariate regression in overall period

Using the model 5.6 and 5.6', and (marginally) significant explanatory variables screened in univariate regression, the research regresses equal-(value-) weighted momentum coefficient γ_{mom} and Winner/Loser return R_{wml} on the combination of them to investigate how these macroeconomic variables capture the time-variation in momentum effects based on 6 months' formation length and 3, 6, 12, 18, and 24 months' holding length, respectively.

[Table 5.10]

Table 5.10 Panel A and B show that the combination of three derived macroeconomic variables, UEXTBILL(Y), DY(H), and CPI(Q) could explain less than 10 percentage of the variation in equal-(value-) weighted momentum coefficient γ_{mom} and Winner/Loser return R_{wml} when momentum portfolios are hold for 3 and 6 months' lengths. As shown in Panel C, D, and E, the explanatory power of GDP(Y) and UEXTBILL(Y) for the variation are less than 10 percentage, except for 10.05 to 12.86 percentage for equal-weighted γ_{mom}, when portfolios are hold for 12, 18, and 24 months. This indicates that macroeconomic variables offer weak explanatory power for time-varying momentum effect with 6 months' formation length.

UEXTBILL(Y) is significantly positive in the explanation for most γ_{mom} and R_{wml}, especially when portfolios are hold for 12, 18, and 24 months. One cannot reject the hypothesis that the coefficient of UNTBILL(Y) is different from zero. This indicates strong momentum effect under the expectation of higher annual short-term interest rate. Besides UEXTBILL(Y), DY(H) (DY(H) and CPI(Q)) are significant positive (positive and negative) explanatory variables for equal-(value-) weighted time-varying momentum effect with 3 months' holding length. The rising DY in past 6 months and the declining CPI in past 3 months significantly strengthen return momentum over 3 months' horizon. Combination with UEXTBILL(Y), CPI(Q) plays determinant role in value-weighted momentum effect with 3 and 6 months' holding lengths.

Besides UEXTBILL(Y), GDP(Y) is significantly negatively associated with γ_{mom} and R_{wml} when holding 12, 18, and 24 months' momentum portfolios. This shows that low previous annual change of GDP at the end of formation month forecasts strong momentum effect with medium and long holding horizons. The findings extend the conclusion by Lucas, Dijk, and Kloek (2002) that over recessions investors load less on momentum stocks, and the conclusion by Asness, Moskowitz, and Pedersen (2008) that momentum premium is negatively related to recessions. The research offers empirical findings that economic condition offers forecasting information on current return momentum. Momentum investors might use two indicators, the previous annual change of GDP and unexpected annual change of TBILL, to make a decision on holding momentum portfolios with medium/long horizon.

Different from findings by Chordia and Shivakumar (2002), Cooper, Gutierrez, and Hameed (2004) that macroeconomic model based on lagged dividend yield, default spread, term structure, and TBILL yield cannot explain 6 months' momentum profits, the research find forecasting power of macroeconomic variables, UEXTBILL(Y), DY(H), CPI(Q), and GDP(Y) for time varying momentum effect in the UK Stock Market when momentum portfolios are formed on previous 6 months' share returns and hold for short-/medium-/long-term period.

C. Multivariate regression in subperiods

The research further tests the relation between the combination of derived macroeconomic variables and momentum coefficient γ_{mom} and Winner/Loser return R_{wml} in the 1980s, the 1990s, and January 2000 to December 2008, respectively. The test in subperiods helps the research to find whether macroeconomic variables have stable explanatory power for time-varying momentum effect. Table 5.11 to 5.15 report adjusted R^2, slope coefficient λ, and its t-statistics from multivariate regression of momentum coefficient γ_{mom} and Winner/Loser return R_{wml} on derived macroeconomic variables in three subperiods for five holding lengths.

[Table 5.11, 5.12, 5.13, 5.14, 5.15]

As indicated in Table 5.11 to 5.15, when momentum portfolios are hold for five horizons, adjusted R^2 of multivariate regression in some subperiods are higher/or lower than corresponding one in overall period. This means the same deprived macroeconomic variables have volatile explanatory power for momentum effect over time. For example, most adjusted R^2 in the 1980s ranges between 0.1174 and 0.2741 through momentum effect with five holding horizons. In the 1990s, it ranges between

0.1102 and 0.2425 through momentum effect with 12 to 24 months' holding length as well as equal-weighted momentum effect with 3 and 6 months' holding length. In 2000 through 2008, adjusted R^2 for value-weighted momentum with 3 and 6 months' horizons is between 12.98 and 39.49, but it is below 0.02 for most other cases.

Similar to adjusted R^2, there exists the variation in significant macroeconomic variables on time-varying momentum effect through holding horizons and over subperiods. Firstly, significant macroeconomic variables, that affect time-varying momentum effects, vary with five holding lengths in the same subperiod. For example, in the 1990s when momentum portfolios are hold for 3 and 6 months, DY(H) is significant variable to explain the time-variation in momentum effect during this decade. When momentum portfolios are hold for 12 months, GDP(Y) as one significant variable accounts for time-varying momentum effect. For momentum portfolios with 18 months' holding lengths, UEXTBILL(Y) and GDP(Y) become significant explanatory variables for time-varying momentum effect. This might be caused by the difference in investment decision-making by momentum investors with different holding horizons although they face the same economic condition in the same period. In the 1990s, investors, who favour short-term momentum strategy, prefer to the change in dividend yield over past 6 months in their decision-making. Investors with medium momentum strategy prefer to unexpected annual change of TBILL and the annual change of GDP. Secondly, for momentum effect with one certain holding horizon, different macroeconomic variables significantly explain time-varying momentum effect over three subperiods. For example, when value-weighted portfolios are hold for 6 months, with higher adjusted R^2 in three subperiods, significant macroeconomic variables in the 1980s, the 1990s, and the 2000s are UEXTBILL(Y), DY(H), and CPI(Q), respectively. This might be caused by the existence of the variation in economic background in three subperiods. In the 1970s UK experienced higher inflation with CPI more than 20 percent, and following the obvious rise in TBILL rate. This leads to investors' more attention to unexpected change in TBILL in their practical decision in the 1980s. The volatile explanatory power of macroeconomic variables is consistent with the findings in Welch and Goyal (2008) that many explanatory variables, such as dividend yield, earning price ratio, book-to-market ratio, term spread, treasury bill rate, and inflation, are not robustly and statistically significant over the sample period.

5.3.2 Momentum effect based on 12 months' formation length

In this subsection, the research investigates the impact of macroeconomic variables on the time-variation in momentum effect based on 12 months' formation length and 3, 6, 12, 18, and 24 months' holding lengths.

A. Univariate regression to extract information variables

Using regression model 5.5 and 5.5', the research regresses equal-(value-) weighted momentum coefficient γ_{mom} and Winner/Loser return R_{wml} on 68 lagged (unexpected) change of macroeconomic variables, individually, for momentum portfolios with 3, 6, 12, 18, and 24 months' holding lengths from 1980 to 2008. Table 5.16, 5.17, 5.18, 5.19, and 5.20 report slope coefficient λ, t-stats, and adjusted R^2 from the univariate regression of momentum effect with 12 months' formation length and five holding horizons on each lagged (unexpected) change of macroeconomic variable. Panel A and B report corresponding parameters for equal-(value-) weighted momentum coefficient γ_{mom} and Winner/Loser return $R_{wml,}$ respectively.

[Table 5.16, 5.17, 5.18, 5.19, 5.20]

As Table 5.16, 5.17, 5.18, 5.19, and 5.20 indicate, for the equal-(value-) weighted momentum portfolios with five holding horizons, four macroeconomic variables, such as GDPG(Y), UEXTBILLG(Y), DY(Q), and EMR(-1)/CPI(H), have significant explanatory power for time-variation in equal-(value-) weighted momentum coefficient γ_{mom} and Winner/Loser return R_{wml}, respectively. Similar to the findings by Cooper, Gutierrez, and Hameed (2004) that 6 months' momentum profit follows lagged market states in the US Stock Market, the research finds significantly negative link between lagged one-year's market return and momentum effect when equal-weighted portfolios are hold for 3 to 12 months in the UK Stock Market. When equal-weighted portfolios are hold for 18 and 24 months, lagged one-year's market return is marginally significantly associated with holding returns.

B. *Multivariate regression in overall period*

Using regression model 5.6 and 5.6', and (marginally) significant explanatory variables in univariate regression, the research regresses equal-(value-) weighted momentum coefficient γ_{mom} and Winner/Loser return R_{wml}, respectively, on the combination of them to investigate how these macroeconomic variables to explain the time-variation in momentum effects with 12 months' formation length and five holding horizons.

[Table 5.21]

Table 5.21 shows that the combination of macroeconomic variables, GDP(Y), UEXTBILL(Y), DY(Q), and EMR(-1)/CPI(H), could explain 15.74 to 24.05, 16.11 to 22.96 percentage of the variation in equal-(value-) weighted momentum coefficient γ_{mom} and Winner/Loser return R_{wml} when momentum portfolios are hold for 6 and 12 months' lengths, which are higher than the case with 3, 18, and 24 months' holding lengths.

For momentum portfolios with five holding horizons, GDP(Y) is (marginally) significantly negative explanatory variable for γ_{mom} and R_{wml}. This means that low annual change of GDP at the end of formation month forecasts strong momentum effects with different holding horizons. When momentum portfolios are hold for 3, 6, and 12 months or value-weighted portfolios for 18 and 24 months, UEXTBILL(Y) is (marginally) significantly positive in the explanation of γ_{mom} and R_{wml}, which indicates strong momentum effect when short-term interest rate is higher than expected. DY(Q), previous quarterly growth in dividend yield, is (marginally) significantly and positively associated with most γ_{mom} and R_{wml}. When value-weighted portfolios are hold for 3 to 18 months, the change in CPI in past six months, CPI(H), has negative impact on momentum effect. For equal-weighted momentum portfolios, previous one year's market return loses explanatory power for momentum effect although it is significant in the univariate analysis.

As the findings on momentum effect with 6 months' formation length in previous subsection, empirical work presents the relation between lagged macroeconomic variables and momentum effect with 12 months' formation length. When comparing the magnitude of adjusted R^2 of multivariate regression in Table 5.10 and Table 5.21, it is found that the combination of lagged macroeconomic variables offers explanatory power for momentum effect with 12 months' formation length stronger than momentum effect with 6 months' formation length through five holding horizons.

C. *Multivariate regression in subperiods*

The research further tests the impact of the combination of macroeconomic variables on momentum coefficient γ_{mom} and Winner/Loser return R_{wml} in the 1980s, the 1990s, and January 2000 to December 2008, respectively, when momentum portfolios are formed on previous 12 months' share returns and hold for 3, 6, 12, 18, and 24 months. Table 5.22, 5.23, 5.24, 5.25, 5.26 report three regression parameters, adjusted R^2, slope coefficient λ, and its t-statistics in three subperiods for the case with five holding lengths.

[Table 5.22, 5.23, 5.24, 5.25, 5.26]

When momentum portfolios are hold for 6 and 12 months, adjusted R^2 in subperiods ranges between 0.0821 to 0.6152, and more than 0.20 in most subperiods. Its strong explanatory power in subperiods is consistent with its strong performance in the overall period. When portfolios are hold for 18 months, most of adjusted R^2 in the 1980s and 1990s are more than 0.16. When portfolios are hold for 3 months and 24 months, adjusted R^2 in three subperiods are less than 0.15 and 0.16 in many cases, which indicates the declining impact of macroeconomic variables on momentum effect in the short and long holding length.

As momentum effect with 6 months' formation length, adjusted R^2 in subperiods is not invariant when momentum portfolios are formed on previous 12 months' share returns and hold for five horizons. When equal-weighted portfolios are hold for 3 to 18 months, adjusted R^2 exhibits the declining pattern over three subperiods, the highest explanatory power of macroeconomic variables on momentum effect in the 1980s. When value-weighted portfolios are hold for 3 to 24 months, explanatory power of macroeconomic variables for momentum effect exhibits the 'U' pattern, the strongest in the 2000s.

As the performance of adjusted R^2, there exists obvious variation in significant macroeconomic variables for time-varying momentum effect with 12 months' formation length over holding horizons and over subperiods. *Firstly*, macroeconomic variables, which are significant to affect time-varying momentum effect in the same subperiod, are different for the cases with five holding lengths. For example, in the 1980s when equal-weighted portfolios are hold for 3 months, UEXTBILL(Y) and

EMR(-1) are two significant macroeconomic variables to explain the time-variation in momentum effect during this decade. When the portfolios are hold for 18 months, GDP(Y) and DY(Q) are two significant variables to explain time-varying momentum effect. This might be caused by the difference in determinant factors in the making-decision of momentum investors with different horizons. *Secondly,* for momentum effect with the same holding length, significant macroeconomic variables are different over three subperiods. For example, when equal-weighted portfolios are hold for 6 months, with higher adjusted R^2 in three subperiods, significant macroeconomic variables in the 1980s and the 1990s are UEXTBILL(Y) and EMR(-1), GDP(Y), respectively, combining with DY(Q). This reflects that momentum investors with same holding horizon might pay attention to different macroeconomic variables in their making-decision over time due to the variation in economic backgrounds in two subperiods. This pattern is consistent with the findings in momentum effect with 6 months' formation length.

5.4 The impact of macroeconomic variables on the time-variation in size effect

In this section, the research investigates the impact of macroeconomic variables on time-varying size effect with 3, 6, 12, 18, and 24 months' holding length in the UK Stock Market from 1980 to 2008, respectively. It finds what macroeconomic variables offer explanatory power for time-varying size effect, and how they affect the variation. Time-varying size effect is measured by two indicators: size coefficient γ_{mv} and Small/Large return R_{sml}, which are estimated in Chapter 4. The first size coefficient γ_{mv} and Small/Large return R_{sml} with 3, 6, 12, 18, and 24 months' holding lengths are estimated in April 1980, July 1980, January 1981, July 1981, and January 1982, respectively. There are 345, 342, 336, 330, and 324 observations for size effect with five holding horizons.

A. Univariate regression to extract macroeconomic variables

The research regresses equal-(value-) weighted size coefficient γ_{size} and Small/Large return R_{sml} on 68 lagged (unexpected) change of macroeconomic variables, individually, for size effect based on five holding horizons. Table 5.27, 5.28, 5.29, 5.30, and 5.31 report slope coefficient λ, t-stats, and adjusted R^2 from the univariate regression of size effect with five holding horizons on each lagged (unexpected) change of macroeconomic variable. Panel A and B report these parameters for equal-(value-) weighted size coefficient γ_{mv} and Small/Large return R_{sml}, respectively.

[Table 5.27, 5.28, 5.29, 5.30, 5.31]

As shown in Table 5.27, 5.28, 5.29, 5.30, and 5.31, CPI(Y), UEXTBILL(Y) or UEXCPI(Y), UEXTBILL(Q) are two significant explanatory variables for the time-variation in size effect with five holding horizons. The findings are similar to the conclusion by Levis and Liodakis (1999) that annual return in UK's small/large spread from 1968 to 1977 is associated with some lagged economic variables, such as the monthly change in consumer price index and monthly change in the three-month Treasury bill.

Besides two common explanatory variables, UEXTERM(Y) significantly impacts on short-/or medium-term time-varying size effect with 3, 6, and 12 months' holding length. GDP(Y) or UEXGDP(Y) plays significant role in medium-/or long-term time-varying size effect with 12, 18, and 24 months' holding length.

B. Multivariate regression in overall period

Using (marginally) significant explanatory variables in univariate regression, the research regresses equal-(value-) weighted size coefficient γ_{mv} and Small/Large return R_{sml}, respectively, on the combination of them to investigate how these macroeconomic variables have impact on the time-variation in size effects over five holding horizons.

[Table 5.32]

Table 5.32 shows that adjusted R^2 from multivariage regression of size effect with 12 months' holding length is higher than one with shorter and longer holding lengths. The combination of macroeconomic variables, GDP(Y), CPI(Y), UEXTBILL(Y), and UEXTERM(Y), could explain 14.93 to 17.64 percentage of the variation in equal-(value-) weighted size coefficient γ_{mv} and Small/Large return R_{sml} when size portfolios are hold for 12 months' length. For the time-variation in size effect with 6 and 18 months' holding lengths, the explanatory power of the combination of macroeconomic variables ranges between 10.31 and 12.72, between 10.75 and 13.26. When size portfolios are hold for 3 and 24 months, their explanatory power falls below 10 percentage.

For size portfolios with 3, 6, and 12 months' holding lengths, UEXTBILL(Y) combined with IP(M), independently, and combined with GDP(Y) are significant variables to explain time-varying size coefficient γ_{mv} and Small/Large return R_{sml}, respectively. CPI(Y) and UEXTERM(Y) are unsignificant because of high correlation between them and UEXTBILL(Y), 0.6187 and -0.7387, respectively, as indicated in Table 5.4. The negative slope coefficient of UEXTBILL(Y) shows that the increase in unexpected annual change of TBILL at the end of formation month forecasts weak small-cap effects over 3 to 12 months, and vice versa. This is indirectly supported by the findings of Zhang, Hopkins, Satchell, and Schwob (2009) on negative relationship between SMB (small minus big) and unexpected inflation, closely related to unexpected short-term interest rate, in the US and UK Stock

Market. The return pattern of small-cap shares is consistent with the fundamental performance of small firms in the findings by Gertler and Gilchrist (1994) and Ehrmann (2000) that although all firms are hit by tightening monetary policy, small firms shrinks much more than large firms after the rise in interest rate due to tightening money policy in US and Germany. The positive slope coefficient of IP(M) and GDP(Y) indicates that the increase in previous monthly industrial production and annual GDP growth benefits following 3 and 12 months' small-cap effect, respectively. When size portfolios are hold for 18 and 24 months, time-varying size effect is driven by GDP(Y), and UEXGDP(Y) and UEXCPI(Y), respectively. Annual (unexpected) change of GDP positively impacts on small-cap effect in the long holding length up to 18 to 24 months. This pro-cyclical small-cap effect is consistent with the conclusion by Fraser (1995) that the disappearance of small-cap premium in the London Stock Market in the early 1990s might be caused by UK's deep recession in this period. It is similar to the findings by Zhang, Hopkins, Satchell, and Schwob (2009) on positive relationship between SMB (small minus big) and unexpected higher GDP in the US and UK Stock Market.

C. Multivariate regression in subperiods

Based on the findings in the whole sample period, the research further explores the impact of the combination of macroeconomic variables on size effect in the 1980s, the 1990s, and January 2000 to December 2008, respectively. Table 5.33, 5.34, 5.35, 5.36, and 5.37 report adjusted R^2, slope coefficient λ, and its t-statistics from multivariate regression of size coefficient γ_{mv} and Small/Large return R_{sml} on the combination of macroeconomic variables in three subperiods for five holding horizons.

[Table 5.33, 5.34, 5.35, 5.36, 5.37]

Higher adjusted R^2 of multivariate regression of size effect with 12 months' holding horizon in subperiods is consistent with its performance in overall period. Among the cases with five holding horizons, adjusted R^2 in subperiods is highest or second highest when size portfolios are hold for 12 months, ranging between 0.1738 and 0.4481. Especially, the combination of macroeconomic variables explains 38.82 to 44.81 percentage of the variance in size coefficient γ_{mv} and Small/Large return R_{sml} in the 1990s and afterwards. Following size effect with 12 months' holding length, one with 6 months' holding length obtains stronger explanatory power from macroeconomic variables in subperiods, adjusted R^2 from 0.2016 to 0.3209 in the 1980s and 2000s. For size portfolios hold for 18 months, macroeconomic variables offer 15 to 38 percentage of the variation in size effect in the 1990s and 2000s, but less than 10 percentage in the 1980s. When size portfolios are hold for 3 and 24 months, the explanatory power is generally lower than 15 percentage and volatile over subperiods.

The empirical work finds the variation in significant macroeconomic variables for time-varying size effect over holding horizons and over three subperiods. *Firstly*, macroeconomic variables, that significantly affect time-varying size effects, are different across the cases with five holding horizons in the same subperiod. For example, in the 1980s when Small/Large positions are hold for 3 to 12 months, UEXTBILL(Y) or CPI(Y), which is closely associated with inflation, are two significant variables to explain the time-variation in short-/medium-run size effect during this decade. When Small/Large portfolio is hold for 18 months, GDP(Y) significantly accounts for time-varying long-run size effect. This reflects that in the 1980s short- or medium-term size effect is more associated with inflation and short-term interest rate than other variables, and long-term size effect is more associated with previous annual change of GDP than other variables. Secondly, significant macroeconomic variables to explain time-varying size effect change over three subperiods. For example, when size decile portfolios are hold for 12 months, with higher adjusted R^2 in three subperiods and overall period, significant macroeconomic variable for size coefficient γ_{mv} in the 1980s, the 1990s, and from 2000 to 2008 is CPI(Y), GPD(Y), UEXTBILL(Y). This indicates that medium-term size effect is affected by different macroeconomic variables over time. Specifically, the same macroeconomic variable has different explanatory power for size effect over time. For example, size effect with 12 months' holding length is marginally negatively sensitive to CPI(Y) in the 1980s, but positive though unsignificant since the 2000.

5.5 The impact of macroeconomic variables on the time-variation in value effect

In this section, the research concentrates on the impact of macroeconomic variables on time-varying value effect with 3, 6, 12, 18, and 24 months' holding length in the UK Stock Market from 1980 to 2008, respectively. It explores what macroeconomic variables capture time-varying value effect and how they affect the variation. Time-varying value effect is measured by two indicators: value coefficient γ_{pb} and Low/High return R_{lmh}, which are estimated in Chapter 4. The first value coefficient γ_{pb} and Low/High return R_{lmh} with 3, 6, 12, 18, and 24 months' holding lengths are estimated in April 1980, July 1980, January 1981, July 1981, and January 1982, respectively. There are 345, 342, 336, 330, and 324 observations for value effect with five holding horizons.

A. Univariate regression to extract macroeconomic variables

The research regresses equal-(value-) weighted value coefficient γ_{pb} and Low/High return R_{lmh} on 68 lagged (unexpected) change of macroeconomic variables, individually, for value portfolios with 3, 6, 12, 18, and 24 months' holding lengths from 1980 to 2008. Table 5.38, 5.39, 5.40, 5.41, and 5.42 report slope coefficient λ, t-stats, and adjusted R^2 from the univariate regression of value effect with five holding horizons on each lagged (unexpected) change of macroeconomic variable. Panel A and B report these parameters for equal-(value-) weighted value coefficient γ_{pb} and Low/High return R_{lmh} , respectively.

[Table 5.38, 5.39, 5.40, 5.41, 5.42]

Table 5.38, 5.39, 5.40, 5.41, and 5.42 show, for equal-(value-) weighted value portfolios with 3, 6, and 12 months' holding length, UEXTBILL(Y), UEXDY(H), and MR(-8) are three significant explanatory variables for the time-variation in value coefficient γ_{pb} and Low/High return R_{lmh}, respectively. Supporting and extending the findings by Levis and Liodakis (1999) that the monthly change in three-month Treasury bill has impact on the annual change in value/growth spread in the UK from 1968 to 1977, the research finds unexpected annual TBILL significantly explains time-varying value effect with 3, 6, and 12 months' holding lengths since the 1980s. When value portfolios are hold for 18 months, GDP(Y) and MR(-8) are significant variables to explain the volatility of value effect. When value portfolios are hold for 24 months, GDP(Y), MO(Y), CPI(Y), and MR(-8) are significant ones.

B. *Multivariate regression in overall period*

With (marginally) significant explanatory variables extracted in univariate regression, the research regresses equal-(value-) weighted value coefficient γ_{pb} and Low/High return R_{lmh}, respectively, on the combination of them to investigate how these macroeconomic variables explain the time-variation in value effects over five holding horizons.

[Table 5.43]

Table 5.43 shows that the combination of lagged macroeconomic variables could explain 16.53 to 40.87 and 5.01 to 28.44 percentage of the variation in equal-(value-) weighted value coefficient γ_{pb} and Low/High R_{lmh}, respectively. For the same holding horizon, the explanatory power of the regression is much stronger for value effect γ_{pb} than for Low/High return R_{lmh}. In Chapter 4, it is found in Panel B2 and B3 of Table 4.12 that the second and third 'Low' value-weighted portfolios have higher percentage (9% to 15%) of observations with highest return among decile value portfolios, following 'Low' portfolio, and that the 6^{th} to 9^{th} value-weighted portfolio has higher percentage (7% to 15%) of observations with lowest return, following 'High' portfolio. Value coefficient γ_{pb} from the regression of value decile portfolios' holding returns on shares' price-to-book ratios at the end of formation month contains the information of all shares, but Low/High return R_{lmh} only includes corresponding information of shares in two portfolios with low and high price-to-book ratio. So, the combination of macroeconomic variables offers explanatory power for value coefficient γ_{pb} stronger than for Low/High return $R_{lmh.}$

Explanatory power of the combination of macroeconomic variables on value coefficient γ_{pb} and Low/High return R_{lmh} rises as holding length extends, except for value-weighted Low/High return $R_{lmh.}$ When value portfolios are hold for 24 months, the fraction of variation predicted by macroeconomic variables increases to higher level, ranging between 28.44 and 40.87.

Although some macroeconomic variables lose significance in multivariate regression of value effect, MR(-8) keeps statistically significant in most cases as its performance in univariate regression. This reflects that market state in past eight years is dominant explanatory variable for value effect, and contains some information in economic factors. The positive slope coefficient of MR(-8) means that high market return in past eight years forecasts strong value effect. This findings is consistent with conclusion by Bird and Whitaker (2004) on counter-cyclical value effect. They find that value effect is confined in the correction period after a large upward market movement in major European market from 1990 to 2002. Besides MR(-8) as common explanatory variable for value coefficient γ_{pb}, UEXDY(H) and GDP(Y) with t-stats of more than 2.0 are significant variables when value portfolios are hold for 3/6 months and 18 months. Different from the findings by Levis and Liodakis (1999) of no significant relation between dividend yield ratio and value spread, the research presents significant explanatory power of unexpected half-yearly change of dividend yield on short-term value effect. This conclusion also supports the findings by Cohen, Polk and Vuolteenaho (2003) that about 75 to 80 percent of value spread is explained by unexpected profitability (cash flows). The performance of macroeconomic variables indicates that the time-variation in short-term value effect is associated with market variable such as unexpected half-yearly change of dividend yield, and long-term value effect is influenced by the annual change of GDP.

C. *Multivariate regression in subperiods*

The research further investigates the combination of macroeconomic variables on time-varying value effect in the 1980s, the 1990s, and January 2000 to December

2008, respectively. Table 5.44, 5.45, 5.46, 5.47, and 5.48 report adjusted R^2, slope coefficient λ, and its t-statistics from multivariate regression of value coefficient γ_{pb} and Low/High return R_{lmh} on macroeconomic variables in three subperiods for five holding horizons.

[Table 5.44, 5.45, 5.46, 5.47, 5.48]

As indicated in Table 5.44, 5.45, 5.46, 5.47, and 5.48, when value portfolios are hold for 3 to 18 months, most adjusted R^2 of multivariate regression in the 1990s and the 2000s are much lower than in the 1980s and in the overall sample period. This means that the explanatory power of macroeconomic variables for value effect volatiles through three subperiods. When value portfolios are hold for 24 months, the combination of macroeconomic variables could explain 32.45 to 59.18 percentage of the variation in value coefficient γ_{pb} and Low/High return R_{lmh} in three subperiods, higher than corresponding one in the overall period and ones in subperiods when value portfolios are hold for 3 to 18 months. High adjusted R^2 in subperiods for 24 months' value effect is consistent with its performance in the overall period.

Significant macroeconomic variables for time-varying value effect are not invariant through five holding horizons and over subperiods. *Firstly,* significant macroeconomic variables are different for value effect with five holding horizons in the same subperiod. For example, although the combination of macroeconomic variables offers explanatory power higher up to 19 percentage of volatility in value effect with five holding horizons in the 1980s, significant explanatory variables are different for short-term value effect to long-term value effect. When holding value portfolios for 3 and 6 months, UEXDY(H) and MR(-8) significantly explain time-varying value-weighted γ_{pb}. When holding ones for 18 months, GDP(Y) combining MR(-8) does. Secondly, macroeconomic variables have different impact on time-varying value effect with one holding horizon over three subperiods. For example, as shown in Table 5.48, when value portfolios are hold for 24 months, with higher adjusted R^2 in three subperiods, the same macroeconomic variable offers different explanatory power for time-varying value effect over time. The signs of slope coefficient of CPI(Y) is opposite in three subperiods. In the 1980s and the 1990s low CPI(Y) forecasts strong value effect, but vice versa in the 2000s. The similar pattern happens in M0(Y) in the 1990s and the 2000s.

5.6 Conclusion

In this chapter, the research focuses on the relation between lagged macroeconomic variables and the time-variation in style effects with five holding horizons in the UK Stock Market from 1980 to 2008. The empirical work finds that some lagged macroeconomic variables, which are associated with economic conditions or market states, have significant explanatory power for time-varying momentum, size, and value effect. The relevant conclusion is described as following three aspects:

5.6.1 Explanatory power of macroeconomic variables for time-varying style effects

- Momentum effect

As the empirical work indicates, lagged macroeconomic variables explain the time-variation in momentum effect with 12 months' formation length stronger than one with 6 months' formation length from 1980 to 2008, with adjusted R^2 in multivariate regression more than 0.10 for the former and less than 0.10 for the latter in most cases. Specially, the explanatory power is stronger, which ranges between 15% and 25%, for time-varying momentum effect with 6 and 12 months' holding lengths. The explanatory power of macroeconomic variables is volatile over time, which exhibits declining (rising) pattern for equal-(value-) weighted momentum effect over the 1980s, the 1990s, and from 2000 to 2008. It is consistent with the findings by Welch and Goyal (2008) on aggregate market return that the performance of predicting model based on some macroeconomic variables is volatile over time in the US Stock Market.

- Size effect

The explanatory power of lagged macroeconomic variables for time-varying size effect with five holding horizons exhibits ‘Λ’ pattern from 1980 to 2008. When decile size portfolios are hold for 12 months, the combination of macroeconomic variables captures 14.93 to 17.64 percentage of the time-variation in size effect. Adjusted R^2 of the multivariate regression ranges between 10.31 and 13.26 percentage for the time-variation in size effect with 6 and 18 months’ holding lengths. It falls below 10 percentage when size portfolios are hold for 3 and 24 months. High adjusted R^2 of multivariate regression for 12 months’ size effect in overall period is consistent with its performance in subperiods when it ranges between 17.38% and 22.11% in the 1980s, and between 38.82% and 44.81% afterwards.

- Value effect

There is obvious difference in explanatory power of macroeconomic variables for time-varying value effect between two measures, which are value coefficient γ_{pb} and Low/High return R_{lmh}. Through five holding horizons, lagged macroeconomic variables explain 16.53 to 40.87 percentage of the variation in value coefficient γ_{pb} from 1980 to 2008, but only 5.01 to 28.44 percentage of the variation in Low/High return R_{lmh}. High explanatory power of macroeconomic variables for value coefficient γ_{pb} is due to information of all firms’ price-to-book ratios and share returns included in $\gamma_{pb.}$ Following ‘Low’ and ‘High’ portfolios, other decile value portfolios have higher percentage of observations with highest return and lowest return. This pattern is captured by value coefficient $\gamma_{pb,}$ but overlook by Low/High return $R_{lmh.}$ In addition, as holding length extends from 5 months to 24 months, the percentage of the variation in value effect driven by lagged macroeconomic variables increases to higher level, ranging 28.44% and 40.87%, except for value-weighted Low/High R_{lmh}. Higher adjusted R^2 of multivariate regression for 24 months' value effect is also found in three subperiods when it ranges between 0.3245 and 0.5918.

5.6.2 Significant macroeconomic variables for time-varying style effects

As concluded in subsection 5.6.1, the combination of lagged macroeconomic variables offers explanatory power for momentum effect with 12 months' formation length and 6/12 months' holding length, size effect with 12 months' holding length, and value effect with 24 months' holding length stronger than corresponding style effects with other formation length or holding lengths. They are denoted as momentum effect (12/6, 12/12), size effect (12), and value effect (24), respectively. The research finds that (marginally) significant macroeconomic variables in the multivariate regression of momentum effect (12/6, 12/12), size effect (12), and value effect (24), are GDP(Y), UEXBILL(Y), DY(Q) and CPI(H); GDP(Y) and UEXBILL(Y); CPI(Y) and MR(-8), respectively. The sign of information coefficient λ in multivariate regression indicates that the previous annual decline in GDP and unexpected annual rise in TBILL might forecast strong mid-term momentum effect and mid-term large-cap effect, and that previous annual decline in CPI and higher market return over past 8 years might forecast strong long-term value effect.

Three style effects are closely associated with macroeconomic conditions. Momentum effect (12/6, 12/12) is stronger in declining economic growth and unexpected rise of interest rate. Winner shares always consist of firms, which have good fundamentals and resist the economic contraction and tightening monetary policy. Conversely, loser shares always consist of firms, which have worse fundamentals and are easily hit by deteriorating macroeconomic conditions. The different response of two kinds of firms to the economic conditions broadens the return spread between winner shares and loser shares. The findings are different from the hypothesis based on previous studies that momentum effect exists in economic expansionary period.

Conversely, strong small-cap effect (12) exists in economic expansion and unexpected decline of interest rate. Faster economic growth and loosing monetary policy benefit small firms' business much more than large firms, and cause the outperformance of small-cap shares over large-cap shares. These findings are supported by the research on firm size by Tamari (1984), Gertler and Gilchrist (1994), and Ehrmann (2000). They are consistent with the hypothesis based on the findings of empirical work on size effect by Jensen, Johnson, and Mercer (1998), Levis and Liodakis (1999), Perez-Quiros and Timmermann (2000).

As the findings in Levis and Liodakis (1999), the research shows strong value effect (24) in the declining CPI. Value firms always have large market capitalization, and benefit the decline in business cost due to lower inflation much more than growth firms, which leads to the rise in their profits. It is consistent with the hypothesis based on previous studies on value effect by Jensen, Johnson, and Mercer (1998). On the other hand, the research finds that strong value effect (24) exists when the share market experiences upward movement in long horizon. In this case, the price of most shares, especially growth shares, is much higher than their firm fundamentals. Investors allocate more position in value shares and less position in growth shares to avoid the risk of downward market, which causes high value premium.

Obviously, momentum effect (12/6, 12/12) and size effect (12) are commonly significantly sensitive to the previous annual change of GDP and unexpected annual change of TBILL. The coefficient signs of GDP(Y) and UEXTBILL(Y) in the multivariate regression of momentum effect (12/6, 12/12) are opposite to corresponding ones in the regression of size effect (12), which means momentum effect and size effect are significant in the opposite economic background. In addition, Table 5.4 shows 0.6187 of correlation coefficient between CPI(Y) and UEXTBILL(Y). Momentum effect (12/6, 12/12) and size effect (12), which is significantly influenced by UEXTBILL(Y), are associated with CPI(Y). This means that momentum effect (12/6, 12/12) and value effect (24) are significant in the opposite inflation condition, and size effect (12) and value effect (24) are significant in the same inflation condition. This offers economic explanation for the empirical findings in Chapter 4 on negative relation between momentum effect and size effect, negative relation between momentum effect and value effect, and positive relation between size effect and value effect in the UK Stock Market.

5.6.3 The variation in significant macroeconomic variables for time-varying style effects

Significant macroeconomic variables for time-varying style effects are different over five holding horizons and over subperiods. The reason for this variation is that style-originated investors use different macroeconomic variables to make decision on share allocation depending on investing horizons, dynamic economic conditions and market states.

Firstly, macroeconomic variables that significantly affect time-varying style effect in the same subperiod are different for five holding horizons. For example, in the 1980s when equal-weighted momentum portfolios are constructed with 12 months' formation length, significant variables to explain the time-variation in momentum effect with 3 and 18 months' holding length are UEXBILL(Y) and EMR(-1), GDP(Y) and DY(Q), respectively. When Small/Large position is hold for 3 to 12 months, UEXTBILL(Y) or CPI(Y) are two significant variables to explain the time-variation in Small/Large return R_{sml}. In the 18 months' long-run horizon, GDP(Y) significantly accounts for time-varying R_{sml}. When value portfolios are hold for 3 and 6 months, UEXDY(H) and MR(-8) significantly explains time-varying value-weighted γ_{pb}. When they are hold for 18 months, GDP(Y) combining with MR(-8) does so.

Secondly, significant macroeconomic variables to explain time-varying style effect with same holding horizon are time-variant over three subperiods. For example, UEXTBILL(Y) and EMR(-1), GDP(Y), respectively, combining with DY(Q), significantly explain the variation in equal-weighted momentum effect (12/6) in the 1980s and the 1990s. For size effect (12), significant macroeconomic variable for size coefficient γ_{mv} in the 1980s, the 1990s, and from 2000 to 2008 is CPI(Y), GDP(Y), UEXTBILL(Y), respectively.

Thirdly, the same macroeconomic variable has opposite explanatory power for style effect over time. For example, size effect (12) is marginally negatively sensitive to CPI(Y) in the 1980s, but positive though unsignificant since the 2000. Value effect (24) is significantly negatively associated to M0(Y) and CPI(Y) in the 1990s, but vice versa since 2000. The same pattern is found in other studies on aggregate market return. Campbell and Hamao (1992) show that the estimate of dividend-price ratio coefficient for predicting returns in Japan Stock Market switches sign from the positive in the 1970s to the negative in the 1980s. Soufian (2001) finds that unexpected inflation has significantly negative and positive impact on expected return in the UK Stock Market in the 1980s and the 1990s, respectively. Humpe and Macmillan (2007) find that the CPI does not have a significant influence over Japan Stock Market from 1965 to 2005 due to volatile macroeconomic conditions. Japan experienced high inflation and stable growth in industrial production from 1971 to 1990, and strong disinflation in the early 1990s and deflation but volatile industrial production in the late 1990s and early 21st century. During the period of low inflation, its influence on stock price may be 'cancelled' by other economic indicators with high volatility, such as industrial production and money supply. Similarly, high inflation with more than 10 percent in the early 1980s and low inflation with less than 4 percent in most period after the 2000 contribute to the different influence of CPI(Y) on size effect (12) and value effect (24) in the UK Stock Market.

Appendix: tables and figures in Chapter 5

Table 5.1 Macroeconomic variables for the time-variation in style effects

Panel A Macroeconomic variables

Macroeconomic Variables	Description	Lagged length	Sources
GDP	Growth of Domestic Production	2 quarters	ESDS IFS
IP	Industrial Production	2 months	Datastream
IPM	Industrial Production Index – Manufacturing	2 months	Datastream
M0	Money Supply M0	1 month	Datastream
UNE	Unemployment Rate	2 month	Datastream
CPI	Consumer Price Index	1 month	Datastream
TBILL	monthly return on a 90-day Treasury Bill	1 month	LSPD
TERM	the difference in the annualized yield on the long-term UK government bonds and the yield on the three-month Treasury Bill.	1 month	ESDS IFS
DY	Dividend Yield based on value-weighted market index of all companies	1 month	LSPD
EMR/VMR(-y)	equal-(value-) weighted y years' compounded return; y=1,2,…10	1 month	LSPD

Panel B The hypothesis on relationship between style effects and macroeconomic variables.

Macroeconomic variables	Momentum effect	Small-cap effect	Value effect
GDP	+	+	+
IP	+	+	+
IPM	+	+	+
M0	0	+	+
UNE	0	0	0
CPI	0	-	-
TBILL	0	-	-
TERM	0	0	0
DY	0	0	0
EMR/VMR(-y)	+	0	0

Note: Panel A in the table reports the description on macroeconomic variables, their lagged length, data sources. Panel B offers the hypothesis on relation between style effects and macroeconomic variables. The symbols '+' and '-' are marked as positive and negative relation between style effects and macroeconomic variables, respectively.

Table 5.2 The autocorrelation and the unit root test of primary macroeconomic variables

Panel A The autocorrelation of primary macroeconomic variables

	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
GDP	0.96	0.92	0.88	0.84	0.81	0.77	0.73	0.68	0.64	0.58
IP	0.99	0.99	0.98	0.98	0.97	0.96	0.96	0.95	0.94	0.93
IPM	0.99	0.99	0.98	0.98	0.97	0.96	0.95	0.94	0.93	0.92
M0	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.91	0.90
UNE	0.99	0.99	0.98	0.97	0.97	0.96	0.94	0.93	0.92	0.91
CPI	0.98	0.94	0.90	0.86	0.82	0.77	0.72	0.68	0.65	0.61
TBILL	0.98	0.96	0.94	0.92	0.90	0.88	0.86	0.84	0.82	0.79
TERM	0.95	0.91	0.86	0.81	0.77	0.72	0.67	0.61	0.56	0.51
DY	0.98	0.97	0.95	0.93	0.91	0.89	0.87	0.84	0.82	0.80

Panel B The unit root statistics of primary macroeconomic variables

	ADF (without trend)			ADF (trend)		
D-lag	2	1	0	2	1	0
GDP	-2.68	-2.65	-2.63	-2.75	-2.72	-2.70
IP	-0.78	-0.82	-0.96	-1.14	-1.29	-1.88
IPM	-0.29	-0.32	-0.56	-2.48	-2.51	-2.77
M0	0.98	0.19	0.48	0.91	0.63	0.71
UNE	-1.21	-0.74	-0.22	-3.15	-3.22	-3.85
CPI	-4.27	-4.26	-4.68	-3.83	-3.78	-3.65
TBILL	-2.31	-2.22	-2.21	-2.83	-2.59	-2.48
TERM	-2.56	-2.74	-2.71	-2.92	-2.79	-2.87
DY	-2.07	-2.06	-2.06	-2.10	-2.05	-2.12
Significant level 5%		-2.87			-3.42	

Note: Panel A of the table reports the first to tenth order autocorrelation of nine primary macroeconomic variables from 1980 to 2008. Panel B reports their unit root statistics. GDP (the Growth of Domestic Product) and TERM (Term Structure) are collected from ESDS IFS (The Economic and Social Data Service, International Financial Statistics). IP (Industrial Production), IPM (Industrial Production Index – Manufacturing), M0 (Money Supply), UNE (Unemployment Rate), and CPI (Consumer Price Index) are collected from Datastream. TBILL (3-month's Interest Rate) and DY (Dividend Yield) are collected from LSPD.

Table 5.3 The autocorrelation of (unexpected) change of primary macroeconomic variables

	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
GDP(Y)	0.89	0.77	0.66	0.60	0.54	0.48	0.41	0.34	0.27	0.15
UEXGDP(Y)	0.89	0.77	0.66	0.58	0.51	0.44	0.36	0.28	0.20	0.10
IP(M)	-0.23	0.00	0.14	-0.09	0.17	-0.07	0.03	0.10	-0.08	-0.04
IP(Q)	0.58	0.34	0.08	0.13	0.17	0.10	0.11	0.04	-0.05	-0.11
IP(H)	0.76	0.67	0.60	0.48	0.38	0.16	0.17	0.13	0.02	0.00
IP(Y)	0.88	0.83	0.76	0.67	0.61	0.52	0.45	0.37	0.27	0.21
UEXIP(Q)	0.39	0.15	0.06	0.07	0.14	0.07	0.12	0.09	-0.03	-0.10
UEXIP(H)	0.65	0.53	0.44	0.30	0.26	0.15	0.16	0.12	0.02	-0.03
UEXIP(Y)	0.84	0.76	0.69	0.59	0.53	0.43	0.36	0.29	0.19	0.13
IPM(M)	-0.20	0.01	0.18	-0.06	0.09	0.08	0.04	0.07	0.00	-0.08
IPM(Q)	0.63	0.40	0.13	0.19	0.23	0.22	0.22	0.12	0.02	-0.05
IPM(H)	0.82	0.75	0.68	0.58	0.50	0.35	0.34	0.28	0.18	0.15
IPM(Y)	0.91	0.86	0.81	0.75	0.69	0.63	0.57	0.50	0.41	0.34
UEXIPM(Q)	0.46	0.22	0.12	0.11	0.17	0.19	0.19	0.11	0.02	-0.07
UEXIPM(H)	0.71	0.60	0.53	0.40	0.35	0.30	0.27	0.21	0.12	0.05
UEXIPM(Y)	0.88	0.82	0.76	0.68	0.62	0.56	0.48	0.40	0.31	0.24
M0 (M)	0.12	-0.13	-0.01	0.06	0.09	0.06	-0.02	0.03	0.00	0.04
M0 (Q)	0.68	0.27	0.01	0.09	0.15	0.12	0.06	0.04	0.04	0.04
M0 (H)	0.85	0.68	0.56	0.44	0.30	0.15	0.12	0.12	0.10	0.11
M0 (Y)	0.92	0.84	0.78	0.72	0.67	0.60	0.54	0.48	0.43	0.38
UEXM0(Q)	0.71	0.40	0.30	0.38	0.42	0.40	0.35	0.33	0.32	0.34
UEXM0 (H)	0.88	0.75	0.67	0.62	0.57	0.54	0.53	0.52	0.51	0.53
UEXM0 (Y)	0.95	0.90	0.86	0.84	0.81	0.79	0.76	0.75	0.74	0.74
UNE (M)	0.55	0.53	0.47	0.49	0.49	0.45	0.40	0.42	0.39	0.36
UNE (Q)	0.92	0.82	0.72	0.70	0.68	0.65	0.61	0.59	0.55	0.51
UNE (H)	0.97	0.94	0.90	0.85	0.80	0.75	0.71	0.67	0.63	0.58
UNE (Y)	0.99	0.97	0.95	0.92	0.89	0.85	0.80	0.76	0.71	0.66
UEXUNE(Q)	0.92	0.83	0.76	0.73	0.70	0.67	0.64	0.62	0.58	0.54
UEXUNE(H)	0.97	0.93	0.88	0.84	0.79	0.75	0.72	0.68	0.64	0.59
UEXUNE(Y)	0.99	0.97	0.94	0.91	0.88	0.84	0.80	0.75	0.71	0.66
CPI (M)	0.16	0.04	0.16	0.00	0.11	0.08	-0.05	-0.02	-0.07	0.00
CPI (Q)	0.78	0.48	0.23	0.18	0.16	0.09	0.00	-0.07	-0.10	-0.16
CPI (H)	0.90	0.77	0.63	0.46	0.30	0.13	0.00	-0.10	-0.20	-0.28
CPI (Y)	0.93	0.84	0.75	0.63	0.50	0.36	0.22	0.09	-0.03	-0.13
UEXCPI(Q)	0.75	0.42	0.19	0.15	0.14	0.09	0.00	-0.05	-0.06	-0.08
UEXCPI(H)	0.88	0.71	0.53	0.38	0.24	0.11	0.00	-0.07	-0.12	-0.16
UEXCPI(Y)	0.93	0.83	0.70	0.57	0.43	0.28	0.13	0.02	-0.06	-0.13
TBILL(M)	0.05	0.10	0.00	0.02	0.02	0.01	0.05	-0.06	0.06	-0.06
TBILL (Q)	0.69	0.40	0.08	0.05	0.05	0.04	0.05	0.01	0.02	0.00
TBILL (H)	0.85	0.71	0.55	0.39	0.24	0.09	0.07	0.03	0.00	-0.05
TBILL (Y)	0.93	0.85	0.76	0.67	0.57	0.47	0.37	0.26	0.17	0.08
UEXTBILL(Q)	0.61	0.28	0.04	-0.01	-0.02	-0.02	0.02	-0.03	0.02	-0.04
UEXTBILL(H)	0.80	0.59	0.38	0.20	0.07	0.00	0.00	-0.03	-0.02	-0.07
UEXTBILL(Y)	0.90	0.78	0.65	0.53	0.40	0.29	0.18	0.07	0.01	-0.07
TERM(M)	-0.05	0.05	0.02	-0.01	0.01	0.00	0.11	-0.13	0.01	-0.21
TERM(Q)	0.66	0.37	0.04	0.03	0.05	0.03	0.03	-0.12	-0.15	-0.21
TERM(H)	0.83	0.70	0.53	0.36	0.17	-0.02	-0.05	-0.13	-0.15	-0.20
TERM(Y)	0.91	0.83	0.73	0.62	0.50	0.39	0.29	0.16	0.07	-0.04
UEXTERM(Q)	0.57	0.26	0.04	0.02	0.03	0.04	0.04	-0.11	-0.14	-0.19
UEXTERM(H)	0.77	0.58	0.39	0.22	0.09	0.00	-0.03	-0.12	-0.15	-0.19
UEXTERM(Y)	0.88	0.76	0.64	0.50	0.38	0.26	0.14	0.01	-0.07	-0.15
DY(M)	-0.01	0.09	0.06	-0.03	0.01	-0.03	0.09	0.00	0.10	-0.06
DY(Q)	0.70	0.43	0.10	0.04	0.03	0.03	0.10	0.10	0.09	-0.10
DY(H)	0.85	0.70	0.55	0.41	0.29	0.15	0.10	0.01	-0.06	-0.14
DY(Y)	0.92	0.82	0.72	0.62	0.53	0.44	0.36	0.26	0.17	0.08
UEXDY(Q)	0.57	0.27	0.07	0.02	0.02	0.05	0.10	0.07	0.07	-0.07
UEXDY(H)	0.77	0.57	0.42	0.27	0.18	0.13	0.11	0.02	-0.06	-0.15
UEXDY(Y)	0.89	0.78	0.68	0.56	0.44	0.33	0.22	0.09	-0.01	-0.10

Note: Table reports the first to tenth order autocorrelation of (unexpected) change of macroeconomic variables on monthly, quarterly, half-yearly, and annual horizons from 1980 to 2008, which is denoted in M, Q, H, and Y in parentheses.

Table 5.4 The correlation coefficient of annual (unexpected) change of macroeconomic variables

	GDP	UEXGDP	IP	UEXIP	IPM	UEXIPM	M0	UEXM0	UNE	UEXUNE	CPI	UEXCPI	TBILL	UEXTBILL	TERM	UEXTERM	DY	UEXDY
GDP	1.00																	
UEXGDP	0.95	1.00																
IP	0.56	0.59	1.00															
UEXIP	0.46	0.52	0.89	1.00														
IPM	0.50	0.48	0.88	0.77	1.00													
UEXIPM	0.47	0.50	0.83	0.87	0.91	1.00												
M0	-0.13	-0.14	0.04	0.04	0.10	0.11	1.00											
UEXM0	-0.03	-0.04	-0.12	-0.11	0.02	0.01	0.57	1.00										
UNE	-0.29	-0.22	-0.59	-0.48	-0.71	-0.60	-0.34	-0.29	1.00									
UEXUNE	-0.31	-0.26	-0.63	-0.54	-0.76	-0.67	-0.33	-0.25	0.97	1.00								
CPI	0.06	0.03	0.20	0.10	0.31	0.22	0.24	0.12	-0.37	-0.40	1.00							
UEXCPI	0.10	0.10	0.39	0.26	0.52	0.40	0.44	0.21	-0.52	-0.55	0.73	1.00						
TBILL	-0.08	-0.13	0.16	0.06	0.25	0.13	0.14	-0.02	-0.36	-0.34	0.67	0.57	1.00					
UEXTBILL	-0.02	-0.04	0.27	0.18	0.38	0.29	0.36	0.09	-0.41	-0.43	0.62	0.74	0.83	1.00				
TERM	-0.04	0.05	-0.27	-0.16	-0.33	-0.20	-0.17	-0.01	0.49	0.47	-0.56	-0.56	-0.76	-0.71	1.00			
UEXTERM	-0.13	-0.06	-0.32	-0.24	-0.41	-0.31	-0.20	-0.02	0.47	0.47	-0.50	-0.58	-0.66	-0.74	0.88	1.00		
DY	-0.16	-0.25	-0.25	-0.33	-0.15	-0.24	0.24	0.18	-0.03	0.01	0.19	0.24	0.22	0.25	-0.18	-0.14	1.00	
UEXDY	0.01	-0.08	-0.09	-0.23	0.03	-0.11	0.25	0.19	-0.18	-0.13	0.28	0.41	0.31	0.36	-0.28	-0.23	0.88	1

Note: The table reports correlation coefficient of annual (unexpected) change of macroeconomic variables from 1980 to 2008.

Table 5.5 Univariate regression of momentum effect on individual lagged macroeconomic variables (Momentum 6/3)

	Panel A Momentum coefficient γ_{mom}						Panel B Winner/Loser return R_{wml}					
	Panel A1 Equal-weighted			Panel A2 Value-weighted			Panel B1 Equal-weighted			Panel B2 Value-weighted		
Macroeconomic variable	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t(λ)	Adj-R^2
GDP(Y)	-0.0039	-1.1409	0.0060	-0.0074	-1.4854	0.0095	-0.0031	-1.0126	0.0003	-0.0088	-1.8050	0.0094
UEXGDP(Y)	-0.0060	-1.1891	0.0060	-0.0123	-1.6742	0.0119	-0.0047	-1.0186	0.0003	-0.0140	-1.9577	0.0105
IP(M)	-0.2352	-0.2800	-0.0028	-0.6027	-0.4140	-0.0025	0.7963	0.7288	-0.0019	0.1330	0.0806	-0.0029
IP(Q)	-0.0808	-0.0885	-0.0029	0.1218	0.0823	-0.0029	1.0547	0.9499	0.0008	0.7896	0.4793	-0.0019
IP(H)	-0.1247	-0.1979	-0.0027	-0.8984	-0.9163	0.0010	0.3857	0.5328	-0.0019	-0.8034	-0.7499	-0.0007
IP(Y)	0.1826	0.4206	-0.0020	-0.5222	-0.8769	0.0002	0.4882	1.0687	0.0011	-0.7101	-1.0859	0.0010
UEXIP(Q)	-0.0004	-0.0673	-0.0029	-0.0003	-0.0327	-0.0029	0.0079	1.0192	0.0016	0.0046	0.3910	-0.0022
UEXIP(H)	-0.0001	-0.0244	-0.0029	-0.0029	-0.3327	-0.0023	0.0062	0.9013	0.0013	-0.0002	-0.0173	-0.0029
UEXIP(Y)	0.0001	0.0189	-0.0029	-0.0049	-0.8040	0.0006	0.0036	0.7694	-0.0001	-0.0054	-0.8118	0.0001
IPM(M)	-0.5221	-0.6563	-0.0021	-0.7620	-0.6335	-0.0023	0.4609	0.4364	-0.0026	-0.4187	-0.2809	-0.0028
IPM(Q)	-0.0765	-0.0906	-0.0029	0.0619	0.0494	-0.0029	0.9866	0.9737	0.0008	0.3257	0.2356	-0.0027
IPM(H)	0.0917	0.1526	-0.0028	-0.5341	-0.6133	-0.0013	0.6281	0.9192	0.0005	-0.5985	-0.6617	-0.0015
IPM(Y)	0.2419	0.6329	-0.0006	-0.1813	-0.3735	-0.0024	0.4366	1.1715	0.0015	-0.3806	-0.6898	-0.0013
UEXIPM(Q)	-0.0013	-0.2373	-0.0027	-0.0012	-0.1411	-0.0028	0.0061	0.8251	0.0000	0.0007	0.0699	-0.0029
UEXIPM(H)	0.0002	0.0455	-0.0029	-0.0021	-0.2708	-0.0025	0.0061	0.9620	0.0019	-0.0012	-0.1503	-0.0028
UEXIPM(Y)	0.0009	0.2716	-0.0025	-0.0022	-0.4507	-0.0020	0.0036	0.9139	0.0007	-0.0037	-0.6822	-0.0011
M0 (M)	0.6687	0.2432	-0.0027	2.5565	0.6430	-0.0018	2.0466	0.3702	-0.0019	7.4335	1.1583	0.0036
M0 (Q)	0.3479	0.1734	-0.0027	1.0711	0.3659	-0.0023	-2.2526	-0.6056	0.0012	-0.2933	-0.0629	-0.0029
M0 (H)	1.2890	0.7378	0.0020	0.7841	0.3227	-0.0022	0.1317	0.0476	-0.0029	-0.9440	-0.2854	-0.0022
M0 (Y)	1.4925	1.2477	0.0133	0.8119	0.5038	-0.0010	0.8537	0.4671	0.0002	0.0368	0.0162	-0.0029
UEXM0(Q)	0.0000	0.6054	-0.0005	0.0001	1.4478	0.0094	0.0000	-0.0505	-0.0029	0.0001	1.0521	0.0079
UEXM0 (H)	0.0000	0.7729	0.0017	0.0001	1.4441	0.0103	0.0000	-0.0164	-0.0029	0.0001	0.8593	0.0044
UEXM0 (Y)	0.0000	1.0125	0.0052	0.0000	1.4915	0.0120	0.0000	0.2193	-0.0024	0.0000	0.9256	0.0051
UNE (M)	-1.2676	-1.3415	0.0067	-0.8370	-0.5286	-0.0013	-1.8650	-1.7967	0.0093	-0.5203	-0.3253	-0.0025
UNE (Q)	-0.5661	-1.2627	0.0087	-0.2236	-0.3392	-0.0022	-0.8807	-1.9877	0.0136	-0.1779	-0.2480	-0.0026
UNE (H)	-0.3002	-1.2369	0.0082	-0.0277	-0.0820	-0.0029	-0.4246	-1.8007	0.0101	0.0736	0.2012	-0.0027
UNE (Y)	-0.2121	-1.7758	0.0164	-0.1125	-0.6489	-0.0008	-0.2470	-2.2370	0.0124	-0.0473	-0.2519	-0.0027
UEXUNE(Q)	-0.0424	-1.1042	0.0065	-0.0089	-0.1665	-0.0028	-0.0624	-1.7084	0.0090	0.0049	0.0870	-0.0029
UEXUNE(H)	-0.0251	-1.0738	0.0061	0.0003	0.0109	-0.0029	-0.0360	-1.6666	0.0079	0.0096	0.2862	-0.0025
UEXUNE(Y)	-0.0158	-1.2483	0.0081	-0.0022	-0.1230	-0.0028	-0.0199	-1.7740	0.0073	0.0044	0.2370	-0.0027
CPI (M)	-0.0829	-0.8631	-0.0007	-0.3139	-1.8489	0.0099	-0.1247	-0.8909	0.0001	-0.4560	-1.8177	0.0159
CPI (Q)	-0.0394	-0.6287	-0.0010	-0.1630	-1.6596	0.0099	-0.1198	-1.2027	0.0074	-0.3324	-2.0761	0.0344
CPI (H)	-0.0289	-0.5292	-0.0004	-0.0935	-1.2467	0.0075	-0.0810	-1.1039	0.0086	-0.1868	-1.7824	0.0261
CPI (Y)	0.0014	0.0347	-0.0029	-0.0282	-0.5924	-0.0007	-0.0128	-0.2518	-0.0022	-0.0676	-1.0669	0.0059
UEXCPI(Q)	0.0064	0.7854	-0.0001	-0.0024	-0.1922	-0.0028	0.0021	0.2356	-0.0027	-0.0099	-0.6873	-0.0011

Continued

UEXCPI(H)	0.0061	1.0402	0.0021	-0.0016	-0.1653	-0.0028	0.0023	0.3445	-0.0025	-0.0083	-0.7563	-0.0003
UEXCPI(Y)	0.0051	1.3560	0.0059	0.0003	0.0497	-0.0029	0.0036	0.8477	-0.0004	-0.0031	-0.4496	-0.0020
TBILL(M)	0.0925	1.1201	0.0008	0.0058	0.0484	-0.0029	0.1155	1.1494	0.0005	0.0327	0.2300	-0.0028
TBILL (Q)	0.0748	1.4967	0.0054	0.0208	0.2809	-0.0027	0.0884	1.4388	0.0039	0.0136	0.1383	-0.0028
TBILL (H)	0.0682	1.8967	0.0118	0.0544	1.1174	0.0008	0.0710	1.5907	0.0064	0.0425	0.6342	-0.0013
TBILL (Y)	0.0695	2.3548	0.0299	0.0714	1.7942	0.0108	0.0697	1.7469	0.0164	0.0758	1.5320	0.0079
UEXTBILL(Q)	16.3102	1.8663	0.0095	9.8760	0.7897	-0.0011	20.1170	2.1122	0.0081	12.8594	0.9479	-0.0008
UEXTBILL(H)	16.7139	2.3077	0.0197	13.8369	1.3712	0.0032	19.2747	2.4445	0.0147	14.5147	1.2405	0.0018
UEXTBILL(Y)	14.8326	2.7613	0.0307	12.9689	1.7375	0.0072	15.0528	2.6134	0.0173	11.9432	1.3396	0.0031
TERM(M)	-1.4885	-1.3746	0.0038	-1.7581	-1.1985	0.0008	-1.4735	-1.3221	0.0009	-1.5068	-0.9441	-0.0010
TERM(Q)	-1.0896	-1.3996	0.0073	-0.7711	-0.7340	-0.0009	-1.0051	-1.1984	0.0022	-0.5213	-0.4346	-0.0023
TERM(H)	-0.3983	-0.7149	-0.0001	-0.2275	-0.3157	-0.0025	-0.2795	-0.4683	-0.0021	0.0145	0.0166	-0.0029
TERM(Y)	-0.5722	-1.5508	0.0093	-0.7410	-1.5163	0.0052	-0.5130	-1.1142	0.0028	-0.6287	-1.0311	0.0011
UEXTERM(Q)	-1.6128	-1.4569	0.0087	-1.4088	-0.9594	0.0006	-1.5202	-1.3180	0.0031	-1.1517	-0.6979	-0.0013
UEXTERM(H)	-1.0369	-1.1764	0.0051	-0.7323	-0.6362	-0.0013	-0.8724	-0.9286	0.0004	-0.3684	-0.2693	-0.0026
UEXTERM(Y)	-0.7237	-1.1207	0.0043	-0.7089	-0.8577	-0.0002	-0.5510	-0.7629	-0.0005	-0.4009	-0.3980	-0.0023
DY(M)	0.1893	1.3977	0.0023	0.0056	0.0294	-0.0029	0.1074	0.6144	-0.0019	-0.1701	-0.7740	-0.0018
DY(Q)	0.2744	2.1819	0.0316	0.2080	1.2453	0.0049	0.3043	1.8197	0.0219	0.1862	0.8480	0.0015
DY(H)	0.2677	2.5720	0.0739	0.3080	2.2310	0.0373	0.3210	2.1165	0.0617	0.3571	2.1184	0.0347
DY(Y)	0.0772	1.3614	0.0120	0.1003	1.3246	0.0070	0.0533	0.8466	0.0012	0.1012	1.0856	0.0042
UEXDY(Q)	8.0493	2.9349	0.0250	4.1975	1.1069	0.0001	7.5615	2.1876	0.0115	1.9027	0.4181	-0.0025
UEXDY(H)	9.1051	3.5602	0.0605	7.9863	2.1840	0.0164	9.6266	3.0132	0.0386	7.7363	1.7226	0.0097
UEXDY(Y)	6.0069	3.3907	0.0554	5.8504	2.2993	0.0189	5.7236	2.7977	0.0280	5.6933	1.8821	0.0115
EMR(-1)/VMR(-1)	-0.0368	-1.1835	0.0112	0.0148	0.1976	-0.0026	-0.0359	-0.7573	0.0050	0.0388	0.4262	-0.0013
EMR(-2)/VMR(-2)	-0.0061	-0.2870	-0.0020	-0.0257	-0.6302	-0.0001	-0.0032	-0.1234	-0.0028	-0.0291	-0.5439	-0.0004
EMR(-3)/VMR(-3)	-0.0028	-0.1886	-0.0025	0.0015	0.0609	-0.0029	-0.0010	-0.0583	-0.0029	0.0058	0.1806	-0.0027
EMR(-4)/VMR(-4)	-0.0042	-0.4906	-0.0008	-0.0031	-0.2105	-0.0027	-0.0054	-0.5508	-0.0009	-0.0076	-0.4002	-0.0020
EMR(-5)/VMR(-5)	-0.0031	-0.5227	-0.0004	0.0023	0.2226	-0.0027	-0.0043	-0.6271	-0.0001	-0.0039	-0.2862	-0.0024
EMR(-6)/VMR(-6)	-0.0046	-1.2614	0.0077	-0.0044	-0.6475	-0.0011	-0.0049	-1.1954	0.0043	-0.0073	-0.8823	0.0006
EMR(-7)/VMR(-7)	-0.0025	-0.9523	0.0024	-0.0033	-0.6461	-0.0011	-0.0028	-0.9727	0.0012	-0.0056	-0.9374	0.0008
EMR(-8)/VMR(-8)	-0.0007	-0.3537	-0.0022	-0.0024	-0.5789	-0.0012	-0.0011	-0.4405	-0.0020	-0.0055	-1.1616	0.0033
EMR(-9)/VMR(-9)	-0.0002	-0.1656	-0.0028	-0.0011	-0.3588	-0.0023	0.0001	0.0299	-0.0029	-0.0021	-0.6140	-0.0013
EMR(-10)/VMR(-10)	-0.0007	-0.6467	-0.0002	0.0000	-0.0028	-0.0029	-0.0006	-0.4188	-0.0018	-0.0010	-0.3867	-0.0023

Note: The table reports parameters of slope coefficient λ, t-stats, and adjusted R-square estimated from univariate regression of momentum coefficient γ_{mom} and Winner/Loser return R_{wml} on individual lagged macroeconomic variables from 1980 to 2008, respectively. Momentum portfolios are formed with shares returns in past 6 months, and hold for 3 months. Momentum coefficient γ_{mom} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal/or value-weighted returns in the holding period on their formation returns. Winner/Loser return R_{wml} is the return spread in 'Winner' portfolio and 'Loser' portfolio. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A reports corresponding parameters for equal-(value-) weighted momentum coefficient γ_{mom}. Panel B reports corresponding parameters for equal-(value-) weighted Winner/Loser return $R_{wml.}$

Table 5.6 Univariate regression of momentum effect on individual lagged macroeconomic variables (Momentum 6/6)

	Panel A Momentum coefficient γ_{mom}						Panel B Winner/Loser return R_{wml}					
	Panel A1 Equal-weighted			Panel A2 Value-weighted			Panel B1 Equal-weighted			Panel B2 Value-weighted		
Macroeconomic variable	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t(λ)	Adj-R^2
GDP(Y)	-0.0106	-1.4968	0.0255	-0.0143	-1.7168	0.0225	-0.0095	-1.4537	0.0137	-0.0166	-2.0315	0.0212
UEXGDP(Y)	-0.0135	-1.3426	0.0166	-0.0202	-1.5956	0.0188	-0.0118	-1.1734	0.0080	-0.0234	-1.8767	0.0177
IP(M)	-0.9386	-0.8651	-0.0019	-0.5420	-0.3119	-0.0028	-0.1435	-0.1043	-0.0029	0.0161	0.0073	-0.0029
IP(Q)	-1.0612	-0.8410	-0.0002	-0.9947	-0.6118	-0.0018	-0.3458	-0.2480	-0.0027	-0.4249	-0.2247	-0.0028
IP(H)	-0.7873	-0.7519	0.0003	-1.9032	-1.6546	0.0065	-0.5229	-0.4958	-0.0019	-2.3185	-1.6638	0.0069
IP(Y)	0.0832	0.1106	-0.0029	-1.0140	-1.2557	0.0034	0.2314	0.3118	-0.0025	-1.4460	-1.5286	0.0060
UEXIP(Q)	-0.0068	-0.8333	-0.0005	-0.0041	-0.3632	-0.0025	-0.0015	-0.1607	-0.0029	-0.0004	-0.0268	-0.0029
UEXIP(H)	-0.0066	-0.8466	0.0005	-0.0105	-1.1348	0.0014	-0.0030	-0.3619	-0.0024	-0.0110	-0.9779	0.0004
UEXIP(Y)	-0.0025	-0.3853	-0.0019	-0.0102	-1.4110	0.0053	-0.0009	-0.1372	-0.0028	-0.0140	-1.6266	0.0079
IPM(M)	-0.6774	-0.6519	-0.0024	-0.7855	-0.5382	-0.0026	-0.1370	-0.1150	-0.0029	-0.5462	-0.2845	-0.0028
IPM(Q)	-0.0081	-0.0062	-0.0029	-0.1258	-0.0826	-0.0029	0.6010	0.4496	-0.0022	-0.0397	-0.0228	-0.0029
IPM(H)	-0.1210	-0.1190	-0.0028	-0.5979	-0.5560	-0.0018	0.0728	0.0745	-0.0029	-0.9552	-0.7763	-0.0009
IPM(Y)	0.3222	0.5061	-0.0011	-0.2598	-0.3887	-0.0024	0.4057	0.6390	-0.0009	-0.5247	-0.6915	-0.0013
UEXIPM(Q)	-0.0016	-0.1916	-0.0028	-0.0013	-0.1300	-0.0029	0.0020	0.2293	-0.0028	-0.0012	-0.0955	-0.0029
UEXIPM(H)	-0.0011	-0.1387	-0.0028	-0.0029	-0.3228	-0.0026	0.0015	0.1918	-0.0028	-0.0048	-0.4637	-0.0022
UEXIPM(Y)	0.0004	0.0725	-0.0029	-0.0035	-0.5408	-0.0017	0.0012	0.2128	-0.0027	-0.0067	-0.9029	0.0003
M0 (M)	0.7065	0.1723	-0.0028	1.1823	0.2090	-0.0028	0.6645	0.0941	-0.0029	2.9002	0.3108	-0.0024
M0 (Q)	1.4838	0.4331	-0.0016	1.6168	0.3479	-0.0021	-0.8328	-0.1514	-0.0026	-0.7774	-0.1105	-0.0028
M0 (H)	1.5083	0.5257	0.0000	0.2381	0.0695	-0.0029	-0.2531	-0.0632	-0.0029	-3.2445	-0.6911	0.0018
M0 (Y)	2.1757	1.0051	0.0121	0.9639	0.3608	-0.0015	1.4122	0.5123	0.0017	-0.5070	-0.1436	-0.0027
UEXM0(Q)	0.0000	0.4583	-0.0010	0.0001	0.9522	0.0041	0.0000	0.0701	-0.0029	0.0001	0.5818	0.0012
UEXM0 (H)	0.0000	0.4126	-0.0010	0.0001	0.8495	0.0037	0.0000	-0.0263	-0.0029	0.0000	0.3795	-0.0011
UEXM0 (Y)	0.0000	0.4362	-0.0006	0.0000	0.7090	0.0021	0.0000	0.0459	-0.0029	0.0000	0.3160	-0.0017
UNE (M)	-1.1803	-0.7226	0.0006	-1.3653	-0.7533	-0.0006	-1.8008	-1.1176	0.0030	-1.0714	-0.5373	-0.0019
UNE (Q)	-0.5811	-0.7639	0.0023	-0.3759	-0.4428	-0.0019	-0.8804	-1.1926	0.0058	-0.3149	-0.3295	-0.0024
UNE (H)	-0.3492	-0.8793	0.0036	-0.2211	-0.4859	-0.0016	-0.4133	-1.1193	0.0037	-0.0709	-0.1430	-0.0028
UNE (Y)	-0.3155	-1.5311	0.0157	-0.2321	-0.9062	0.0021	-0.3327	-1.8040	0.0121	-0.1568	-0.5833	-0.0013
UEXUNE(Q)	-0.0443	-0.6644	0.0015	-0.0187	-0.2631	-0.0025	-0.0624	-0.9313	0.0035	-0.0091	-0.1158	-0.0029
UEXUNE(H)	-0.0277	-0.6953	0.0018	-0.0090	-0.2069	-0.0027	-0.0349	-0.9447	0.0025	0.0002	0.0043	-0.0029
UEXUNE(Y)	-0.0216	-1.0022	0.0060	-0.0099	-0.3969	-0.0020	-0.0233	-1.2149	0.0046	-0.0025	-0.0969	-0.0029
CPI (M)	-0.1675	-0.8967	0.0011	-0.4411	-1.7308	0.0109	-0.3386	-1.4985	0.0090	-0.6844	-1.8987	0.0204
CPI (Q)	-0.1160	-0.8354	0.0042	-0.3129	-1.7912	0.0230	-0.2322	-1.3276	0.0179	-0.5265	-2.1626	0.0485
CPI (H)	-0.0916	-0.8016	0.0081	-0.2211	-1.7242	0.0290	-0.1654	-1.2173	0.0232	-0.3581	-2.1437	0.0559
CPI (Y)	-0.0215	-0.2808	-0.0015	-0.0620	-0.7504	0.0029	-0.0359	-0.4059	-0.0001	-0.1087	-1.0406	0.0097
UEXCPI(Q)	0.0066	0.4742	-0.0017	-0.0111	-0.5510	-0.0011	0.0000	-0.0022	-0.0029	-0.0169	-0.7069	0.0000

Continued

UEXCPI(H)	0.0074	0.6231	0.0003	-0.0079	-0.4955	-0.0011	0.0018	0.1371	-0.0028	-0.0153	-0.8257	0.0019
UEXCPI(Y)	0.0069	0.9419	0.0040	-0.0019	-0.1983	-0.0027	0.0045	0.5628	-0.0008	-0.0058	-0.5352	-0.0012
TBILL(M)	0.1925	1.4648	0.0040	0.0475	0.2723	-0.0027	0.1841	1.2504	0.0017	0.0887	0.4115	-0.0024
TBILL (Q)	0.1221	1.5927	0.0067	0.0512	0.4829	-0.0021	0.1074	1.1563	0.0025	0.0394	0.2778	-0.0026
TBILL (H)	0.0880	1.3236	0.0078	0.0794	1.0194	0.0014	0.0637	0.8207	0.0011	0.0510	0.4906	-0.0017
TBILL (Y)	0.0983	2.2526	0.0257	0.1115	1.9419	0.0154	0.0981	1.9223	0.0178	0.1253	1.8193	0.0133
UEXTBILL(Q)	30.1138	2.2078	0.0156	21.6084	1.1702	0.0018	31.2654	2.0476	0.0116	27.0071	1.2601	0.0023
UEXTBILL(H)	25.4710	2.2313	0.0200	21.5627	1.4575	0.0052	24.0763	1.8657	0.0120	21.7688	1.2394	0.0029
UEXTBILL(Y)	21.5149	2.3550	0.0280	20.7564	1.7963	0.0114	19.9467	2.0138	0.0164	19.6420	1.4529	0.0060
TERM(M)	-2.3172	-1.1841	0.0041	-3.4679	-1.4589	0.0049	-1.7874	-0.9272	0.0001	-3.3972	-1.3077	0.0023
TERM(Q)	-1.3980	-1.0302	0.0044	-1.4688	-0.9200	0.0011	-1.1264	-0.7779	0.0005	-1.4916	-0.7798	0.0000
TERM(H)	-0.1105	-0.1094	-0.0028	-0.3053	-0.2831	-0.0026	0.1436	0.1415	-0.0028	-0.2307	-0.1817	-0.0028
TERM(Y)	-0.5154	-0.8581	0.0014	-0.7491	-1.0338	0.0016	-0.6342	-1.0426	0.0018	-0.9832	-1.1677	0.0025
UEXTERM(Q)	-2.2652	-1.1408	0.0070	-2.7595	-1.1907	0.0044	-1.7892	-0.8575	0.0016	-2.7711	-1.0234	0.0023
UEXTERM(H)	-1.0030	-0.6197	0.0003	-1.2815	-0.7258	-0.0003	-0.6124	-0.3732	-0.0021	-1.1557	-0.5429	-0.0014
UEXTERM(Y)	-0.6178	-0.5472	-0.0006	-0.9397	-0.7586	-0.0003	-0.5036	-0.4483	-0.0018	-0.9590	-0.6497	-0.0010
DY(M)	0.4741	1.9774	0.0113	0.2930	1.0839	-0.0002	0.3924	1.2438	0.0041	0.3031	0.9171	-0.0009
DY(Q)	0.5710	2.3128	0.0623	0.5544	2.0052	0.0276	0.5726	1.7609	0.0447	0.6160	1.8328	0.0235
DY(H)	0.3695	2.1949	0.0602	0.3647	1.7384	0.0277	0.3367	1.7348	0.0352	0.4056	1.6756	0.0236
DY(Y)	0.0724	0.6752	0.0028	0.1090	0.8391	0.0035	-0.0050	-0.0464	-0.0029	0.0879	0.5786	0.0000
UEXDY(Q)	16.4675	3.0277	0.0479	13.6966	2.3026	0.0145	15.1404	2.1661	0.0283	13.3919	1.8674	0.0088
UEXDY(H)	14.8669	3.1306	0.0706	13.9029	2.4994	0.0290	13.4909	2.3860	0.0411	14.1701	2.1706	0.0204
UEXDY(Y)	8.2067	2.5706	0.0444	8.1492	2.0731	0.0203	6.0521	1.7996	0.0158	7.9613	1.7776	0.0126
EMR(-1)/VMR(-1)	-0.0867	-1.5930	0.0304	0.0370	0.2975	-0.0018	-0.0843	-1.1649	0.0200	0.0510	0.3230	-0.0015
EMR(-2)/VMR(-2)	-0.0123	-0.2889	-0.0013	0.0152	0.2063	-0.0024	-0.0057	-0.1172	-0.0027	0.0152	0.1585	-0.0026
EMR(-3)/VMR(-3)	-0.0018	-0.0616	-0.0029	0.0223	0.5170	0.0000	0.0008	0.0247	-0.0029	0.0282	0.5049	0.0003
EMR(-4)/VMR(-4)	-0.0069	-0.3869	-0.0005	0.0046	0.1820	-0.0027	-0.0115	-0.6274	0.0019	-0.0014	-0.0444	-0.0029
EMR(-5)/VMR(-5)	-0.0037	-0.3094	-0.0014	0.0140	0.7835	0.0023	-0.0074	-0.5967	0.0017	0.0050	0.2218	-0.0025
EMR(-6)/VMR(-6)	-0.0067	-0.9262	0.0069	-0.0012	-0.1057	-0.0029	-0.0082	-1.0859	0.0078	-0.0042	-0.3198	-0.0023
EMR(-7)/VMR(-7)	-0.0029	-0.5493	0.0003	0.0008	0.1017	-0.0029	-0.0040	-0.7131	0.0015	-0.0026	-0.2749	-0.0025
EMR(-8)/VMR(-8)	-0.0014	-0.3382	-0.0017	-0.0020	-0.3002	-0.0023	-0.0020	-0.4474	-0.0011	-0.0060	-0.8124	0.0011
EMR(-9)/VMR(-9)	0.0001	0.0410	-0.0029	0.0016	0.3304	-0.0022	0.0004	0.1101	-0.0028	-0.0004	-0.0782	-0.0029
EMR(-10)/VMR(-10)	-0.0008	-0.3577	-0.0016	0.0029	0.7813	0.0010	-0.0010	-0.3607	-0.0015	0.0015	0.3621	-0.0022

Note: The table reports parameters of slope coefficient λ, t-stats, and adjusted R-square estimated from univariate regression of momentum coefficient γ_{mom} and Winner/Loser return R_{wml} on individual lagged macroeconomic variables from 1980 to 2008, respectively. Momentum portfolios are formed with shares returns in past 6 months, and hold for 6 months. Momentum coefficient γ_{mom} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their formation returns. Winner/Loser return R_{wml} is the return spread in 'Winner' portfolio and 'Loser' portfolio. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A reports corresponding parameters for equal-(value-) weighted momentum coefficient γ_{mom}. Panel B reports corresponding parameters for equal-(value-) weighted Winner/Loser return $R_{wml.}$

Table 5.7 Univariate regression of momentum effect on individual lagged macroeconomic variables (Momentum 6/12)

	Panel A Momentum coefficient γ_{mom}						Panel B Winner/Loser return R_{wml}					
	Panel A1 Equal-weighted			Panel A2 Value-weighted			Panel B1 Equal-weighted			Panel B2 Value-weighted		
Macroeconomic variable	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t(λ)	Adj-R^2
GDP(Y)	-0.0259	-2.1111	0.0687	-0.0248	-2.0871	0.0364	-0.0282	-2.3645	0.0539	-0.0247	-2.1335	0.0231
UEXGDP(Y)	-0.0344	-1.9043	0.0514	-0.0375	-2.0085	0.0357	-0.0367	-2.0602	0.0381	-0.0355	-1.9231	0.0201
IP(M)	-1.9477	-1.1416	-0.0011	-1.1268	-0.4897	-0.0026	-1.0085	-0.4414	-0.0027	0.3851	0.1197	-0.0030
IP(Q)	-1.8315	-0.8511	0.0004	-1.4123	-0.5886	-0.0018	-1.1302	-0.4385	-0.0021	0.0734	0.0255	-0.0030
IP(H)	-1.0283	-0.5757	-0.0006	-2.1660	-1.2270	0.0032	-0.9162	-0.4503	-0.0018	-2.1781	-0.9991	0.0012
IP(Y)	0.0160	0.0137	-0.0030	-1.0126	-0.7600	0.0002	-0.1380	-0.1021	-0.0029	-1.0524	-0.7167	-0.0007
UEXIP(Q)	-0.0132	-1.0072	0.0009	-0.0094	-0.6019	-0.0018	-0.0073	-0.4556	-0.0022	0.0003	0.0153	-0.0030
UEXIP(H)	-0.0115	-0.8174	0.0014	-0.0140	-0.9527	0.0009	-0.0088	-0.5438	-0.0013	-0.0104	-0.5795	-0.0016
UEXIP(Y)	-0.0045	-0.3997	-0.0016	-0.0113	-0.9379	0.0021	-0.0051	-0.3986	-0.0018	-0.0120	-0.8392	0.0009
IPM(M)	-1.3892	-0.7719	-0.0020	-0.8757	-0.4339	-0.0028	-1.1914	-0.5276	-0.0025	0.3770	0.1381	-0.0030
IPM(Q)	0.1189	0.0606	-0.0030	0.2217	0.0976	-0.0030	0.9975	0.4562	-0.0022	1.5651	0.6395	-0.0018
IPM(H)	-0.1048	-0.0675	-0.0030	-0.4030	-0.2445	-0.0027	-0.0874	-0.0504	-0.0030	-0.1156	-0.0613	-0.0030
IPM(Y)	0.6856	0.7487	0.0005	0.3186	0.3006	-0.0025	0.6310	0.6036	-0.0010	0.5498	0.4933	-0.0021
UEXIPM(Q)	-0.0044	-0.3442	-0.0025	-0.0025	-0.1664	-0.0029	-0.0006	-0.0455	-0.0030	0.0059	0.3415	-0.0027
UEXIPM(H)	-0.0022	-0.1731	-0.0028	-0.0025	-0.1727	-0.0029	-0.0004	-0.0311	-0.0030	0.0023	0.1482	-0.0029
UEXIPM(Y)	0.0021	0.2227	-0.0026	0.0001	0.0053	-0.0030	0.0014	0.1338	-0.0029	0.0011	0.0979	-0.0029
M0 (M)	-1.0925	-0.1673	-0.0029	2.1382	0.2855	-0.0028	-1.7579	-0.1629	-0.0028	2.5555	0.1852	-0.0028
M0 (Q)	-0.1454	-0.0289	-0.0030	1.9601	0.3399	-0.0024	-5.5854	-0.7276	0.0024	-5.8861	-0.6046	0.0006
M0 (H)	0.2902	0.0587	-0.0029	-1.8638	-0.3965	-0.0019	-3.4026	-0.4739	0.0012	-9.2032	-1.2776	0.0155
M0 (Y)	2.3657	0.5914	0.0046	0.7460	0.1720	-0.0025	0.7610	0.1436	-0.0025	-3.0032	-0.5084	0.0019
UEXM0(Q)	0.0000	-0.1707	-0.0027	0.0001	0.6013	0.0001	-0.0001	-0.4172	-0.0006	0.0000	0.0843	-0.0029
UEXM0 (H)	0.0000	-0.3471	-0.0012	0.0000	0.2307	-0.0024	-0.0001	-0.6130	0.0039	0.0000	-0.3345	-0.0013
UEXM0 (Y)	0.0000	-0.2538	-0.0017	0.0000	0.0749	-0.0029	0.0000	-0.4388	0.0014	0.0000	-0.3846	-0.0004
UNE (M)	-0.6093	-0.2484	-0.0026	-3.4816	-1.2312	0.0047	-0.9610	-0.3562	-0.0023	-2.8573	-1.0278	0.0004
UNE (Q)	-0.4864	-0.4411	-0.0014	-1.2839	-0.9463	0.0035	-0.6798	-0.5681	-0.0010	-1.1860	-0.8862	0.0007
UNE (H)	-0.5070	-0.8555	0.0029	-0.7012	-0.9458	0.0037	-0.4866	-0.7710	0.0006	-0.5400	-0.7523	-0.0004
UNE (Y)	-0.5069	-1.4192	0.0175	-0.4876	-1.1648	0.0083	-0.4555	-1.2778	0.0080	-0.3560	-0.8935	0.0010
UEXUNE(Q)	-0.0396	-0.4105	-0.0015	-0.0923	-0.8154	0.0019	-0.0497	-0.4795	-0.0014	-0.0863	-0.8007	-0.0001
UEXUNE(H)	-0.0357	-0.6174	0.0004	-0.0516	-0.7474	0.0012	-0.0380	-0.6192	-0.0005	-0.0460	-0.7090	-0.0008
UEXUNE(Y)	-0.0352	-1.0538	0.0071	-0.0331	-0.8535	0.0024	-0.0319	-0.9358	0.0025	-0.0245	-0.6709	-0.0010
CPI (M)	-0.3468	-0.9318	0.0043	-0.6953	-1.5969	0.0145	-0.5751	-1.1720	0.0104	-0.9729	-1.5902	0.0199
CPI (Q)	-0.2294	-0.8029	0.0089	-0.4929	-1.5271	0.0299	-0.3963	-1.0667	0.0207	-0.7266	-1.6542	0.0447
CPI (H)	-0.1263	-0.6579	0.0059	-0.2745	-1.2900	0.0223	-0.2245	-0.9538	0.0158	-0.4327	-1.5930	0.0388
CPI (Y)	0.0149	0.1293	-0.0027	-0.0026	-0.0200	-0.0030	-0.0049	-0.0357	-0.0030	-0.0311	-0.1969	-0.0025
UEXCPI(Q)	0.0142	0.5174	-0.0005	-0.0213	-0.6552	0.0004	0.0100	0.3014	-0.0022	-0.0209	-0.5383	-0.0008

Continued

UEXCPI(H)	0.0166	0.7544	0.0040	-0.0107	-0.4202	-0.0013	0.0133	0.5009	0.0000	-0.0142	-0.4783	-0.0009
UEXCPI(Y)	0.0142	1.0492	0.0096	0.0005	0.0357	-0.0030	0.0132	0.8277	0.0042	-0.0005	-0.0287	-0.0030
TBILL(M)	0.2971	1.5024	0.0041	0.0971	0.4334	-0.0025	0.3364	1.3299	0.0030	0.1896	0.6731	-0.0018
TBILL (Q)	0.2357	1.8903	0.0123	0.1731	1.1468	0.0019	0.2179	1.2540	0.0057	0.1737	0.8278	0.0003
TBILL (H)	0.1762	1.7568	0.0151	0.2129	1.7656	0.0128	0.1296	1.0166	0.0035	0.1803	1.1821	0.0046
TBILL (Y)	0.1799	2.8764	0.0378	0.2213	2.7305	0.0340	0.1782	2.4132	0.0237	0.2533	2.6942	0.0292
UEXTBILL(Q)	50.7535	2.5972	0.0194	38.3818	1.5370	0.0047	57.0940	2.1547	0.0159	51.9209	1.6902	0.0063
UEXTBILL(H)	44.2036	2.4440	0.0264	42.2632	1.8662	0.0131	43.2962	1.8446	0.0158	45.7082	1.7298	0.0095
UEXTBILL(Y)	35.8685	2.4573	0.0336	38.8701	2.0362	0.0227	33.4115	1.9430	0.0182	40.5404	1.9976	0.0156
TERM(M)	-2.7061	-1.1689	0.0011	-3.2224	-1.0849	0.0005	-1.4223	-0.5549	-0.0022	-2.7330	-0.8205	-0.0013
TERM(Q)	-1.4073	-0.7911	0.0002	-1.2459	-0.5859	-0.0015	-0.7346	-0.3535	-0.0024	-1.1380	-0.4487	-0.0022
TERM(H)	0.0535	0.0377	-0.0030	-0.4663	-0.2834	-0.0026	0.6251	0.4438	-0.0021	-0.4383	-0.2499	-0.0027
TERM(Y)	-0.4208	-0.4524	-0.0018	-0.8368	-0.7884	-0.0001	-0.5877	-0.5710	-0.0014	-1.4038	-1.2001	0.0024
UEXTERM(Q)	-2.4480	-0.9879	0.0020	-2.3972	-0.8018	-0.0001	-1.5240	-0.5321	-0.0017	-2.1778	-0.6199	-0.0014
UEXTERM(H)	-0.9348	-0.4341	-0.0018	-1.1977	-0.4733	-0.0018	-0.0966	-0.0416	-0.0030	-0.9892	-0.3436	-0.0025
UEXTERM(Y)	-0.5302	-0.3401	-0.0023	-1.0795	-0.5936	-0.0012	-0.3327	-0.2142	-0.0028	-1.3477	-0.6982	-0.0011
DY(M)	0.4707	1.2527	0.0029	0.1584	0.3603	-0.0026	0.2531	0.5356	-0.0019	0.0844	0.1740	-0.0029
DY(Q)	0.5054	1.4052	0.0185	0.3609	0.7976	0.0035	0.4484	0.9932	0.0083	0.3883	0.7460	0.0020
DY(H)	0.3389	1.1482	0.0196	0.2016	0.5862	0.0018	0.2659	0.7989	0.0063	0.1867	0.4923	-0.0003
DY(Y)	0.0612	0.3112	-0.0013	-0.0074	-0.0336	-0.0030	-0.0560	-0.2709	-0.0020	-0.0922	-0.3947	-0.0014
UEXDY(Q)	16.6050	1.9317	0.0188	9.4587	0.9103	0.0012	12.6312	1.2241	0.0054	8.2751	0.7446	-0.0008
UEXDY(H)	14.4172	1.7828	0.0263	10.4949	1.1187	0.0063	11.1307	1.2084	0.0086	9.6734	0.9643	0.0023
UEXDY(Y)	7.2515	1.1554	0.0127	4.1790	0.6168	0.0001	3.5120	0.5338	-0.0005	2.4362	0.3501	-0.0023
EMR(-1)/VMR(-1)	-0.1484	-1.3260	0.0375	0.0783	0.3161	-0.0006	-0.1742	-1.2136	0.0342	0.0822	0.2870	-0.0012
EMR(-2)/VMR(-2)	0.0028	0.0328	-0.0030	0.0780	0.5399	0.0040	-0.0096	-0.1003	-0.0027	0.0778	0.4518	0.0017
EMR(-3)/VMR(-3)	0.0109	0.1969	-0.0018	0.0353	0.4445	0.0007	0.0048	0.0787	-0.0028	0.0411	0.4341	0.0004
EMR(-4)/VMR(-4)	-0.0041	-0.1373	-0.0026	0.0088	0.1954	-0.0025	-0.0201	-0.6127	0.0027	-0.0089	-0.1620	-0.0026
EMR(-5)/VMR(-5)	0.0000	0.0018	-0.0030	0.0234	0.7806	0.0045	-0.0106	-0.4927	0.0006	0.0091	0.2547	-0.0022
EMR(-6)/VMR(-6)	-0.0056	-0.4329	-0.0001	0.0037	0.1937	-0.0026	-0.0119	-0.8300	0.0057	-0.0030	-0.1401	-0.0028
EMR(-7)/VMR(-7)	-0.0019	-0.1841	-0.0024	0.0064	0.4537	-0.0011	-0.0072	-0.6407	0.0025	0.0011	0.0687	-0.0030
EMR(-8)/VMR(-8)	-0.0021	-0.2564	-0.0019	-0.0005	-0.0408	-0.0030	-0.0061	-0.6402	0.0032	-0.0058	-0.4630	-0.0012
EMR(-9)/VMR(-9)	0.0023	0.4255	-0.0005	0.0036	0.4017	-0.0012	0.0009	0.1440	-0.0027	0.0004	0.0430	-0.0030
EMR(-10)/VMR(-10)	0.0002	0.0516	-0.0030	0.0067	1.0287	0.0072	-0.0010	-0.1913	-0.0024	0.0055	0.7933	0.0017

Note: The table reports parameters of slope coefficient λ, t-stats, and adjusted R-square estimated from univariate regression of momentum coefficient γ_{mom} and Winner/Loser return R_{wml} on individual lagged macroeconomic variables from 1980 to 2008, respectively. Momentum portfolios are formed with shares returns in past 6 months, and hold for 12 months. Momentum coefficient γ_{mom} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their formation returns. Winner/Loser return R_{wml} is the return spread in 'Winner' portfolio and 'Loser' portfolio. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A reports corresponding parameters for equal-(value-) weighted momentum coefficient γ_{mom}. Panel B reports corresponding parameters for equal-(value-) weighted Winner/Loser return $R_{wml.}$

Table 5.8 Univariate regression of momentum effect on individual lagged macroeconomic variables (Momentum 6/18)

	Panel A Momentum coefficient γ_{mom}						Panel B Winner/Loser return R_{wml}					
	Panel A1 Equal-weighted			Panel A2 Value-weighted			Panel B1 Equal-weighted			Panel B2 Value-weighted		
Macroeconomic variable	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t(λ)	Adj-R^2
GDP(Y)	-0.0411	-2.0985	0.1032	-0.0344	-2.4097	0.0530	-0.0455	-2.4277	0.0886	-0.0374	-2.7118	0.0408
UEXGDP(Y)	-0.0545	-1.9449	0.0770	-0.0530	-2.3587	0.0541	-0.0616	-2.2124	0.0689	-0.0555	-2.5813	0.0382
IP(M)	-2.8360	-1.3315	-0.0007	-2.1249	-0.8766	-0.0021	-1.4719	-0.5232	-0.0026	-0.0755	-0.0229	-0.0030
IP(Q)	-3.0599	-1.2306	0.0026	-3.0828	-1.2308	0.0012	-2.0236	-0.7459	-0.0013	-1.2953	-0.3880	-0.0026
IP(H)	-1.5714	-0.7767	0.0002	-2.1941	-1.2127	0.0017	-1.5796	-0.6811	-0.0008	-2.3763	-0.9399	0.0006
IP(Y)	-0.6307	-0.4366	-0.0018	-1.8734	-1.3016	0.0051	-1.2777	-0.7673	0.0005	-2.1409	-1.2904	0.0040
UEXIP(Q)	-0.0218	-1.3792	0.0030	-0.0205	-1.2142	0.0010	-0.0143	-0.8077	-0.0012	-0.0096	-0.4454	-0.0025
UEXIP(H)	-0.0166	-1.0045	0.0024	-0.0189	-1.2260	0.0022	-0.0129	-0.7014	-0.0008	-0.0163	-0.7795	-0.0005
UEXIP(Y)	-0.0084	-0.6324	-0.0003	-0.0152	-1.2341	0.0038	-0.0117	-0.7622	0.0007	-0.0177	-1.1051	0.0031
IPM(M)	-1.5767	-0.6465	-0.0023	-0.4888	-0.2349	-0.0030	-2.1164	-0.7097	-0.0021	0.8314	0.2982	-0.0029
IPM(Q)	-0.3683	-0.1479	-0.0030	0.4376	0.1723	-0.0029	0.0200	0.0077	-0.0030	1.9245	0.6442	-0.0018
IPM(H)	-0.0142	-0.0079	-0.0030	0.9755	0.5436	-0.0019	-0.4068	-0.2008	-0.0029	1.2187	0.5233	-0.0019
IPM(Y)	0.5556	0.5304	-0.0017	0.6431	0.5299	-0.0017	0.1287	0.1088	-0.0030	1.0062	0.7301	-0.0009
UEXIPM(Q)	-0.0070	-0.4255	-0.0023	-0.0003	-0.0207	-0.0030	-0.0080	-0.4615	-0.0024	0.0083	0.4271	-0.0026
UEXIPM(H)	-0.0027	-0.1735	-0.0029	0.0040	0.2641	-0.0028	-0.0043	-0.2596	-0.0027	0.0080	0.4262	-0.0023
UEXIPM(Y)	0.0018	0.1654	-0.0029	0.0053	0.4771	-0.0019	-0.0023	-0.1871	-0.0029	0.0066	0.4749	-0.0019
M0 (M)	2.1676	0.2363	-0.0028	8.3792	0.9669	-0.0006	-2.3739	-0.1601	-0.0029	2.8835	0.1802	-0.0029
M0 (Q)	1.9871	0.2699	-0.0024	7.5637	1.0771	0.0035	-6.3250	-0.5528	0.0012	-3.7506	-0.2964	-0.0020
M0 (H)	4.0699	0.4908	0.0022	3.0749	0.4715	-0.0008	-0.7905	-0.0699	-0.0029	-6.1814	-0.5965	0.0030
M0 (Y)	5.3711	0.8962	0.0198	5.2240	0.9526	0.0132	2.4880	0.3289	0.0004	0.8845	0.1133	-0.0027
UEXM0(Q)	0.0001	0.3763	-0.0013	0.0001	0.8722	0.0042	-0.0001	-0.2330	-0.0021	0.0000	0.0851	-0.0029
UEXM0 (H)	0.0000	0.3030	-0.0013	0.0001	0.5764	0.0014	-0.0001	-0.2692	-0.0014	0.0000	-0.1626	-0.0025
UEXM0 (Y)	0.0000	0.3866	0.0005	0.0000	0.4184	0.0001	0.0000	-0.0948	-0.0028	0.0000	-0.1553	-0.0025
UNE (M)	-1.0902	-0.3528	-0.0023	-3.4535	-1.0616	0.0025	-0.8637	-0.2664	-0.0027	-2.0448	-0.6272	-0.0018
UNE (Q)	-0.7905	-0.5785	-0.0006	-1.3979	-0.9018	0.0026	-0.7928	-0.5573	-0.0013	-1.0405	-0.6742	-0.0010
UNE (H)	-0.8094	-1.0486	0.0057	-1.0314	-1.1158	0.0076	-0.6733	-0.8468	0.0012	-0.7590	-0.8404	0.0008
UNE (Y)	-0.8883	-1.7683	0.0338	-0.8325	-1.4189	0.0213	-0.7790	-1.6106	0.0169	-0.6584	-1.2171	0.0070
UEXUNE(Q)	-0.0755	-0.6066	0.0002	-0.1166	-0.8770	0.0027	-0.0732	-0.5760	-0.0009	-0.0985	-0.7720	-0.0003
UEXUNE(H)	-0.0660	-0.8641	0.0037	-0.0792	-0.9372	0.0043	-0.0611	-0.7898	0.0010	-0.0690	-0.8726	0.0006
UEXUNE(Y)	-0.0661	-1.3980	0.0178	-0.0624	-1.1979	0.0110	-0.0585	-1.2868	0.0085	-0.0522	-1.0851	0.0034
CPI (M)	-0.2928	-0.6212	0.0000	-0.3810	-0.7559	0.0008	-0.6599	-1.0920	0.0078	-0.6649	-0.9164	0.0047
CPI (Q)	-0.1430	-0.4397	-0.0003	-0.2406	-0.6407	0.0027	-0.4316	-1.0437	0.0143	-0.4329	-0.8287	0.0093
CPI (H)	-0.0446	-0.2020	-0.0024	-0.0819	-0.3360	-0.0014	-0.2051	-0.8279	0.0067	-0.1598	-0.5132	0.0011
CPI (Y)	0.0963	0.7378	0.0040	0.1080	0.7349	0.0037	0.0612	0.4483	-0.0010	0.1508	0.8571	0.0056
UEXCPI(Q)	0.0335	0.8446	0.0052	0.0088	0.2363	-0.0026	0.0209	0.4888	-0.0008	0.0183	0.4135	-0.0018

Continued

UEXCPI(H)	0.0332	1.0345	0.0133	0.0116	0.3950	-0.0015	0.0234	0.6850	0.0027	0.0178	0.5240	-0.0007
UEXCPI(Y)	0.0243	1.2667	0.0185	0.0117	0.6384	0.0007	0.0201	1.0458	0.0073	0.0194	0.9739	0.0038
TBILL(M)	0.2474	0.9428	-0.0002	0.2807	1.0333	-0.0003	0.0930	0.3119	-0.0028	0.3676	1.1219	0.0001
TBILL (Q)	0.2390	1.3231	0.0061	0.3010	1.7004	0.0079	0.1340	0.6324	-0.0010	0.3262	1.3858	0.0054
TBILL (H)	0.2241	1.6261	0.0140	0.3359	2.3948	0.0259	0.1267	0.8100	0.0008	0.3481	2.1517	0.0174
TBILL (Y)	0.2099	2.6286	0.0289	0.2936	3.0767	0.0442	0.1974	2.1741	0.0169	0.3905	3.4647	0.0520
UEXTBILL(Q)	52.0882	1.6600	0.0108	60.8657	1.8534	0.0112	40.4386	1.2338	0.0028	77.7084	2.1340	0.0122
UEXTBILL(H)	52.2504	1.8029	0.0210	64.9372	2.2427	0.0249	39.4884	1.2854	0.0066	74.3968	2.4819	0.0212
UEXTBILL(Y)	41.2018	2.0426	0.0251	55.3388	2.3977	0.0353	32.7132	1.5619	0.0095	66.7363	2.9089	0.0337
TERM(M)	-3.1937	-0.8962	0.0003	-7.2605	-2.0172	0.0100	-0.7633	-0.2245	-0.0029	-6.6708	-1.6642	0.0042
TERM(Q)	-1.2198	-0.5039	-0.0017	-3.8735	-1.5872	0.0076	0.2310	0.0962	-0.0030	-3.9726	-1.3585	0.0043
TERM(H)	0.1294	0.0722	-0.0030	-2.1926	-1.2128	0.0041	0.8444	0.5199	-0.0021	-2.4619	-1.2931	0.0029
TERM(Y)	-0.3113	-0.2692	-0.0027	-1.5367	-1.1678	0.0042	-0.5926	-0.4519	-0.0020	-2.7147	-1.7675	0.0118
UEXTERM(Q)	-2.3206	-0.6559	-0.0004	-6.3601	-1.7875	0.0118	-0.1202	-0.0350	-0.0030	-6.3140	-1.5539	0.0066
UEXTERM(H)	-0.7954	-0.2745	-0.0025	-4.2973	-1.4993	0.0082	0.7320	0.2703	-0.0027	-4.3058	-1.3284	0.0044
UEXTERM(Y)	-0.3622	-0.1819	-0.0029	-3.1221	-1.4825	0.0081	-0.0841	-0.0465	-0.0030	-4.0403	-1.7687	0.0092
DY(M)	0.4905	1.1538	0.0007	0.2744	0.5672	-0.0022	0.3571	0.6702	-0.0016	0.3665	0.6152	-0.0020
DY(Q)	0.4552	1.2330	0.0072	0.3411	0.7212	0.0013	0.4518	0.9717	0.0040	0.5504	0.9641	0.0044
DY(H)	0.2473	0.8008	0.0040	-0.0115	-0.0303	-0.0030	0.1700	0.5185	-0.0007	0.0279	0.0680	-0.0030
DY(Y)	0.0569	0.2670	-0.0022	0.0153	0.0595	-0.0030	-0.0354	-0.1668	-0.0028	-0.0449	-0.1724	-0.0028
UEXDY(Q)	16.1666	1.6771	0.0091	9.6372	0.8293	0.0002	13.1006	1.1875	0.0026	12.8462	0.9808	0.0008
UEXDY(H)	12.0417	1.3284	0.0089	4.9018	0.4544	-0.0016	8.8502	0.9245	0.0015	7.0694	0.6307	-0.0010
UEXDY(Y)	5.3608	0.7369	0.0020	0.9040	0.1086	-0.0029	2.0577	0.2920	-0.0025	0.8229	0.1038	-0.0030
EMR(-1)/VMR(-1)	-0.1652	-1.2148	0.0263	0.0718	0.2653	-0.0015	-0.2089	-1.2156	0.0300	0.0090	0.0286	-0.0030
EMR(-2)/VMR(-2)	-0.0031	-0.0324	-0.0030	0.0809	0.5138	0.0025	-0.0183	-0.1810	-0.0024	0.0518	0.2745	-0.0015
EMR(-3)/VMR(-3)	0.0130	0.1980	-0.0021	0.0195	0.2119	-0.0022	0.0115	0.1738	-0.0025	-0.0008	-0.0069	-0.0030
EMR(-4)/VMR(-4)	-0.0076	-0.2148	-0.0023	-0.0024	-0.0432	-0.0030	-0.0187	-0.5187	0.0000	-0.0365	-0.5439	0.0012
EMR(-5)/VMR(-5)	-0.0076	-0.3319	-0.0014	0.0158	0.4366	-0.0005	-0.0170	-0.7105	0.0028	-0.0119	-0.2758	-0.0021
EMR(-6)/VMR(-6)	-0.0124	-0.7510	0.0053	0.0009	0.0369	-0.0030	-0.0161	-0.9243	0.0068	-0.0125	-0.4406	-0.0011
EMR(-7)/VMR(-7)	-0.0100	-0.7538	0.0059	0.0057	0.3093	-0.0020	-0.0154	-1.1329	0.0122	-0.0068	-0.3336	-0.0021
EMR(-8)/VMR(-8)	-0.0109	-0.9885	0.0140	-0.0059	-0.3722	-0.0011	-0.0134	-1.1512	0.0152	-0.0160	-0.9659	0.0065
EMR(-9)/VMR(-9)	-0.0008	-0.1357	-0.0029	0.0005	0.0484	-0.0030	-0.0010	-0.1473	-0.0029	-0.0063	-0.5446	-0.0004
EMR(-10)/VMR(-10)	-0.0020	-0.4711	-0.0010	0.0060	0.7080	0.0030	-0.0017	-0.3215	-0.0020	0.0034	0.3793	-0.0018

Note: The table reports parameters of slope coefficient λ, t-stats, and adjusted R-square estimated from univariate regression of momentum coefficient γ_{mom} and Winner/Loser return R_{wml} on individual lagged macroeconomic variables from 1980 to 2008, respectively. Momentum portfolios are formed with shares returns in past 6 months, and hold for 18 months. Momentum coefficient γ_{mom} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their formation returns. Winner/Loser return R_{wml} is the return spread in 'Winner' portfolio and 'Loser' portfolio. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A reports corresponding parameters for equal-(value-) weighted momentum coefficient γ_{mom}. Panel B reports corresponding parameters for equal-(value-) weighted Winner/Loser return $R_{wml.}$

Table 5.9 Univariate regression of momentum effect on individual lagged macroeconomic variables (Momentum 6/24)

	Panel A Momentum coefficient γ_{mom}						Panel B Winner/Loser return R_{wml}					
	Panel A1 Equal-weighted			Panel A2 Value-weighted			Panel B1 Equal-weighted			Panel B2 Value-weighted		
Macroeconomic variable	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t(λ)	Adj-R^2
GDP(Y)	-0.0390	-2.0874	0.0842	-0.0246	-1.6750	0.0225	-0.0408	-2.3091	0.0600	-0.0329	-2.2642	0.0256
UEXGDP(Y)	-0.0530	-1.9797	0.0661	-0.0423	-1.9594	0.0294	-0.0575	-2.1785	0.0506	-0.0517	-2.5195	0.0273
IP(M)	-3.9776	-1.7578	0.0010	-2.2363	-0.8354	-0.0021	-2.8691	-0.9475	-0.0017	-0.0237	-0.0060	-0.0031
IP(Q)	-4.4698	-1.6155	0.0078	-4.3820	-1.7026	0.0046	-4.1351	-1.3711	0.0030	-3.1818	-0.8249	-0.0006
IP(H)	-2.3769	-1.1207	0.0036	-2.8390	-1.4893	0.0039	-2.9434	-1.1878	0.0037	-3.3682	-1.1926	0.0031
IP(Y)	-0.7444	-0.4768	-0.0015	-1.9468	-1.0366	0.0047	-1.2569	-0.6616	-0.0002	-2.5914	-1.3292	0.0056
UEXIP(Q)	-0.0311	-1.7649	0.0081	-0.0265	-1.4686	0.0029	-0.0275	-1.4064	0.0027	-0.0182	-0.7169	-0.0013
UEXIP(H)	-0.0246	-1.3772	0.0078	-0.0235	-1.4327	0.0042	-0.0254	-1.2553	0.0045	-0.0251	-1.0570	0.0021
UEXIP(Y)	-0.0113	-0.7867	0.0015	-0.0164	-1.1342	0.0040	-0.0164	-0.9496	0.0032	-0.0222	-1.2074	0.0050
IPM(M)	-3.4413	-1.3947	0.0002	-1.8872	-0.8336	-0.0024	-3.6828	-1.1723	-0.0006	-0.7933	-0.2583	-0.0030
IPM(Q)	-1.7243	-0.6273	-0.0012	-1.0760	-0.3906	-0.0026	-1.6669	-0.5327	-0.0019	-0.3714	-0.1029	-0.0031
IPM(H)	-0.8198	-0.4041	-0.0021	0.5848	0.2694	-0.0027	-1.4250	-0.5676	-0.0012	0.2220	0.0756	-0.0031
IPM(Y)	0.1579	0.1330	-0.0030	0.9860	0.6468	-0.0003	-0.1711	-0.1180	-0.0030	1.0413	0.6137	-0.0011
UEXIPM(Q)	-0.0178	-0.9909	0.0010	-0.0095	-0.5513	-0.0022	-0.0202	-1.0072	0.0004	-0.0047	-0.2047	-0.0030
UEXIPM(H)	-0.0107	-0.6131	-0.0007	-0.0002	-0.0140	-0.0031	-0.0143	-0.7060	-0.0003	-0.0018	-0.0781	-0.0031
UEXIPM(Y)	-0.0019	-0.1542	-0.0029	0.0066	0.4867	-0.0016	-0.0068	-0.4576	-0.0017	0.0038	0.2218	-0.0028
M0 (M)	-1.1688	-0.1060	-0.0030	5.1667	0.6083	-0.0023	-5.3841	-0.3101	-0.0023	1.1295	0.0684	-0.0031
M0 (Q)	-0.4839	-0.0569	-0.0031	6.4609	0.8975	0.0011	-9.0408	-0.7319	0.0043	-3.0476	-0.2321	-0.0025
M0 (H)	-1.3491	-0.1529	-0.0026	0.3093	0.0466	-0.0031	-8.0874	-0.6578	0.0092	-7.6106	-0.6690	0.0045
M0 (Y)	2.6666	0.4422	0.0020	4.2678	0.8182	0.0065	-1.5486	-0.1908	-0.0020	0.7583	0.0900	-0.0029
UEXM0(Q)	0.0000	0.1290	-0.0029	0.0001	0.8457	0.0033	-0.0001	-0.4367	-0.0002	0.0000	0.1002	-0.0030
UEXM0 (H)	0.0000	-0.0446	-0.0031	0.0001	0.5364	0.0004	-0.0001	-0.6315	0.0056	0.0000	-0.1715	-0.0026
UEXM0 (Y)	0.0000	0.0493	-0.0030	0.0000	0.4466	-0.0001	-0.0001	-0.4935	0.0034	0.0000	-0.1487	-0.0026
UNE (M)	0.6184	0.1857	-0.0029	-3.2355	-0.8892	0.0012	0.7904	0.2180	-0.0029	-1.6610	-0.4230	-0.0024
UNE (Q)	-0.0563	-0.0377	-0.0031	-1.4253	-0.8478	0.0021	-0.1245	-0.0760	-0.0031	-0.8031	-0.4343	-0.0021
UNE (H)	-0.4112	-0.4891	-0.0011	-1.0759	-1.1313	0.0072	-0.3162	-0.3450	-0.0023	-0.7246	-0.7180	-0.0002
UNE (Y)	-0.6620	-1.2495	0.0155	-0.8212	-1.4814	0.0180	-0.5865	-1.0984	0.0065	-0.6019	-1.1225	0.0040
UEXUNE(Q)	-0.0171	-0.1286	-0.0030	-0.1313	-0.9397	0.0034	-0.0212	-0.1485	-0.0030	-0.0995	-0.6812	-0.0008
UEXUNE(H)	-0.0309	-0.3785	-0.0018	-0.0923	-1.0652	0.0057	-0.0282	-0.3261	-0.0024	-0.0749	-0.8529	0.0005
UEXUNE(Y)	-0.0467	-0.9490	0.0064	-0.0690	-1.3406	0.0122	-0.0408	-0.8027	0.0017	-0.0552	-1.1272	0.0030
CPI (M)	-0.3097	-0.6299	0.0000	-0.1752	-0.3155	-0.0024	-0.7433	-1.0739	0.0086	-0.4083	-0.4975	-0.0006
CPI (Q)	-0.1538	-0.4409	-0.0003	-0.1704	-0.4059	-0.0005	-0.5092	-1.1107	0.0175	-0.3718	-0.6138	0.0046
CPI (H)	-0.0579	-0.2469	-0.0021	-0.0327	-0.1178	-0.0029	-0.2725	-1.0059	0.0114	-0.1327	-0.3548	-0.0007
CPI (Y)	0.1237	0.8761	0.0073	0.1470	0.8452	0.0077	0.0810	0.5237	-0.0002	0.1829	0.9031	0.0073
UEXCPI(Q)	0.0208	0.4502	-0.0002	0.0036	0.0828	-0.0030	0.0047	0.0940	-0.0030	0.0165	0.3068	-0.0023

Continued

UEXCPI(H)	0.0219	0.6181	0.0033	0.0080	0.2485	-0.0025	0.0084	0.2194	-0.0025	0.0124	0.3032	-0.0022
UEXCPI(Y)	0.0201	0.9771	0.0102	0.0144	0.7020	0.0019	0.0148	0.6998	0.0017	0.0216	0.9550	0.0040
TBILL(M)	0.2007	0.7155	-0.0014	0.2097	0.7157	-0.0017	0.0195	0.0598	-0.0031	0.2443	0.6973	-0.0019
TBILL (Q)	0.2825	1.3839	0.0085	0.4044	2.1039	0.0145	0.1908	0.8115	0.0004	0.4369	1.7531	0.0097
TBILL (H)	0.2233	1.5460	0.0122	0.4211	2.7426	0.0369	0.1207	0.6966	-0.0002	0.4162	2.4039	0.0214
TBILL (Y)	0.2232	2.4248	0.0295	0.3346	3.2137	0.0509	0.2208	2.1252	0.0180	0.4172	3.6433	0.0494
UEXTBILL(Q)	52.5877	1.4427	0.0097	59.6912	1.6333	0.0091	41.8087	1.1438	0.0022	78.8869	1.9759	0.0102
UEXTBILL(H)	48.1948	1.5200	0.0155	70.9780	2.2872	0.0266	35.8831	1.0863	0.0037	81.3986	2.5989	0.0214
UEXTBILL(Y)	37.4806	1.6917	0.0181	64.6691	2.6504	0.0434	28.0427	1.2131	0.0047	76.1583	3.3676	0.0372
TERM(M)	-1.1307	-0.2809	-0.0027	-5.4313	-1.6327	0.0034	0.3249	0.0782	-0.0031	-5.3066	-1.3165	0.0008
TERM(Q)	-0.3389	-0.1193	-0.0030	-3.2684	-1.3351	0.0036	0.7113	0.2423	-0.0028	-3.1832	-1.0336	0.0009
TERM(H)	1.1288	0.5268	-0.0008	-2.6555	-1.4310	0.0062	1.5589	0.8510	-0.0002	-2.9891	-1.5611	0.0043
TERM(Y)	0.3744	0.2814	-0.0026	-1.6503	-1.1229	0.0043	-0.1035	-0.0698	-0.0031	-3.1253	-2.0118	0.0136
UEXTERM(Q)	-0.5822	-0.1436	-0.0030	-4.8302	-1.4264	0.0045	0.9347	0.2263	-0.0029	-4.6115	-1.0985	0.0012
UEXTERM(H)	0.6135	0.1799	-0.0028	-4.3742	-1.5785	0.0073	1.5930	0.4998	-0.0019	-4.3669	-1.3183	0.0034
UEXTERM(Y)	1.0023	0.4386	-0.0017	-3.3501	-1.5508	0.0083	1.0500	0.5257	-0.0021	-4.4891	-2.0147	0.0097
DY(M)	0.4521	1.0439	-0.0002	0.4326	0.8075	-0.0011	0.2694	0.5105	-0.0024	0.5366	0.8982	-0.0012
DY(Q)	0.4220	1.1065	0.0049	0.5311	1.0465	0.0062	0.4520	0.9849	0.0029	0.7580	1.3542	0.0088
DY(H)	0.2232	0.6655	0.0021	0.2194	0.5304	0.0006	0.1871	0.5178	-0.0007	0.2751	0.6545	0.0006
DY(Y)	0.1094	0.4810	-0.0001	0.1841	0.6701	0.0031	0.0513	0.2223	-0.0027	0.1481	0.5359	-0.0006
UEXDY(Q)	14.5590	1.3766	0.0059	13.5708	0.9804	0.0026	12.1295	1.0658	0.0010	15.9420	1.0151	0.0019
UEXDY(H)	10.5799	1.0429	0.0053	11.4934	0.9230	0.0042	8.6804	0.8372	0.0006	12.7384	1.0412	0.0025
UEXDY(Y)	5.4731	0.6741	0.0017	7.5912	0.8186	0.0037	3.6137	0.4592	-0.0017	7.4144	0.9052	0.0009
EMR(-1)/VMR(-1)	-0.1742	-1.1518	0.0267	0.0185	0.0624	-0.0030	-0.2211	-1.0853	0.0285	-0.0667	-0.1885	-0.0024
EMR(-2)/VMR(-2)	-0.0188	-0.1799	-0.0022	0.0151	0.0827	-0.0029	-0.0357	-0.3219	-0.0010	-0.0316	-0.1442	-0.0026
EMR(-3)/VMR(-3)	-0.0035	-0.0512	-0.0030	-0.0352	-0.3381	-0.0007	-0.0045	-0.0638	-0.0030	-0.0601	-0.4683	0.0013
EMR(-4)/VMR(-4)	-0.0097	-0.2689	-0.0020	-0.0350	-0.5614	0.0022	-0.0230	-0.6064	0.0009	-0.0739	-0.9486	0.0116
EMR(-5)/VMR(-5)	-0.0097	-0.4125	-0.0007	-0.0211	-0.5153	0.0008	-0.0194	-0.7704	0.0034	-0.0486	-0.9772	0.0100
EMR(-6)/VMR(-6)	-0.0107	-0.6074	0.0024	-0.0172	-0.5776	0.0017	-0.0143	-0.7388	0.0034	-0.0279	-0.7927	0.0049
EMR(-7)/VMR(-7)	-0.0108	-0.7669	0.0064	-0.0116	-0.5231	0.0007	-0.0176	-1.1332	0.0135	-0.0241	-0.9900	0.0071
EMR(-8)/VMR(-8)	-0.0129	-1.1277	0.0185	-0.0133	-0.7403	0.0056	-0.0154	-1.2784	0.0173	-0.0254	-1.2843	0.0169
EMR(-9)/VMR(-9)	-0.0013	-0.1922	-0.0027	-0.0056	-0.4270	-0.0004	-0.0004	-0.0593	-0.0031	-0.0130	-0.9201	0.0062
EMR(-10)/VMR(-10)	-0.0028	-0.5721	0.0005	0.0027	0.2574	-0.0020	-0.0017	-0.2923	-0.0022	-0.0004	-0.0379	-0.0031

Note: The table reports parameters of slope coefficient λ, t-stats, and adjusted R-square estimated from univariate regression of momentum coefficient γ_{mom} and Winner/Loser return R_{wml} on individual lagged macroeconomic variables from 1980 to 2008, respectively. Momentum portfolios are formed with shares returns in past 6 months, and hold for 24 months. Momentum coefficient γ_{mom} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their formation returns. Winner/Loser return R_{wml} is the return spread in 'Winner' portfolio and 'Loser' portfolio. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A reports corresponding parameters for equal-(value-) weighted momentum coefficient γ_{mom}. Panel B reports corresponding parameters for equal-(value-) weighted Winner/Loser return $R_{wml.}$

Table 5.10 Multivariate regression of momentum effect on the combination of lagged macroeconomic variables (Momentum-6 months' formation length)

Panel A 3 months' holding length

	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	4		3		2		3	
Adj-R^2	0.0854		0.0585		0.0658		0.0840	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXTBILL(Y)	9.9444	1.5959	16.4070	1.9604	9.0180	1.1901	21.6687	2.0963
DY(H)	0.2387	2.0957	0.2668	1.9340	0.2947	2.0277	0.3059	1.7946
CPI(Q)			-0.2441	-2.6133			-0.4384	-2.9670

Panel B 6 months' holding length

	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	8		4		6		4	
Adj-R^2	0.0712		0.0755		0.0411		0.0993	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXTBILL(Y)	14.8005	1.3389	32.0312	2.1736	13.8497	1.0782	39.5337	2.3694
DY(H)	0.3254	1.7585	0.2782	1.2462	0.2955	1.3631	0.3016	1.2251
CPI(Q)			-0.4647	-2.4359			-0.7132	-2.8191

Panel C 12 months' holding length

	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	7		5		6		5	
Adj-R^2	0.1005		0.0580		0.0709		0.0379	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0255	-2.4409	-0.0244	-2.3510	-0.0279	-2.5993	-0.0243	-2.3235
UEXTBILL(Y)	34.8205	2.9525	37.8669	2.2167	32.2650	2.2203	39.5416	2.0890

Panel D 18 months' holding length

	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	8		5		6		5	
Adj-R^2	0.1286		0.0867		0.0971		0.0731	
Information ariables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0407	-2.3295	-0.0338	-2.8332	-0.0452	-2.5612	-0.0368	-3.1601
UEXTBILL(Y)	39.5986	2.5098	54.0065	2.6518	30.9327	1.8984	65.2874	3.1746

Panel E 24 months' holding length

	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	9		7		6		5	
Adj-R^2	0.1008		0.0646		0.0640		0.0616	
Macroeconomic variables	Λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0386	-2.2909	-0.0239	-2.0087	-0.0405	-2.4004	-0.0321	-2.6236
UEXTBILL(Y)	35.8703	1.8183	63.6713	2.6381	26.3515	1.2667	74.8187	3.3177

Note: This table presents slope coefficient λ, t-stats, and adjusted R^2 for multivariate regression of momentum coefficient γ_{mom}, and Winner/Loser return R_{wml} on the combination of lagged macroeconomic variables from January 1980 to December 2008. Momentum portfolios are formed with share returns in past 6 months, and hold for 3, 6, 12, 18, and 24 months, respectively. Momentum coefficient γ_{mom} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their formation returns. Winner/Loser return R_{wml} is the return spread in 'Winner' portfolio and 'Loser' portfolio. UEXTBILL(Y) is unexpected change of TBILL in previous 12 months. DY(H) is the change of DY in past 6 months. CPI(Q) is the change of CPI in past 3 months. GDP(Y) is the change of GDP in past 12 months. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A to E report corresponding parameters for equal-(value-) weighted momentum coefficient γ_{mom} and Winner/Loser return R_{wml} with 3, 6, 12, 18, and 24 months' holding lengths, respectively.

Table 5.11 Multivariate regression of momentum effect on the combination of lagged macroeconomic variables in subperiods (Momentum 6/3)

Panel A April 1980-December 1989								
	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	5		1		4		1	
Adj-R^2	0.2490		0.1337		0.2090		0.1174	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXTBILL(Y)	13.5924	2.5516	21.9173	3.0679	18.8571	3.0049	28.9324	3.3980
DY(H)	0.1858	1.5681	0.1071	0.8095	0.1473	1.2512	0.0098	0.0698
CPI(Q)			-0.1153	-1.2365			-0.1227	-1.2772

Panel B January 1990-December 1999								
	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	2		2		2		2	
Adj-R^2	0.1464		0.0320		0.1224		0.0546	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXTBILL(Y)	12.8746	1.3057	-3.0066	-0.1789	7.3256	0.7209	-12.3422	-0.6929
DY(H)	0.3974	3.6832	0.3997	1.9262	0.4043	3.2425	0.4901	2.2533
CPI(Q)			0.0602	0.4780			0.1155	0.7302

Panel C January 2000-December 2008								
	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	2		2		2		3	
Adj-R^2	0.0201		0.1298		0.0100		0.2609	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXTBILL(Y)	-52.4636	-1.6794	-27.6507	-0.6457	-44.7272	-1.0466	-30.3292	-0.6602
DY(H)	-0.0771	-0.3256	-0.0597	-0.2313	0.1160	0.3084	-0.0974	-0.2886
CPI(Q)			-0.5903	-3.8902			-1.0892	-4.9547

Panel D April 1980-December 2008								
	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	4		3		2		3	
Adj-R^2	0.0854		0.0585		0.0658		0.0840	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXTBILL(Y)	9.9444	1.5959	16.4070	1.9604	9.0180	1.1901	21.6687	2.0963
DY(H)	0.2387	2.0957	0.2668	1.9340	0.2947	2.0277	0.3059	1.7946
CPI(Q)			-0.2441	-2.6133			-0.4384	-2.9670

Note: This table presents slope coefficient λ, t-stats, and adjusted R^2 for multivariate regression of momentum coefficient γ_{mom}, and Winner/Loser return R_{wml} on the combination of lagged macroeconomic variables from January 1980 to December 2008. Momentum portfolios are formed with share returns in past 6 months, and hold for 3 months. Momentum coefficient γ_{mom} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their formation returns. Winner/Loser return R_{wml} is the return spread in 'Winner' portfolio and 'Loser' portfolio. UNTBILL(Y) is unexpected change of TBILL in previous 12 months. DY(H) is the change of DY in past 6 months. CPI(Q) is the change of CPI in past 3 months. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A to D report corresponding parameters for equal-(value-) weighted momentum coefficient γ_{mom} and Winner/Loser return R_{wml} in the 1980s, the 1990s, from 2000 to 2008, and the whole sample period, respectively.

Table 5.12 Multivariate regression of momentum effect on the combination of lagged macroeconomic variables in subperiods (Momentum 6/6)

Panel A July 1980-December 1989

	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	6		2		6		5	
Adj-R^2	0.2741		0.1813		0.2196		0.1675	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXTBILL(Y)	27.1195	5.5584	40.5715	4.3627	35.1553	4.2596	48.4745	4.7192
DY(H)	0.1550	1.2367	-0.0549	-0.2961	0.0594	0.4072	-0.1526	-0.7225
CPI(Q)			-0.0611	-0.3722			0.0252	0.1389

Panel B January 1990-December 1999

	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	4		3		4		3	
Adj-R^2	0.1763		0.0743		0.1102		0.0699	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXTBILL(Y)	15.9571	0.9218	-4.6560	-0.1713	4.1309	0.2718	-12.6711	-0.4990
DY(H)	0.6853	3.8040	0.7976	2.2975	0.5543	3.4510	0.8187	2.6812
CPI(Q)			0.0924	0.3262			0.0395	0.1242

Panel C January 2000-December 2008

	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	3		6		3		2	
Adj-R^2	0.0823		0.3209		0.0373		0.3949	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXTBILL(Y)	-124.2990	-2.4852	-29.9155	-0.5707	-123.1133	-1.8072	-19.6466	-0.3227
DY(H)	-0.3220	-0.8691	-0.4186	-1.0734	-0.2423	-0.4800	-0.4405	-1.0651
CPI(Q)			-1.1278	-3.7224			-1.7136	-4.7578

Panel D July 1980-December 2008

	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	8		4		6		4	
Adj-R^2	0.0712		0.0755		0.0411		0.0993	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXTBILL(Y)	14.8005	1.3389	32.0312	2.1736	13.8497	1.0782	39.5337	2.3694
DY(H)	0.3254	1.7585	0.2782	1.2462	0.2955	1.3631	0.3016	1.2251
CPI(Q)			-0.4647	-2.4359			-0.7132	-2.8191

Note: This table presents slope coefficient λ, t-stats, and adjusted R^2 for multivariate regression of momentum coefficient γ_{mom}, and Winner/Loser return R_{wml} on the combination of lagged macroeconomic variables from January 1980 to December 2008. Momentum portfolios are formed with share returns in past 6 months, and hold for 6 months. Momentum coefficient γ_{mom} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their formation returns. Winner/Loser return R_{wml} is the return spread in 'Winner' portfolio and 'Loser' portfolio. UEXTBILL(Y) is unexpected change of TBILL in previous 12 months. DY(H) is the change of DY in past 6 months. CPI(Q) is the change of CPI in past 3 months. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A to D report corresponding parameters for equal-(value-) weighted momentum coefficient γ_{mom} and Winner/Loser return R_{wml} in the 1980s, the 1990s, from 2000 to 2008, and the whole sample period, respectively.

Table 5.13 Multivariate regression of momentum effect on the combination of lagged macroeconomic variables in subperiods (Momentum 6/12)

Panel A January 1981-December 1989

	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	4		4		4		2	
Adj-R^2	0.2300		0.1790		0.2029		0.1887	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0108	-1.4825	-0.0063	-0.8620	-0.0170	-1.8707	-0.0077	-1.0586
UEXTBILL(Y)	46.8892	6.4782	50.4248	3.0999	61.6909	5.0278	68.8114	3.8234

Panel B January 1990-December 1999

	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	5		3		4		3	
Adj-R^2	0.2425		0.1722		0.1937		0.1446	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0511	-3.1705	-0.0606	-3.2786	-0.0448	-3.6165	-0.0558	-3.2609
UEXTBILL(Y)	27.8153	1.7224	27.2094	1.3074	5.4260	0.3871	13.8631	0.6324

Panel C January 2000-December 2008

	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	7		7		5		5	
Adj-R^2	0.0180		-0.0057		0.0076		-0.0042	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0365	-0.8124	-0.0203	-0.3322	-0.0296	-0.5847	-0.0213	-0.2937
UEXTBILL(Y)	-33.8342	-0.7713	-43.7111	-0.7055	-61.7565	-0.9530	-77.7833	-0.8237

Panel D January 1981-December 2008

	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	7		5		6		5	
Adj-R^2	0.1005		0.0580		0.0709		0.0379	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0255	-2.4409	-0.0244	-2.3510	-0.0279	-2.5993	-0.0243	-2.3235
UEXTBILL(Y)	34.8205	2.9525	37.8669	2.2167	32.2650	2.2203	39.5416	2.0890

Note: This table presents slope coefficient λ, t-stats, and adjusted R^2 for multivariate regression of momentum coefficient γ_{mom}, and Winner/Loser return R_{wml} on the combination of lagged macroeconomic variables from January 1980 to December 2008. Momentum portfolios are formed with share returns in past 6 months, and hold for 12 months. Momentum coefficient γ_{mom} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their formation returns. Winner/Loser return R_{wml} is the return spread in 'Winner' portfolio and 'Loser' portfolio. GDP(Y) is the change of GDP in past 12 months. UEXTBILL(Y) is unexpected change of TBILL in previous 12 months. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A to D report corresponding parameters for equal-(value-) weighted momentum coefficient γ_{mom} and Winner/Loser return R_{wml} in the 1980s, the 1990s, from 2000 to 2008, and the whole sample period, respectively.

Table 5.14 Multivariate regression of momentum effect on the combination of lagged macroeconomic variables in subperiods (Momentum 6/18)

Panel A July 1981-December 1989								
	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	4		4		4		5	
Adj-R^2	0.1865		0.1605		0.1950		0.2072	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0309	-1.8998	-0.0266	-2.3587	-0.0408	-2.2343	-0.0342	-2.9800
UEXTBILL(Y)	30.5151	2.4733	37.4925	1.5110	39.2556	2.7926	67.1931	2.5553

Panel B January 1990-December 1999								
	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	5		3		5		2	
Adj-R^2	0.2110		0.1539		0.1547		0.1189	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0543	-2.6439	-0.0473	-2.0770	-0.0468	-2.7152	-0.0403	-1.9188
UEXTBILL(Y)	47.8457	2.2001	76.5314	2.9183	25.4993	1.2879	68.0717	2.6854

Panel C January 2000-December 2008								
	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	7		7		5		5	
Adj-R^2	0.0040		-0.0149		-0.0021		-0.0178	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0484	-0.8237	0.0051	0.0683	-0.0346	-0.5292	0.0023	0.0248
UEXTBILL(Y)	11.9980	0.2012	-46.3487	-0.7868	-45.7176	-0.5286	-35.2509	-0.3516

Panel D July 1981-December 2008								
	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	8		5		6		5	
Adj-R^2	0.1286		0.0867		0.0971		0.0731	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0407	-2.3295	-0.0338	-2.8332	-0.0452	-2.5612	-0.0368	-3.1601
UEXTBILL(Y)	39.5986	2.5098	54.0065	2.6518	30.9327	1.8984	65.2874	3.1746

Note: This table presents slope coefficient λ, t-stats, and adjusted R^2 for multivariate regression of momentum coefficient γ_{mom}, and Winner/Loser return R_{wml} on the combination of lagged macroeconomic variables from January 1980 to December 2008. Momentum portfolios are formed with share returns in past 6 months, and hold for 18 months. Momentum coefficient γ_{mom} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their formation returns. Winner/Loser return R_{wml} is the return spread in 'Winner' portfolio and 'Loser' portfolio. GDP(Y) is the change of GDP in past 12 months. UEXTBILL(Y) is unexpected change of TBILL in previous 12 months. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A to D report corresponding parameters for equal-(value-) weighted momentum coefficient γ_{mom} and Winner/Loser return R_{wml} in the 1980s, the 1990s, from 2000 to 2008, and the whole sample period, respectively.

Table 5.15 Multivariate regression of momentum effect on the combination of lagged macroeconomic variables in subperiods (Momentum 6/24)

Panel A January 1982-December 1989

	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	4		4		4		4	
Adj-R^2	0.1336		0.0448		0.1303		0.1214	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0292	-2.1906	-0.0168	-1.5126	-0.0356	-2.2514	-0.0302	-2.1432
UEXTBILL(Y)	19.9703	1.2933	30.4610	1.1296	33.3996	1.7499	69.6338	2.4532

Panel B January 1990-December 1999

	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	7		3		6		2	
Adj-R^2	0.2052		0.1810		0.1603		0.1463	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0518	-2.3500	-0.0271	-1.1781	-0.0478	-2.7329	-0.0275	-1.4322
UEXTBILL(Y)	44.1549	1.7840	104.8900	3.8580	10.0216	0.4798	83.2529	3.4110

Panel C January 2000-December 2008

	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	6		5		4		4	
Adj-R^2	0.0184		-0.0084		-0.0109		-0.0136	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0714	-1.2925	-0.0480	-0.7302	-0.0490	-0.7137	-0.0490	-0.5599
UEXTBILL(Y)	113.0103	1.5206	62.4231	0.8367	75.6309	0.6603	79.6372	0.5999

Panel D January 1982-December 2008

	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	9		7		6		5	
Adj-R^2	0.1008		0.0646		0.0640		0.0616	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0386	-2.2909	-0.0239	-2.0087	-0.0405	-2.4004	-0.0321	-2.6236
UEXTBILL(Y)	35.8703	1.8183	63.6713	2.6381	26.3515	1.2667	74.8187	3.3177

Note: This table presents slope coefficient λ, t-stats, and adjusted R^2 for multivariate regression of momentum coefficient γ_{mom}, and Winner/Loser return R_{wml} on the combination of lagged macroeconomic variables from January 1980 to December 2008. Momentum portfolios are formed with share returns in past 6 months, and hold for 24 months. Momentum coefficient γ_{mom} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their formation returns. Winner/Loser return R_{wml} is the return spread in 'Winner' portfolio and 'Loser' portfolio. GDP(Y) is the change of GDP in past 12 months. UEXTBILL(Y) is unexpected change of TBILL in previous 12 months. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A to D report corresponding parameters for equal-(value-) weighted momentum coefficient γ_{mom} and Winner/Loser return R_{wml} in the 1980s, the 1990s, from 2000 to 2008, and the whole sample period, respectively.

Table 5.16 Univariate regression of momentum effect on individual lagged macroeconomic variables (Momentum 12/3)

	Panel A Momentum coefficient γ_{mom}						Panel B Winner/Loser return R_{wml}					
	Panel A1 Equal-weighted			Panel A2 Value-weighted			Panel B1 Equal-weighted			Panel B2 Value-weighted		
Macroeconomic variable	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t(λ)	Adj-R^2
GDP(Y)	-0.0048	-1.8056	0.0241	-0.0072	-2.0154	0.0182	-0.0076	-2.0631	0.0189	-0.0145	-2.6409	0.0271
UEXGDP(Y)	-0.0077	-1.8522	0.0264	-0.0118	-2.0768	0.0210	-0.0114	-1.9801	0.0184	-0.0222	-2.5299	0.0270
IP(M)	-0.6190	-1.1845	-0.0008	-0.7163	-0.6190	-0.0019	0.1571	0.1496	-0.0029	0.2055	0.1104	-0.0029
IP(Q)	-0.4661	-0.7862	-0.0004	0.0754	0.0710	-0.0029	0.2765	0.2696	-0.0026	1.4903	0.9094	0.0002
IP(H)	-0.6155	-1.2978	0.0064	-0.8244	-1.1421	0.0029	-0.5704	-0.7451	-0.0003	-0.8668	-0.7611	-0.0007
IP(Y)	-0.1405	-0.3950	-0.0018	-0.4805	-1.0700	0.0017	-0.0600	-0.1201	-0.0028	-0.8223	-1.1252	0.0018
UEXIP(Q)	-0.0033	-0.8455	-0.0002	-0.0014	-0.1847	-0.0027	0.0026	0.3669	-0.0024	0.0072	0.6043	-0.0013
UEXIP(H)	-0.0041	-1.1199	0.0034	-0.0040	-0.6086	-0.0008	-0.0011	-0.1774	-0.0028	-0.0002	-0.0231	-0.0029
UEXIP(Y)	-0.0030	-0.9616	0.0037	-0.0046	-0.9929	0.0027	-0.0020	-0.4399	-0.0019	-0.0057	-0.7873	0.0001
IPM(M)	-1.0081	-2.0838	0.0030	-0.9470	-0.9048	-0.0011	-0.7838	-0.7865	-0.0017	-0.6845	-0.3902	-0.0026
IPM(Q)	-0.4731	-0.8291	0.0000	0.1753	0.1913	-0.0028	0.1400	0.1494	-0.0028	1.1361	0.7940	-0.0008
IPM(H)	-0.3092	-0.6525	-0.0001	-0.4856	-0.7516	-0.0005	-0.0862	-0.1247	-0.0028	-0.5000	-0.5271	-0.0020
IPM(Y)	0.0036	0.0117	-0.0029	-0.1428	-0.4177	-0.0023	0.0780	0.1902	-0.0028	-0.2447	-0.4475	-0.0023
UEXIPM(Q)	-0.0046	-1.2667	0.0029	-0.0016	-0.2375	-0.0027	-0.0009	-0.1331	-0.0028	0.0037	0.3472	-0.0025
UEXIPM(H)	-0.0031	-0.8853	0.0015	-0.0026	-0.4481	-0.0019	-0.0004	-0.0694	-0.0029	-0.0003	-0.0290	-0.0029
UEXIPM(Y)	-0.0014	-0.5089	-0.0009	-0.0018	-0.4952	-0.0018	-0.0004	-0.1046	-0.0029	-0.0025	-0.4395	-0.0022
M0 (M)	-1.6367	-0.6405	-0.0006	-1.4985	-0.3563	-0.0022	-0.4962	-0.0945	-0.0028	1.0041	0.1216	-0.0028
M0 (Q)	-1.4332	-0.9870	0.0029	-1.1349	-0.4429	-0.0017	-4.4281	-1.3726	0.0153	-4.2061	-0.8164	0.0032
M0 (H)	0.5889	0.4852	-0.0009	1.2549	0.6616	0.0003	0.4904	0.1941	-0.0024	1.3751	0.3741	-0.0015
M0 (Y)	0.6421	0.7073	0.0031	0.3036	0.2669	-0.0024	0.4634	0.2793	-0.0019	-0.3071	-0.1372	-0.0027
UEXM0(Q)	0.0000	-0.5393	0.0006	0.0000	0.1961	-0.0025	0.0000	-0.7008	0.0024	0.0000	0.0570	-0.0029
UEXM0 (H)	0.0000	-0.1864	-0.0024	0.0000	0.5692	0.0004	0.0000	-0.3870	-0.0011	0.0000	0.2828	-0.0019
UEXM0 (Y)	0.0000	0.1543	-0.0026	0.0000	0.8280	0.0034	0.0000	-0.0289	-0.0029	0.0000	0.5157	-0.0001
UNE (M)	-0.2820	-0.4093	-0.0020	-0.2496	-0.2230	-0.0027	-0.7995	-0.7592	-0.0004	-0.4655	-0.3071	-0.0026
UNE (Q)	-0.0533	-0.1679	-0.0027	-0.0834	-0.1887	-0.0027	-0.1963	-0.4422	-0.0020	-0.1725	-0.2624	-0.0026
UNE (H)	-0.0183	-0.1059	-0.0028	0.0383	0.1815	-0.0028	-0.0605	-0.2595	-0.0026	0.0780	0.2262	-0.0027
UNE (Y)	-0.1033	-1.3012	0.0063	-0.1031	-1.0342	0.0003	-0.1577	-1.4674	0.0041	-0.1381	-0.8196	-0.0009
UEXUNE(Q)	-0.0112	-0.4180	-0.0016	-0.0092	-0.2741	-0.0026	-0.0265	-0.7015	-0.0005	-0.0089	-0.1809	-0.0028
UEXUNE(H)	-0.0055	-0.3381	-0.0021	-0.0010	-0.0517	-0.0029	-0.0123	-0.5531	-0.0015	0.0017	0.0574	-0.0029
UEXUNE(Y)	-0.0063	-0.7400	0.0006	-0.0044	-0.4515	-0.0023	-0.0103	-0.8999	0.0002	-0.0048	-0.3098	-0.0027
CPI (M)	-0.0320	-0.3683	-0.0022	-0.1696	-1.2901	0.0037	-0.0770	-0.5136	-0.0016	-0.3942	-1.5889	0.0097
CPI (Q)	-0.0058	-0.1024	-0.0028	-0.0780	-0.9384	0.0023	-0.0460	-0.4511	-0.0012	-0.2291	-1.3906	0.0129
CPI (H)	-0.0311	-0.6527	0.0030	-0.0902	-1.3459	0.0142	-0.0769	-1.1326	0.0089	-0.2059	-1.7298	0.0286
CPI (Y)	-0.0249	-0.7783	0.0058	-0.0659	-1.5182	0.0183	-0.0449	-0.9991	0.0064	-0.1430	-2.0239	0.0324
UEXCPI(Q)	0.0062	0.8706	0.0024	0.0010	0.1157	-0.0029	0.0071	0.7100	-0.0006	-0.0020	-0.1516	-0.0028

Continued

UEXCPI(H)	0.0047	0.8398	0.0031	-0.0004	-0.0625	-0.0029	0.0050	0.6884	-0.0006	-0.0046	-0.4301	-0.0022
UEXCPI(Y)	0.0034	1.0017	0.0051	-0.0012	-0.2919	-0.0026	0.0043	0.9569	0.0012	-0.0047	-0.6802	-0.0011
TBILL(M)	0.0910	1.4969	0.0043	0.1096	1.0815	0.0007	0.1637	1.6221	0.0047	0.1385	0.7969	-0.0009
TBILL (Q)	0.0693	1.6776	0.0115	0.0518	0.8527	-0.0001	0.1398	2.0446	0.0163	0.0506	0.4607	-0.0020
TBILL (H)	0.0540	1.8474	0.0157	0.0336	0.8432	-0.0004	0.0935	2.0951	0.0154	0.0366	0.5148	-0.0019
TBILL (Y)	0.0437	2.1822	0.0233	0.0436	1.5283	0.0061	0.0718	2.1752	0.0203	0.0593	1.0884	0.0030
UEXTBILL(Q)	15.1459	2.4388	0.0187	15.9840	1.8392	0.0054	29.7632	2.9585	0.0245	21.6404	1.4501	0.0025
UEXTBILL(H)	14.3029	2.7805	0.0305	12.6698	1.7849	0.0062	26.9656	3.3059	0.0360	18.1020	1.4707	0.0036
UEXTBILL(Y)	11.9311	3.3813	0.0410	9.9480	1.9661	0.0077	20.2282	3.5079	0.0384	13.4411	1.4806	0.0039
TERM(M)	-1.1303	-1.7915	0.0048	-1.5467	-1.6402	0.0021	-1.6319	-1.6744	0.0024	-1.7228	-1.1811	-0.0007
TERM(Q)	-0.9576	-1.9252	0.0130	-1.1173	-1.5760	0.0046	-1.5336	-2.1084	0.0105	-1.0630	-0.9172	-0.0005
TERM(H)	-0.4356	-1.2425	0.0040	-0.0934	-0.1987	-0.0028	-0.8040	-1.5583	0.0048	0.1994	0.2393	-0.0027
TERM(Y)	-0.3228	-1.3872	0.0049	-0.2484	-0.7460	-0.0013	-0.5544	-1.4414	0.0046	-0.2945	-0.4553	-0.0021
UEXTERM(Q)	-1.3329	-1.9587	0.0131	-1.6782	-1.7524	0.0059	-2.0058	-2.0263	0.0089	-1.7403	-1.1329	0.0004
UEXTERM(H)	-0.9692	-1.7709	0.0112	-0.7809	-1.0282	0.0003	-1.6033	-2.0177	0.0097	-0.4712	-0.3661	-0.0025
UEXTERM(Y)	-0.5666	-1.4131	0.0061	-0.3438	-0.6114	-0.0018	-0.9125	-1.5201	0.0047	-0.0678	-0.0675	-0.0029
DY(M)	0.1444	1.3503	0.0032	0.1421	0.8139	-0.0009	0.1159	0.6583	-0.0016	0.1350	0.4313	-0.0023
DY(Q)	0.2432	2.6152	0.0518	0.2513	1.9925	0.0173	0.3857	2.6180	0.0422	0.4275	1.8249	0.0177
DY(H)	0.2164	3.0348	0.0983	0.2467	2.2398	0.0427	0.3509	3.1624	0.0843	0.4589	2.5370	0.0527
DY(Y)	0.0857	1.6627	0.0342	0.0816	1.1827	0.0087	0.1060	1.6436	0.0157	0.1492	1.3408	0.0108
UEXDY(Q)	6.5836	2.9816	0.0347	5.7865	1.7755	0.0071	8.9435	2.5243	0.0198	7.8709	1.3906	0.0036
UEXDY(H)	7.2386	3.4824	0.0780	7.0434	2.4203	0.0236	10.7504	3.5709	0.0556	10.9226	2.1582	0.0196
UEXDY(Y)	4.9445	3.2239	0.0767	4.5050	2.1004	0.0200	6.6730	3.3355	0.0447	7.1455	1.9894	0.0174
EMR(-1)/VMR(-1)	-0.0545	-2.4760	0.0596	-0.0307	-0.4319	-0.0004	-0.0775	-1.9013	0.0386	-0.0567	-0.5274	0.0001
EMR(-2)/VMR(-2)	-0.0171	-0.9814	0.0123	-0.0255	-0.6236	0.0020	-0.0234	-0.9155	0.0064	-0.0492	-0.7715	0.0035
EMR(-3)/VMR(-3)	-0.0031	-0.2412	-0.0019	-0.0030	-0.1347	-0.0027	-0.0041	-0.2284	-0.0023	-0.0021	-0.0596	-0.0029
EMR(-4)/VMR(-4)	-0.0030	-0.4203	-0.0008	-0.0064	-0.5039	-0.0012	-0.0070	-0.6756	0.0009	-0.0135	-0.6414	-0.0003
EMR(-5)/VMR(-5)	-0.0003	-0.0629	-0.0029	0.0044	0.5576	-0.0013	-0.0033	-0.4601	-0.0010	0.0017	0.1267	-0.0028
EMR(-6)/VMR(-6)	-0.0015	-0.4671	-0.0007	-0.0023	-0.4482	-0.0021	-0.0040	-0.8940	0.0024	-0.0041	-0.4897	-0.0019
EMR(-7)/VMR(-7)	-0.0008	-0.3360	-0.0019	-0.0001	-0.0309	-0.0029	-0.0024	-0.7231	0.0003	-0.0003	-0.0520	-0.0029
EMR(-8)/VMR(-8)	-0.0008	-0.4112	-0.0013	-0.0017	-0.5648	-0.0014	-0.0023	-0.8597	0.0020	-0.0039	-0.8275	-0.0001
EMR(-9)/VMR(-9)	-0.0001	-0.0501	-0.0029	-0.0004	-0.1811	-0.0028	-0.0002	-0.1045	-0.0029	-0.0007	-0.2056	-0.0027
EMR(-10)/VMR(-10)	-0.0001	-0.1123	-0.0028	0.0006	0.3459	-0.0024	-0.0003	-0.1662	-0.0027	0.0006	0.2210	-0.0027

Note: The table reports parameters of slope coefficient λ, t-stats, and adjusted R-square estimated from univariate regression of momentum coefficient γ_{mom} and Winner/Loser return R_{wml} on individual lagged macroeconomic variables from 1980 to 2008, respectively. Momentum portfolios are formed with share returns in past 12 months, and hold for 3 months. Momentum coefficient γ_{mom} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their formation returns. Winner/Loser return R_{wml} is the return spread in 'Winner' portfolio and 'Loser' portfolio. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A reports corresponding parameters for equal-(value-) weighted momentum coefficient γ_{mom}. Panel B reports corresponding parameters for equal-(value-) weighted Winner/Loser return $R_{wml.}$

Table 5.17 Univariate regression of momentum effect on individual lagged macroeconomic variables (Momentum 12/6)

	Panel A Momentum coefficient γ_{mom}						Panel B Winner/Loser return R_{wml}					
	Panel A1 Equal-weighted			Panel A2 Value-weighted			Panel B1 Equal-weighted			Panel B2 Value-weighted		
Macroeconomic variable	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t(λ)	Adj-R^2
GDP(Y)	-0.0111	-1.8301	0.0531	-0.0132	-1.8282	0.0348	-0.0162	-1.8888	0.0431	-0.0223	-2.0892	0.0338
UEXGDP(Y)	-0.0158	-1.6827	0.0463	-0.0188	-1.6524	0.0301	-0.0219	-1.6041	0.0329	-0.0314	-1.8273	0.0281
IP(M)	-1.6502	-1.9561	0.0029	-1.3279	-1.0527	-0.0011	-1.6325	-1.1603	-0.0008	-0.7700	-0.3260	-0.0027
IP(Q)	-1.9997	-1.8886	0.0146	-1.3033	-0.9775	0.0006	-2.4029	-1.4337	0.0067	-1.2553	-0.5405	-0.0018
IP(H)	-1.7148	-1.6910	0.0251	-1.7420	-1.5428	0.0108	-2.3941	-1.5665	0.0178	-2.5974	-1.3306	0.0074
IP(Y)	-0.6000	-0.8613	0.0051	-0.9441	-1.2759	0.0066	-0.8726	-0.8185	0.0036	-1.6385	-1.3075	0.0068
UEXIP(Q)	-0.0127	-1.9156	0.0123	-0.0086	-0.9831	0.0004	-0.0136	-1.2652	0.0037	-0.0077	-0.4883	-0.0020
UEXIP(H)	-0.0142	-1.9964	0.0263	-0.0126	-1.4650	0.0080	-0.0180	-1.6213	0.0150	-0.0169	-1.0995	0.0037
UEXIP(Y)	-0.0089	-1.3964	0.0201	-0.0101	-1.4218	0.0111	-0.0121	-1.2488	0.0131	-0.0162	-1.3352	0.0092
IPM(M)	-1.7163	-1.9968	0.0038	-1.9761	-1.7380	0.0013	-2.0115	-1.4945	0.0006	-2.0214	-0.9692	-0.0014
IPM(Q)	-1.2072	-1.0996	0.0045	-1.1113	-0.8530	0.0001	-1.1009	-0.6766	-0.0006	-1.1732	-0.5379	-0.0018
IPM(H)	-0.9445	-0.9624	0.0073	-0.9547	-0.9201	0.0020	-1.1754	-0.8207	0.0031	-1.5079	-0.8639	0.0012
IPM(Y)	-0.1921	-0.3436	-0.0018	-0.3715	-0.6540	-0.0009	-0.2874	-0.3432	-0.0019	-0.5456	-0.5720	-0.0014
UEXIPM(Q)	-0.0100	-1.4669	0.0077	-0.0098	-1.1796	0.0019	-0.0097	-0.9371	0.0009	-0.0106	-0.7310	-0.0010
UEXIPM(H)	-0.0089	-1.2226	0.0105	-0.0086	-1.0490	0.0031	-0.0098	-0.9289	0.0034	-0.0120	-0.8532	0.0010
UEXIPM(Y)	-0.0047	-0.8241	0.0055	-0.0054	-0.8871	0.0022	-0.0059	-0.7058	0.0021	-0.0083	-0.8247	0.0013
M0 (M)	-3.6474	-0.9660	0.0016	-3.7434	-0.7249	-0.0007	-4.7234	-0.7756	0.0000	-7.6401	-0.8127	0.0003
M0 (Q)	-1.8466	-0.7009	0.0009	-0.3228	-0.0848	-0.0029	-4.8930	-1.1351	0.0072	-3.6115	-0.5289	-0.0006
M0 (H)	0.2444	0.1020	-0.0028	1.0080	0.3456	-0.0018	-0.3694	-0.0947	-0.0028	0.1257	0.0235	-0.0029
M0 (Y)	0.4600	0.2466	-0.0017	0.2051	0.0968	-0.0028	-0.1002	-0.0322	-0.0029	-1.0279	-0.2653	-0.0020
UEXM0(Q)	0.0000	-0.5622	0.0015	0.0000	0.1594	-0.0026	-0.0001	-0.5704	0.0013	0.0000	-0.0607	-0.0029
UEXM0 (H)	0.0000	-0.3268	-0.0012	0.0000	0.4083	-0.0003	0.0000	-0.3181	-0.0012	0.0000	0.2050	-0.0022
UEXM0 (Y)	0.0000	-0.2202	-0.0020	0.0000	0.3855	-0.0006	0.0000	-0.2142	-0.0021	0.0000	0.1730	-0.0024
UNE (M)	0.5051	0.3662	-0.0018	-0.1346	-0.0971	-0.0029	0.5819	0.2775	-0.0023	0.7478	0.3073	-0.0025
UNE (Q)	0.3660	0.5551	0.0008	0.1686	0.2536	-0.0026	0.6150	0.6151	0.0011	0.4774	0.4083	-0.0019
UNE (H)	0.1198	0.3414	-0.0015	0.0060	0.0172	-0.0029	0.2052	0.4025	-0.0014	0.1070	0.1792	-0.0028
UNE (Y)	-0.1247	-0.7876	0.0024	-0.1669	-0.9154	0.0016	-0.1439	-0.6068	-0.0002	-0.2093	-0.6948	-0.0005
UEXUNE(Q)	0.0143	0.2580	-0.0021	0.0015	0.0287	-0.0029	0.0203	0.2446	-0.0023	0.0140	0.1624	-0.0028
UEXUNE(H)	0.0079	0.2394	-0.0022	0.0014	0.0462	-0.0029	0.0129	0.2625	-0.0022	0.0075	0.1445	-0.0028
UEXUNE(Y)	-0.0043	-0.2521	-0.0023	-0.0077	-0.4387	-0.0020	-0.0044	-0.1718	-0.0027	-0.0090	-0.3176	-0.0025
CPI (M)	-0.1174	-0.8625	0.0006	-0.2522	-1.3117	0.0049	-0.2580	-1.0824	0.0037	-0.4999	-1.4218	0.0075
CPI (Q)	-0.0998	-0.9034	0.0067	-0.2194	-1.4508	0.0192	-0.1908	-1.0126	0.0105	-0.4443	-1.5647	0.0279
CPI (H)	-0.1154	-1.1931	0.0290	-0.2387	-1.9709	0.0618	-0.2059	-1.3393	0.0357	-0.4730	-2.2139	0.0832
CPI (Y)	-0.0616	-0.9627	0.0182	-0.1199	-1.5582	0.0351	-0.0953	-0.9624	0.0163	-0.2287	-1.6683	0.0439
UEXCPI(Q)	0.0032	0.2397	-0.0024	-0.0021	-0.1216	-0.0028	0.0024	0.1181	-0.0028	-0.0018	-0.0629	-0.0029

Continued

UEXCPI(H)	0.0031	0.2672	-0.0019	-0.0045	-0.3235	-0.0019	0.0026	0.1500	-0.0027	-0.0093	-0.3997	-0.0014
UEXCPI(Y)	0.0038	0.5506	0.0010	-0.0028	-0.3403	-0.0019	0.0048	0.4330	-0.0006	-0.0060	-0.4134	-0.0014
TBILL(M)	0.1200	1.2888	0.0020	0.1114	0.8399	-0.0009	0.2377	1.5834	0.0044	0.2567	1.1165	0.0007
TBILL (Q)	0.0796	1.1981	0.0046	0.0490	0.5455	-0.0016	0.1604	1.4666	0.0087	0.0819	0.5126	-0.0017
TBILL (H)	0.0589	1.0713	0.0058	0.0346	0.4881	-0.0015	0.0931	1.0074	0.0054	0.0330	0.2609	-0.0025
TBILL (Y)	0.0587	1.6176	0.0157	0.0713	1.4421	0.0101	0.0945	1.6509	0.0154	0.1120	1.2581	0.0080
UEXTBILL(Q)	20.1913	1.8359	0.0122	19.4165	1.4537	0.0037	40.4623	2.3232	0.0203	36.2870	1.6340	0.0049
UEXTBILL(H)	18.0106	1.7912	0.0180	15.7914	1.3841	0.0047	32.7696	2.0758	0.0234	25.3031	1.3360	0.0037
UEXTBILL(Y)	15.6764	1.9440	0.0270	15.1137	1.6153	0.0103	26.0993	2.0906	0.0286	22.8881	1.4404	0.0073
TERM(M)	-1.5386	-1.2719	0.0027	-1.2554	-0.8379	-0.0011	-2.2203	-1.2738	0.0016	-2.1677	-0.8970	-0.0011
TERM(Q)	-0.9276	-1.0104	0.0030	-0.6934	-0.6274	-0.0014	-1.6753	-1.2704	0.0044	-1.2123	-0.6260	-0.0013
TERM(H)	-0.1485	-0.2104	-0.0026	0.4098	0.5130	-0.0018	-0.2136	-0.2079	-0.0027	0.9875	0.6964	-0.0007
TERM(Y)	-0.1674	-0.3559	-0.0021	-0.0488	-0.0883	-0.0029	-0.4193	-0.6115	-0.0010	-0.2445	-0.2403	-0.0027
UEXTERM(Q)	-1.4777	-1.1434	0.0048	-1.2011	-0.7706	-0.0005	-2.3882	-1.2929	0.0048	-2.0979	-0.7885	-0.0004
UEXTERM(H)	-0.7537	-0.6920	0.0004	-0.1102	-0.0866	-0.0029	-1.3112	-0.8391	0.0009	0.0395	0.0177	-0.0029
UEXTERM(Y)	-0.3137	-0.3888	-0.0019	0.1421	0.1495	-0.0028	-0.5928	-0.5108	-0.0015	0.4112	0.2365	-0.0026
DY(M)	0.3513	1.9591	0.0113	0.5353	2.0725	0.0127	0.5054	1.6756	0.0083	0.8116	1.8185	0.0093
DY(Q)	0.4536	2.8023	0.0720	0.5523	2.4446	0.0498	0.7371	2.4744	0.0725	0.9247	2.2341	0.0472
DY(H)	0.3185	2.4192	0.0826	0.3241	1.7927	0.0391	0.4753	2.3059	0.0696	0.6165	1.9019	0.0486
DY(Y)	0.1213	1.2267	0.0263	0.1110	0.8518	0.0087	0.1436	0.9843	0.0127	0.2009	0.9100	0.0100
UEXDY(Q)	12.7522	3.2146	0.0526	14.4553	2.5944	0.0310	18.6052	2.7810	0.0421	21.8858	2.2924	0.0234
UEXDY(H)	12.0511	3.2898	0.0851	12.2955	2.3626	0.0406	17.3431	2.8808	0.0665	19.7611	2.1746	0.0351
UEXDY(Y)	7.5894	2.6008	0.0708	7.2548	1.8616	0.0291	9.6789	2.2252	0.0427	12.0626	1.8057	0.0270
EMR(-1)/VMR(-1)	-0.1115	-2.4271	0.0976	-0.0461	-0.3251	0.0000	-0.1643	-2.1973	0.0803	-0.0779	-0.3316	-0.0001
EMR(-2)/VMR(-2)	-0.0331	-0.9271	0.0191	-0.0056	-0.0690	-0.0028	-0.0461	-0.8163	0.0134	-0.0170	-0.1229	-0.0025
EMR(-3)/VMR(-3)	-0.0054	-0.2124	-0.0017	0.0077	0.1710	-0.0023	-0.0100	-0.2557	-0.0013	0.0128	0.1690	-0.0024
EMR(-4)/VMR(-4)	-0.0071	-0.5203	0.0018	-0.0077	-0.3055	-0.0016	-0.0162	-0.7519	0.0063	-0.0192	-0.4455	-0.0002
EMR(-5)/VMR(-5)	-0.0014	-0.1500	-0.0025	0.0083	0.5234	0.0003	-0.0079	-0.5364	0.0020	0.0038	0.1405	-0.0027
EMR(-6)/VMR(-6)	-0.0033	-0.5656	0.0014	-0.0034	-0.3540	-0.0019	-0.0087	-0.9308	0.0085	-0.0079	-0.4916	-0.0010
EMR(-7)/VMR(-7)	-0.0016	-0.3686	-0.0011	0.0012	0.1682	-0.0027	-0.0053	-0.7266	0.0044	-0.0006	-0.0546	-0.0029
EMR(-8)/VMR(-8)	-0.0021	-0.5978	0.0020	-0.0028	-0.4939	-0.0008	-0.0060	-0.9911	0.0120	-0.0078	-0.8539	0.0027
EMR(-9)/VMR(-9)	-0.0001	-0.0299	-0.0029	0.0008	0.1750	-0.0027	-0.0008	-0.1930	-0.0025	0.0003	0.0420	-0.0029
EMR(-10)/VMR(-10)	-0.0001	-0.0776	-0.0029	0.0019	0.5853	0.0000	-0.0005	-0.1647	-0.0025	0.0022	0.4112	-0.0016

Note: The table reports parameters of slope coefficient λ, t-stats, and adjusted R-square estimated from univariate regression of momentum coefficient γ_{mom} and Winner/Loser return R_{wml} on individual lagged macroeconomic variables from 1980 to 2008, respectively. Momentum portfolios are formed with share returns in past 12 months, and hold for 6 months. Momentum coefficient γ_{mom} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their formation returns. Winner/Loser return R_{wml} is the return spread in 'Winner' portfolio and 'Loser' portfolio. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A reports corresponding parameters for equal-(value-) weighted momentum coefficient γ_{mom}. Panel B reports corresponding parameters for equal-(value-) weighted Winner/Loser return $R_{wml.}$

Table 5.18 Univariate regression of momentum effect on individual lagged macroeconomic variables (Momentum 12/12)

	Panel A Momentum coefficient γ_{mom}						Panel B Winner/Loser return R_{wml}					
	Panel A1 Equal-weighted			Panel A2 Value-weighted			Panel B1 Equal-weighted			Panel B2 Value-weighted		
Macroeconomic variable	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t(λ)	Adj-R^2
GDP(Y)	-0.0230	-2.2841	0.0917	-0.0217	-2.1949	0.0497	-0.0376	-2.6357	0.0793	-0.0320	-2.1598	0.0302
UEXGDP(Y)	-0.0332	-2.1443	0.0816	-0.0318	-1.8946	0.0454	-0.0518	-2.3756	0.0638	-0.0451	-1.7937	0.0252
IP(M)	-2.6558	-1.9053	0.0029	-1.1004	-0.6280	-0.0024	-2.3829	-1.0331	-0.0015	-1.1190	-0.3694	-0.0028
IP(Q)	-2.8952	-1.5004	0.0114	-1.0584	-0.5073	-0.0018	-3.6551	-1.2873	0.0044	-2.1188	-0.6049	-0.0016
IP(H)	-2.7850	-1.6415	0.0258	-1.7136	-1.0409	0.0038	-4.3154	-1.7881	0.0194	-3.1869	-1.1351	0.0038
IP(Y)	-0.9893	-0.9067	0.0056	-0.7316	-0.6799	-0.0001	-1.8064	-1.1044	0.0063	-1.4974	-0.7692	0.0006
UEXIP(Q)	-0.0195	-1.6077	0.0109	-0.0089	-0.6571	-0.0012	-0.0202	-1.0949	0.0019	-0.0157	-0.6989	-0.0013
UEXIP(H)	-0.0223	-1.7329	0.0252	-0.0135	-1.0132	0.0034	-0.0299	-1.5929	0.0133	-0.0255	-1.1343	0.0036
UEXIP(Y)	-0.0141	-1.3179	0.0194	-0.0092	-0.8467	0.0030	-0.0215	-1.3844	0.0138	-0.0190	-1.0037	0.0043
IPM(M)	-2.2750	-1.5223	0.0016	-0.8453	-0.4840	-0.0026	-2.4876	-1.1298	-0.0012	-0.8487	-0.3066	-0.0029
IPM(Q)	-1.3283	-0.6703	0.0005	-0.1573	-0.0802	-0.0030	-1.0631	-0.3859	-0.0023	-0.3081	-0.0994	-0.0030
IPM(H)	-1.3970	-0.8805	0.0057	-0.5959	-0.4250	-0.0020	-2.0810	-0.9622	0.0033	-0.9929	-0.4290	-0.0022
IPM(Y)	-0.0951	-0.1146	-0.0029	0.2368	0.2880	-0.0026	-0.3504	-0.2643	-0.0025	0.5531	0.3706	-0.0023
UEXIPM(Q)	-0.0130	-1.0266	0.0039	-0.0044	-0.3342	-0.0025	-0.0112	-0.6274	-0.0013	-0.0070	-0.3396	-0.0026
UEXIPM(H)	-0.0122	-0.9561	0.0069	-0.0056	-0.4626	-0.0017	-0.0139	-0.7908	0.0011	-0.0102	-0.5211	-0.0017
UEXIPM(Y)	-0.0056	-0.6166	0.0017	-0.0008	-0.0888	-0.0029	-0.0084	-0.6337	0.0004	-0.0015	-0.1028	-0.0029
M0 (M)	-5.8471	-0.9285	0.0016	-6.4588	-0.9245	0.0005	-9.5578	-0.8194	0.0010	-15.1731	-1.0876	0.0026
M0 (Q)	-3.3782	-0.7361	0.0020	-0.7200	-0.1519	-0.0029	-9.2503	-1.2308	0.0091	-7.3849	-0.8001	0.0013
M0 (H)	0.0327	0.0076	-0.0030	1.0354	0.2577	-0.0024	-2.3184	-0.3251	-0.0014	-4.4150	-0.5405	0.0002
M0 (Y)	0.6166	0.1809	-0.0021	0.5772	0.1636	-0.0025	-1.0550	-0.1705	-0.0022	-3.3179	-0.4641	0.0015
UEXM0(Q)	-0.0001	-0.5832	0.0023	0.0000	-0.1548	-0.0027	-0.0001	-0.6722	0.0036	-0.0001	-0.4827	-0.0002
UEXM0 (H)	0.0000	-0.4276	0.0007	0.0000	-0.0003	-0.0030	-0.0001	-0.5539	0.0029	-0.0001	-0.3883	-0.0005
UEXM0 (Y)	0.0000	-0.3221	-0.0004	0.0000	-0.0098	-0.0030	0.0000	-0.4652	0.0024	-0.0001	-0.4302	0.0010
UNE (M)	1.7383	0.7199	0.0023	-1.1572	-0.5250	-0.0015	3.3938	0.9220	0.0036	0.2054	0.0500	-0.0030
UNE (Q)	0.6711	0.6059	0.0020	-0.4285	-0.4037	-0.0017	1.3685	0.8179	0.0037	0.0913	0.0489	-0.0030
UNE (H)	0.1386	0.2466	-0.0023	-0.2953	-0.5228	-0.0009	0.4940	0.5736	0.0000	-0.1078	-0.1130	-0.0029
UNE (Y)	-0.2299	-0.8370	0.0040	-0.3271	-0.8916	0.0059	-0.1386	-0.3116	-0.0022	-0.3124	-0.5478	-0.0006
UEXUNE(Q)	0.0337	0.3649	-0.0012	-0.0424	-0.4978	-0.0012	0.0716	0.5126	-0.0003	-0.0270	-0.1887	-0.0028
UEXUNE(H)	0.0110	0.2017	-0.0025	-0.0252	-0.4773	-0.0012	0.0328	0.3948	-0.0015	-0.0205	-0.2373	-0.0027
UEXUNE(Y)	-0.0105	-0.3658	-0.0015	-0.0220	-0.6722	0.0011	-0.0027	-0.0590	-0.0030	-0.0234	-0.4571	-0.0016
CPI (M)	-0.2294	-0.8399	0.0023	-0.4608	-1.5655	0.0104	-0.5122	-0.9745	0.0056	-1.1837	-1.8002	0.0227
CPI (Q)	-0.1849	-0.8287	0.0100	-0.3753	-1.5060	0.0303	-0.3525	-0.8307	0.0123	-0.8691	-1.5515	0.0487
CPI (H)	-0.1702	-0.9535	0.0241	-0.2998	-1.4886	0.0495	-0.3287	-1.0001	0.0298	-0.6317	-1.5125	0.0645
CPI (Y)	-0.0592	-0.5365	0.0046	-0.1015	-0.8295	0.0110	-0.1077	-0.5749	0.0052	-0.1544	-0.6578	0.0064
UEXCPI(Q)	0.0078	0.3058	-0.0017	-0.0074	-0.2876	-0.0023	0.0068	0.1597	-0.0027	-0.0243	-0.4933	-0.0008

Continued

UEXCPI(H)	0.0077	0.3656	-0.0005	-0.0067	-0.3107	-0.0018	0.0075	0.2095	-0.0022	-0.0169	-0.4148	-0.0008
UEXCPI(Y)	0.0088	0.6691	0.0050	-0.0021	-0.1547	-0.0027	0.0113	0.4871	0.0013	-0.0005	-0.0218	-0.0030
TBILL(M)	0.1968	1.2535	0.0022	0.1314	0.8291	-0.0016	0.4085	1.4520	0.0042	0.2599	0.8359	-0.0014
TBILL (Q)	0.1248	1.0656	0.0042	0.1083	0.8411	0.0004	0.2491	1.1528	0.0062	0.1586	0.6110	-0.0009
TBILL (H)	0.1006	1.0018	0.0069	0.1359	1.2016	0.0082	0.1451	0.7903	0.0037	0.1893	0.8548	0.0033
TBILL (Y)	0.1045	1.7491	0.0200	0.1466	1.9569	0.0252	0.1684	1.6394	0.0164	0.2742	2.1201	0.0257
UEXTBILL(Q)	31.4699	1.5937	0.0114	30.3698	1.7246	0.0054	62.8451	1.8061	0.0156	51.8052	1.4801	0.0040
UEXTBILL(H)	27.9316	1.5150	0.0166	30.9205	1.7267	0.0120	49.3265	1.5408	0.0168	50.0608	1.5133	0.0084
UEXTBILL(Y)	24.3336	1.6350	0.0252	29.2735	1.8051	0.0224	40.0870	1.5535	0.0218	50.2796	1.7986	0.0187
TERM(M)	-1.6553	-0.9638	-0.0004	-0.9620	-0.5298	-0.0025	-2.4157	-0.8984	-0.0012	-0.8035	-0.2341	-0.0029
TERM(Q)	-0.7819	-0.5362	-0.0014	-0.4793	-0.3076	-0.0026	-1.2449	-0.5269	-0.0017	-0.1799	-0.0601	-0.0030
TERM(H)	0.1901	0.1627	-0.0028	0.4346	0.3210	-0.0023	0.8117	0.4497	-0.0018	1.4293	0.5777	-0.0009
TERM(Y)	0.0183	0.0230	-0.0030	-0.1008	-0.1085	-0.0029	-0.3435	-0.2872	-0.0026	-0.5411	-0.3589	-0.0024
UEXTERM(Q)	-1.4329	-0.7204	-0.0002	-0.8868	-0.4339	-0.0023	-2.1360	-0.6756	-0.0009	-0.5977	-0.1525	-0.0029
UEXTERM(H)	-0.4240	-0.2381	-0.0026	0.1603	0.0813	-0.0030	-0.3517	-0.1261	-0.0029	1.2054	0.3291	-0.0024
UEXTERM(Y)	0.0035	0.0025	-0.0030	0.1120	0.0737	-0.0030	0.0427	0.0208	-0.0030	0.5079	0.1915	-0.0028
DY(M)	0.4558	1.4188	0.0063	0.6079	1.5144	0.0073	0.6673	1.0988	0.0034	1.5133	2.0360	0.0155
DY(Q)	0.5179	1.7343	0.0346	0.5563	1.4173	0.0241	0.9127	1.5625	0.0349	1.2711	1.7060	0.0380
DY(H)	0.3577	1.4572	0.0390	0.3113	1.0070	0.0168	0.5409	1.2596	0.0281	0.7281	1.2616	0.0285
DY(Y)	0.1205	0.7026	0.0083	0.0496	0.2394	-0.0018	0.1227	0.4619	0.0008	0.1547	0.4481	0.0004
UEXDY(Q)	15.2544	2.0306	0.0278	14.3086	1.4464	0.0139	22.2821	1.6212	0.0183	33.2396	1.8950	0.0234
UEXDY(H)	14.0720	1.9966	0.0436	11.9929	1.3108	0.0181	19.8938	1.6000	0.0272	27.6315	1.7179	0.0295
UEXDY(Y)	8.4133	1.5265	0.0323	5.5409	0.8153	0.0066	10.2372	1.1595	0.0140	14.2636	1.2507	0.0153
EMR(-1)/VMR(-1)	-0.1791	-1.8859	0.0955	-0.0008	-0.0031	-0.0030	-0.2959	-1.8061	0.0842	-0.0666	-0.1570	-0.0021
EMR(-2)/VMR(-2)	-0.0371	-0.5323	0.0076	0.0491	0.3659	0.0019	-0.0703	-0.6491	0.0093	0.0740	0.3059	0.0002
EMR(-3)/VMR(-3)	-0.0015	-0.0317	-0.0030	0.0175	0.2318	-0.0014	-0.0082	-0.1153	-0.0026	0.0191	0.1409	-0.0025
EMR(-4)/VMR(-4)	-0.0081	-0.3389	-0.0007	-0.0020	-0.0488	-0.0029	-0.0215	-0.5658	0.0023	-0.0248	-0.3181	-0.0010
EMR(-5)/VMR(-5)	-0.0011	-0.0755	-0.0029	0.0148	0.5529	0.0022	-0.0101	-0.4146	-0.0003	0.0003	0.0052	-0.0030
EMR(-6)/VMR(-6)	-0.0047	-0.4452	0.0004	-0.0006	-0.0381	-0.0030	-0.0119	-0.6766	0.0040	-0.0087	-0.2958	-0.0020
EMR(-7)/VMR(-7)	-0.0028	-0.3594	-0.0009	0.0085	0.6816	0.0028	-0.0092	-0.6870	0.0042	0.0051	0.2324	-0.0024
EMR(-8)/VMR(-8)	-0.0053	-0.7894	0.0088	-0.0019	-0.1907	-0.0025	-0.0135	-1.1547	0.0215	-0.0110	-0.6488	0.0018
EMR(-9)/VMR(-9)	-0.0004	-0.0865	-0.0029	0.0025	0.3343	-0.0015	-0.0021	-0.2887	-0.0019	0.0005	0.0375	-0.0030
EMR(-10)/VMR(-10)	-0.0005	-0.1844	-0.0026	0.0039	0.6573	0.0029	-0.0014	-0.2637	-0.0020	0.0047	0.4749	-0.0004

Note: The table reports parameters of slope coefficient λ, t-stats, and adjusted R-square estimated from univariate regression of momentum coefficient γ_{mom} and Winner/Loser return R_{wml} on individual lagged macroeconomic variables from 1980 to 2008, respectively. Momentum portfolios are formed with share returns in past 12 months, and hold for 12 months. Momentum coefficient γ_{mom} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their formation returns. Winner/Loser return R_{wml} is the return spread in 'Winner' portfolio and 'Loser' portfolio. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A reports corresponding parameters for equal-(value-) weighted momentum coefficient γ_{mom}. Panel B reports corresponding parameters for equal-(value-) weighted Winner/Loser return $R_{wml.}$

Table 5.19 Univariate regression of momentum effect on individual lagged macroeconomic variables (Momentum 12/18)

	Panel A Momentum coefficient γ_{mom}						Panel B Winner/Loser return R_{wml}					
	Panel A1 Equal-weighted			Panel A2 Value-weighted			Panel B1 Equal-weighted			Panel B2 Value-weighted		
Macroeconomic variable	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t(λ)	Adj-R^2
GDP(Y)	-0.0305	-2.2739	0.1061	-0.0250	-2.2500	0.0556	-0.0509	-2.6923	0.0955	-0.0425	-2.6080	0.0425
UEXGDP(Y)	-0.0438	-2.2010	0.0930	-0.0383	-2.0901	0.0559	-0.0727	-2.5541	0.0831	-0.0611	-2.2775	0.0372
IP(M)	-3.2266	-1.7177	0.0025	-1.9909	-1.0734	-0.0014	-3.0767	-1.0803	-0.0014	-3.5684	-1.1200	-0.0016
IP(Q)	-3.8792	-1.5694	0.0137	-1.8161	-0.8307	-0.0001	-5.0671	-1.5716	0.0062	-3.4286	-0.9637	-0.0002
IP(H)	-3.6131	-1.7749	0.0286	-2.0030	-1.1122	0.0048	-6.0173	-2.2301	0.0254	-4.5161	-1.4560	0.0076
IP(Y)	-1.4584	-1.1279	0.0091	-1.2358	-1.0639	0.0040	-3.2171	-1.6371	0.0162	-3.0229	-1.3869	0.0082
UEXIP(Q)	-0.0250	-1.5802	0.0118	-0.0141	-0.9839	0.0007	-0.0272	-1.2094	0.0027	-0.0271	-1.1533	0.0007
UEXIP(H)	-0.0285	-1.7711	0.0267	-0.0169	-1.1814	0.0054	-0.0401	-1.8567	0.0161	-0.0358	-1.4744	0.0070
UEXIP(Y)	-0.0183	-1.4224	0.0215	-0.0119	-1.0459	0.0052	-0.0320	-1.7458	0.0213	-0.0287	-1.3899	0.0099
IPM(M)	-2.0830	-1.0496	-0.0006	-1.0335	-0.5463	-0.0026	-2.0040	-0.7080	-0.0023	-2.5090	-0.7919	-0.0023
IPM(Q)	-1.3053	-0.5171	-0.0008	-0.2367	-0.1189	-0.0030	-1.1910	-0.3463	-0.0025	-0.4394	-0.1311	-0.0030
IPM(H)	-1.4351	-0.7780	0.0030	0.0565	0.0392	-0.0030	-2.4773	-0.9555	0.0028	-0.4424	-0.1700	-0.0029
IPM(Y)	-0.1415	-0.1460	-0.0029	0.3273	0.3310	-0.0024	-0.9731	-0.5795	-0.0006	0.1819	0.0949	-0.0030
UEXIPM(Q)	-0.0123	-0.7481	0.0010	-0.0048	-0.3578	-0.0026	-0.0100	-0.4322	-0.0022	-0.0093	-0.4180	-0.0025
UEXIPM(H)	-0.0122	-0.7752	0.0034	-0.0029	-0.2291	-0.0028	-0.0150	-0.6827	0.0001	-0.0080	-0.3737	-0.0024
UEXIPM(Y)	-0.0058	-0.5407	0.0002	0.0014	0.1596	-0.0029	-0.0120	-0.7283	0.0015	-0.0015	-0.0880	-0.0030
M0 (M)	-5.5479	-0.7478	-0.0004	-3.2524	-0.4814	-0.0023	-14.6767	-1.1035	0.0030	-17.0833	-1.1888	0.0024
M0 (Q)	-3.0711	-0.5280	-0.0004	1.6282	0.3240	-0.0024	-12.7001	-1.2895	0.0118	-8.5687	-0.7921	0.0014
M0 (H)	1.4916	0.2536	-0.0017	2.5976	0.5622	0.0002	-2.4632	-0.2436	-0.0019	-4.2205	-0.4125	-0.0008
M0 (Y)	1.1390	0.2489	-0.0011	1.8592	0.4394	0.0010	-2.5747	-0.3087	0.0001	-2.0406	-0.2286	-0.0017
UEXM0(Q)	0.0000	-0.3270	-0.0014	0.0000	0.1047	-0.0029	-0.0002	-0.8421	0.0086	-0.0002	-0.6057	0.0015
UEXM0 (H)	0.0000	-0.1173	-0.0028	0.0000	0.2459	-0.0020	-0.0001	-0.6085	0.0056	-0.0001	-0.4466	0.0006
UEXM0 (Y)	0.0000	-0.0405	-0.0030	0.0000	0.2216	-0.0020	-0.0001	-0.5180	0.0051	-0.0001	-0.4260	0.0013
UNE (M)	1.7618	0.5963	0.0005	-1.4995	-0.5738	-0.0010	4.8854	1.1091	0.0059	1.9800	0.4024	-0.0021
UNE (Q)	0.7303	0.5559	0.0008	-0.3949	-0.3281	-0.0022	2.1631	1.0865	0.0078	1.2693	0.5857	-0.0006
UNE (H)	0.1580	0.2365	-0.0024	-0.3308	-0.4793	-0.0009	0.9797	0.9442	0.0046	0.5302	0.4526	-0.0016
UNE (Y)	-0.3633	-1.0161	0.0084	-0.4500	-0.9743	0.0111	-0.0923	-0.1589	-0.0028	-0.1535	-0.2089	-0.0026
UEXUNE(Q)	0.0294	0.2597	-0.0021	-0.0541	-0.5276	-0.0006	0.1148	0.6797	0.0014	0.0341	0.1959	-0.0028
UEXUNE(H)	0.0084	0.1261	-0.0028	-0.0325	-0.5054	-0.0006	0.0635	0.6305	0.0007	0.0220	0.2065	-0.0028
UEXUNE(Y)	-0.0195	-0.5358	0.0003	-0.0330	-0.7921	0.0047	0.0058	0.1002	-0.0030	-0.0085	-0.1287	-0.0029
CPI (M)	-0.2280	-0.6770	0.0004	-0.3045	-0.9825	0.0018	-0.7327	-1.0998	0.0084	-1.0514	-1.4732	0.0126
CPI (Q)	-0.1800	-0.7142	0.0049	-0.2093	-0.8405	0.0056	-0.5596	-1.1297	0.0220	-0.6784	-1.1493	0.0214
CPI (H)	-0.1662	-0.8293	0.0138	-0.1553	-0.7798	0.0088	-0.5018	-1.3574	0.0469	-0.3948	-0.8820	0.0174
CPI (Y)	-0.0339	-0.2894	-0.0014	-0.0075	-0.0615	-0.0030	-0.1730	-0.8267	0.0107	0.0144	0.0587	-0.0030
UEXCPI(Q)	0.0128	0.4028	-0.0008	0.0078	0.2926	-0.0024	-0.0015	-0.0278	-0.0030	-0.0037	-0.0708	-0.0030

Continued

UEXCPI(H)	0.0112	0.4264	0.0004	0.0048	0.2153	-0.0025	-0.0042	-0.0928	-0.0029	0.0016	0.0373	-0.0030
UEXCPI(Y)	0.0107	0.6567	0.0047	0.0030	0.1994	-0.0026	0.0028	0.0953	-0.0029	0.0109	0.3881	-0.0013
TBILL(M)	0.2110	1.0460	0.0008	0.3015	1.5984	0.0033	0.3358	0.9542	0.0001	0.4754	1.2830	0.0012
TBILL (Q)	0.1157	0.7851	0.0010	0.2317	1.5995	0.0098	0.1539	0.5778	-0.0008	0.3723	1.1983	0.0059
TBILL (H)	0.0983	0.7853	0.0031	0.2073	1.6142	0.0188	0.0787	0.3395	-0.0018	0.3284	1.2908	0.0116
TBILL (Y)	0.1131	1.5319	0.0142	0.1998	2.2456	0.0403	0.1420	1.1510	0.0058	0.3743	2.6087	0.0376
UEXTBILL(Q)	30.3820	1.1414	0.0057	50.3954	2.2277	0.0163	48.9034	1.1008	0.0043	90.7217	2.0242	0.0137
UEXTBILL(H)	26.3070	1.0467	0.0083	45.4966	2.0133	0.0242	35.3051	0.8202	0.0036	81.6230	1.9127	0.0204
UEXTBILL(Y)	22.4869	1.1612	0.0126	38.2184	1.8497	0.0332	28.1732	0.8677	0.0049	71.4012	2.0980	0.0308
TERM(M)	-1.9074	-0.7860	-0.0008	-1.8753	-0.8479	-0.0013	-0.9390	-0.2622	-0.0029	-1.0729	-0.2672	-0.0029
TERM(Q)	-0.4333	-0.2354	-0.0027	-1.7303	-1.0038	0.0011	0.4948	0.1726	-0.0029	-2.0116	-0.5732	-0.0015
TERM(H)	0.8622	0.6053	-0.0003	-0.2072	-0.1461	-0.0029	2.4712	1.1378	0.0042	0.0744	0.0273	-0.0030
TERM(Y)	0.4582	0.4672	-0.0015	-0.3568	-0.3191	-0.0023	0.6576	0.4326	-0.0020	-1.1343	-0.5867	-0.0010
UEXTERM(Q)	-1.2557	-0.4764	-0.0016	-2.4404	-1.0434	0.0013	-0.0218	-0.0055	-0.0030	-2.3287	-0.5076	-0.0020
UEXTERM(H)	0.2481	0.1105	-0.0030	-1.1197	-0.5281	-0.0015	1.9979	0.5867	-0.0011	-0.8147	-0.1966	-0.0028
UEXTERM(Y)	0.7470	0.4300	-0.0015	-0.6490	-0.3777	-0.0021	2.0031	0.7763	0.0006	-0.9339	-0.3016	-0.0025
DY(M)	0.5148	1.3586	0.0047	0.7911	1.7795	0.0116	0.8236	1.0614	0.0034	2.2267	2.5123	0.0280
DY(Q)	0.5731	1.6810	0.0270	0.6203	1.4633	0.0253	1.0058	1.3940	0.0270	1.6639	2.0100	0.0515
DY(H)	0.3707	1.3353	0.0263	0.2587	0.7633	0.0085	0.4896	0.9432	0.0136	0.7441	1.2293	0.0224
DY(Y)	0.1362	0.7154	0.0063	0.1220	0.5584	0.0030	0.1102	0.3484	-0.0011	0.2979	0.8411	0.0066
UEXDY(Q)	16.7603	1.8846	0.0212	16.3226	1.4932	0.0154	23.6595	1.3788	0.0126	44.2619	2.0678	0.0334
UEXDY(H)	14.5494	1.7499	0.0295	10.3188	0.9922	0.0101	18.6570	1.2260	0.0143	30.0246	1.6099	0.0267
UEXDY(Y)	8.3306	1.2769	0.0195	4.9539	0.6300	0.0034	8.4139	0.7800	0.0044	15.5429	1.2149	0.0139
EMR(-1)/VMR(-1)	-0.1847	-1.5813	0.0651	-0.0611	-0.2725	-0.0009	-0.2985	-1.3701	0.0548	-0.2404	-0.5861	0.0060
EMR(-2)/VMR(-2)	-0.0291	-0.3502	0.0012	0.0083	0.0641	-0.0029	-0.0464	-0.3451	0.0004	-0.0127	-0.0532	-0.0030
EMR(-3)/VMR(-3)	0.0024	0.0431	-0.0030	-0.0144	-0.1912	-0.0021	0.0073	0.0845	-0.0029	-0.0599	-0.4228	0.0011
EMR(-4)/VMR(-4)	-0.0068	-0.2380	-0.0020	-0.0282	-0.6581	0.0046	-0.0115	-0.2552	-0.0021	-0.0871	-0.9942	0.0163
EMR(-5)/VMR(-5)	-0.0034	-0.1927	-0.0024	-0.0053	-0.1849	-0.0025	-0.0095	-0.3314	-0.0015	-0.0464	-0.8390	0.0085
EMR(-6)/VMR(-6)	-0.0069	-0.5342	0.0017	-0.0118	-0.6383	0.0022	-0.0096	-0.4293	-0.0001	-0.0328	-0.9253	0.0077
EMR(-7)/VMR(-7)	-0.0065	-0.6669	0.0041	0.0003	0.0174	-0.0030	-0.0126	-0.7528	0.0056	-0.0133	-0.4844	0.0000
EMR(-8)/VMR(-8)	-0.0092	-1.0772	0.0196	-0.0082	-0.6633	0.0046	-0.0180	-1.2194	0.0250	-0.0274	-1.2916	0.0196
EMR(-9)/VMR(-9)	-0.0016	-0.3301	-0.0018	-0.0008	-0.0977	-0.0029	-0.0024	-0.2900	-0.0021	-0.0090	-0.6083	0.0013
EMR(-10)/VMR(-10)	-0.0011	-0.3389	-0.0019	0.0023	0.3198	-0.0013	-0.0002	-0.0329	-0.0030	-0.0012	-0.0988	-0.0029

Note: The table reports parameters of slope coefficient λ, t-stats, and adjusted R-square estimated from univariate regression of momentum coefficient γ_{mom} and Winner/Loser return R_{wml} on individual lagged macroeconomic variables from 1980 to 2008, respectively. Momentum portfolios are formed with share returns in past 12 months, and hold for 18 months. Momentum coefficient γ_{mom} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their formation returns. Winner/Loser return R_{wml} is the return spread in 'Winner' portfolio and 'Loser' portfolio. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A reports corresponding parameters for equal-(value-) weighted momentum coefficient γ_{mom}. Panel B reports corresponding parameters for equal-(value-) weighted Winner/Loser return $R_{wml.}$

Table 5.20 Univariate regression of momentum effect on individual lagged macroeconomic variables (Momentum 12/24)

	Panel A Momentum coefficient γ_{mom}						Panel B Winner/Loser return R_{wml}					
	Panel A1 Equal-weighted			Panel A2 Value-weighted			Panel B1 Equal-weighted			Panel B2 Value-weighted		
Macroeconomic variable	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t(λ)	Adj-R^2
GDP(Y)	-0.0246	-1.8755	0.0587	-0.0177	-1.5679	0.0225	-0.0319	-1.6703	0.0277	-0.0360	-2.2176	0.0250
UEXGDP(Y)	-0.0388	-2.0223	0.0626	-0.0302	-1.7325	0.0288	-0.0542	-2.0155	0.0348	-0.0528	-2.1433	0.0228
IP(M)	-5.1010	-2.1931	0.0089	-2.8575	-1.4600	-0.0001	-6.8237	-1.7957	0.0033	-5.7626	-1.7595	0.0002
IP(Q)	-6.2598	-2.0536	0.0347	-2.9873	-1.4057	0.0038	-10.3011	-2.2365	0.0272	-6.3348	-1.7925	0.0051
IP(H)	-5.1836	-2.1518	0.0534	-2.2901	-1.3332	0.0058	-9.6553	-2.6815	0.0550	-5.7207	-1.9232	0.0116
IP(Y)	-1.6152	-1.1455	0.0099	-1.0581	-0.8853	0.0014	-3.0545	-1.3069	0.0106	-3.2022	-1.3973	0.0077
UEXIP(Q)	-0.0397	-2.0850	0.0294	-0.0223	-1.5759	0.0051	-0.0588	-1.9670	0.0180	-0.0462	-1.9737	0.0062
UEXIP(H)	-0.0423	-2.2414	0.0537	-0.0212	-1.5193	0.0084	-0.0710	-2.4968	0.0443	-0.0497	-2.0832	0.0135
UEXIP(Y)	-0.0247	-1.6805	0.0356	-0.0124	-1.0843	0.0047	-0.0451	-1.9645	0.0351	-0.0345	-1.6189	0.0130
IPM(M)	-3.2338	-1.5676	0.0020	-1.7508	-0.9391	-0.0019	-3.9939	-1.2469	-0.0008	-4.0469	-1.3212	-0.0014
IPM(Q)	-2.1705	-0.8318	0.0022	-0.8767	-0.4933	-0.0024	-3.0513	-0.8221	0.0000	-2.0124	-0.5952	-0.0021
IPM(H)	-2.2147	-1.1106	0.0093	0.1067	0.0852	-0.0031	-4.1993	-1.3842	0.0101	-0.9607	-0.3643	-0.0026
IPM(Y)	-0.1387	-0.1351	-0.0030	0.7546	0.8030	0.0001	-0.5721	-0.3001	-0.0024	0.3711	0.1839	-0.0029
UEXIPM(Q)	-0.0189	-1.1047	0.0051	-0.0097	-0.7834	-0.0014	-0.0231	-0.9264	0.0005	-0.0199	-0.9038	-0.0012
UEXIPM(H)	-0.0185	-1.1173	0.0097	-0.0043	-0.3926	-0.0025	-0.0283	-1.1765	0.0058	-0.0151	-0.7022	-0.0013
UEXIPM(Y)	-0.0080	-0.7049	0.0023	0.0036	0.4340	-0.0022	-0.0159	-0.8580	0.0031	-0.0029	-0.1606	-0.0030
M0 (M)	-6.1902	-0.7355	-0.0002	-2.8094	-0.4209	-0.0026	-15.4317	-0.9902	0.0022	-13.9832	-0.9270	0.0000
M0 (Q)	-3.7446	-0.5647	0.0003	2.6061	0.5184	-0.0018	-14.2901	-1.3456	0.0116	-4.9285	-0.4262	-0.0018
M0 (H)	-1.7858	-0.2896	-0.0015	1.1692	0.2459	-0.0026	-9.7335	-0.9683	0.0111	-5.0102	-0.4552	-0.0004
M0 (Y)	-0.7582	-0.1735	-0.0024	1.4268	0.3554	-0.0010	-7.3207	-0.9011	0.0169	-1.4050	-0.1470	-0.0026
UEXM0(Q)	0.0000	-0.2825	-0.0019	0.0001	0.3827	-0.0014	-0.0002	-0.8673	0.0075	-0.0001	-0.3043	-0.0020
UEXM0 (H)	0.0000	-0.2058	-0.0023	0.0000	0.4112	-0.0005	-0.0002	-0.8403	0.0104	-0.0001	-0.3183	-0.0013
UEXM0 (Y)	0.0000	-0.1678	-0.0024	0.0000	0.3732	-0.0006	-0.0001	-0.8108	0.0135	-0.0001	-0.3576	-0.0002
UNE (M)	2.6727	0.8496	0.0039	-1.5246	-0.5876	-0.0013	6.6127	1.3815	0.0097	3.1537	0.6147	-0.0010
UNE (Q)	1.1600	0.8214	0.0053	-0.4222	-0.3471	-0.0022	2.8690	1.3067	0.0120	1.9279	0.8424	0.0018
UNE (H)	0.3415	0.4771	-0.0006	-0.4157	-0.6118	-0.0001	1.1858	1.0225	0.0059	0.6509	0.5381	-0.0012
UNE (Y)	-0.3229	-0.9690	0.0047	-0.4826	-1.1322	0.0110	-0.0933	-0.1669	-0.0029	-0.0921	-0.1260	-0.0030
UEXUNE(Q)	0.0601	0.5056	0.0002	-0.0682	-0.7187	0.0003	0.1628	0.9103	0.0040	0.0660	0.3769	-0.0023
UEXUNE(H)	0.0267	0.3832	-0.0013	-0.0441	-0.7233	0.0008	0.0886	0.8257	0.0027	0.0328	0.3065	-0.0025
UEXUNE(Y)	-0.0127	-0.3530	-0.0019	-0.0397	-1.0322	0.0067	0.0124	0.2163	-0.0028	-0.0056	-0.0850	-0.0031
CPI (M)	-0.2762	-0.8692	0.0012	-0.1646	-0.4903	-0.0019	-0.9131	-1.3106	0.0109	-0.8455	-1.0530	0.0055
CPI (Q)	-0.2467	-0.9539	0.0099	-0.0897	-0.3350	-0.0017	-0.7860	-1.4596	0.0359	-0.5281	-0.7826	0.0095
CPI (H)	-0.2269	-1.0646	0.0239	-0.0830	-0.3798	-0.0002	-0.7019	-1.7078	0.0736	-0.3091	-0.6096	0.0076
CPI (Y)	-0.0428	-0.3258	-0.0009	0.0140	0.0975	-0.0029	-0.2147	-0.8981	0.0133	0.0474	0.1657	-0.0025
UEXCPI(Q)	-0.0010	-0.0311	-0.0031	0.0135	0.4612	-0.0014	-0.0315	-0.5607	0.0004	0.0069	0.1216	-0.0030

Continued

UEXCPI(H)	-0.0001	-0.0042	-0.0031	0.0101	0.4306	-0.0012	-0.0296	-0.6268	0.0031	0.0092	0.1900	-0.0027
UEXCPI(Y)	0.0073	0.4420	0.0000	0.0070	0.4210	-0.0008	-0.0040	-0.1369	-0.0028	0.0193	0.6232	0.0015
TBILL(M)	0.1283	0.6860	-0.0019	0.2978	1.4929	0.0023	0.2830	0.8450	-0.0013	0.4411	1.0517	0.0000
TBILL (Q)	0.0209	0.1424	-0.0030	0.2605	1.5957	0.0110	0.0220	0.0813	-0.0031	0.4104	1.1823	0.0062
TBILL (H)	0.0134	0.1006	-0.0030	0.2465	1.6859	0.0234	-0.0605	-0.2332	-0.0025	0.3950	1.4030	0.0149
TBILL (Y)	0.0837	0.8945	0.0050	0.2224	2.0099	0.0429	0.1078	0.6628	0.0009	0.4096	2.4584	0.0383
UEXTBILL(Q)	15.5642	0.6061	-0.0011	49.3403	1.9475	0.0130	34.6673	0.8543	-0.0002	92.0272	1.8583	0.0117
UEXTBILL(H)	8.8164	0.3476	-0.0020	48.0005	1.9410	0.0231	11.1636	0.2648	-0.0026	88.6499	1.9460	0.0206
UEXTBILL(Y)	11.7891	0.5678	0.0006	42.0674	1.8484	0.0349	15.0228	0.4395	-0.0013	79.7407	2.2385	0.0331
TERM(M)	-0.6574	-0.2546	-0.0029	-1.0833	-0.5375	-0.0026	0.4798	0.1236	-0.0031	-0.9675	-0.2494	-0.0030
TERM(Q)	0.5041	0.2598	-0.0027	-1.5329	-0.8810	-0.0002	0.5066	0.1676	-0.0030	-2.0367	-0.5768	-0.0018
TERM(H)	2.1062	1.1410	0.0109	-0.4825	-0.3089	-0.0025	3.8680	1.2714	0.0109	-0.2188	-0.0777	-0.0031
TERM(Y)	1.0408	0.8066	0.0040	-0.3022	-0.2317	-0.0026	1.1189	0.5461	-0.0007	-1.1675	-0.5659	-0.0012
UEXTERM(Q)	0.0470	0.0171	-0.0031	-1.9804	-0.8639	-0.0006	0.4036	0.0958	-0.0031	-2.3133	-0.5073	-0.0022
UEXTERM(H)	1.8795	0.7198	0.0015	-1.2801	-0.5801	-0.0014	3.4126	0.8456	0.0014	-1.1966	-0.2846	-0.0027
UEXTERM(Y)	2.0946	0.9493	0.0076	-0.7517	-0.3870	-0.0020	3.2953	0.9734	0.0048	-1.0553	-0.3294	-0.0025
DY(M)	0.5464	1.4143	0.0044	0.8841	1.9472	0.0127	0.9645	1.1780	0.0039	2.5589	2.8877	0.0321
DY(Q)	0.6426	1.8244	0.0297	0.7080	1.5854	0.0289	1.2097	1.5942	0.0314	1.8131	2.2657	0.0525
DY(H)	0.4527	1.5473	0.0350	0.4053	1.1289	0.0214	0.6967	1.2585	0.0236	0.9470	1.5610	0.0324
DY(Y)	0.2286	1.1326	0.0199	0.2850	1.1716	0.0256	0.2882	0.8403	0.0077	0.5201	1.4183	0.0222
UEXDY(Q)	18.1246	1.8917	0.0216	18.7088	1.5109	0.0180	29.5487	1.6516	0.0163	49.4656	2.1416	0.0360
UEXDY(H)	17.0768	1.9103	0.0358	14.2257	1.2186	0.0186	26.7679	1.7041	0.0253	35.8389	1.8347	0.0334
UEXDY(Y)	11.4543	1.6543	0.0340	9.6006	1.0689	0.0178	16.6815	1.5011	0.0202	22.3566	1.6764	0.0270
EMR(-1)/VMR(-1)	-0.1939	-1.5247	0.0622	-0.1157	-0.5197	0.0037	-0.3271	-1.3095	0.0520	-0.3574	-0.8495	0.0140
EMR(-2)/VMR(-2)	-0.0390	-0.4353	0.0035	-0.0605	-0.4464	0.0023	-0.0569	-0.3873	0.0011	-0.1405	-0.5347	0.0046
EMR(-3)/VMR(-3)	-0.0112	-0.1899	-0.0019	-0.0561	-0.7203	0.0088	-0.0120	-0.1286	-0.0027	-0.1370	-0.8901	0.0157
EMR(-4)/VMR(-4)	-0.0114	-0.3969	-0.0005	-0.0523	-1.1614	0.0196	-0.0183	-0.3913	-0.0011	-0.1347	-1.4265	0.0368
EMR(-5)/VMR(-5)	-0.0099	-0.5707	0.0014	-0.0251	-0.8275	0.0077	-0.0182	-0.6188	0.0014	-0.0794	-1.3187	0.0255
EMR(-6)/VMR(-6)	-0.0086	-0.6665	0.0033	-0.0236	-1.1247	0.0144	-0.0106	-0.4651	-0.0003	-0.0507	-1.1926	0.0184
EMR(-7)/VMR(-7)	-0.0091	-0.8946	0.0087	-0.0086	-0.5119	0.0009	-0.0160	-0.9133	0.0078	-0.0277	-0.8649	0.0079
EMR(-8)/VMR(-8)	-0.0099	-1.1168	0.0195	-0.0103	-0.7338	0.0070	-0.0178	-1.1744	0.0186	-0.0342	-1.3853	0.0265
EMR(-9)/VMR(-9)	-0.0019	-0.3315	-0.0016	-0.0026	-0.2615	-0.0020	-0.0015	-0.1502	-0.0028	-0.0132	-0.7611	0.0047
EMR(-10)/VMR(-10)	-0.0019	-0.4975	0.0000	0.0020	0.2546	-0.0019	-0.0007	-0.0981	-0.0030	-0.0025	-0.1665	-0.0027

Note: The table reports parameters of slope coefficient λ, t-stats, and adjusted R-square estimated from univariate regression of momentum coefficient γ_{mom} and Winner/Loser return R_{wml} on individual lagged macroeconomic variables from 1980 to 2008, respectively. Momentum portfolios are formed with share returns in past 12 months, and hold for 24 months. Momentum coefficient γ_{mom} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their formation returns. Winner/Loser return R_{wml} is the return spread in 'Winner' portfolio and 'Loser' portfolio. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A reports corresponding parameters for equal-(value-) weighted momentum coefficient γ_{mom}. Panel B reports corresponding parameters for equal-(value-) weighted Winner/Loser return $R_{wml.}$

Table 5.21 Multivariate regression of momentum effect on the combination of lagged macroeconomic variables (Momentum-12 months' formation length)

Panel A 3 months' holding length

	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	3		2		2		3	
Adj-R^2	0.1228		0.0813		0.0972		0.1064	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP (Y)	-0.0042	-1.9358	-0.0065	-2.0271	-0.0068	-2.1333	-0.0129	-2.5043
UEXTBILL(Y)	9.6828	2.9657	21.1592	2.8077	16.6478	2.9570	36.4822	3.0549
DY(Q)	0.1618	2.0106	0.2241	1.7694	0.2729	1.8105	0.3927	1.7035
CPI(H)			-0.1727	-2.2408			-0.3463	-2.6895
EMR(-1)	-0.0332	-1.4480			-0.0417	-0.9352		

Panel B 6 months' holding length

	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	5		5		5		5	
Adj-R^2	0.1753		0.2169		0.1574		0.2405	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP (Y)	-0.0098	-2.2378	-0.0113	-1.9985	-0.0148	-2.9137	-0.0186	-2.1934
UEXTBILL(Y)	11.0404	1.8311	41.7750	2.9912	18.6212	1.8318	75.0935	3.4077
DY(Q)	0.3220	2.7186	0.5015	2.3244	0.5484	2.3767	0.8348	2.2404
CPI(H)			-0.4046	-2.7780			-0.7718	-3.1972
EMR(-1)	-0.0680	-1.4979			-0.0933	-1.2439		

Panel C 12 months' holding length

	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	8		8		7		8	
Adj-R^2	0.1821		0.2157		0.1611		0.2296	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP (Y)	-0.0203	-2.6166	-0.0185	-2.2239	-0.0336	-2.8836	-0.0259	-1.9840
UEXTBILL(Y)	18.4719	1.6721	68.8807	2.7257	29.7813	1.4934	129.5681	2.9703
DY(Q)	0.3048	1.4829	0.4517	1.2245	0.5724	1.3327	1.0602	1.5924
CPI(H)			-0.5657	-2.4349			-1.1467	-2.3865
EMR(-1)	-0.1184	-1.3526			-0.1903	-1.2424		

Panel D 18 months' holding length

	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	8		9		8		9	
Adj-R^2	0.1621		0.1579		0.1416		0.1852	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP (Y)	-0.0286	-2.4460	-0.0230	-2.4644	-0.0486	-2.7199	-0.0390	-2.5309
UEXTBILL(Y)	15.3726	1.0874	63.8265	2.3120	15.3012	0.6144	126.1555	2.7390
DY(Q)	0.4220	1.7590	0.5192	1.3090	0.8247	1.6452	1.4598	1.9367
CPI(H)			-0.3979	-1.7883			-0.8910	-1.7935
EMR(-1)	-0.1022	-0.9540			-0.1523	-0.7347		

Continued

Panel E 24 months' holding length								
	Mometnum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	9		9		8		9	
Adj-R^2	0.1110		0.1051		0.0771		0.1492	
Macroeconomic variables	Λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP (Y)	-0.0225	-1.9572	-0.0164	-1.7342	-0.0285	-1.5882	-0.0333	-2.0110
UEXTBILL(Y)	3.9579	0.2176	60.9019	1.9711	0.9943	0.0307	126.7514	2.6215
DY(Q)	0.4851	1.9481	0.5866	1.3122	0.9225	1.7902	1.5788	2.0831
CPI(H)			-0.3230	-1.2777			-0.8174	-1.4216
EMR(-1)	-0.1183	-0.9867			-0.2074	-0.8660		

Note: This table presents slope coefficient λ, t-stats, and adjusted R^2 for multivariate regression of momentum coefficient γ_{mom}, and Winner/Loser return R_{wml} on the combination of lagged macroeconomic variables from January 1980 to December 2008. Momentum portfolios are formed with share returns in past 12 months, and hold for 3, 6, 12, 18, and 24 months, respectively. Momentum coefficient γ_{mom} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their formation returns. Winner/Loser return R_{wml} is the return spread in 'Winner' portfolio and 'Loser' portfolio. GDP(Y) is the change of GDP in past 12 months. UEXTBILL(Y) is unexpected change of TBILL in previous 12 months. DY(Q) is the change of DY in past 3 months. CPI(H) is the change of CPI in past 6 months. EMR(-1) is equal-weighted market return in past 12 months. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A to E report corresponding parameters for equal-(value-) weighted momentum coefficient γ_{mom} and Winner/Loser return R_{wml} with 3, 6, 12, 18, and 24 months' holding lengths, respectively.

Table 5.22 Multivariate regression of momentum effect on the combination of lagged macroeconomic variables in subperiods (Momentum 12/3)

Panel A April 1980-December 1989

	Momentum coefficient γ_{mom}				Long/short return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	1		2		4		2	
Adj-R^2	0.4903		0.1187		0.4195		0.1204	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	0.0010	0.7041	-0.0009	-0.2919	0.0007	0.2095	-0.0051	-1.0015
UEXTBILL(Y)	12.3718	4.8539	15.9565	3.3182	25.8601	4.1219	27.1335	3.0228
DY(Q)	0.0935	1.3249	0.1256	1.0294	0.0834	0.5124	0.0698	0.2934
CPI(H)			-0.0516	-1.0303			-0.0016	-0.0164
EMR(-1)	-0.0648	-5.0949			-0.1292	-3.1124		

Panel B January 1990-December 1999

	Momentum coefficient γ_{mom}				Long/short return R_{lms}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	2		1		2		1	
Adj-R^2	0.2392		0.0935		0.2232		0.0534	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0158	-3.7838	-0.0176	-2.9359	-0.0245	-3.8312	-0.0205	-2.4217
UEXTBILL(Y)	19.8662	2.8928	5.3491	0.3716	24.6615	2.5612	5.8236	0.2923
DY(Q)	0.1908	2.0191	0.2235	1.3828	0.2848	1.7226	0.3781	1.3547
CPI(H)			0.0994	0.9452			0.0717	0.4707
EMR(-1)	0.0508	1.1045			0.1424	2.0861		

Panel C January 2000-December 2008

	Momentum coefficient γ_{mom}				Long/short return R_{lms}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	2		4		2		5	
Adj-R^2	0.1498		0.2079		0.0919		0.2814	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0261	-1.9537	-0.0140	-0.7578	-0.0345	-1.5171	-0.0286	-0.7922
UEXTBILL(Y)	-34.3459	-1.7826	-14.5247	-0.3152	-59.8930	-1.2483	-16.6304	-0.2141
DY(Q)	0.0998	0.6013	0.0309	0.1211	0.2384	0.7080	0.1663	0.3527
CPI(H)			-0.3452	-2.3722			-0.7064	-3.5273
EMR(-1)	0.0278	0.5979			0.0430	0.4110		

Panel D April 1980-December 2008

	Momentum coefficient γ_{mom}				Long/short return R_{lms}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	3		2		2		3	
Adj-R^2	0.1228		0.0813		0.0972		0.1064	
Macroeconomic	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0042	-1.9358	-0.0065	-2.0271	-0.0068	-2.1333	-0.0129	-2.5043
UEXTBILL(Y)	9.6828	2.9657	21.1592	2.8077	16.6478	2.9570	36.4822	3.0549
DY(Q)	0.1618	2.0106	0.2241	1.7694	0.2729	1.8105	0.3927	1.7035
CPI(H)			-0.1727	-2.2408			-0.3463	-2.6895
EMR(-1)	-0.0332	-1.4480			-0.0417	-0.9352		

Note: This table presents slope coefficient λ, t-stats, and adjusted R^2 for multivariate regression of momentum coefficient γ_{mom}, and Winner/Loser return R_{wml} on the combination of lagged macroeconomic variables from January 1980 to December 2008. Momentum portfolios are formed with share returns in past 12 months, and hold for 3 months. Momentum coefficient γ_{mom} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their formation returns. Winner/Loser return R_{wml} is the return spread in 'Winner' portfolio and 'Loser' portfolio. GDP(Y) is the change of GDP in past 12 months. UEXTBILL(Y) is unexpected change of TBILL in previous 12 months. DY(Q) is the change of DY in past 3 months. CPI(H) is the change of CPI in past 6 months. EMR(-1) is equal-weighted market return in past 12 months. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A to D report corresponding parameters for equal-(value-) weighted momentum coefficient γ_{mom} and Winner/Loser return R_{wml} in the 1980s, the 1990s, from 2000 to 2008, and the whole sample period, respectively.

Table 5.23 Multivariate regression of momentum effect on the combination of lagged macroeconomic variables in subperiods (Momentum 12/6)

Panel A July 1980-December 1989

	Momentum coefficient γ_{mom}				Long/short return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	2		3		4		2	
Adj-R^2	0.5224		0.2178		0.4462		0.2210	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0008	-0.2866	-0.0005	-0.1148	-0.0036	-0.5546	-0.0059	-0.8136
UEXTBILL(Y)	19.7516	5.1568	30.6954	4.1912	37.2772	4.1377	48.2459	4.0154
DY(Q)	0.2708	2.3740	0.1413	0.9484	0.4396	1.6477	0.2752	0.7970
CPI(H)			-0.0945	-1.1304			0.0105	0.0744
EMR(-1)	-0.0844	-3.9728			-0.1647	-2.9579		

Panel B January 1990-December 1999

	Momentum coefficient γ_{mom}				Long/short return R_{lms}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	3		3		3		3	
Adj-R^2	0.3003		0.1883		0.2293		0.0872	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0251	-3.0544	-0.0317	-3.0719	-0.0356	-3.3118	-0.0332	-2.2186
UEXTBILL(Y)	11.4618	1.0923	-6.7839	-0.3092	9.6617	0.6608	-1.3927	-0.0386
DY(Q)	0.2835	2.0342	0.5031	2.2167	0.3538	1.8374	0.6059	2.0754
CPI(H)			0.1945	1.0526			0.1116	0.3916
EMR(-1)	-0.0116	-0.1479			0.0919	0.8578		

Panel C January 2000-December 2008

	Momentum coefficient γ_{mom}				Long/short return R_{lms}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	4		4		5		6	
Adj-R^2	0.2214		0.5410		0.1895		0.6152	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0585	-2.4802	-0.0308	-1.4501	-0.0880	-2.2294	-0.0613	-1.3904
UEXTBILL(Y)	-26.0910	-1.0190	88.2552	1.4754	-2.0367	-0.0427	191.0603	1.8091
DY(Q)	0.2967	1.2790	0.3799	1.3373	0.7958	1.7280	0.9086	1.7957
CPI(H)			-0.8136	-3.7452			-1.5944	-5.2715
EMR(-1)	0.0523	0.5506			0.0543	0.3264		

Panel D July 1980-December 2008

	Momentum coefficient γ_{mom}				Long/short return R_{lms}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	5		5		5		5	
Adj-R^2	0.1753		0.2169		0.1574		0.2405	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0098	-2.2378	-0.0113	-1.9985	-0.0148	-2.9137	-0.0186	-2.1934
UEXTBILL(Y)	11.0404	1.8311	41.7750	2.9912	18.6212	1.8318	75.0935	3.4077
DY(Q)	0.3220	2.7186	0.5015	2.3244	0.5484	2.3767	0.8348	2.2404
CPI(H)			-0.4046	-2.7780			-0.7718	-3.1972
EMR(-1)	-0.0680	-1.4979			-0.0933	-1.2439		

Note: This table presents slope coefficient λ, t-stats, and adjusted R^2 for multivariate regression of momentum coefficient γ_{mom}, and Winner/Loser return R_{wml} on the combination of lagged macroeconomic variables from January 1980 to December 2008. Momentum portfolios are formed with share returns in past 12 months, and hold for 6 months. Momentum coefficient γ_{mom} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their formation returns. Winner/Loser return R_{wml} is the return spread in 'Winner' portfolio and 'Loser' portfolio. GDP(Y) is the change of GDP in past 12 months. UEXTBILL(Y) is unexpected change of TBILL in previous 12 months. DY(Q) is the change of DY in past 3 months. CPI(H) is the change of CPI in past 6 months. EMR(-1) is equal-weighted market return in past 12 months. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A to D report corresponding parameters for equal-(value-) weighted momentum coefficient γ_{mom} and Winner/Loser return R_{wml} in the 1980s, the 1990s, from 2000 to 2008, and the whole sample period, respectively.

Table 5.24 Multivariate regression of momentum effect on the combination of lagged macroeconomic variables in subperiods (Momentum 12/12)

Panel A January 1981-December 1989

	Momentum coefficient γ_{mom}				Long/short return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	4		6		4		6	
Adj-R^2	0.3851		0.1366		0.3541		0.2637	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0128	-1.9113	-0.0025	-0.3440	-0.0300	-2.2834	-0.0077	-0.5876
UEXTBILL(Y)	25.9150	2.9540	35.7892	1.8411	49.8927	2.9455	53.1343	1.5763
DY(Q)	0.7010	2.3325	-0.0986	-0.4041	1.4067	2.2154	0.2415	0.5987
CPI(H)			0.0645	0.4968			0.5835	1.6462
EMR(-1)	-0.0604	-1.0746			-0.1578	-1.3777		

Panel B January 1990-December 1999

	Momentum coefficient γ_{mom}				Long/short return R_{lms}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	7		3		7		3	
Adj-R^2	0.3732		0.2631		0.2956		0.1713	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0344	-2.4792	-0.0447	-3.3189	-0.0505	-3.0409	-0.0429	-2.1712
UEXTBILL(Y)	10.9511	0.7018	21.2979	0.9152	9.8222	0.4049	53.7418	1.3283
DY(Q)	0.2622	1.2346	0.6051	1.5299	0.3320	0.9958	1.0679	1.8167
CPI(H)			0.1388	0.6348			-0.1680	-0.4768
EMR(-1)	-0.1566	-1.0640			-0.0458	-0.2618		

Panel C January 2000-December 2008

	Momentum coefficient γ_{mom}				Long/short return R_{lms}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	7		7		7		8	
Adj-R^2	0.1303		0.5348		0.0821		0.5923	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0743	-1.9155	-0.0351	-0.9664	-0.0852	-1.1354	-0.0487	-0.7557
UEXTBILL(Y)	-56.2767	-1.3326	161.3283	2.3506	-90.1294	-1.2185	387.9281	3.2166
DY(Q)	0.1045	0.2670	0.2846	0.6672	0.4726	0.5451	1.2139	1.6873
CPI(H)			-1.1905	-4.0484			-2.6110	-5.8173
EMR(-1)	0.0767	0.4221			0.0020	0.0056		

Panel D January 1981-December 2008

	Momentum coefficient γ_{mom}				Long/short return R_{lms}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	8		8		7		8	
Adj-R^2	0.1821		0.2157		0.1611		0.2296	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0203	-2.6166	-0.0185	-2.2239	-0.0336	-2.8836	-0.0259	-1.9840
UEXTBILL(Y)	18.4719	1.6721	68.8807	2.7257	29.7813	1.4934	129.5681	2.9703
DY(Q)	0.3048	1.4829	0.4517	1.2245	0.5724	1.3327	1.0602	1.5924
CPI(H)			-0.5657	-2.4349			-1.1467	-2.3865
EMR(-1)	-0.1184	-1.3526			-0.1903	-1.2424		

Note: This table presents slope coefficient λ, t-stats, and adjusted R^2 for multivariate regression of momentum coefficient γ_{mom}, and Winner/Loser return R_{wml} on the combination of lagged macroeconomic variables from January 1980 to December 2008. Momentum portfolios are formed with share returns in past 12 months, and hold for 12 months. Momentum coefficient γ_{mom} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their formation returns. Winner/Loser return R_{wml} is the return spread in 'Winner' portfolio and 'Loser' portfolio. GDP(Y) is the change of GDP in past 12 months. UEXTBILL(Y) is unexpected change of TBILL in previous 12 months. DY(Q) is the change of DY in past 3 months. CPI(H) is the change of CPI in past 6 months. EMR(-1) is equal-weighted market return in past 12 months. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A to D report corresponding parameters for equal-(value-) weighted momentum coefficient γ_{mom} and Winner/Loser return R_{wml} in the 1980s, the 1990s, from 2000 to 2008, and the whole sample period, respectively.

Table 5.25 Multivariate regression of momentum effect on the combination of lagged macroeconomic variables in subperiods (Momentum 12/18)

Panel A July 1981-December 1989								
	Momentum coefficient γ_{mom}				Long/short return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	3		6		4		7	
Adj-R^2	0.2570		0.1023		0.2848		0.2384	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0255	-2.3739	-0.0122	-1.4035	-0.0525	-2.5721	-0.0307	-1.9392
UEXTBILL(Y)	14.8199	1.1248	14.6500	0.6084	23.1169	0.9344	36.5113	0.8316
DY(Q)	1.0638	2.2854	-0.0098	-0.0304	2.0363	2.2028	0.4303	0.6667
CPI(H)			0.2238	1.3910			0.8627	1.6325
EMR(-1)	0.0794	0.7045			0.0515	0.2234		

Panel B January 1990-December 1999								
	Momentum coefficient γ_{mom}				Long/short return R_{lms}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	7		5		6		2	
Adj-R^2	0.2876		0.2996		0.2474		0.1615	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0364	-1.9036	-0.0702	-3.3863	-0.0512	-2.3189	-0.0151	-0.5946
UEXTBILL(Y)	9.1630	0.5155	-52.2884	-1.8113	3.6660	0.1523	117.1984	2.7403
DY(Q)	0.4257	1.5360	0.8793	2.8348	0.6213	1.6053	1.3144	2.1557
CPI(H)			0.5956	2.2216			-0.4590	-1.1931
EMR(-1)	-0.2090	-1.0058			-0.1154	-0.5048		

Panel C January 2000-December 2008								
	Momentum coefficient γ_{mom}				Long/short return R_{lms}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	7		5		8		8	
Adj-R^2	0.0556		0.5406		0.0319		0.4925	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0660	-1.6427	-0.0364	-0.7014	-0.0706	-0.7776	-0.0736	-1.0487
UEXTBILL(Y)	-29.8846	-0.4472	462.9111	3.3498	-65.6622	-0.5194	502.8608	3.8529
DY(Q)	-0.0099	-0.0208	1.2912	1.7458	0.5004	0.4709	2.1607	2.4730
CPI(H)			-2.3613	-6.4620			-2.4604	-6.1061
EMR(-1)	0.0479	0.2564			-0.0503	-0.1067		

Panel D July 1981-December 2008								
	Momentum coefficient γ_{mom}				Long/short return R_{lms}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	8		9		8		9	
Adj-R^2	0.1621		0.1579		0.1416		0.1852	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0286	-2.4460	-0.0230	-2.4644	-0.0486	-2.7199	-0.0390	-2.5309
UEXTBILL(Y)	15.3726	1.0874	63.8265	2.3120	15.3012	0.6144	126.1555	2.7390
DY(Q)	0.4220	1.7590	0.5192	1.3090	0.8247	1.6452	1.4598	1.9367
CPI(H)			-0.3979	-1.7883			-0.8910	-1.7935
EMR(-1)	-0.1022	-0.9540			-0.1523	-0.7347		

Note: This table presents slope coefficient λ, t-stats, and adjusted R^2 for multivariate regression of momentum coefficient γ_{mom}, and Winner/Loser return R_{wml} on the combination of lagged macroeconomic variables from January 1980 to December 2008. Momentum portfolios are formed with share returns in past 12 months, and hold for 18 months. Momentum coefficient γ_{mom} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their formation returns. Winner/Loser return R_{wml} is the return spread in 'Winner' portfolio and 'Loser' portfolio. GDP(Y) is the change of GDP in past 12 months. UEXTBILL(Y) is unexpected change of TBILL in previous 12 months. DY(Q) is the change of DY in past 3 months. CPI(H) is the change of CPI in past 6 months. EMR(-1) is equal-weighted market return in past 12 months. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A to D report corresponding parameters for equal-(value-) weighted momentum coefficient γ_{mom} and Winner/Loser return R_{wml} in the 1980s, the 1990s, from 2000 to 2008, and the whole sample period, respectively.

Table 5.26 Multivariate regression of momentum effect on the combination of lagged macroeconomic variables in subperiods (Momentum 12/24)

Panel A January 1982-December 1989

	Momentum coefficient γ_{mom}				Long/short return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	4		5		4		7	
Adj-R^2	0.0587		0.0061		0.0627		0.1896	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0145	-1.5145	-0.0044	-0.5873	-0.0218	-1.0883	-0.0268	-1.4989
UEXTBILLG(Y)	-6.5877	-0.3187	1.2262	0.0520	0.7289	0.0175	27.9906	0.6297
DY(Q)	1.2138	2.4816	0.2045	0.6499	2.3366	2.0976	0.7575	1.0029
CPI(H)			0.2186	0.9592			0.9747	1.2904
EMR(-1)	0.0682	0.6361			-0.0358	-0.1629		

Panel B January 1990-December 1999

	Momentum coefficient γ_{mom}				Long/short return R_{lms}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	8		4		8		2	
Adj-R^2	0.3183		0.2024		0.2817		0.1680	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0393	-2.2924	-0.0137	-0.6780	-0.0563	-2.8806	0.0018	0.0787
UEXTBILLG(Y)	6.0338	0.3805	96.5451	2.7664	-8.5234	-0.4138	135.8729	3.3175
DY(Q)	0.3191	1.2949	0.1771	0.3486	0.5730	1.7761	1.0960	1.4884
CPI(H)			-0.1035	-0.3620			-0.4148	-1.0360
EMR(-1)	-0.2277	-1.0550			-0.1192	-0.5012		

Panel C January 2000-December 2008

	Momentum coefficient γ_{mom}				Long/short return R_{lms}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	7		7		7		7	
Adj-R^2	0.0668		0.3892		0.0185		0.4320	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0877	-2.5308	-0.1115	-3.1314	-0.0853	-0.9576	-0.1255	-1.9521
UEXTBILLG(Y)	16.5707	0.2118	290.2160	3.4032	-8.0204	-0.0521	608.4799	4.0463
DY(Q)	0.1061	0.2376	0.7283	1.6760	0.6069	0.6216	2.3008	2.9312
CPI(H)			-0.9629	-3.4945			-2.4943	-4.8563
EMR(-1)	0.0675	0.3322			-0.0649	-0.1231		

Panel D January 1982-December 2008

	Momentum coefficient γ_{mom}				Long/short return R_{lms}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	9		9		8		9	
Adj-R^2	0.1110		0.1051		0.0771		0.1492	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0225	-1.9572	-0.0164	-1.7342	-0.0285	-1.5882	-0.0333	-2.0110
UEXTBILLG(Y)	3.9579	0.2176	60.9019	1.9711	0.9943	0.0307	126.7514	2.6215
DY(Q)	0.4851	1.9481	0.5866	1.3122	0.9225	1.7902	1.5788	2.0831
CPI(H)			-0.3230	-1.2777			-0.8174	-1.4216
EMR(-1)	-0.1183	-0.9867			-0.2074	-0.8660		

Note: This table presents slope coefficient λ, t-stats, and adjusted R^2 for multivariate regression of momentum coefficient γ_{mom}, and Winner/Loser return R_{wml} on the combination of lagged macroeconomic variables from January 1980 to December 2008. Momentum portfolios are formed with share returns in past 12 months, and hold for 24 months. Momentum coefficient γ_{mom} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their formation returns. Winner/Loser return R_{wml} is the return spread in 'Winner' portfolio and 'Loser' portfolio. GDP(Y) is the change of GDP in past 12 months. UEXTBILL(Y) is unexpected change of TBILL in previous 12 months. DY(Q) is the change of DY in past 3 months. CPI(H) is the change of CPI in past 6 months. EMR(-1) is equal-weighted market return in past 12 months. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A to D report corresponding parameters for equal-(value-) weighted momentum coefficient γ_{mom} and Winner/Loser return R_{wml} in the 1980s, the 1990s, from 2000 to 2008, and the whole sample period, respectively.

Table 5.27 Univariate regression of size effect on individual lagged macroeconomic variables (Size-3)

	Panel A Size coefficient γ_{size}						Panel B Small/Large return R_{sml}					
	Panel A1 Equal-weighted			Panel A2 Value-weighted			Panel B1 Equal-weighted			Panel B2 Value-weighted		
Macroeconomic variable	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t(λ)	Adj-R^2
GDP(Y)	0.0006	0.9040	0.0042	0.0005	0.8634	0.0040	0.0037	0.7425	0.0023	0.0034	0.7082	0.0021
UEXGDP(Y)	0.0008	0.7581	0.0028	0.0007	0.7383	0.0027	0.0054	0.6783	0.0018	0.0052	0.6766	0.0021
IP(M)	0.4048	3.0311	0.0142	0.3217	2.6506	0.0092	3.2028	3.0725	0.0152	2.4730	2.4573	0.0096
IP(Q)	0.3099	1.9601	0.0179	0.2384	1.5788	0.0109	2.7322	2.0892	0.0244	2.0708	1.6796	0.0153
IP(H)	0.1282	1.0511	0.0047	0.0802	0.6911	0.0004	1.4600	1.4126	0.0139	0.9945	0.9996	0.0061
IP(Y)	0.0057	0.0775	-0.0029	-0.0094	-0.1296	-0.0028	0.2231	0.3549	-0.0020	0.0689	0.1035	-0.0028
UEXIP(Q)	0.0026	2.6227	0.0297	0.0020	2.2058	0.0193	0.0218	2.6871	0.0351	0.0165	2.2130	0.0222
UEXIP(H)	0.0016	1.6811	0.0160	0.0011	1.2559	0.0077	0.0154	1.9251	0.0259	0.0109	1.4691	0.0140
UEXIP(Y)	0.0007	0.9454	0.0045	0.0004	0.6089	0.0002	0.0075	1.1778	0.0108	0.0047	0.7724	0.0033
IPM(M)	0.2735	1.8878	0.0053	0.1927	1.4382	0.0017	2.3775	2.1347	0.0076	1.6285	1.5485	0.0028
IPM(Q)	0.1573	1.0421	0.0033	0.0955	0.6440	-0.0004	1.3632	1.1320	0.0049	0.7461	0.6153	-0.0002
IPM(H)	0.0231	0.1939	-0.0026	-0.0129	-0.1143	-0.0028	0.3690	0.3766	-0.0016	-0.0098	-0.0100	-0.0029
IPM(Y)	-0.0441	-0.7941	0.0001	-0.0552	-1.0094	0.0023	-0.2963	-0.6555	-0.0006	-0.4260	-0.8889	0.0025
UEXIPM(Q)	0.0017	1.7073	0.0116	0.0012	1.2497	0.0049	0.0140	1.7835	0.0144	0.0092	1.2381	0.0057
UEXIPM(H)	0.0007	0.7141	0.0007	0.0003	0.3303	-0.0021	0.0063	0.8367	0.0028	0.0028	0.3744	-0.0016
UEXIPM(Y)	0.0001	0.1392	-0.0028	-0.0001	-0.2020	-0.0026	0.0014	0.2646	-0.0023	-0.0009	-0.1621	-0.0026
M0 (M)	0.2583	0.6058	-0.0018	0.1925	0.4609	-0.0022	2.4479	0.7972	-0.0013	1.7852	0.5957	-0.0019
M0 (Q)	0.1270	0.3404	-0.0021	0.1019	0.2915	-0.0023	1.0479	0.3695	-0.0019	1.0208	0.3959	-0.0018
M0 (H)	0.2694	1.1599	0.0052	0.2320	1.1503	0.0039	2.0753	1.0608	0.0053	1.7385	1.0731	0.0037
M0 (Y)	-0.0789	-0.4776	-0.0012	-0.0791	-0.5279	-0.0010	-0.5868	-0.4725	-0.0013	-0.5314	-0.4768	-0.0014
UEXM0(Q)	0.0000	-0.0472	-0.0029	0.0000	-0.0879	-0.0028	0.0000	-0.1325	-0.0028	0.0000	-0.1315	-0.0028
UEXM0 (H)	0.0000	0.0675	-0.0029	0.0000	0.0455	-0.0029	0.0000	-0.0468	-0.0029	0.0000	-0.0304	-0.0029
UEXM0 (Y)	0.0000	-0.1524	-0.0027	0.0000	-0.1867	-0.0026	0.0000	-0.2978	-0.0019	0.0000	-0.3222	-0.0020
UNE (M)	0.0683	0.4310	-0.0019	0.0945	0.6039	-0.0006	0.4121	0.3190	-0.0023	0.6316	0.4750	-0.0011
UNE (Q)	0.0551	0.7927	0.0013	0.0691	1.0336	0.0045	0.3967	0.6996	0.0008	0.5427	0.9595	0.0051
UNE (H)	0.0228	0.6328	-0.0005	0.0313	0.9077	0.0022	0.1662	0.5680	-0.0007	0.2627	0.9082	0.0034
UNE (Y)	0.0252	1.3525	0.0074	0.0276	1.5706	0.0111	0.2116	1.5006	0.0095	0.2404	1.7134	0.0156
UEXUNE(Q)	0.0046	0.7808	0.0014	0.0059	1.0410	0.0048	0.0321	0.6556	0.0006	0.0453	0.9537	0.0051
UEXUNE(H)	0.0026	0.7685	0.0009	0.0034	1.0446	0.0041	0.0186	0.6567	0.0003	0.0272	0.9911	0.0050
UEXUNE(Y)	0.0019	1.0389	0.0034	0.0023	1.2990	0.0070	0.0147	1.0026	0.0032	0.0189	1.3242	0.0088
CPI (M)	-0.0134	-0.8656	-0.0007	-0.0122	-0.8173	-0.0008	-0.0993	-0.9506	-0.0008	-0.0827	-0.8013	-0.0012
CPI (Q)	-0.0163	-1.4368	0.0095	-0.0146	-1.4482	0.0082	-0.1206	-1.5729	0.0086	-0.1051	-1.6497	0.0072
CPI (H)	-0.0153	-1.6576	0.0240	-0.0130	-1.5370	0.0188	-0.1174	-1.7570	0.0239	-0.0958	-1.6832	0.0178
CPI (Y)	-0.0146	-2.3151	0.0542	-0.0123	-2.3067	0.0426	-0.1087	-2.2628	0.0505	-0.0873	-2.2204	0.0370
UEXCPI(Q)	-0.0022	-1.8152	0.0093	-0.0019	-1.7235	0.0078	-0.0138	-1.6079	0.0054	-0.0109	-1.1192	0.0031

Continued

UEXCPI(H)	-0.0023	-2.2490	0.0238	-0.0022	-2.3353	0.0246	-0.0157	-2.2414	0.0187	-0.0150	-2.2091	0.0203
UEXCPI(Y)	-0.0019	-2.8702	0.0438	-0.0018	-2.9657	0.0435	-0.0138	-2.9885	0.0383	-0.0131	-3.0699	0.0402
TBILL(M)	-0.0361	-3.0302	0.0185	-0.0342	-2.8513	0.0187	-0.2581	-3.0093	0.0156	-0.2520	-2.7698	0.0176
TBILL (Q)	-0.0286	-3.4594	0.0435	-0.0260	-3.1783	0.0400	-0.2116	-3.7865	0.0400	-0.1959	-3.6894	0.0398
TBILL (H)	-0.0186	-3.0725	0.0387	-0.0165	-2.8767	0.0339	-0.1347	-3.1995	0.0340	-0.1173	-2.8923	0.0296
TBILL (Y)	-0.0215	-4.8180	0.1169	-0.0188	-4.5328	0.0995	-0.1586	-4.3967	0.1073	-0.1341	-4.2755	0.0885
UEXTBILL(Q)	-4.8231	-3.1896	0.0385	-4.4679	-2.9540	0.0370	-36.5712	-3.6439	0.0374	-34.8512	-3.3954	0.0396
UEXTBILL(H)	-3.7968	-3.0351	0.0415	-3.5061	-2.8683	0.0396	-28.6622	-3.4592	0.0399	-27.1160	-3.3265	0.0416
UEXTBILL(Y)	-3.8986	-4.4020	0.0856	-3.5530	-4.2089	0.0796	-28.8310	-4.6259	0.0790	-26.1355	-4.3807	0.0752
TERM(M)	0.2792	1.8288	0.0060	0.2675	1.7324	0.0063	2.0251	1.9057	0.0050	1.9773	1.7405	0.0059
TERM(Q)	0.3210	2.4299	0.0309	0.2955	2.3189	0.0292	2.5983	2.7688	0.0345	2.4244	2.6322	0.0350
TERM(H)	0.1901	2.0023	0.0219	0.1717	1.9516	0.0198	1.4775	2.0944	0.0224	1.3547	2.0765	0.0218
TERM(Y)	0.2174	3.1593	0.0641	0.1970	3.2694	0.0588	1.4958	2.7583	0.0507	1.3458	3.0117	0.0475
UEXTERM(Q)	0.3974	2.3320	0.0239	0.3694	2.2140	0.0231	3.1212	2.5800	0.0251	2.9318	2.3696	0.0258
UEXTERM(H)	0.3427	2.2433	0.0304	0.3124	2.1516	0.0282	2.7511	2.5306	0.0334	2.5510	2.4860	0.0333
UEXTERM(Y)	0.3243	2.8544	0.0527	0.2967	2.9654	0.0493	2.3464	2.8153	0.0463	2.1573	2.8815	0.0454
DY(M)	0.0047	0.1845	-0.0028	0.0082	0.3290	-0.0025	-0.0189	-0.0961	-0.0029	0.0135	0.0704	-0.0029
DY(Q)	0.0070	0.3255	-0.0021	0.0055	0.2644	-0.0023	0.0305	0.1790	-0.0026	0.0051	0.0327	-0.0029
DY(H)	-0.0046	-0.2862	-0.0020	-0.0086	-0.5897	0.0004	-0.0097	-0.0707	-0.0029	-0.0596	-0.5334	-0.0001
DY(Y)	-0.0045	-0.4194	-0.0010	-0.0055	-0.5415	0.0003	-0.0189	-0.2366	-0.0023	-0.0310	-0.4405	-0.0011
UEXDY(Q)	-0.2634	-0.3873	-0.0018	-0.2357	-0.3420	-0.0019	-3.0170	-0.5830	-0.0004	-3.0291	-0.6092	0.0000
UEXDY(H)	-0.4147	-0.7603	0.0021	-0.4685	-0.8654	0.0043	-3.4286	-0.7602	0.0029	-4.3297	-1.0309	0.0078
UEXDY(Y)	-0.4022	-1.0786	0.0070	-0.4299	-1.2260	0.0099	-2.8111	-0.9422	0.0053	-3.2864	-1.2429	0.0101
EMR(-1)/VMR(-1)	0.0086	1.8760	0.0266	0.0073	0.8605	0.0057	0.0911	2.6316	0.0529	0.0954	1.6050	0.0228
EMR(-2)/VMR(-2)	0.0029	0.8893	0.0054	0.0052	0.9248	0.0096	0.0308	1.2315	0.0128	0.0449	1.1761	0.0133
EMR(-3)/VMR(-3)	0.0010	0.3966	-0.0008	0.0037	1.1059	0.0131	0.0167	0.8989	0.0070	0.0349	1.5086	0.0218
EMR(-4)/VMR(-4)	0.0007	0.3938	-0.0007	0.0026	1.2286	0.0147	0.0102	0.7755	0.0050	0.0220	1.5034	0.0187
EMR(-5)/VMR(-5)	0.0001	0.0837	-0.0028	0.0018	1.1978	0.0139	0.0042	0.4841	0.0002	0.0145	1.3947	0.0164
EMR(-6)/VMR(-6)	0.0003	0.4310	-0.0009	0.0014	1.4511	0.0173	0.0047	0.8169	0.0042	0.0117	1.6955	0.0218
EMR(-7)/VMR(-7)	0.0003	0.5794	0.0007	0.0010	1.2003	0.0160	0.0043	0.9416	0.0074	0.0083	1.4028	0.0193
EMR(-8)/VMR(-8)	0.0003	0.7533	0.0019	0.0006	1.0599	0.0094	0.0037	1.1770	0.0095	0.0051	1.2803	0.0115
EMR(-9)/VMR(-9)	0.0003	0.8139	0.0038	0.0004	0.8695	0.0064	0.0031	1.2716	0.0132	0.0039	1.1512	0.0120
EMR(-10)/VMR(-10)	0.0003	1.2663	0.0155	0.0003	0.6700	0.0029	0.0028	1.4784	0.0218	0.0017	0.6788	0.0017

Note: The table reports parameters of slope coefficient λ, t-stats, and adjusted R-square estimated from univariate regression of size coefficient γ_{mv} and Small/Large return R_{sml} on individual lagged macroeconomic variables from 1980 to 2008, respectively. Size decile portfolios are formed with shares' market values at the end of each month, and hold for 3 months. Size coefficient γ_{mv} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their log mean market values. Small/Large return R_{sml} is the return spread between 'Small' portfolio and 'Large' portfolio. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A reports corresponding parameters for equal-(value-) weighted size coefficient γ_{mv}. Panel B reports corresponding parameters for equal-(value-) weighted Small/Large return $R_{sml.}$

Table 5.28 Univariate regression of size effect on individual lagged macroeconomic variables (Size-6)

	Panel A Size coefficient γ_{size}						Panel B Small/Large return R_{sml}					
	Panel A1 Equal-weighted			Panel A2 Value-weighted			Panel B1 Equal-weighted			Panel B2 Value-weighted		
Macroeconomic variable	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t(λ)	Adj-R^2
GDP(Y)	0.0012	1.0654	0.0090	0.0010	0.8907	0.0072	0.0089	1.0276	0.0086	0.0070	0.7668	0.0056
UEXGDP(Y)	0.0013	0.7394	0.0033	0.0011	0.6306	0.0024	0.0100	0.7342	0.0033	0.0079	0.5464	0.0018
IP(M)	0.3080	1.7404	0.0009	0.1934	1.1700	-0.0012	2.8881	1.9996	0.0028	1.6801	1.2472	-0.0006
IP(Q)	0.2242	0.9785	0.0012	0.1072	0.4923	-0.0018	2.9113	1.5225	0.0090	1.6439	0.8562	0.0016
IP(H)	0.0900	0.4463	-0.0015	0.0010	0.0050	-0.0029	1.4046	0.8275	0.0031	0.3486	0.2057	-0.0025
IP(Y)	-0.0276	-0.2077	-0.0026	-0.0619	-0.4860	-0.0011	0.1038	0.0987	-0.0029	-0.3106	-0.2884	-0.0021
UEXIP(Q)	0.0017	1.2461	0.0025	0.0009	0.7185	-0.0012	0.0194	1.6914	0.0085	0.0109	0.9994	0.0014
UEXIP(H)	0.0010	0.6722	-0.0002	0.0002	0.1675	-0.0028	0.0143	1.1597	0.0066	0.0057	0.4806	-0.0011
UEXIP(Y)	0.0002	0.1374	-0.0028	-0.0003	-0.2557	-0.0024	0.0050	0.5089	-0.0007	-0.0002	-0.0226	-0.0029
IPM(M)	0.1473	0.7280	-0.0020	0.0394	0.2071	-0.0029	1.4131	0.8727	-0.0015	0.2288	0.1458	-0.0029
IPM(Q)	0.0276	0.1067	-0.0029	-0.0639	-0.2619	-0.0025	0.7732	0.3748	-0.0020	-0.2814	-0.1400	-0.0028
IPM(H)	-0.0510	-0.2445	-0.0024	-0.1236	-0.6387	0.0009	-0.1104	-0.0658	-0.0029	-1.0319	-0.6523	0.0017
IPM(Y)	-0.1115	-1.0524	0.0045	-0.1305	-1.3116	0.0088	-0.7338	-0.9390	0.0025	-0.9890	-1.3222	0.0090
UEXIPM(Q)	0.0004	0.2882	-0.0026	-0.0002	-0.1444	-0.0028	0.0066	0.5355	-0.0015	-0.0004	-0.0366	-0.0029
UEXIPM(H)	-0.0002	-0.1588	-0.0027	-0.0008	-0.5769	-0.0003	0.0013	0.1036	-0.0028	-0.0057	-0.4811	-0.0008
UEXIPM(Y)	-0.0007	-0.7011	0.0009	-0.0010	-1.0579	0.0058	-0.0040	-0.4878	-0.0010	-0.0078	-0.9963	0.0060
M0 (M)	1.0687	1.5613	0.0044	0.8652	1.4134	0.0026	8.2310	1.3876	0.0045	6.0782	1.1631	0.0019
M0 (Q)	0.8478	1.5821	0.0122	0.7393	1.6383	0.0103	6.1356	1.2797	0.0105	5.1783	1.3435	0.0085
M0 (H)	0.4016	0.9444	0.0042	0.3291	0.8878	0.0026	2.7938	0.7619	0.0029	2.1812	0.6957	0.0013
M0 (Y)	-0.2633	-0.8396	0.0046	-0.2475	-0.8716	0.0047	-2.2736	-0.9684	0.0066	-1.9982	-0.9646	0.0059
UEXM0(Q)	0.0000	0.5344	0.0002	0.0000	0.5560	0.0002	0.0000	0.3918	-0.0011	0.0000	0.4621	-0.0006
UEXM0 (H)	0.0000	0.3995	-0.0007	0.0000	0.4420	-0.0004	0.0000	0.2452	-0.0020	0.0000	0.3320	-0.0013
UEXM0 (Y)	0.0000	-0.1064	-0.0028	0.0000	-0.0767	-0.0029	0.0000	-0.2410	-0.0021	0.0000	-0.1563	-0.0026
UNE (M)	0.1981	0.7449	0.0005	0.2721	1.0898	0.0044	1.1640	0.5377	-0.0010	2.0978	1.0160	0.0048
UNE (Q)	0.0885	0.7227	0.0012	0.1249	1.0870	0.0066	0.5406	0.5531	-0.0003	1.0022	1.0790	0.0079
UNE (H)	0.0631	0.9582	0.0044	0.0811	1.2958	0.0109	0.4613	0.9211	0.0037	0.6912	1.4380	0.0149
UNE (Y)	0.0498	1.2512	0.0130	0.0558	1.4792	0.0200	0.4092	1.4000	0.0153	0.4846	1.7200	0.0278
UEXUNE(Q)	0.0081	0.7881	0.0022	0.0110	1.1447	0.0078	0.0484	0.5846	0.0001	0.0852	1.0912	0.0085
UEXUNE(H)	0.0053	0.8536	0.0032	0.0070	1.1903	0.0092	0.0346	0.7026	0.0014	0.0562	1.1987	0.0107
UEXUNE(Y)	0.0043	1.1294	0.0090	0.0050	1.3973	0.0159	0.0313	1.1093	0.0080	0.0407	1.5034	0.0192
CPI (M)	-0.0450	-1.4703	0.0070	-0.0379	-1.3484	0.0052	-0.3351	-1.5660	0.0064	-0.2700	-1.4874	0.0043
CPI (Q)	-0.0397	-1.5484	0.0260	-0.0325	-1.3928	0.0192	-0.3125	-1.6749	0.0274	-0.2428	-1.5409	0.0190
CPI (H)	-0.0321	-1.5099	0.0436	-0.0260	-1.3415	0.0322	-0.2457	-1.5394	0.0433	-0.1885	-1.3463	0.0297
CPI (Y)	-0.0295	-2.0145	0.0889	-0.0246	-1.9452	0.0700	-0.2237	-2.1036	0.0863	-0.1767	-2.1377	0.0638
UEXCPI(Q)	-0.0055	-2.3298	0.0273	-0.0053	-2.4702	0.0300	-0.0396	-2.2407	0.0241	-0.0399	-2.5611	0.0298

Continued

UEXCPI(H)	-0.0051	-2.5594	0.0509	-0.0050	-2.6705	0.0557	-0.0383	-2.5497	0.0480	-0.0385	-2.7875	0.0589
UEXCPI(Y)	-0.0040	-2.9378	0.0782	-0.0038	-3.0282	0.0787	-0.0305	-3.0572	0.0763	-0.0288	-3.2834	0.0818
TBILL(M)	-0.0466	-2.0391	0.0112	-0.0420	-1.9364	0.0102	-0.3521	-2.1989	0.0107	-0.3267	-2.1351	0.0111
TBILL (Q)	-0.0409	-2.3750	0.0344	-0.0361	-2.2443	0.0305	-0.2916	-2.3856	0.0293	-0.2567	-2.2994	0.0270
TBILL (H)	-0.0457	-3.6427	0.0963	-0.0401	-3.6988	0.0846	-0.3299	-3.3275	0.0846	-0.2764	-3.3157	0.0707
TBILL (Y)	-0.0372	-4.3936	0.1385	-0.0326	-4.4354	0.1214	-0.2748	-4.1630	0.1276	-0.2323	-4.1452	0.1088
UEXTBILL(Q)	-6.1579	-2.1411	0.0237	-5.6850	-2.0593	0.0231	-44.9869	-2.2500	0.0212	-42.8132	-2.1830	0.0232
UEXTBILL(H)	-6.9404	-2.8183	0.0557	-6.3974	-2.8296	0.0541	-50.2434	-2.8237	0.0491	-46.5550	-2.8628	0.0506
UEXTBILL(Y)	-7.3228	-3.7671	0.1204	-6.6211	-3.8897	0.1126	-53.8241	-3.7680	0.1099	-47.6256	-3.9726	0.1029
TERM(M)	0.4492	1.5167	0.0062	0.4193	1.4957	0.0062	3.5715	1.6586	0.0068	3.3924	1.6437	0.0076
TERM(Q)	0.4554	1.8951	0.0239	0.4130	1.9119	0.0223	3.4796	1.8817	0.0236	3.2149	1.8959	0.0242
TERM(H)	0.4166	2.3166	0.0439	0.3840	2.4687	0.0427	2.8710	2.0390	0.0348	2.6655	2.2520	0.0360
TERM(Y)	0.3263	2.4151	0.0566	0.2999	2.4238	0.0547	2.1512	2.0834	0.0409	1.9453	2.3289	0.0400
UEXTERM(Q)	0.5875	1.7828	0.0202	0.5367	1.7706	0.0192	4.6352	1.8477	0.0214	4.3174	1.8436	0.0224
UEXTERM(H)	0.5892	2.0607	0.0359	0.5381	2.1418	0.0341	4.3754	2.0028	0.0333	4.0672	2.0994	0.0346
UEXTERM(Y)	0.5732	2.5477	0.0655	0.5274	2.7128	0.0635	3.9142	2.2582	0.0511	3.5925	2.4950	0.0516
DY(M)	0.0031	0.0607	-0.0029	-0.0047	-0.1051	-0.0029	0.0857	0.1981	-0.0027	-0.0086	-0.0224	-0.0029
DY(Q)	0.0020	0.0462	-0.0029	-0.0066	-0.1759	-0.0026	0.0728	0.2002	-0.0023	-0.0202	-0.0642	-0.0029
DY(H)	-0.0193	-0.6808	0.0030	-0.0233	-0.8999	0.0070	-0.0821	-0.3618	-0.0011	-0.1274	-0.6390	0.0023
DY(Y)	-0.0140	-0.6823	0.0045	-0.0139	-0.7037	0.0054	-0.0654	-0.4372	-0.0002	-0.0593	-0.4198	-0.0003
UEXDY(Q)	-0.8359	-0.7123	0.0016	-0.9694	-0.8730	0.0040	-5.7020	-0.5807	0.0006	-7.5103	-0.7900	0.0044
UEXDY(H)	-1.0170	-1.0924	0.0089	-1.1274	-1.3087	0.0137	-6.8116	-0.8645	0.0061	-8.1969	-1.1265	0.0127
UEXDY(Y)	-0.8013	-1.1833	0.0126	-0.8285	-1.3006	0.0161	-5.0014	-0.9372	0.0073	-5.3155	-1.0917	0.0109
EMR(-1)/VMR(-1)	0.0102	1.1119	0.0131	0.0076	0.4369	0.0007	0.1084	1.6078	0.0275	0.1110	0.8623	0.0109
EMR(-2)/VMR(-2)	0.0024	0.3637	-0.0007	0.0055	0.4939	0.0027	0.0322	0.6573	0.0038	0.0493	0.6228	0.0049
EMR(-3)/VMR(-3)	0.0000	-0.0058	-0.0029	0.0049	0.7216	0.0084	0.0144	0.3907	-0.0001	0.0499	0.9869	0.0175
EMR(-4)/VMR(-4)	0.0006	0.1606	-0.0024	0.0048	1.0847	0.0205	0.0117	0.4619	0.0011	0.0381	1.2485	0.0232
EMR(-5)/VMR(-5)	-0.0005	-0.2396	-0.0018	0.0023	0.7852	0.0085	0.0013	0.0799	-0.0028	0.0187	0.9350	0.0102
EMR(-6)/VMR(-6)	0.0003	0.2209	-0.0021	0.0022	1.0986	0.0165	0.0059	0.5410	0.0016	0.0178	1.2744	0.0203
EMR(-7)/VMR(-7)	0.0002	0.2143	-0.0022	0.0014	0.8019	0.0113	0.0046	0.5520	0.0018	0.0108	0.8956	0.0120
EMR(-8)/VMR(-8)	0.0005	0.5724	0.0019	0.0010	0.8038	0.0102	0.0063	0.9964	0.0108	0.0077	0.8805	0.0104
EMR(-9)/VMR(-9)	0.0004	0.5844	0.0030	0.0004	0.4396	0.0010	0.0045	0.9227	0.0103	0.0037	0.5530	0.0025
EMR(-10)/VMR(-10)	0.0006	1.0306	0.0217	0.0003	0.4138	0.0015	0.0051	1.2712	0.0285	0.0018	0.3160	-0.0008

Note: The table reports parameters of slope coefficient λ, t-stats, and adjusted R-square estimated from univariate regression of size coefficient γ_{mv} and Small/Large return R_{sml} on individual lagged macroeconomic variables from 1980 to 2008, respectively. Size decile portfolios are formed with shares' market values at the end of each month, and hold for 6 months. Size coefficient γ_{mv} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their log mean market values. Small/Large return R_{sml} is the return spread between 'Small' portfolio and 'Large' portfolio. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A reports corresponding parameters for equal-(value-) weighted size coefficient γ_{mv}. Panel B reports corresponding parameters for equal-(value-) weighted Small/Large return $R_{sml.}$

Table 5.29 Univariate regression of size effect on individual lagged macroeconomic variables (Size-12)

	Panel A Size coefficient γ_{size}						Panel B Small/Large return R_{sml}					
	Panel A1 Equal-weighted			Panel A2 Value-weighted			Panel B1 Equal-weighted			Panel B2 Value-weighted		
Macroeconomic variable	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t(λ)	Adj-R^2
GDP(Y)	0.0035	1.8897	0.0371	0.0029	1.6411	0.0313	0.0312	2.1453	0.0490	0.0247	1.7284	0.0394
UEXGDP(Y)	0.0041	1.4963	0.0201	0.0034	1.2778	0.0169	0.0361	1.7273	0.0268	0.0283	1.3313	0.0208
IP(M)	0.0353	0.1491	-0.0030	-0.1264	-0.5312	-0.0027	1.0906	0.5435	-0.0027	-0.8124	-0.3880	-0.0028
IP(Q)	-0.1325	-0.3880	-0.0024	-0.2891	-0.8813	0.0002	0.4133	0.1442	-0.0029	-1.5566	-0.5353	-0.0014
IP(H)	-0.0669	-0.2159	-0.0027	-0.1765	-0.6016	-0.0004	0.3603	0.1411	-0.0029	-1.0475	-0.4129	-0.0014
IP(Y)	-0.0839	-0.3799	-0.0019	-0.1517	-0.7266	0.0015	-0.2088	-0.1249	-0.0029	-1.1118	-0.7114	0.0012
UEXIP(Q)	-0.0007	-0.3503	-0.0027	-0.0017	-0.8903	-0.0005	0.0030	0.1794	-0.0029	-0.0096	-0.5642	-0.0017
UEXIP(H)	-0.0009	-0.4094	-0.0021	-0.0019	-0.8601	0.0013	0.0008	0.0417	-0.0030	-0.0108	-0.5792	-0.0004
UEXIP(Y)	-0.0010	-0.5026	-0.0011	-0.0016	-0.8777	0.0034	-0.0028	-0.1881	-0.0027	-0.0110	-0.7657	0.0023
IPM(M)	-0.1791	-0.7060	-0.0025	-0.3225	-1.2574	-0.0010	-0.7133	-0.3542	-0.0029	-2.4709	-1.1443	-0.0009
IPM(Q)	-0.5326	-1.5909	0.0073	-0.6255	-2.0034	0.0142	-3.4172	-1.3233	0.0039	-4.7711	-2.0035	0.0145
IPM(H)	-0.3997	-1.3626	0.0100	-0.4508	-1.6733	0.0171	-2.6916	-1.2265	0.0067	-3.5021	-1.8037	0.0183
IPM(Y)	-0.2958	-1.3562	0.0167	-0.3219	-1.6059	0.0254	-1.8499	-1.1379	0.0097	-2.2712	-1.5947	0.0218
UEXIPM(Q)	-0.0030	-1.4356	0.0038	-0.0037	-1.8793	0.0095	-0.0180	-1.1046	0.0010	-0.0273	-1.7662	0.0089
UEXIPM(H)	-0.0036	-1.5810	0.0124	-0.0040	-1.9336	0.0209	-0.0235	-1.3774	0.0079	-0.0304	-1.9795	0.0208
UEXIPM(Y)	-0.0029	-1.5272	0.0192	-0.0031	-1.8401	0.0292	-0.0188	-1.3666	0.0127	-0.0231	-1.9374	0.0276
M0 (M)	0.4666	0.5464	-0.0025	0.3962	0.5199	-0.0025	2.7360	0.3682	-0.0027	2.0587	0.3155	-0.0028
M0 (Q)	-0.0130	-0.0180	-0.0030	0.0533	0.0847	-0.0030	-1.4938	-0.2389	-0.0027	-0.5975	-0.1122	-0.0029
M0 (H)	-0.5184	-0.7776	0.0015	-0.4066	-0.6859	0.0003	-5.7710	-1.0432	0.0061	-4.2649	-0.8997	0.0035
M0 (Y)	-0.9231	-1.4045	0.0320	-0.6890	-1.1815	0.0207	-9.1113	-1.8221	0.0529	-6.1861	-1.4514	0.0305
UEXM0(Q)	0.0000	-0.2260	-0.0025	0.0000	-0.0759	-0.0029	-0.0001	-0.3301	-0.0018	0.0000	-0.1326	-0.0028
UEXM0 (H)	0.0000	-0.4062	-0.0008	0.0000	-0.2363	-0.0023	-0.0001	-0.5305	0.0010	0.0000	-0.3031	-0.0017
UEXM0 (Y)	0.0000	-0.6761	0.0048	0.0000	-0.4782	0.0009	-0.0001	-0.8346	0.0091	0.0000	-0.5460	0.0022
UNE (M)	0.6672	1.3571	0.0113	0.7738	1.6854	0.0204	4.5630	1.2149	0.0080	6.0926	1.7807	0.0224
UNE (Q)	0.3256	1.3486	0.0183	0.3711	1.6587	0.0306	2.3097	1.2588	0.0145	2.9913	1.8138	0.0353
UNE (H)	0.1765	1.2288	0.0185	0.2000	1.4979	0.0306	1.3026	1.1912	0.0162	1.6504	1.6675	0.0372
UNE (Y)	0.1014	1.1543	0.0219	0.1099	1.3369	0.0325	0.8414	1.2316	0.0251	0.9660	1.5587	0.0451
UEXUNE(Q)	0.0288	1.3756	0.0212	0.0323	1.6896	0.0340	0.1981	1.2390	0.0158	0.2505	1.7520	0.0361
UEXUNE(H)	0.0178	1.3109	0.0223	0.0198	1.5763	0.0351	0.1244	1.1974	0.0173	0.1549	1.6534	0.0380
UEXUNE(Y)	0.0108	1.2636	0.0257	0.0117	1.4751	0.0381	0.0806	1.2460	0.0234	0.0947	1.6032	0.0444
CPI (M)	-0.1076	-1.5306	0.0183	-0.0876	-1.3806	0.0142	-0.8083	-1.5570	0.0168	-0.6194	-1.3907	0.0121
CPI (Q)	-0.0944	-1.8924	0.0584	-0.0762	-1.6722	0.0456	-0.7205	-1.9615	0.0556	-0.5401	-1.6603	0.0399
CPI (H)	-0.0714	-1.8189	0.0837	-0.0576	-1.6027	0.0657	-0.5442	-1.8481	0.0797	-0.4086	-1.5534	0.0576
CPI (Y)	-0.0475	-1.9498	0.0863	-0.0399	-1.7901	0.0736	-0.3509	-1.8832	0.0769	-0.2796	-1.6898	0.0630
UEXCPI(Q)	-0.0113	-2.2114	0.0457	-0.0099	-2.2056	0.0423	-0.0891	-2.2362	0.0468	-0.0763	-2.3327	0.0444

Continued

UEXCPI(H)	-0.0098	-2.2126	0.0714	-0.0085	-2.2012	0.0652	-0.0778	-2.2520	0.0735	-0.0655	-2.3161	0.0676
UEXCPI(Y)	-0.0065	-2.0368	0.0767	-0.0056	-1.9871	0.0684	-0.0512	-2.0506	0.0783	-0.0422	-2.0151	0.0686
TBILL(M)	-0.1332	-2.6004	0.0401	-0.1148	-2.5975	0.0359	-1.0260	-2.4604	0.0389	-0.8642	-2.5250	0.0357
TBILL (Q)	-0.1128	-3.1146	0.1032	-0.0971	-3.0917	0.0926	-0.8567	-2.8755	0.0975	-0.7141	-2.9285	0.0878
TBILL (H)	-0.0836	-3.7712	0.1208	-0.0727	-3.6045	0.1109	-0.6218	-3.4124	0.1094	-0.5213	-3.2561	0.0998
TBILL (Y)	-0.0531	-3.2058	0.1049	-0.0473	-3.0337	0.1014	-0.3872	-2.9722	0.0912	-0.3398	-2.8184	0.0914
UEXTBILL(Q)	-17.9225	-2.9435	0.0818	-15.5997	-2.9078	0.0751	-139.3756	-2.8203	0.0811	-118.3855	-2.9010	0.0759
UEXTBILL(H)	-15.8837	-3.1006	0.1123	-13.8598	-3.0099	0.1037	-122.0271	-2.9684	0.1086	-103.2993	-2.9333	0.1010
UEXTBILL(Y)	-12.0556	-2.9416	0.1226	-10.6110	-2.8257	0.1153	-90.6167	-2.7727	0.1134	-76.9653	-2.6446	0.1062
TERM(M)	1.1143	2.4151	0.0181	1.0334	2.4775	0.0190	7.4476	1.9595	0.0124	6.7848	2.0159	0.0137
TERM(Q)	0.9819	2.2785	0.0438	0.8935	2.3242	0.0442	6.7093	1.8646	0.0329	6.0883	1.9453	0.0354
TERM(H)	0.6099	1.7728	0.0347	0.5687	1.7865	0.0369	3.7150	1.3370	0.0200	3.4863	1.3737	0.0233
TERM(Y)	0.3460	1.3002	0.0222	0.3402	1.3793	0.0266	2.0338	0.9891	0.0113	2.1048	1.1163	0.0169
UEXTERM(Q)	1.3343	2.3642	0.0418	1.2193	2.4536	0.0425	9.1718	1.9406	0.0317	8.3141	2.0275	0.0341
UEXTERM(H)	1.1058	2.1432	0.0483	1.0127	2.1674	0.0494	7.2917	1.7143	0.0336	6.6581	1.7704	0.0367
UEXTERM(Y)	0.7495	1.7791	0.0410	0.7092	1.8561	0.0449	4.5833	1.3685	0.0240	4.4034	1.4567	0.0294
DY(M)	-0.0244	-0.3643	-0.0025	-0.0149	-0.2392	-0.0028	-0.1421	-0.2678	-0.0027	-0.0375	-0.0771	-0.0030
DY(Q)	-0.0211	-0.3433	-0.0019	-0.0170	-0.2956	-0.0021	-0.0960	-0.2038	-0.0026	-0.0392	-0.0908	-0.0029
DY(H)	-0.0424	-0.8164	0.0077	-0.0382	-0.7910	0.0076	-0.2567	-0.6623	0.0035	-0.1956	-0.5568	0.0019
DY(Y)	-0.0239	-0.5854	0.0051	-0.0187	-0.4934	0.0030	-0.1462	-0.4822	0.0019	-0.0733	-0.2612	-0.0014
UEXDY(Q)	-1.0681	-0.6315	-0.0002	-0.8457	-0.5269	-0.0009	-6.9301	-0.5061	-0.0011	-4.2944	-0.3387	-0.0020
UEXDY(H)	-1.3663	-0.8666	0.0050	-1.2140	-0.8273	0.0047	-8.5380	-0.6937	0.0021	-6.4352	-0.5721	0.0008
UEXDY(Y)	-1.0558	-0.7975	0.0071	-0.8860	-0.7206	0.0057	-6.4400	-0.6362	0.0032	-4.0330	-0.4342	0.0002
EMR(-1)/VMR(-1)	0.0052	0.2943	-0.0015	0.0036	0.1150	-0.0027	0.0627	0.4426	0.0006	0.0569	0.2370	-0.0016
EMR(-2)/VMR(-2)	-0.0012	-0.0947	-0.0028	0.0098	0.4712	0.0039	0.0122	0.1219	-0.0027	0.0795	0.5108	0.0049
EMR(-3)/VMR(-3)	-0.0023	-0.2371	-0.0014	0.0086	0.7229	0.0106	-0.0013	-0.0181	-0.0030	0.0787	0.8664	0.0169
EMR(-4)/VMR(-4)	-0.0011	-0.1551	-0.0022	0.0091	1.1333	0.0305	0.0012	0.0223	-0.0030	0.0663	1.1633	0.0281
EMR(-5)/VMR(-5)	-0.0022	-0.5453	0.0041	0.0031	0.5915	0.0050	-0.0106	-0.3524	-0.0002	0.0216	0.5732	0.0039
EMR(-6)/VMR(-6)	-0.0003	-0.1131	-0.0027	0.0030	0.7947	0.0116	0.0016	0.0761	-0.0029	0.0213	0.7989	0.0099
EMR(-7)/VMR(-7)	-0.0006	-0.2732	-0.0014	0.0011	0.3368	0.0005	-0.0005	-0.0297	-0.0030	0.0073	0.3087	-0.0004
EMR(-8)/VMR(-8)	0.0007	0.3931	0.0006	0.0013	0.5509	0.0056	0.0101	0.7537	0.0097	0.0105	0.5830	0.0065
EMR(-9)/VMR(-9)	0.0007	0.5373	0.0049	0.0002	0.0835	-0.0028	0.0072	0.6843	0.0091	-0.0001	-0.0082	-0.0030
EMR(-10)/VMR(-10)	0.0010	0.9358	0.0225	0.0003	0.2101	-0.0015	0.0087	1.1192	0.0301	0.0015	0.1277	-0.0024

Note: The table reports parameters of slope coefficient λ, t-stats, and adjusted R-square estimated from univariate regression of size coefficient γ_{mv} and Small/Large return R_{sml} on individual lagged macroeconomic variables from 1980 to 2008, respectively. Size decile portfolios are formed with shares' market values at the end of each month, and hold for 12 months. Size coefficient γ_{mv} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their log mean market values. Small/Large return R_{sml} is the return spread between 'Small' portfolio and 'Large' portfolio. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A reports corresponding parameters for equal-(value-) weighted size coefficient γ_{mv}. Panel B reports corresponding parameters for equal-(value-) weighted Small/Large return $R_{sml.}$

Table 5.30 Univariate regression of size effect on individual lagged macroeconomic variables (Size-18)

	Panel A Size coefficient γ_{size}						Panel B Small/Large return R_{sml}					
	Panel A1 Equal-weighted			Panel A2 Value-weighted			Panel B1 Equal-weighted			Panel B2 Value-weighted		
Macroeconomic variable	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t(λ)	Adj-R^2
GDP(Y)	0.0054	2.1580	0.0552	0.0044	1.8383	0.0440	0.0489	2.4124	0.0787	0.0368	1.8775	0.0578
UEXGDP(Y)	0.0077	1.9745	0.0476	0.0062	1.6611	0.0374	0.0700	2.2758	0.0688	0.0520	1.7281	0.0489
IP(M)	0.1435	0.4052	-0.0029	-0.0152	-0.0457	-0.0030	1.6276	0.5754	-0.0026	-0.1075	-0.0414	-0.0030
IP(Q)	-0.0652	-0.1451	-0.0030	-0.2266	-0.5376	-0.0019	0.8682	0.2442	-0.0028	-1.0651	-0.3202	-0.0026
IP(H)	-0.0560	-0.1455	-0.0029	-0.2069	-0.5690	-0.0009	0.4184	0.1395	-0.0029	-1.5744	-0.5590	-0.0008
IP(Y)	0.0801	0.1906	-0.0024	-0.0520	-0.1402	-0.0027	1.1291	0.3580	-0.0009	-0.6019	-0.2296	-0.0023
UEXIP(Q)	-0.0004	-0.1436	-0.0030	-0.0014	-0.5341	-0.0020	0.0035	0.1550	-0.0030	-0.0085	-0.4141	-0.0024
UEXIP(H)	-0.0010	-0.3385	-0.0024	-0.0021	-0.7380	0.0002	-0.0007	-0.0316	-0.0030	-0.0142	-0.6548	-0.0002
UEXIP(Y)	-0.0004	-0.1377	-0.0028	-0.0014	-0.5186	-0.0001	0.0014	0.0641	-0.0030	-0.0115	-0.5889	0.0007
IPM(M)	-0.1756	-0.4487	-0.0027	-0.3078	-0.8360	-0.0019	-0.9651	-0.3239	-0.0029	-2.4761	-0.9050	-0.0017
IPM(Q)	-0.5850	-1.1512	0.0045	-0.6541	-1.4085	0.0086	-3.7630	-0.9772	0.0023	-4.7109	-1.4072	0.0079
IPM(H)	-0.5464	-1.2118	0.0118	-0.6148	-1.5098	0.0201	-3.4932	-1.0356	0.0074	-4.5818	-1.6038	0.0204
IPM(Y)	-0.3321	-0.9307	0.0122	-0.3880	-1.1877	0.0225	-2.0302	-0.7706	0.0067	-2.8753	-1.2317	0.0226
UEXIPM(Q)	-0.0035	-1.0912	0.0024	-0.0040	-1.3720	0.0060	-0.0225	-0.9372	0.0009	-0.0294	-1.3891	0.0058
UEXIPM(H)	-0.0046	-1.3448	0.0125	-0.0050	-1.6225	0.0199	-0.0298	-1.1669	0.0081	-0.0366	-1.6708	0.0191
UEXIPM(Y)	-0.0036	-1.2375	0.0188	-0.0040	-1.5091	0.0299	-0.0236	-1.0826	0.0127	-0.0299	-1.5864	0.0300
M0 (M)	-0.5880	-0.4759	-0.0025	-0.4126	-0.3726	-0.0027	-8.2585	-0.7977	-0.0013	-6.2714	-0.6993	-0.0017
M0 (Q)	-1.1712	-0.9683	0.0036	-0.7977	-0.7407	0.0007	-12.9279	-1.3148	0.0108	-8.3519	-0.9818	0.0045
M0 (H)	-1.5479	-1.2652	0.0212	-1.0720	-1.0056	0.0113	-16.4341	-1.6954	0.0438	-10.5922	-1.3159	0.0224
M0 (Y)	-1.4289	-1.4977	0.0482	-1.0249	-1.1948	0.0294	-14.4027	-1.9881	0.0862	-9.6097	-1.5126	0.0489
UEXM0(Q)	0.0000	-0.5300	0.0006	0.0000	-0.2796	-0.0021	-0.0002	-0.7221	0.0042	-0.0001	-0.3682	-0.0012
UEXM0 (H)	0.0000	-0.6489	0.0055	0.0000	-0.3741	-0.0004	-0.0002	-0.8665	0.0128	-0.0001	-0.4652	0.0012
UEXM0 (Y)	0.0000	-0.7767	0.0127	0.0000	-0.5037	0.0033	-0.0001	-1.0049	0.0236	-0.0001	-0.6010	0.0060
UNE (M)	0.9039	1.1970	0.0130	1.0284	1.4866	0.0224	7.0358	1.2238	0.0136	8.9393	1.7463	0.0321
UNE (Q)	0.4331	1.1558	0.0199	0.4842	1.4154	0.0322	3.5308	1.2357	0.0231	4.3489	1.7202	0.0488
UNE (H)	0.2434	1.0822	0.0219	0.2681	1.3024	0.0342	2.1012	1.2248	0.0288	2.4923	1.6476	0.0557
UNE (Y)	0.1399	1.0649	0.0260	0.1483	1.2125	0.0370	1.3311	1.3357	0.0419	1.4644	1.6291	0.0682
UEXUNE(Q)	0.0405	1.2665	0.0263	0.0445	1.5283	0.0404	0.3155	1.2986	0.0274	0.3793	1.7712	0.0546
UEXUNE(H)	0.0258	1.2347	0.0295	0.0280	1.4679	0.0440	0.2069	1.3107	0.0329	0.2429	1.7448	0.0618
UEXUNE(Y)	0.0160	1.2484	0.0357	0.0169	1.4397	0.0504	0.1357	1.4140	0.0448	0.1521	1.7775	0.0756
CPI (M)	-0.1224	-1.4165	0.0138	-0.1011	-1.2894	0.0110	-0.9190	-1.4125	0.0132	-0.7451	-1.2826	0.0109
CPI (Q)	-0.0960	-1.7781	0.0357	-0.0802	-1.5893	0.0303	-0.7088	-1.7562	0.0332	-0.5771	-1.5450	0.0284
CPI (H)	-0.0683	-1.8115	0.0457	-0.0577	-1.6234	0.0397	-0.4851	-1.7012	0.0390	-0.3984	-1.5000	0.0340
CPI (Y)	-0.0452	-1.9390	0.0464	-0.0399	-1.7947	0.0442	-0.3133	-1.7638	0.0376	-0.2729	-1.6131	0.0374
UEXCPI(Q)	-0.0130	-1.9466	0.0362	-0.0114	-1.9221	0.0343	-0.1019	-1.9123	0.0385	-0.0898	-1.9679	0.0392

Continued

UEXCPI(H)	-0.0105	-1.9514	0.0494	-0.0093	-1.9392	0.0474	-0.0823	-1.9441	0.0518	-0.0725	-1.9995	0.0526
UEXCPI(Y)	-0.0068	-1.8215	0.0498	-0.0059	-1.7511	0.0461	-0.0525	-1.8389	0.0516	-0.0448	-1.7561	0.0490
TBILL(M)	-0.1182	-2.2666	0.0177	-0.1069	-2.2801	0.0178	-0.8489	-2.0151	0.0153	-0.7817	-2.1012	0.0173
TBILL (Q)	-0.0940	-2.5113	0.0420	-0.0854	-2.5160	0.0427	-0.6603	-2.1734	0.0350	-0.6106	-2.2922	0.0396
TBILL (H)	-0.0750	-2.7933	0.0577	-0.0679	-2.7260	0.0582	-0.5268	-2.4348	0.0483	-0.4778	-2.4256	0.0522
TBILL (Y)	-0.0423	-1.6457	0.0383	-0.0408	-1.7064	0.0442	-0.2934	-1.4960	0.0309	-0.2976	-1.6633	0.0427
UEXTBILL(Q)	-14.9444	-2.1943	0.0331	-13.5879	-2.1896	0.0336	-108.9772	-1.9831	0.0298	-100.1866	-2.0483	0.0333
UEXTBILL(H)	-13.8318	-2.2744	0.0504	-12.6115	-2.2667	0.0516	-100.3470	-2.0689	0.0452	-92.0578	-2.1210	0.0500
UEXTBILL(Y)	-10.3289	-1.9380	0.0532	-9.5857	-1.9365	0.0565	-74.4818	-1.7929	0.0471	-69.8052	-1.8299	0.0545
TERM(M)	0.7228	1.2216	0.0024	0.7226	1.3287	0.0036	4.7994	1.0513	0.0011	5.0464	1.2301	0.0029
TERM(Q)	0.6333	1.1476	0.0089	0.6409	1.2904	0.0120	3.8925	0.8854	0.0047	4.3610	1.1384	0.0096
TERM(H)	0.4587	0.9896	0.0100	0.4970	1.1985	0.0158	2.5474	0.7032	0.0039	3.2852	1.0444	0.0120
TERM(Y)	0.1496	0.3571	-0.0002	0.2043	0.5419	0.0036	0.8183	0.2629	-0.0016	1.5681	0.5769	0.0041
UEXTERM(Q)	0.8784	1.2059	0.0088	0.8820	1.3409	0.0117	5.6428	0.9769	0.0054	6.1218	1.2080	0.0099
UEXTERM(H)	0.7690	1.1091	0.0122	0.8020	1.2895	0.0173	4.6117	0.8437	0.0063	5.4816	1.1557	0.0143
UEXTERM(Y)	0.5105	0.8411	0.0095	0.5670	1.0385	0.0159	2.9977	0.6469	0.0043	3.9725	0.9809	0.0139
DY(M)	-0.0884	-0.9229	0.0008	-0.0684	-0.7713	-0.0002	-0.6026	-0.8419	0.0000	-0.3835	-0.5923	-0.0014
DY(Q)	-0.0732	-0.7961	0.0053	-0.0623	-0.7237	0.0044	-0.4650	-0.6878	0.0027	-0.3507	-0.5646	0.0013
DY(H)	-0.0540	-0.7459	0.0076	-0.0461	-0.6770	0.0065	-0.3345	-0.6298	0.0039	-0.2432	-0.4900	0.0018
DY(Y)	-0.0428	-0.8223	0.0128	-0.0363	-0.7333	0.0109	-0.2986	-0.7893	0.0101	-0.2197	-0.6054	0.0063
UEXDY(Q)	-2.5060	-1.0199	0.0062	-2.1312	-0.9275	0.0052	-16.3885	-0.8846	0.0037	-12.5751	-0.7428	0.0022
UEXDY(H)	-2.0342	-0.8676	0.0078	-1.7612	-0.8063	0.0069	-12.8176	-0.7323	0.0043	-9.7751	-0.6057	0.0026
UEXDY(Y)	-1.5354	-0.8055	0.0101	-1.2958	-0.7264	0.0084	-10.1023	-0.7196	0.0067	-7.2014	-0.5487	0.0034
EMR(-1)/VMR(-1)	0.0006	0.0259	-0.0030	0.0052	0.1325	-0.0026	0.0288	0.1619	-0.0026	0.0398	0.1340	-0.0026
EMR(-2)/VMR(-2)	-0.0043	-0.2555	-0.0015	0.0176	0.6413	0.0106	-0.0050	-0.0390	-0.0030	0.1318	0.6459	0.0109
EMR(-3)/VMR(-3)	-0.0046	-0.3364	0.0008	0.0145	0.8526	0.0208	-0.0142	-0.1355	-0.0024	0.1116	0.8717	0.0227
EMR(-4)/VMR(-4)	-0.0039	-0.4136	0.0030	0.0127	1.1402	0.0374	-0.0191	-0.2715	-0.0006	0.0818	1.0079	0.0274
EMR(-5)/VMR(-5)	-0.0032	-0.6040	0.0063	0.0050	0.6713	0.0099	-0.0173	-0.4406	0.0016	0.0307	0.5678	0.0059
EMR(-6)/VMR(-6)	-0.0009	-0.2364	-0.0016	0.0045	0.7549	0.0168	-0.0029	-0.1001	-0.0028	0.0279	0.6550	0.0108
EMR(-7)/VMR(-7)	-0.0007	-0.2131	-0.0018	0.0018	0.3535	0.0022	0.0007	0.0282	-0.0030	0.0092	0.2501	-0.0005
EMR(-8)/VMR(-8)	0.0011	0.4003	0.0025	0.0017	0.4465	0.0052	0.0133	0.6234	0.0107	0.0107	0.3773	0.0031
EMR(-9)/VMR(-9)	0.0015	0.6644	0.0160	0.0006	0.1872	-0.0014	0.0126	0.7376	0.0204	0.0000	0.0007	-0.0030
EMR(-10)/VMR(-10)	0.0013	0.8669	0.0252	0.0004	0.1701	-0.0018	0.0120	1.0490	0.0370	0.0009	0.0518	-0.0029

Note: The table reports parameters of slope coefficient λ, t-stats, and adjusted R-square estimated from univariate regression of size coefficient γ_{mv} and Small/Large return R_{sml} on individual lagged macroeconomic variables from 1980 to 2008, respectively. Size decile portfolios are formed with shares' market values at the end of each month, and hold for 18 months. Size coefficient γ_{mv} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their log mean market values. Small/Large return R_{sml} is the return spread between 'Small' portfolio and 'Large' portfolio. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A reports corresponding parameters for equal-(value-) weighted size coefficient γ_{mv}. Panel B reports corresponding parameters for equal-(value-) weighted Small/Large return $R_{sml.}$

Table 5.31 Univariate regression of size effect on individual lagged macroeconomic variables (Size-24)

	Panel A Size coefficient γ_{size}						Panel B Small/Large return R_{sml}					
	Panel A1 Equal-weighted			Panel A2 Value-weighted			Panel B1 Equal-weighted			Panel B2 Value-weighted		
Macroeconomic variable	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t(λ)	Adj-R^2
GDP(Y)	0.0045	1.7954	0.0255	0.0038	1.5812	0.0222	0.0366	1.7611	0.0283	0.0284	1.3951	0.0218
UEXGDP(Y)	0.0076	2.0210	0.0324	0.0063	1.7015	0.0271	0.0656	2.1225	0.0402	0.0499	1.5796	0.0298
IP(M)	0.3591	0.7162	-0.0023	0.0828	0.1911	-0.0031	3.5563	0.8697	-0.0018	0.3806	0.1140	-0.0031
IP(Q)	0.5273	0.6500	0.0006	0.1470	0.2110	-0.0027	5.6396	0.8358	0.0040	1.2319	0.2215	-0.0027
IP(H)	0.4096	0.5046	0.0018	0.0846	0.1195	-0.0028	4.3499	0.6425	0.0061	0.4383	0.0763	-0.0030
IP(Y)	0.1060	0.1724	-0.0023	-0.0638	-0.1165	-0.0028	1.0860	0.2265	-0.0018	-1.0094	-0.2475	-0.0016
UEXIP(Q)	0.0023	0.4969	-0.0016	0.0001	0.0299	-0.0031	0.0267	0.7070	0.0003	0.0011	0.0352	-0.0031
UEXIP(H)	0.0020	0.3596	-0.0013	-0.0003	-0.0541	-0.0031	0.0245	0.5228	0.0013	-0.0030	-0.0773	-0.0030
UEXIP(Y)	0.0010	0.1973	-0.0022	-0.0007	-0.1559	-0.0026	0.0127	0.3048	-0.0008	-0.0084	-0.2408	-0.0017
IPM(M)	-0.3399	-0.6764	-0.0023	-0.5316	-1.1644	-0.0007	-2.0227	-0.5387	-0.0026	-4.3718	-1.3139	-0.0003
IPM(Q)	-0.5717	-0.8431	0.0020	-0.7574	-1.2314	0.0079	-3.7462	-0.7470	0.0005	-6.2175	-1.4156	0.0100
IPM(H)	-0.4466	-0.6736	0.0039	-0.6313	-1.0553	0.0142	-2.9705	-0.6117	0.0020	-5.4582	-1.3015	0.0197
IPM(Y)	-0.3974	-0.7653	0.0124	-0.4911	-1.0334	0.0260	-2.8667	-0.7700	0.0102	-4.1236	-1.2425	0.0331
UEXIPM(Q)	-0.0042	-0.9898	0.0024	-0.0053	-1.3915	0.0079	-0.0272	-0.8735	0.0008	-0.0420	-1.5389	0.0092
UEXIPM(H)	-0.0047	-0.9760	0.0084	-0.0059	-1.3541	0.0191	-0.0322	-0.9141	0.0058	-0.0484	-1.5894	0.0234
UEXIPM(Y)	-0.0039	-0.9243	0.0149	-0.0048	-1.2550	0.0303	-0.0277	-0.9034	0.0117	-0.0400	-1.5011	0.0375
M0 (M)	-1.2913	-0.6570	-0.0014	-0.8073	-0.4741	-0.0023	-16.0640	-0.9746	0.0013	-11.2080	-0.8124	-0.0003
M0 (Q)	-1.6605	-0.9721	0.0062	-1.1531	-0.7643	0.0024	-18.6724	-1.3639	0.0164	-13.2951	-1.1224	0.0099
M0 (H)	-1.7687	-1.2597	0.0190	-1.2764	-1.0128	0.0110	-18.8884	-1.7554	0.0385	-13.4627	-1.4259	0.0247
M0 (Y)	-1.7339	-1.6859	0.0498	-1.2775	-1.3427	0.0322	-16.5893	-2.1889	0.0769	-11.5138	-1.6748	0.0475
UEXM0(Q)	0.0000	-0.5527	0.0022	0.0000	-0.2863	-0.0017	-0.0002	-0.7628	0.0072	-0.0001	-0.4183	-0.0001
UEXM0 (H)	0.0000	-0.6362	0.0068	0.0000	-0.3613	0.0000	-0.0002	-0.8656	0.0149	-0.0001	-0.4964	0.0027
UEXM0 (Y)	0.0000	-0.7403	0.0131	0.0000	-0.4715	0.0033	-0.0002	-0.9791	0.0234	-0.0001	-0.5942	0.0065
UNE (M)	1.0535	1.0174	0.0122	1.2273	1.2860	0.0224	9.4541	1.2428	0.0172	11.7826	1.7401	0.0383
UNE (Q)	0.5045	0.9971	0.0189	0.5827	1.2495	0.0331	4.6390	1.2503	0.0277	5.7203	1.7359	0.0584
UNE (H)	0.2913	0.9828	0.0223	0.3272	1.1914	0.0364	2.7370	1.2645	0.0340	3.2454	1.6701	0.0654
UNE (Y)	0.1973	1.1531	0.0378	0.2035	1.2803	0.0504	1.9215	1.5766	0.0609	2.0297	1.8087	0.0908
UEXUNE(Q)	0.0519	1.2196	0.0310	0.0580	1.4869	0.0493	0.4435	1.4373	0.0380	0.5294	1.9427	0.0740
UEXUNE(H)	0.0332	1.2082	0.0353	0.0367	1.4448	0.0545	0.2866	1.4436	0.0441	0.3363	1.8939	0.0824
UEXUNE(Y)	0.0219	1.3167	0.0486	0.0231	1.4896	0.0678	0.1936	1.6449	0.0636	0.2132	1.9838	0.1033
CPI (M)	-0.1267	-1.5033	0.0096	-0.1082	-1.3677	0.0083	-0.9146	-1.4857	0.0078	-0.7764	-1.3609	0.0072
CPI (Q)	-0.0859	-1.5770	0.0188	-0.0758	-1.4434	0.0179	-0.5938	-1.4869	0.0142	-0.5251	-1.3792	0.0147
CPI (H)	-0.0550	-1.3478	0.0191	-0.0502	-1.2737	0.0196	-0.3592	-1.1694	0.0125	-0.3346	-1.1288	0.0147
CPI (Y)	-0.0457	-1.5034	0.0318	-0.0422	-1.4525	0.0335	-0.3134	-1.3767	0.0240	-0.2921	-1.3439	0.0279
UEXCPI(Q)	-0.0123	-1.5640	0.0220	-0.0113	-1.5563	0.0229	-0.0992	-1.7152	0.0237	-0.0923	-1.7881	0.0274

Continued

UEXCPI(H)	-0.0096	-1.5240	0.0279	-0.0091	-1.5616	0.0308	-0.0769	-1.6731	0.0293	-0.0740	-1.8088	0.0364
UEXCPI(Y)	-0.0071	-1.5813	0.0379	-0.0065	-1.5174	0.0388	-0.0567	-1.7738	0.0400	-0.0514	-1.7066	0.0434
TBILL(M)	-0.1109	-1.8996	0.0098	-0.1060	-2.0521	0.0114	-0.8245	-1.8583	0.0087	-0.8244	-2.1950	0.0124
TBILL (Q)	-0.0760	-1.4727	0.0177	-0.0768	-1.7139	0.0230	-0.5285	-1.3119	0.0135	-0.5797	-1.7712	0.0232
TBILL (H)	-0.0484	-0.9999	0.0146	-0.0507	-1.2018	0.0209	-0.3008	-0.7770	0.0082	-0.3465	-1.0763	0.0166
TBILL (Y)	-0.0379	-0.9036	0.0201	-0.0396	-1.0719	0.0281	-0.2500	-0.7535	0.0136	-0.2844	-1.0116	0.0253
UEXTBILL(Q)	-13.9351	-1.6271	0.0192	-13.6123	-1.7643	0.0230	-104.1866	-1.5936	0.0174	-106.5719	-1.8999	0.0252
UEXTBILL(H)	-10.4623	-1.2042	0.0186	-10.6692	-1.3810	0.0246	-73.4229	-1.0790	0.0145	-79.9291	-1.3940	0.0243
UEXTBILL(Y)	-8.4587	-1.0506	0.0236	-8.6024	-1.1978	0.0308	-57.8387	-0.9111	0.0175	-61.8599	-1.1417	0.0279
TERM(M)	0.6967	1.0708	0.0005	0.7388	1.2557	0.0019	5.0791	1.0537	0.0000	6.0000	1.3989	0.0027
TERM(Q)	0.6180	0.9765	0.0050	0.6876	1.2344	0.0092	4.2297	0.8917	0.0031	5.4418	1.3610	0.0105
TERM(H)	0.1088	0.1612	-0.0026	0.2483	0.4252	0.0002	-0.0404	-0.0076	-0.0031	1.6637	0.3817	-0.0005
TERM(Y)	0.0413	0.0681	-0.0029	0.1176	0.2196	-0.0015	0.3066	0.0655	-0.0030	1.1673	0.2959	-0.0004
UEXTERM(Q)	0.8545	1.0491	0.0049	0.9326	1.2948	0.0086	6.1015	1.0020	0.0036	7.5337	1.4508	0.0104
UEXTERM(H)	0.4866	0.5511	0.0012	0.6386	0.8277	0.0061	2.8426	0.4216	-0.0007	4.9693	0.8874	0.0067
UEXTERM(Y)	0.1806	0.2045	-0.0020	0.3250	0.4192	0.0013	0.7831	0.1149	-0.0028	2.5498	0.4467	0.0017
DY(M)	-0.0799	-0.7090	-0.0009	-0.0650	-0.6127	-0.0013	-0.6136	-0.6929	-0.0009	-0.4723	-0.5713	-0.0014
DY(Q)	-0.0937	-0.8851	0.0066	-0.0849	-0.8491	0.0067	-0.6426	-0.7911	0.0045	-0.5723	-0.7472	0.0048
DY(H)	-0.0901	-1.1103	0.0179	-0.0808	-1.0457	0.0177	-0.6429	-1.0403	0.0146	-0.5465	-0.9358	0.0137
DY(Y)	-0.0789	-1.3495	0.0350	-0.0673	-1.1788	0.0310	-0.5827	-1.3549	0.0313	-0.4454	-1.0446	0.0233
UEXDY(Q)	-2.8897	-0.9076	0.0056	-2.5490	-0.8595	0.0053	-21.1867	-0.8579	0.0047	-18.1732	-0.7956	0.0044
UEXDY(H)	-3.1165	-1.0664	0.0150	-2.8014	-1.0202	0.0149	-23.0287	-1.0338	0.0132	-19.7955	-0.9486	0.0127
UEXDY(Y)	-2.8433	-1.2524	0.0288	-2.4461	-1.1258	0.0260	-21.6251	-1.2820	0.0274	-16.9631	-1.0528	0.0216
EMR(-1)/VMR(-1)	-0.0011	-0.0407	-0.0031	0.0170	0.3364	0.0000	0.0393	0.1973	-0.0025	0.1440	0.3847	0.0009
EMR(-2)/VMR(-2)	-0.0050	-0.2445	-0.0016	0.0269	0.7755	0.0197	0.0024	0.0154	-0.0031	0.2024	0.7938	0.0196
EMR(-3)/VMR(-3)	-0.0067	-0.3846	0.0028	0.0232	1.0138	0.0403	-0.0191	-0.1427	-0.0023	0.1693	0.9983	0.0378
EMR(-4)/VMR(-4)	-0.0068	-0.5931	0.0099	0.0150	1.0574	0.0368	-0.0371	-0.4325	0.0033	0.0951	0.9223	0.0252
EMR(-5)/VMR(-5)	-0.0043	-0.6694	0.0090	0.0067	0.6734	0.0135	-0.0233	-0.4856	0.0027	0.0406	0.5578	0.0075
EMR(-6)/VMR(-6)	-0.0022	-0.4475	0.0029	0.0046	0.5595	0.0109	-0.0100	-0.2683	-0.0011	0.0296	0.4979	0.0073
EMR(-7)/VMR(-7)	-0.0006	-0.1306	-0.0025	0.0023	0.3392	0.0031	0.0044	0.1355	-0.0025	0.0146	0.2923	0.0012
EMR(-8)/VMR(-8)	0.0018	0.4544	0.0074	0.0016	0.3213	0.0024	0.0184	0.6057	0.0149	0.0079	0.2087	-0.0009
EMR(-9)/VMR(-9)	0.0022	0.7279	0.0260	0.0007	0.1798	-0.0012	0.0191	0.8359	0.0330	0.0015	0.0491	-0.0030
EMR(-10)/VMR(-10)	0.0018	0.8128	0.0320	0.0005	0.1533	-0.0018	0.0163	0.9931	0.0468	0.0005	0.0217	-0.0031

Note: The table reports parameters of slope coefficient λ, t-stats, and adjusted R-square estimated from univariate regression of size coefficient γ_{mv} and Small/Large return R_{sml} on individual lagged macroeconomic variables from 1980 to 2008, respectively. Size decile portfolios are formed with shares' market values at the end of each month, and hold for 24 months. Size coefficient γ_{mv} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their log mean market values. Small/Large return R_{sml} is the return spread between 'Small' portfolio and 'Large' portfolio. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A reports corresponding parameters for equal-(value-) weighted size coefficient γ_{mv}. Panel B reports corresponding parameters for equal-(value-) weighted Small/Large return $R_{sml.}$

Table 5.32 Multivariate regression of size effect on the combination of lagged macroeconomic variables

Panel A 3 months' holding length

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	7		6		4		5	
Adj-R^2	0.0988		0.0855		0.0927		0.0806	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
IP(M)	0.3913	3.0781	0.3138	2.6042	3.0960	2.9481	2.4282	2.5129
CPI(Y)	-0.0046	-0.5906	-0.0027	-0.3868	-0.0353	-0.5910	-0.0140	-0.2732
UEXTBILL(Y)	-2.9674	-2.0517	-2.8757	-2.1250	-22.6178	-2.0061	-22.1973	-2.1969
UEXTERM(Y)	0.0440	0.3177	0.0452	0.3480	0.2121	0.2073	0.2915	0.3001

Panel B 6 months' holding length

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	13		10		10		9	
Adj-R^2	0.1272		0.1131		0.1192		0.1031	
Macroeconomic	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
CPI(Y)	-0.0136	-0.7275	-0.0088	-0.5320	-0.1129	-0.8252	-0.0642	-0.5349
UEXTBILL(Y)	-5.6816	-1.7483	-5.4062	-1.7710	-44.9141	-1.9425	-41.8923	-1.9232
UEXTERM(Y)	-0.0228	-0.0909	0.0075	0.0323	-0.8591	-0.4451	-0.3945	-0.2211

Panel C 12 months' holding length

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	10		10		10		10	
Adj-R^2	0.1689		0.1496		0.1764		0.1493	
Macroeconomic	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	0.0034	2.0411	0.0029	1.8107	0.0290	2.3280	0.0233	1.9025
CPI(Y)	-0.0250	-0.9071	-0.0185	-0.7415	-0.1888	-0.8871	-0.1253	-0.6690
UEXTBILL(Y)	-10.3982	-2.1117	-8.8450	-1.8997	-92.8557	-2.5106	-75.6362	-2.1449
UEXTERM(Y)	-0.2560	-0.6648	-0.1139	-0.3144	-4.0384	-1.3199	-2.3041	-0.7984

Panel D 18 months' holding length

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	14		15		14		15	
Adj-R^2	0.1181		0.1075		0.1326		0.1158	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	0.0056	2.4797	0.0045	2.1269	0.0499	2.8110	0.0374	2.2134
CPI(Y)	-0.0311	-1.1188	-0.0247	-0.9478	-0.2147	-0.9876	-0.1572	-0.7857
UEXTBILL(Y)	-5.9877	-0.9851	-6.1316	-1.0683	-44.0507	-0.9096	-47.4844	-1.0616

Panel E 24 months' holding length

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	18		20		18		18	
Adj-R^2	0.0787		0.0750		0.0888		0.0834	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXGDP(Y)	0.0084	2.2564	0.0070	1.9619	0.0724	2.4914	0.0554	1.9183
UEXCPI(Y)	-0.0070	-1.7244	-0.0061	-1.5404	-0.0581	-2.0257	-0.0487	-1.7056
UEXTBILL(Q)	-4.8635	-0.7981	-5.7310	-1.0558	-28.8353	-0.6477	-43.7022	-1.1543

Note: This table presents slope coefficient λ, t-stats, and adjusted R^2 for multivariate regression of size coefficient γ_{mv}, and Small/Large return R_{sml} on the combination of lagged macroeconomic variables from January 1980 to December 2008. Decile size portfolios are formed with shares' market values at the end of each month, and hold for 3, 6, 12, 18, and 24 months, respectively. Size coefficient γ_{mv} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their log mean market value in the formation time. Small/Large return R_{sml} is the return spread between 'Small' portfolio and 'Large' portfolio. IP(M) is the previous monthly change of Industry Production (IP). CPI(Y)/UEXCPI(Y) is the previous/ununexpected annual change of CPI. UEXTBILL(Q,Y) is unexpected change of TBILL in previous three months, 12 months. UEXTERM(Y) is unexpected change of TERM in previous 12 months. GDP(Y)/UEXGDP(Y) is pervious annual/unexpected annual change of GDP. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A to E report corresponding parameters for equal-(value-) weighted size coefficient γ_{mv} and Small/Large return R_{sml} with 3, 6, 12, 18, and 24 months' holding lengths, respectively.

Table 5.33 Multivariate regression of size effect on the combination of lagged macroeconomic variables in subperiods (Size: 3 months' holding length)

Panel A April 1980-December 1989

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	7		6		2		4	
Adj-R^2	0.1411		0.1376		0.1312		0.1155	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
IP(M)	0.2492	1.6784	0.1866	1.3693	1.8744	1.3273	1.4088	1.1503
CPI(Y)	-0.0153	-2.2624	-0.0137	-2.2346	-0.0740	-1.1299	-0.0516	-0.8931
UEXTBILL(Y)	-1.6054	-1.8455	-1.2080	-1.4063	-19.9177	-2.0433	-16.3429	-1.8513
UEXTERM(Y)	0.0339	0.2503	0.0804	0.6402	-0.1852	-0.1946	0.3809	0.3847

Panel B January 1990-December 1999

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	2		2		2		2	
Adj-R^2	0.1391		0.1261		0.1294		0.1295	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
IP(M)	0.6466	2.1220	0.6006	2.0247	3.8544	1.8984	3.5804	1.8205
CPI(Y)	-0.0093	-0.9557	-0.0079	-0.8416	-0.0658	-0.9097	-0.0531	-0.8029
UEXTBILL(Y)	-4.2773	-1.8178	-4.4181	-1.9791	-30.7559	-1.7362	-33.4199	-2.0469
UEXTERM(Y)	-0.0288	-0.1332	-0.0517	-0.2364	-0.3857	-0.2463	-0.5683	-0.3659

Panel C January 2000-December 2008

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	2		2		1		2	
Adj-R^2	0.1100		0.0598		0.1458		0.0725	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
IP(M)	0.6049	1.7809	0.4452	1.4983	6.2172	2.0955	4.6090	1.8323
CPI(Y)	0.0151	1.5797	0.0142	1.5153	0.1151	1.5469	0.1027	1.3180
UEXTBILL(Y)	-5.2966	-0.9340	-4.5844	-0.7992	-19.4426	-0.4760	-12.6472	-0.2908
UEXTERM(Y)	0.8996	1.3712	0.6008	1.0602	10.5112	1.9600	7.1853	1.5315

Panel D April 1980-December 2008

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	7		6		4		5	
Adj-R^2	0.0988		0.0855		0.0927		0.0806	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
IP(M)	0.3913	3.0781	0.3138	2.6042	3.0960	2.9481	2.4282	2.5129
CPI(Y)	-0.0046	-0.5906	-0.0027	-0.3868	-0.0353	-0.5910	-0.0140	-0.2732
UEXTBILL(Y)	-2.9674	-2.0517	-2.8757	-2.1250	-22.6178	-2.0061	-22.1973	-2.1969
UEXTERM(Y)	0.0440	0.3177	0.0452	0.3480	0.2121	0.2073	0.2915	0.3001

Note: This table presents slope coefficient λ, t-stats, and adjusted R^2 for multivariate regression of size coefficient γ_{mv}, and Small/Large return R_{sml} on the combination of lagged macroeconomic variables in the 1980s, the 1990s, and from 2000 to 2008. Decile size portfolios are formed with shares' market values at the end of each month, and hold for 3 months, Size coefficient γ_{mv} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their log mean market values in the formation time. Small/Large return R_{sml} is the return spread in 'Small' portfolio and 'Large' portfolio. IP(M) is the previous monthly change of Industry Production (IP). CPI(Y) is the previous annual change of CPI. UEXTBILL(Y) is unexpected change of TBILL in previous 12 months. UEXTERM(Y) is unexpected change of TERM in previous 12 months. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A to D report corresponding parameters for equal-(value-) weighted size coefficient γ_{mv} and Small/Large return R_{sml} with three subperiods and overall period, respectively.

Table 5.34 Multivariate regression of size effect on the combination of lagged macroeconomic variables in subperiods (Size: 6 months' holding length)

Panel A July 1980-December 1989

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	8		8		5		3	
Adj-R^2	0.2435		0.2458		0.2225		0.2016	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
CPI(Y)	-0.0515	-3.0372	-0.0452	-3.1131	-0.3671	-2.8026	-0.3033	-2.7685
UEXTBILL(Y)	-0.8797	-0.2660	-0.5157	-0.1734	-15.9417	-0.6395	-11.6080	-0.5470
UEXTERM(Y)	0.0272	0.0848	0.1070	0.3658	-1.1434	-0.5326	-0.2930	-0.1583

Panel B January 1990-December 1999

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	4		4		4		4	
Adj-R^2	0.1768		0.1574		0.1830		0.1791	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
CPI(Y)	-0.0205	-1.1540	-0.0156	-0.8886	-0.1342	-1.0152	-0.0833	-0.6648
UEXTBILL(Y)	-7.3022	-1.8247	-7.6767	-1.8549	-59.9120	-2.0671	-66.4462	-2.2279
UEXTERM(Y)	-0.1825	-0.4671	-0.1922	-0.4903	-1.9396	-0.6740	-1.8322	-0.6458

Panel C January 2000-December 2008

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	4		4		4		4	
Adj-R^2	0.2987		0.2341		0.3209		0.2478	
Macroeconomic	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
CPI(Y)	0.0374	2.6722	0.0355	2.4566	0.2953	2.7462	0.2795	2.5688
UEXTBILL(Y)	-21.3517	-2.1227	-17.6026	-1.6368	-157.2094	-2.2550	-115.9658	-1.5160
UEXTERM(Y)	1.2554	1.6245	1.0004	1.3462	13.3003	2.1985	11.2484	2.0648

Panel D July 1980-December 2008

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	13		10		10		9	
Adj-R^2	0.1272		0.1131		0.1192		0.1031	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
CPI(Y)	-0.0136	-0.7275	-0.0088	-0.5320	-0.1129	-0.8252	-0.0642	-0.5349
UEXTBILL(Y)	-5.6816	-1.7483	-5.4062	-1.7710	-44.9141	-1.9425	-41.8923	-1.9232
UEXTERM(Y)	-0.0228	-0.0909	0.0075	0.0323	-0.8591	-0.4451	-0.3945	-0.2211

Note: This table presents slope coefficient λ, t-stats, and adjusted R^2 for multivariate regression of size coefficient γ_{mv}, and Small/Large return R_{sml} on the combination of lagged macroeconomic variables in the 1980s, the 1990s, and from 2000 to 2008. Decile size portfolios are formed with shares' market values at the end of each month, and hold for 6 months, Size coefficient γ_{mv} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their log mean market values in the formation time. Small/Large return R_{sml} is the return spread in 'Small' portfolio and 'Large' portfolio. CPI(Y) is the previous annual change of CPI. UEXTBILL(Y) is unexpected change of TBILL in previous 12 months. UEXTERM(Y) is unexpected change of TERM in previous 12 months. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A to D report corresponding parameters for equal-(value-) weighted size coefficient γ_{mv} and Small/Large return R_{sml} with three subperiods and overall period, respectively.

Table 5.35 Multivariate regression of size effect on the combination of lagged macroeconomic variables in subperiods (Size: 12 months' holding length)

Panel A January 1981-December 1989

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	11		10		10		8	
Adj-R^2	0.2095		0.1891		0.2211		0.1738	
Macroeconomic variables	λ	$t(\lambda)$	λ	$t(\lambda)$	λ	$t(\lambda)$	λ	$t(\lambda)$
GDP(Y)	0.0005	0.4046	0.0000	-0.0300	0.0060	0.6646	-0.0002	-0.0249
CPI(Y)	-0.0876	-1.8044	-0.0719	-1.8672	-0.6764	-1.8914	-0.5114	-2.0833
UEXTBILL(Y)	-1.7121	-0.3740	-0.5162	-0.1342	-32.6086	-1.0432	-17.9835	-0.7472
UEXTERM(Y)	-0.2960	-0.6194	-0.1064	-0.2524	-5.8114	-1.6269	-3.8814	-1.2853

Panel B January 1990-December 1999

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	5		5		6		5	
Adj-R^2	0.4102		0.4107		0.4378		0.4481	
Macroeconomic variables	λ	$t(\lambda)$	λ	$t(\lambda)$	λ	$t(\lambda)$	λ	$t(\lambda)$
GDP(Y)	0.0092	4.2160	0.0088	4.2992	0.0683	4.9153	0.0657	5.1246
CPI(Y)	-0.0443	-1.6640	-0.0325	-1.1825	-0.2862	-1.4787	-0.1723	-0.8797
UEXTBILL(Y)	-6.3463	-1.2714	-7.4444	-1.4552	-64.2267	-1.6221	-76.4939	-1.8856
UEXTERM(Y)	-0.1602	-0.3478	-0.1474	-0.3380	-2.2428	-0.6562	-1.6574	-0.5242

Panel C January 2000-December 2008

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	3		3		3		3	
Adj-R^2	0.4267		0.3882		0.4324		0.4036	
Macroeconomic	λ	$t(\lambda)$	λ	$t(\lambda)$	λ	$t(\lambda)$	λ	$t(\lambda)$
GDP(Y)	0.0073	1.5160	0.0061	1.3742	0.0610	1.7708	0.0480	1.6343
CPI(Y)	0.0298	1.3114	0.0245	1.0743	0.2591	1.4872	0.2076	1.2262
UEXTBILL(Y)	-70.2552	-4.1313	-62.0499	-4.1842	-544.9059	-3.9265	-468.1832	-4.1554
UEXTERM(Y)	-2.3767	-1.5280	-2.3532	-1.7040	-17.1842	-1.4006	-17.1327	-1.6697

Panel D January 1981-December 2008

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	10		10		10		10	
Adj-R^2	0.1689		0.1496		0.1764		0.1493	
Macroeconomic	λ	$t(\lambda)$	λ	$t(\lambda)$	λ	$t(\lambda)$	λ	$t(\lambda)$
GDP(Y)	0.0034	2.0411	0.0029	1.8107	0.0290	2.3280	0.0233	1.9025
CPI(Y)	-0.0250	-0.9071	-0.0185	-0.7415	-0.1888	-0.8871	-0.1253	-0.6690
UEXTBILL(Y)	-10.3982	-2.1117	-8.8450	-1.8997	-92.8557	-2.5106	-75.6362	-2.1449
UEXTERM(Y)	-0.2560	-0.6648	-0.1139	-0.3144	-4.0384	-1.3199	-2.3041	-0.7984

Note: This table presents slope coefficient λ, t-stats, and adjusted R^2 for multivariate regression of size coefficient γ_{mv}, and Small/Large return R_{sml} on the combination of lagged macroeconomic variables in the 1980s, the 1990s, and from 2000 to 2008. Decile size portfolios are formed with shares' market values at the end of each month, and hold for 12 months, Size coefficient γ_{mv} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their log mean market values in the formation time. Small/Large return R_{sml} is the return spread in 'Small' portfolio and 'Large' portfolio. GDP(Y) is the previous annual change of GDP. CPI(Y) is the previous annual change of CPI. UEXTBILL(Y) is unexpected change of TBILL in previous 12 months. UEXTERM(Y) is unexpected change of TERM in previous 12 months. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A to D report corresponding parameters for equal-(value-) weighted size coefficient γ_{mv} and Small/Large return R_{sml} with three subperiods and overall period, respectively.

Table 5.36 Multivariate regression of size effect on the combination of lagged macroeconomic variables in subperiods (Size: 18 months' holding length)

Panel A July 1981-December 1989

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	12		11		11		8	
Adj-R^2	0.0744		0.0549		0.1046		0.0732	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	Λ	t(λ)	λ	t(λ)
GDP(Y)	0.0034	2.0588	0.0022	1.5741	0.0351	2.8063	0.0202	1.8212
CPI(Y)	-0.0558	-1.1997	-0.0475	-1.2117	-0.3783	-1.0753	-0.2929	-1.1375
UEXTBILL(Y)	4.7440	0.8142	4.0164	0.7877	41.4778	0.9263	34.7442	0.9694

Panel B January 1990-December 1999

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	7		6		7		7	
Adj-R^2	0.3397		0.3388		0.3662		0.3782	
Macroeconomic	λ	t(λ)	λ	t(λ)	Λ	t(λ)	λ	t(λ)
GDP(Y)	0.0089	2.8687	0.0084	2.9225	0.0727	3.1038	0.0677	3.0725
CPI(Y)	-0.0326	-0.8392	-0.0203	-0.5631	-0.2228	-0.7563	-0.1160	-0.4242
UEXTBILL(Y)	-11.1332	-2.1472	-12.0757	-2.3902	-89.6820	-2.5369	-102.7167	-3.1108

Panel C January 2000-December 2008

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	7		7		6		6	
Adj-R^2	0.1662		0.1589		0.2051		0.2043	
Macroeconomic	λ	t(λ)	λ	t(λ)	Λ	t(λ)	λ	t(λ)
GDP(Y)	0.0076	0.7453	0.0062	0.6802	0.0529	0.8276	0.0360	0.6733
CPI(Y)	0.0309	0.9831	0.0272	0.9396	0.2952	1.3200	0.2593	1.2999
UEXTBILL(Y)	-44.8596	-4.6299	-39.8856	-4.4076	-335.7370	-4.6783	-292.7927	-4.4400

Panel D July 1981-December 2008

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	14		15		14		15	
Adj-R^2	0.1181		0.1075		0.1326		0.1158	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	Λ	t(λ)	λ	t(λ)
GDP(Y)	0.0056	2.4797	0.0045	2.1269	0.0499	2.8110	0.0374	2.2134
CPI(Y)	-0.0311	-1.1188	-0.0247	-0.9478	-0.2147	-0.9876	-0.1572	-0.7857
UEXTBILL(Y)	-5.9877	-0.9851	-6.1316	-1.0683	-44.0507	-0.9096	-47.4844	-1.0616

Note: This table presents slope coefficient λ, t-stats, and adjusted R^2 for multivariate regression of size coefficient γ_{mv}, and Small/Large return R_{sml} on the combination of lagged macroeconomic variables in the 1980s, the 1990s, and from 2000 to 2008. Decile size portfolios are formed with shares' market values at the end of each month, and hold for 18 months, Size coefficient γ_{mv} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their log mean market values in the formation time. Small/Large return R_{sml} is the return spread in 'Small' portfolio and 'Large' portfolio. GDP(Y) is the previous annual change of GDP. CPI(Y) is the previous annual change of CPI. UEXTBILL(Y) is unexpected change of TBILL in previous 12 months. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A to D report corresponding parameters for equal-(value-) weighted size coefficient γ_{mv} and Small/Large return R_{sml} with three subperiods and overall period, respectively.

Table 5.37 Multivariate regression of size effect on the combination of lagged macroeconomic variables in subperiods (Size: 24 months' holding length)

Panel A January 1982-December 1989

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	13		12		12		10	
Adj-R^2	0.0059		-0.0016		0.0145		0.0024	
Macroeconomic variables	λ	$t(\lambda)$	λ	$t(\lambda)$	λ	$t(\lambda)$	λ	$t(\lambda)$
UEXGDP(Y)	0.0051	1.2718	0.0036	1.2540	0.0454	1.6117	0.0270	1.6695
UEXCPI(Y)	0.0004	0.0770	0.0005	0.1095	-0.0008	-0.0161	0.0017	0.0523
UEXTBILL(Q)	-1.0519	-0.1615	-1.8526	-0.3372	-6.6173	-0.1459	-20.6622	-0.5738

Panel B January 1990-December 1999

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	7		7		8		8	
Adj-R^2	0.3869		0.3831		0.4022		0.4011	
Macroeconomic variables	λ	$t(\lambda)$	λ	$t(\lambda)$	λ	$t(\lambda)$	λ	$t(\lambda)$
UEXGDP(Y)	0.0164	3.5718	0.0153	3.5220	0.1350	4.0423	0.1238	3.8363
UEXCPI(Y)	-0.0185	-4.5130	-0.0168	-4.1799	-0.1454	-4.5899	-0.1318	-4.1499
UEXTBILL(Q)	-4.5592	-0.5615	-6.1669	-0.8032	-21.4485	-0.3520	-41.2093	-0.7086

Panel C January 2000-December 2008

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	13		15		10		11	
Adj-R^2	0.0878		0.0782		0.1132		0.1110	
Macroeconomic	λ	$t(\lambda)$	λ	$t(\lambda)$	λ	$t(\lambda)$	λ	$t(\lambda)$
UEXGDP(Y)	0.0012	0.0776	-0.0011	-0.0787	-0.0165	-0.1885	-0.0437	-0.5897
UEXCPI(Y)	0.0094	0.7538	0.0092	0.7432	0.1042	1.3424	0.0976	1.2281
UEXTBILL(Q)	-63.7850	-3.0623	-54.9866	-2.8716	-437.7071	-3.2386	-351.3304	-2.7569

Panel D January 1982-December 2008

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	18		20		18		18	
Adj-R^2	0.0787		0.0750		0.0888		0.0834	
Macroeconomic variables	λ_{IV}	$t(\lambda_{IV})$	λ_{IV}	$t(\lambda_{IV})$	λ_{IV}	$t(\lambda_{IV})$	λ_{IV}	$t(\lambda_{IV})$
UEXGDP(Y)	0.0084	2.2564	0.0070	1.9619	0.0724	2.4914	0.0554	1.9183
UEXCPI(Y)	-0.0070	-1.7244	-0.0061	-1.5404	-0.0581	-2.0257	-0.0487	-1.7056
UEXTBILL(Q)	-4.8635	-0.7981	-5.7310	-1.0558	-28.8353	-0.6477	-43.7022	-1.1543

Note: This table presents slope coefficient λ, t-stats, and adjusted R^2 for multivariate regression of size coefficient γ_{mv}, and Small/Large return R_{sml} on the combination of lagged macroeconomic variables in the 1980s, the 1990s, and from 2000 to 2008. Decile size portfolios are formed with shares' market values at the end of each month, and hold for 24 months, Size coefficient γ_{mv} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their log mean market values in the formation time. Small/Large return R_{sml} is the return spread in 'Small' portfolio and 'Large' portfolio. UEXGDP(Y) is the unexpected annual change of GDP. UEXCPI(Y) is the unexpected annual change of CPI. UEXTBILL(Q) is unexpected change of TBILL in previous 3 months. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A to D report corresponding parameters for equal-(value-) weighted size coefficient γ_{mv} and Small/Large return R_{sml} with three subperiods and overall period, respectively.

Table 5.38 Univariate regression of value effect on individual lagged macroeconomic variables (Value-3)

	Panel A Value coefficient γ_{mv}						Panel B Low/High return R_{lmh}					
	Panel A1 Equal-weighted			Panel A2 Value-weighted			Panel B1 Equal-weighted			Panel B2 Value-weighted		
Macroeconomic variable	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t(λ)	Adj-R^2
GDP(Y)	0.0000	0.0076	-0.0029	0.0002	0.3187	-0.0010	0.0019	0.5176	-0.0004	0.0052	1.2580	0.0063
UEXGDP(Y)	0.0001	0.1126	-0.0027	0.0003	0.3804	0.0002	0.0032	0.5413	-0.0001	0.0094	1.3740	0.0099
IP(M)	0.1084	1.0763	0.0019	0.1082	1.0343	0.0015	0.7240	0.8295	-0.0013	2.5662	2.1105	0.0077
IP(Q)	0.0765	0.5748	0.0021	0.0728	0.5431	0.0012	0.2603	0.2429	-0.0025	0.9341	0.7283	0.0000
IP(H)	0.1199	1.2191	0.0235	0.0966	1.1101	0.0126	0.6928	1.0039	0.0038	1.1968	1.4605	0.0074
IP(Y)	0.0324	0.4753	0.0016	0.0254	0.4144	-0.0004	0.3069	0.7180	0.0002	0.2907	0.5908	-0.0015
UEXIP(Q)	0.0004	0.5694	0.0006	0.0005	0.6602	0.0013	0.0006	0.0824	-0.0029	0.0082	0.9424	0.0020
UEXIP(H)	0.0006	0.8404	0.0080	0.0006	0.8581	0.0062	0.0026	0.4094	-0.0014	0.0082	1.1029	0.0047
UEXIP(Y)	0.0005	0.8011	0.0088	0.0004	0.8288	0.0066	0.0028	0.6475	0.0004	0.0051	1.0068	0.0028
IPM(M)	0.1223	1.0170	0.0036	0.1612	1.3674	0.0073	0.8105	0.9112	-0.0007	2.5470	2.0165	0.0081
IPM(Q)	0.0473	0.3224	-0.0007	0.0952	0.6621	0.0052	0.1256	0.1195	-0.0028	0.9698	0.8407	0.0007
IPM(H)	0.0703	0.6749	0.0079	0.0643	0.7019	0.0053	0.4426	0.6634	0.0004	0.8957	1.1813	0.0040
IPM(Y)	0.0192	0.3151	-0.0007	0.0130	0.2350	-0.0020	0.3050	0.8295	0.0014	0.0992	0.2647	-0.0027
UEXIPM(Q)	0.0004	0.4362	0.0000	0.0008	0.9049	0.0078	0.0008	0.1117	-0.0028	0.0095	1.2466	0.0044
UEXIPM(H)	0.0004	0.5186	0.0029	0.0006	0.7651	0.0072	0.0019	0.3082	-0.0020	0.0076	1.1476	0.0047
UEXIPM(Y)	0.0003	0.4677	0.0021	0.0003	0.5616	0.0027	0.0022	0.5823	-0.0003	0.0033	0.7971	0.0001
M0 (M)	-0.1108	-0.4891	-0.0021	0.0841	0.2980	-0.0025	-2.5112	-0.7830	0.0002	-0.1332	-0.0288	-0.0029
M0 (Q)	0.0861	0.3974	-0.0014	0.0975	0.4048	-0.0011	1.1047	0.4800	-0.0010	2.1470	0.8743	0.0009
M0 (H)	-0.0805	-0.4275	-0.0001	0.0060	0.0325	-0.0029	-0.7854	-0.3785	-0.0008	1.2206	0.6158	-0.0003
M0 (Y)	-0.1200	-0.8828	0.0128	-0.1152	-0.8120	0.0102	-0.5743	-0.4673	-0.0002	0.2056	0.1515	-0.0027
UEXM0(Q)	0.0000	0.0701	-0.0029	0.0000	-0.1308	-0.0028	0.0000	0.1639	-0.0028	0.0000	-0.2517	-0.0024
UEXM0 (H)	0.0000	0.0148	-0.0029	0.0000	-0.1341	-0.0028	0.0000	0.1803	-0.0026	0.0000	0.0257	-0.0029
UEXM0 (Y)	0.0000	-0.1904	-0.0026	0.0000	-0.3916	-0.0015	0.0000	0.0562	-0.0029	0.0000	-0.1054	-0.0028
UNE (M)	-0.0750	-0.6413	0.0021	-0.0182	-0.1603	-0.0026	-0.4758	-0.5297	-0.0014	0.9042	0.6535	0.0000
UNE (Q)	-0.0320	-0.5804	0.0027	-0.0087	-0.1672	-0.0025	-0.2016	-0.4622	-0.0012	0.3395	0.6155	-0.0004
UNE (H)	-0.0168	-0.5562	0.0023	-0.0084	-0.3002	-0.0017	-0.1502	-0.6422	0.0003	0.0756	0.2980	-0.0025
UNE (Y)	-0.0075	-0.5586	0.0007	-0.0012	-0.0936	-0.0028	-0.0776	-0.6918	0.0000	0.1395	1.0254	0.0020
UEXUNE(Q)	-0.0019	-0.4528	-0.0001	0.0003	0.0674	-0.0029	-0.0156	-0.4495	-0.0015	0.0357	0.8255	0.0010
UEXUNE(H)	-0.0012	-0.4557	0.0000	-0.0001	-0.0363	-0.0029	-0.0120	-0.5659	-0.0006	0.0151	0.6391	-0.0010
UEXUNE(Y)	-0.0007	-0.5038	0.0000	0.0000	-0.0068	-0.0029	-0.0080	-0.7127	0.0003	0.0119	0.9205	0.0008
CPI (M)	-0.0020	-0.3116	-0.0027	0.0041	0.4700	-0.0022	0.0052	0.0632	-0.0029	0.0212	0.1502	-0.0028
CPI (Q)	0.0016	0.3164	-0.0025	0.0009	0.1529	-0.0028	0.0664	0.9071	0.0033	0.0547	0.5853	-0.0008
CPI (H)	-0.0009	-0.2309	-0.0026	-0.0026	-0.6575	-0.0002	0.0596	0.9859	0.0094	0.0367	0.5273	-0.0005
CPI (Y)	-0.0021	-0.6473	0.0017	-0.0039	-1.2244	0.0114	0.0295	0.6497	0.0041	-0.0034	-0.0696	-0.0029
UEXCPI(Q)	0.0002	0.1932	-0.0023	-0.0001	-0.0767	-0.0028	0.0068	0.8151	0.0007	0.0026	0.2544	-0.0026

Continued

UEXCPI(H)	-0.0004	-0.4161	-0.0003	-0.0007	-0.7280	0.0059	0.0047	0.6988	0.0006	-0.0004	-0.0464	-0.0029
UEXCPI(Y)	-0.0008	-1.2773	0.0300	-0.0010	-1.6218	0.0461	0.0010	0.2009	-0.0026	-0.0043	-0.8959	0.0007
TBILL(M)	-0.0037	-0.4466	-0.0020	-0.0019	-0.1992	-0.0027	-0.0964	-1.2614	0.0017	-0.0655	-0.5151	-0.0018
TBILL (Q)	-0.0063	-1.0728	0.0059	-0.0074	-1.0479	0.0081	-0.0830	-1.5570	0.0089	-0.0660	-0.8370	0.0009
TBILL (H)	-0.0087	-1.9832	0.0333	-0.0111	-2.5207	0.0504	-0.0792	-1.8824	0.0199	-0.0918	-1.6958	0.0128
TBILL (Y)	-0.0055	-1.4260	0.0274	-0.0080	-2.1455	0.0561	-0.0348	-0.9320	0.0065	-0.0849	-2.2965	0.0260
UEXTBILL(Q)	-0.9862	-0.7605	0.0039	-1.0881	-0.7232	0.0046	-12.8058	-1.2892	0.0059	-10.6889	-0.7801	0.0002
UEXTBILL(H)	-1.5118	-1.3855	0.0248	-1.8264	-1.5416	0.0338	-14.5614	-1.7607	0.0168	-15.1085	-1.4519	0.0080
UEXTBILL(Y)	-1.6079	-1.7580	0.0564	-2.0639	-2.2608	0.0857	-10.4805	-1.5405	0.0163	-16.2410	-2.2128	0.0209
TERM(M)	0.0779	0.8920	-0.0002	0.1164	1.1831	0.0026	0.7851	1.0142	-0.0008	1.1267	0.8366	-0.0007
TERM(Q)	0.0620	0.7899	0.0021	0.0923	1.0988	0.0071	0.5743	0.7139	0.0003	0.9206	0.8198	0.0014
TERM(H)	0.0576	0.9933	0.0060	0.1050	1.8073	0.0241	0.3675	0.5251	-0.0001	1.0780	1.4164	0.0094
TERM(Y)	0.0569	1.0766	0.0151	0.0865	1.6855	0.0350	0.2369	0.4705	-0.0005	0.7560	1.4644	0.0096
UEXTERM(Q)	0.0730	0.7211	0.0006	0.1155	1.0364	0.0052	0.7750	0.7708	0.0002	1.2496	0.7993	0.0012
UEXTERM(H)	0.0778	0.8768	0.0039	0.1334	1.4372	0.0151	0.6638	0.6616	0.0008	1.4178	1.1188	0.0059
UEXTERM(Y)	0.0833	1.0624	0.0115	0.1367	1.8173	0.0324	0.4522	0.5364	0.0003	1.2824	1.3749	0.0105
DY(M)	-0.0138	-1.2581	0.0012	-0.0203	-1.5521	0.0052	-0.0719	-0.6035	-0.0021	-0.2356	-1.3117	0.0018
DY(Q)	-0.0245	-2.0853	0.0383	-0.0261	-2.2814	0.0396	-0.2656	-2.0965	0.0342	-0.3484	-2.3501	0.0300
DY(H)	-0.0239	-2.3400	0.0891	-0.0251	-2.9625	0.0890	-0.2350	-2.0426	0.0650	-0.3260	-2.4702	0.0643
DY(Y)	-0.0130	-1.9107	0.0609	-0.0122	-1.9473	0.0479	-0.1163	-2.4196	0.0359	-0.0915	-1.0601	0.0095
UEXDY(Q)	-0.9068	-2.2554	0.0502	-1.0259	-2.4038	0.0587	-7.0890	-2.4377	0.0219	-10.3498	-2.7028	0.0243
UEXDY(H)	-1.0507	-2.6594	0.1239	-1.1108	-3.1069	0.1257	-8.0505	-2.7090	0.0540	-11.1505	-3.2521	0.0532
UEXDY(Y)	-0.7273	-2.3582	0.1254	-0.7520	-2.7896	0.1215	-5.4555	-2.5462	0.0522	-6.6946	-2.5203	0.0398
EMR(-1)/VMR(-1)	0.0024	1.5375	0.0063	0.0048	1.4675	0.0090	0.0248	0.9988	0.0045	0.0633	0.9352	0.0060
EMR(-2)/VMR(-2)	0.0015	1.7473	0.0062	0.0030	1.7268	0.0098	0.0255	1.7464	0.0164	0.0222	0.5099	0.0002
EMR(-3)/VMR(-3)	0.0001	0.0628	-0.0029	0.0015	1.5420	0.0056	0.0065	0.5875	-0.0002	-0.0033	-0.1381	-0.0027
EMR(-4)/VMR(-4)	0.0000	-0.0382	-0.0029	0.0018	2.7695	0.0247	0.0020	0.2692	-0.0023	0.0059	0.3984	-0.0017
EMR(-5)/VMR(-5)	-0.0003	-0.4435	0.0003	0.0007	1.7994	0.0064	0.0000	-0.0004	-0.0029	0.0005	0.0573	-0.0029
EMR(-6)/VMR(-6)	0.0002	0.5304	0.0007	0.0011	2.9379	0.0372	0.0018	0.4777	-0.0011	0.0065	0.8909	0.0030
EMR(-7)/VMR(-7)	0.0003	1.1345	0.0081	0.0008	2.8184	0.0385	0.0013	0.4357	-0.0013	0.0055	1.0201	0.0046
EMR(-8)/VMR(-8)	0.0004	2.2536	0.0348	0.0009	2.9338	0.0758	0.0036	1.8199	0.0173	0.0080	1.9133	0.0253
EMR(-9)/VMR(-9)	0.0003	2.1587	0.0279	0.0006	3.0454	0.0611	0.0028	1.9980	0.0208	0.0056	1.8985	0.0211
EMR(-10)/VMR(-10)	0.0001	2.1280	0.0125	0.0003	2.1187	0.0292	0.0017	1.8619	0.0134	0.0025	1.1179	0.0049

Note: The table reports parameters of slope coefficient λ, t-stats, and adjusted R-square estimated from univariate regression of value coefficient γ_{pb} and Low/High return R_{lmh} on individual lagged macroeconomic variables from 1980 to 2008, respectively. Decile valuee portfolios are formed with shares' price-to-book values at the end of each month, and hold for 3 months. Value coefficient γ_{pb} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their mean price-to-book values. Low/High return R_{lmh} is the return spread in 'Low' portfolio and 'High' portfolio. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A reports corresponding parameters for equal-(value-) weighted value coefficient γ_{pb}. Panel B reports corresponding parameters for equal-(value-) weighted Low/High return R_{lmh} .

Table 5.39 Univariate regression of value effect on individual lagged macroeconomic variables (Value-6)

	Panel A Value coefficient γ_{mv}						Panel B Low/High return R_{lmh}					
	Panel A1 Equal-weighted			Panel A2 Value-weighted			Panel B1 Equal-weighted			Panel B2 Value-weighted		
Macroeconomic variable	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t(λ)	Adj-R^2
GDP(Y)	0.0000	0.0583	-0.0029	0.0003	0.3368	-0.0005	0.0040	0.6909	0.0011	0.0054	0.7731	0.0014
UEXGDP(Y)	0.0000	0.0308	-0.0029	0.0003	0.2030	-0.0018	0.0057	0.5559	0.0005	0.0090	0.7468	0.0022
IP(M)	0.1828	0.9303	0.0022	0.2321	1.0659	0.0037	1.5504	1.1328	-0.0002	2.9227	1.8775	0.0031
IP(Q)	0.2173	0.9945	0.0120	0.1886	0.8333	0.0060	1.8577	1.3103	0.0052	2.0412	1.5547	0.0030
IP(H)	0.2180	1.5055	0.0296	0.1862	1.1600	0.0160	1.5702	1.6244	0.0096	1.6035	1.5012	0.0051
IP(Y)	0.0469	0.6169	0.0006	0.0145	0.1831	-0.0027	0.6953	1.2045	0.0029	-0.0050	-0.0073	-0.0029
UEXIP(Q)	0.0011	0.8475	0.0060	0.0012	0.8726	0.0055	0.0090	0.9408	0.0012	0.0147	1.5362	0.0038
UEXIP(H)	0.0014	1.2592	0.0177	0.0013	1.1075	0.0114	0.0111	1.3684	0.0066	0.0144	1.7268	0.0068
UEXIP(Y)	0.0009	1.0611	0.0134	0.0007	0.8198	0.0063	0.0080	1.3473	0.0069	0.0057	0.8820	0.0002
IPM(M)	0.1892	0.8224	0.0030	0.2901	1.0688	0.0081	1.6229	1.1415	0.0003	3.6395	2.3103	0.0070
IPM(Q)	0.1092	0.4556	0.0014	0.1430	0.5701	0.0031	1.3087	0.9041	0.0018	1.7891	1.4152	0.0024
IPM(H)	0.1061	0.8519	0.0063	0.0768	0.5615	0.0009	1.1067	1.2874	0.0046	0.7629	0.8670	-0.0008
IPM(Y)	0.0378	0.5991	0.0003	0.0052	0.0761	-0.0029	0.7824	1.5844	0.0075	-0.0388	-0.0756	-0.0029
UEXIPM(Q)	0.0008	0.5039	0.0017	0.0012	0.7462	0.0065	0.0078	0.7958	0.0005	0.0161	1.8493	0.0061
UEXIPM(H)	0.0008	0.6793	0.0042	0.0008	0.6755	0.0036	0.0082	1.0775	0.0033	0.0107	1.4544	0.0035
UEXIPM(Y)	0.0005	0.6424	0.0036	0.0004	0.4467	0.0003	0.0067	1.2980	0.0063	0.0030	0.5998	-0.0018
M0 (M)	-0.0868	-0.1950	-0.0028	0.2738	0.5577	-0.0015	-2.5816	-0.4523	-0.0017	5.5204	1.0176	0.0005
M0 (Q)	-0.1397	-0.4001	-0.0014	0.0790	0.2196	-0.0025	-1.6910	-0.3564	-0.0012	2.5782	0.6502	-0.0005
M0 (H)	-0.2828	-0.9176	0.0105	-0.2070	-0.6146	0.0028	-1.6195	-0.4850	0.0004	1.0285	0.3058	-0.0021
M0 (Y)	-0.3272	-1.3726	0.0417	-0.3504	-1.2935	0.0379	-1.6982	-0.7749	0.0060	-0.3715	-0.1351	-0.0027
UEXM0(Q)	0.0000	-0.2367	-0.0025	0.0000	-0.1049	-0.0029	0.0000	-0.1910	-0.0025	0.0000	0.1556	-0.0026
UEXM0 (H)	0.0000	-0.3379	-0.0019	0.0000	-0.2839	-0.0023	0.0000	-0.1198	-0.0028	0.0000	0.1404	-0.0026
UEXM0 (Y)	0.0000	-0.4707	-0.0010	0.0000	-0.5629	0.0000	0.0000	-0.0703	-0.0029	0.0000	0.0577	-0.0029
UNE (M)	-0.1398	-0.6968	0.0035	-0.0790	-0.3368	-0.0013	-1.0945	-0.6566	0.0000	1.9880	1.0195	0.0030
UNE (Q)	-0.0583	-0.6604	0.0040	-0.0283	-0.2759	-0.0016	-0.5808	-0.7739	0.0022	0.5751	0.6605	0.0001
UNE (H)	-0.0325	-0.7697	0.0045	-0.0112	-0.2279	-0.0022	-0.4269	-1.1907	0.0066	0.3356	0.6810	0.0006
UNE (Y)	-0.0142	-0.7380	0.0020	-0.0019	-0.0818	-0.0029	-0.1743	-0.8641	0.0026	0.2728	0.9017	0.0054
UEXUNE(Q)	-0.0035	-0.5472	0.0007	-0.0003	-0.0420	-0.0029	-0.0422	-0.6957	0.0010	0.0602	0.8254	0.0019
UEXUNE(H)	-0.0023	-0.6202	0.0013	-0.0001	-0.0194	-0.0029	-0.0330	-0.9493	0.0037	0.0354	0.7859	0.0017
UEXUNE(Y)	-0.0013	-0.6528	0.0010	0.0001	0.0551	-0.0029	-0.0182	-0.9255	0.0033	0.0266	0.9322	0.0051
CPI (M)	0.0026	0.2061	-0.0028	-0.0011	-0.0766	-0.0029	0.1917	0.9252	0.0022	0.1499	0.6364	-0.0010
CPI (Q)	-0.0016	-0.1593	-0.0028	-0.0085	-0.7908	0.0011	0.1509	0.8773	0.0089	0.0942	0.5365	-0.0001
CPI (H)	-0.0034	-0.4492	-0.0009	-0.0104	-1.2976	0.0119	0.1152	0.8661	0.0141	0.0274	0.1996	-0.0024
CPI (Y)	-0.0056	-0.8553	0.0098	-0.0110	-1.5853	0.0357	0.0381	0.4278	0.0014	-0.0464	-0.4566	0.0010
UEXCPI(Q)	-0.0020	-0.8272	0.0120	-0.0031	-1.1393	0.0275	0.0048	0.2757	-0.0023	-0.0063	-0.3529	-0.0023

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UEXCPI(H)	-0.0025	-1.3296	0.0444	-0.0035	-1.7208	0.0754	0.0005	0.0355	-0.0029	-0.0120	-0.8512	0.0021
UEXCPI(Y)	-0.0023	-1.5384	0.0995	-0.0032	-2.0378	0.1507	-0.0026	-0.2647	-0.0020	-0.0144	-1.4775	0.0150
TBILL(M)	-0.0140	-1.0010	0.0019	-0.0216	-1.4456	0.0062	-0.2189	-1.5473	0.0059	-0.2454	-1.1479	0.0038
TBILL (Q)	-0.0188	-1.7278	0.0272	-0.0266	-2.0969	0.0452	-0.1760	-1.5652	0.0167	-0.2207	-1.6240	0.0159
TBILL (H)	-0.0179	-1.8751	0.0550	-0.0270	-2.7079	0.1027	-0.1092	-0.9923	0.0131	-0.2298	-2.1845	0.0404
TBILL (Y)	-0.0101	-1.5285	0.0369	-0.0161	-2.3866	0.0778	-0.0705	-1.0189	0.0114	-0.2084	-3.0865	0.0737
UEXTBILL(Q)	-3.5892	-1.5447	0.0316	-4.9637	-1.8889	0.0497	-32.8469	-1.8213	0.0186	-38.9625	-1.7079	0.0155
UEXTBILL(H)	-4.1693	-1.9581	0.0776	-5.8132	-2.3852	0.1221	-30.3645	-1.8426	0.0289	-43.4518	-2.3919	0.0368
UEXTBILL(Y)	-3.4004	-1.8512	0.0983	-4.9996	-2.4474	0.1718	-19.5624	-1.3742	0.0220	-39.3323	-2.7997	0.0586
TERM(M)	0.1048	0.6895	-0.0011	0.1986	1.0845	0.0025	1.0226	0.6040	-0.0016	2.5912	1.0923	0.0023
TERM(Q)	0.0940	0.7038	0.0014	0.2234	1.4626	0.0167	0.7650	0.4904	-0.0008	2.4133	1.2061	0.0101
TERM(H)	0.1054	1.0546	0.0085	0.2292	2.1745	0.0402	0.5825	0.4546	-0.0003	2.5284	1.7865	0.0269
TERM(Y)	0.0881	0.9329	0.0136	0.1668	1.6730	0.0444	0.3690	0.4579	-0.0008	1.5131	1.5987	0.0192
UEXTERM(Q)	0.1152	0.6484	0.0004	0.2729	1.3487	0.0122	1.1140	0.5369	-0.0006	3.3197	1.1880	0.0098
UEXTERM(H)	0.1366	0.8925	0.0050	0.3119	1.8404	0.0301	1.0106	0.5249	0.0003	3.5703	1.5290	0.0217
UEXTERM(Y)	0.1404	1.0121	0.0127	0.2902	1.8860	0.0504	0.6672	0.4518	-0.0003	2.8715	1.6323	0.0268
DY(M)	-0.0555	-2.0413	0.0226	-0.0632	-2.3192	0.0235	-0.5165	-1.4771	0.0135	-0.6867	-2.0121	0.0148
DY(Q)	-0.0500	-2.2488	0.0626	-0.0540	-2.8208	0.0582	-0.5210	-1.8531	0.0501	-0.6910	-2.3598	0.0539
DY(H)	-0.0375	-2.1048	0.0825	-0.0403	-2.7011	0.0758	-0.3108	-1.9476	0.0408	-0.3637	-1.5536	0.0335
DY(Y)	-0.0165	-1.6192	0.0362	-0.0169	-1.4664	0.0297	-0.1088	-1.1180	0.0097	-0.0324	-0.1904	-0.0023
UEXDY(Q)	-2.0293	-2.5922	0.0983	-2.3020	-3.2067	0.1011	-16.0792	-2.3669	0.0444	-22.3039	-3.1191	0.0526
UEXDY(H)	-1.8249	-2.5747	0.1424	-2.0357	-3.1112	0.1414	-13.3492	-2.4700	0.0550	-17.5234	-2.6487	0.0579
UEXDY(Y)	-1.1922	-2.1486	0.1280	-1.3093	-2.4880	0.1232	-8.0051	-2.1265	0.0411	-8.7101	-1.6229	0.0288
EMR(-1)/VMR(-1)	0.0049	1.8776	0.0111	0.0131	1.9712	0.0260	0.0673	1.6356	0.0167	0.0882	0.6348	0.0045
EMR(-2)/VMR(-2)	0.0024	1.5707	0.0053	0.0048	1.5700	0.0084	0.0467	1.8551	0.0206	-0.0134	-0.1571	-0.0024
EMR(-3)/VMR(-3)	-0.0003	-0.1149	-0.0027	0.0030	1.5641	0.0078	0.0106	0.4976	-0.0003	-0.0257	-0.5184	0.0017
EMR(-4)/VMR(-4)	-0.0001	-0.0828	-0.0028	0.0040	3.0745	0.0402	0.0030	0.2183	-0.0025	0.0005	0.0178	-0.0029
EMR(-5)/VMR(-5)	-0.0007	-0.5573	0.0042	0.0011	1.3195	0.0044	-0.0009	-0.0831	-0.0028	-0.0060	-0.3112	-0.0018
EMR(-6)/VMR(-6)	0.0005	0.7559	0.0034	0.0024	3.6615	0.0601	0.0039	0.5948	0.0004	0.0108	0.7525	0.0043
EMR(-7)/VMR(-7)	0.0005	0.9923	0.0078	0.0015	2.0057	0.0378	0.0024	0.4409	-0.0007	0.0076	0.7001	0.0035
EMR(-8)/VMR(-8)	0.0009	2.9985	0.0615	0.0018	3.1851	0.1086	0.0081	2.4672	0.0357	0.0145	1.7909	0.0375
EMR(-9)/VMR(-9)	0.0005	1.9795	0.0316	0.0011	2.7147	0.0693	0.0053	2.0601	0.0275	0.0086	1.5151	0.0219
EMR(-10)/VMR(-10)	0.0003	2.4180	0.0237	0.0007	2.2481	0.0476	0.0039	2.2835	0.0276	0.0052	1.1890	0.0120

Note: The table reports parameters of slope coefficient λ, t-stats, and adjusted R-square estimated from univariate regression of value coefficient γ_{pb} and Low/High return R_{lmh} on individual lagged macroeconomic variables from 1980 to 2008, respectively. Decile value portfolios are formed with shares' price-to-book values at the end of each month, and hold for 6 months. Value coefficient γ_{pb} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their mean price-to-book values. Low/High return R_{lmh} is the return spread in 'Low' portfolio and 'High' portfolio. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A reports corresponding parameters for equal-(value-) weighted value coefficient γ_{pb}. Panel B reports corresponding parameters for equal-(value-) weighted Low/High return R_{lmh} .

Table 5.40 Univariate regression of value effect on individual lagged macroeconomic variables (Value-12)

	Panel A Value coefficient γ_{mv}						Panel B Low/High return R_{lmh}					
	Panel A1 Equal-weighted			Panel A2 Value-weighted			Panel B1 Equal-weighted			Panel B2 Value-weighted		
Macroeconomic variable	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t(λ)	Adj-R^2
GDP(Y)	0.0010	1.0812	0.0122	0.0020	1.8900	0.0574	0.0106	1.0924	0.0066	0.0151	1.4521	0.0115
UEXGDP(Y)	0.0009	0.6420	0.0017	0.0023	1.4551	0.0306	0.0112	0.7461	0.0016	0.0180	1.1146	0.0058
IP(M)	0.1829	1.0375	-0.0007	0.0369	0.2820	-0.0029	2.4609	1.3328	-0.0006	0.2663	0.1217	-0.0030
IP(Q)	0.1285	0.5624	-0.0006	-0.0272	-0.1454	-0.0029	1.9862	0.8407	0.0002	-0.8358	-0.3320	-0.0026
IP(H)	0.2637	1.3872	0.0186	0.1580	0.8450	0.0050	2.3342	1.2933	0.0067	0.2269	0.1167	-0.0029
IP(Y)	0.0600	0.6811	-0.0004	0.0542	0.5176	-0.0008	1.0403	0.9351	0.0016	-0.6267	-0.3984	-0.0018
UEXIP(Q)	0.0008	0.5932	-0.0012	-0.0002	-0.1702	-0.0029	0.0118	0.8732	-0.0005	-0.0043	-0.2757	-0.0027
UEXIP(H)	0.0014	1.1417	0.0068	0.0006	0.5338	-0.0012	0.0156	1.1577	0.0036	-0.0013	-0.0864	-0.0030
UEXIP(Y)	0.0009	1.1241	0.0046	0.0005	0.5889	-0.0006	0.0108	1.1233	0.0033	-0.0051	-0.3952	-0.0019
IPM(M)	0.1376	0.8689	-0.0016	0.0978	0.7170	-0.0023	2.4189	1.5694	-0.0005	0.9027	0.5078	-0.0027
IPM(Q)	-0.0843	-0.5043	-0.0018	-0.1258	-0.6992	-0.0003	0.8880	0.4870	-0.0022	-1.3935	-0.7008	-0.0016
IPM(H)	0.1360	0.9313	0.0039	0.0617	0.4092	-0.0015	2.0927	1.3851	0.0064	-0.1477	-0.1002	-0.0030
IPM(Y)	0.0588	0.7900	0.0006	0.0295	0.3768	-0.0021	1.5170	1.4909	0.0107	-0.3268	-0.2405	-0.0025
UEXIPM(Q)	-0.0003	-0.2821	-0.0027	-0.0005	-0.4971	-0.0020	0.0080	0.7224	-0.0017	-0.0054	-0.4213	-0.0026
UEXIPM(H)	0.0004	0.4663	-0.0021	0.0000	-0.0384	-0.0030	0.0120	1.1082	0.0016	-0.0048	-0.3937	-0.0025
UEXIPM(Y)	0.0005	0.7154	-0.0005	0.0001	0.1711	-0.0028	0.0113	1.3452	0.0061	-0.0046	-0.4408	-0.0019
M0 (M)	-0.0148	-0.0377	-0.0030	0.2003	0.5259	-0.0025	-0.3114	-0.0492	-0.0030	2.9526	0.4050	-0.0026
M0 (Q)	-0.0641	-0.1584	-0.0028	-0.0001	-0.0002	-0.0030	0.9641	0.2079	-0.0028	2.4479	0.4408	-0.0021
M0 (H)	-0.3834	-0.9401	0.0082	-0.3692	-0.8602	0.0077	-1.3695	-0.3320	-0.0022	1.4852	0.2888	-0.0023
M0 (Y)	-0.5213	-1.6125	0.0483	-0.5634	-1.6402	0.0589	-3.2358	-0.7967	0.0083	-0.2239	-0.0472	-0.0030
UEXM0(Q)	0.0000	-0.8288	0.0013	0.0000	-0.7256	0.0018	0.0000	-0.2730	-0.0025	0.0000	0.1475	-0.0027
UEXM0 (H)	0.0000	-0.9746	0.0052	0.0000	-0.8809	0.0069	0.0000	-0.2358	-0.0025	0.0000	0.2635	-0.0017
UEXM0 (Y)	0.0000	-1.0903	0.0104	0.0000	-1.0686	0.0160	0.0000	-0.2994	-0.0018	0.0000	0.3806	0.0003
UNE (M)	-0.1709	-0.7289	0.0013	-0.0300	-0.1289	-0.0029	-2.2807	-0.8679	0.0014	2.5778	0.7241	0.0012
UNE (Q)	-0.0689	-0.6841	0.0014	-0.0019	-0.0183	-0.0030	-1.1041	-0.8820	0.0034	0.7631	0.4440	-0.0007
UNE (H)	-0.0421	-0.7325	0.0026	-0.0083	-0.1351	-0.0028	-0.6545	-0.8433	0.0048	0.3251	0.3123	-0.0016
UNE (Y)	-0.0248	-0.7064	0.0038	-0.0078	-0.1817	-0.0023	-0.3062	-0.5700	0.0030	0.1086	0.1597	-0.0024
UEXUNE(Q)	-0.0048	-0.5270	0.0000	0.0021	0.2097	-0.0024	-0.0910	-0.8039	0.0034	0.0943	0.6125	0.0021
UEXUNE(H)	-0.0032	-0.5491	0.0007	0.0008	0.1263	-0.0027	-0.0592	-0.7952	0.0044	0.0501	0.4954	0.0009
UEXUNE(Y)	-0.0021	-0.5742	0.0018	0.0001	0.0183	-0.0030	-0.0321	-0.6411	0.0037	0.0263	0.3983	0.0004
CPI (M)	-0.0026	-0.1004	-0.0029	-0.0199	-0.8066	0.0005	0.2742	0.6302	0.0007	0.0192	0.0454	-0.0030
CPI (Q)	-0.0054	-0.2623	-0.0021	-0.0188	-0.9963	0.0085	0.1952	0.5959	0.0039	0.0262	0.0739	-0.0029
CPI (H)	-0.0091	-0.5641	0.0035	-0.0188	-1.2634	0.0256	0.1169	0.5084	0.0031	-0.0310	-0.1140	-0.0027
CPI (Y)	-0.0113	-1.0255	0.0203	-0.0162	-1.5589	0.0464	-0.0282	-0.2157	-0.0022	-0.1084	-0.6039	0.0061
UEXCPI(Q)	-0.0025	-0.9307	0.0083	-0.0046	-1.9752	0.0355	0.0045	0.1584	-0.0028	-0.0203	-0.6984	0.0001

Continued

UEXCPI(H)	-0.0029	-1.2113	0.0276	-0.0046	-2.2951	0.0733	0.0016	0.0678	-0.0029	-0.0188	-0.7480	0.0023
UEXCPI(Y)	-0.0028	-1.3971	0.0661	-0.0036	-1.9983	0.1139	-0.0030	-0.1671	-0.0025	-0.0156	-0.8328	0.0060
TBILL(M)	-0.0163	-0.6130	0.0000	-0.0455	-1.5655	0.0209	-0.1667	-0.4433	-0.0012	-0.5694	-1.4786	0.0124
TBILL (Q)	-0.0179	-0.9143	0.0093	-0.0415	-1.9391	0.0651	-0.1246	-0.4675	0.0004	-0.5042	-1.9527	0.0384
TBILL (H)	-0.0200	-1.2922	0.0295	-0.0349	-2.3373	0.0994	-0.1398	-0.7459	0.0061	-0.4391	-2.4767	0.0638
TBILL (Y)	-0.0111	-1.0059	0.0186	-0.0184	-1.8939	0.0583	-0.1065	-0.9563	0.0084	-0.3048	-2.6136	0.0665
UEXTBILL(Q)	-4.5149	-1.2414	0.0217	-8.5733	-2.1249	0.0890	-35.0742	-0.8563	0.0056	-80.2527	-1.8851	0.0302
UEXTBILL(H)	-4.6468	-1.4682	0.0423	-7.9143	-2.5256	0.1327	-32.6731	-0.9780	0.0098	-74.0509	-2.2999	0.0459
UEXTBILL(Y)	-3.6256	-1.3127	0.0492	-5.6138	-2.2586	0.1261	-23.6306	-0.9379	0.0097	-54.5198	-2.2032	0.0472
TERM(M)	0.2614	0.8693	0.0023	0.4796	1.6268	0.0155	2.3640	0.7252	-0.0005	4.3731	1.1557	0.0033
TERM(Q)	0.0958	0.4061	-0.0009	0.3530	1.5138	0.0257	1.1138	0.3773	-0.0014	3.6991	1.0565	0.0100
TERM(H)	0.0432	0.2472	-0.0021	0.2431	1.6354	0.0254	0.2701	0.1263	-0.0028	2.4478	0.9840	0.0089
TERM(Y)	0.0244	0.1536	-0.0024	0.0696	0.4456	0.0018	0.2840	0.1736	-0.0025	0.7128	0.3874	-0.0009
UEXTERM(Q)	0.1806	0.5513	0.0008	0.5058	1.5270	0.0275	1.9870	0.4989	-0.0004	5.1735	1.0867	0.0102
UEXTERM(H)	0.0990	0.3620	-0.0011	0.4178	1.6720	0.0317	1.0811	0.3170	-0.0017	4.3679	1.0825	0.0126
UEXTERM(Y)	0.0631	0.2640	-0.0016	0.2397	1.1401	0.0184	0.5382	0.2118	-0.0024	2.2829	0.7588	0.0050
DY(M)	-0.0499	-1.9725	0.0063	-0.0447	-1.9973	0.0047	-0.5001	-1.3697	0.0023	-0.4263	-0.9178	-0.0001
DY(Q)	-0.0444	-1.8444	0.0201	-0.0398	-1.7548	0.0162	-0.4705	-1.2838	0.0119	-0.3150	-0.6817	0.0019
DY(H)	-0.0343	-1.2489	0.0292	-0.0320	-1.2557	0.0261	-0.1625	-0.4806	0.0012	0.0003	0.0008	-0.0030
DY(Y)	-0.0073	-0.4393	0.0004	-0.0053	-0.3188	-0.0011	0.0108	0.0448	-0.0030	0.2959	1.0603	0.0211
UEXDY(Q)	-1.7552	-2.3248	0.0311	-1.6445	-2.2803	0.0279	-15.8700	-1.8326	0.0130	-10.4421	-0.8520	0.0021
UEXDY(H)	-1.7216	-1.9490	0.0553	-1.5926	-1.8763	0.0485	-11.4475	-1.2497	0.0118	-5.8620	-0.4978	-0.0001
UEXDY(Y)	-0.8763	-1.1349	0.0290	-0.7640	-0.9888	0.0221	-3.7997	-0.4613	0.0005	3.4227	0.3519	-0.0009
EMR(-1)/VMR(-1)	0.0100	1.9579	0.0226	0.0194	1.4267	0.0333	0.1720	1.7337	0.0405	-0.0012	-0.0045	-0.0030
EMR(-2)/VMR(-2)	0.0069	2.0648	0.0280	0.0103	1.3011	0.0263	0.1098	1.7593	0.0414	-0.1040	-0.6650	0.0094
EMR(-3)/VMR(-3)	0.0018	0.4948	0.0017	0.0067	1.4169	0.0291	0.0386	0.8033	0.0089	-0.0624	-0.6469	0.0085
EMR(-4)/VMR(-4)	0.0012	0.5202	0.0012	0.0076	2.5404	0.0877	0.0211	0.6579	0.0046	-0.0072	-0.1242	-0.0027
EMR(-5)/VMR(-5)	-0.0001	-0.0504	-0.0029	0.0025	1.1935	0.0175	0.0064	0.2599	-0.0014	-0.0106	-0.2779	-0.0015
EMR(-6)/VMR(-6)	0.0013	1.1220	0.0178	0.0041	2.9554	0.1044	0.0084	0.5553	0.0022	0.0113	0.4416	0.0003
EMR(-7)/VMR(-7)	0.0010	1.0644	0.0207	0.0022	1.5708	0.0476	0.0059	0.4420	0.0013	0.0027	0.1309	-0.0027
EMR(-8)/VMR(-8)	0.0021	3.4214	0.1541	0.0032	3.2291	0.1905	0.0198	2.8766	0.0747	0.0214	1.5401	0.0329
EMR(-9)/VMR(-9)	0.0012	2.8222	0.0960	0.0020	2.9899	0.1245	0.0140	2.4643	0.0701	0.0110	1.0488	0.0135
EMR(-10)/VMR(-10)	0.0008	3.2801	0.0811	0.0012	2.2828	0.0709	0.0106	2.8799	0.0759	0.0073	0.9290	0.0091

Note: The table reports parameters of slope coefficient λ, t-stats, and adjusted R-square estimated from univariate regression of value coefficient γ_{pb} and Low/High return R_{lmh} on individual lagged macroeconomic variables from 1980 to 2008, respectively. Decile value portfolios are formed with shares' price-to-book values at the end of each month, and hold for 12 months. Value coefficient γ_{pb} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their mean price-to-book values. Low/High return R_{lmh} is the return spread in 'Low' portfolio and 'High' portfolio. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A reports corresponding parameters for equal-(value-) weighted value coefficient γ_{pb}. Panel B reports corresponding parameters for equal-(value-) weighted Low/High return R_{lmh} .

Table 5.41 Univariate regression of value effect on individual lagged macroeconomic variables (Value-18)

	Panel A Value coefficient γ_{mv}						Panel B Low/High return R_{lmh}					
	Panel A1 Equal-weighted			Panel A2 Value-weighted			Panel B1 Equal-weighted			Panel B2 Value-weighted		
Macroeconomic variable	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t(λ)	Adj-R^2
GDP(Y)	0.0028	2.3737	0.0612	0.0036	2.8658	0.1101	0.0263	1.9150	0.0267	0.0256	1.4971	0.0213
UEXGDP(Y)	0.0037	2.2471	0.0438	0.0047	2.6434	0.0787	0.0360	1.8015	0.0208	0.0330	1.3515	0.0142
IP(M)	0.2033	1.2497	-0.0015	0.0825	0.5091	-0.0028	3.0839	1.4929	-0.0012	-1.1252	-0.3538	-0.0028
IP(Q)	0.2817	1.4102	0.0031	0.0769	0.4036	-0.0026	2.6170	0.9776	-0.0003	-1.4689	-0.4133	-0.0023
IP(H)	0.4661	2.6469	0.0338	0.2974	1.5349	0.0129	3.5612	1.5096	0.0082	0.3190	0.0955	-0.0030
IP(Y)	0.3042	1.8408	0.0341	0.2852	1.5565	0.0316	3.3020	1.5752	0.0198	0.5311	0.1568	-0.0025
UEXIP(Q)	0.0013	1.1031	-0.0004	0.0002	0.1640	-0.0030	0.0136	0.8848	-0.0014	-0.0128	-0.5637	-0.0018
UEXIP(H)	0.0023	1.9583	0.0111	0.0011	0.8675	0.0004	0.0196	1.1845	0.0021	-0.0073	-0.2917	-0.0024
UEXIP(Y)	0.0023	2.0045	0.0251	0.0017	1.3314	0.0125	0.0220	1.3544	0.0099	-0.0035	-0.1395	-0.0028
IPM(M)	0.1916	1.1924	-0.0016	0.1473	0.8660	-0.0021	3.3863	1.6416	-0.0007	-0.7506	-0.2503	-0.0029
IPM(Q)	0.0914	0.4349	-0.0023	0.0182	0.0921	-0.0030	2.0938	0.7956	-0.0010	-1.1393	-0.3367	-0.0025
IPM(H)	0.3508	2.2326	0.0221	0.1951	1.0726	0.0052	4.1057	2.0430	0.0150	0.5484	0.1697	-0.0028
IPM(Y)	0.2374	1.7123	0.0290	0.1917	1.1998	0.0191	3.2510	1.8948	0.0283	0.7249	0.2440	-0.0017
UEXIPM(Q)	0.0005	0.3965	-0.0026	0.0001	0.1241	-0.0030	0.0138	0.8838	-0.0012	-0.0097	-0.4617	-0.0023
UEXIPM(H)	0.0015	1.3186	0.0037	0.0006	0.5229	-0.0017	0.0215	1.3892	0.0043	-0.0053	-0.2253	-0.0027
UEXIPM(Y)	0.0017	1.5920	0.0169	0.0011	0.9254	0.0055	0.0230	1.6741	0.0158	-0.0003	-0.0139	-0.0030
M0 (M)	-0.4035	-0.6496	-0.0021	-0.2504	-0.4180	-0.0026	-6.4440	-0.8113	-0.0017	1.1355	0.1134	-0.0030
M0 (Q)	-0.3744	-0.6659	-0.0003	-0.3605	-0.6690	-0.0003	-4.1813	-0.5820	-0.0012	2.7438	0.3203	-0.0024
M0 (H)	-0.6840	-1.3094	0.0164	-0.6737	-1.3268	0.0170	-6.8441	-1.0630	0.0071	-0.0558	-0.0070	-0.0030
M0 (Y)	-0.7370	-1.7799	0.0529	-0.7473	-2.0244	0.0580	-7.5480	-1.2473	0.0277	-2.1230	-0.3184	-0.0010
UEXM0(Q)	0.0000	-1.2535	0.0120	0.0000	-0.9504	0.0084	-0.0002	-1.0095	0.0066	0.0001	0.6245	0.0022
UEXM0 (H)	0.0000	-1.3517	0.0219	0.0000	-1.0718	0.0179	-0.0001	-1.0079	0.0108	0.0001	0.6130	0.0049
UEXM0 (Y)	0.0000	-1.4066	0.0326	0.0000	-1.2217	0.0322	-0.0001	-1.0483	0.0168	0.0001	0.5335	0.0046
UNE (M)	-0.2932	-0.7273	0.0039	-0.0648	-0.1587	-0.0027	-2.5010	-0.5270	-0.0004	1.9160	0.3128	-0.0017
UNE (Q)	-0.1411	-0.7781	0.0069	-0.0459	-0.2324	-0.0019	-1.3707	-0.6155	0.0019	0.0078	0.0026	-0.0030
UNE (H)	-0.0789	-0.7467	0.0077	-0.0295	-0.2432	-0.0015	-0.6781	-0.4844	0.0011	-0.0624	-0.0335	-0.0030
UNE (Y)	-0.0232	-0.3631	0.0002	-0.0048	-0.0629	-0.0029	0.0802	0.0794	-0.0028	0.1058	0.0920	-0.0027
UEXUNE(Q)	-0.0097	-0.5832	0.0038	-0.0008	-0.0437	-0.0030	-0.1047	-0.5179	0.0012	0.0598	0.2192	-0.0019
UEXUNE(H)	-0.0059	-0.5625	0.0040	-0.0007	-0.0553	-0.0030	-0.0605	-0.4582	0.0008	0.0320	0.1780	-0.0021
UEXUNE(Y)	-0.0023	-0.3622	0.0003	0.0003	0.0380	-0.0030	-0.0098	-0.1115	-0.0027	0.0291	0.2570	-0.0007
CPI (M)	-0.0094	-0.3107	-0.0026	-0.0254	-0.8768	0.0001	0.1771	0.3493	-0.0023	-0.0892	-0.1366	-0.0029
CPI (Q)	-0.0109	-0.4732	-0.0010	-0.0282	-1.3075	0.0115	0.0895	0.2377	-0.0023	-0.1475	-0.3178	-0.0014
CPI (H)	-0.0164	-0.8972	0.0085	-0.0254	-1.4979	0.0261	-0.0191	-0.0767	-0.0030	-0.1398	-0.4106	0.0007
CPI (Y)	-0.0180	-1.3188	0.0293	-0.0189	-1.5220	0.0347	-0.1459	-0.9724	0.0080	-0.1260	-0.5300	0.0041
UEXCPI(Q)	-0.0028	-0.7342	0.0047	-0.0053	-1.5710	0.0254	0.0027	0.0688	-0.0030	-0.0223	-0.4819	-0.0009

Continued

UEXCPI(H)	-0.0029	-0.8431	0.0135	-0.0048	-1.5487	0.0433	-0.0007	-0.0195	-0.0030	-0.0195	-0.4755	0.0003
UEXCPI(Y)	-0.0029	-0.9865	0.0375	-0.0033	-1.2150	0.0501	-0.0058	-0.2135	-0.0022	-0.0112	-0.3503	-0.0004
TBILL(M)	-0.0213	-0.6880	-0.0003	-0.0403	-1.4043	0.0074	-0.3380	-0.8382	0.0006	-0.6699	-1.4633	0.0093
TBILL (Q)	-0.0193	-0.8618	0.0048	-0.0355	-1.5688	0.0249	-0.2131	-0.7326	0.0019	-0.4935	-1.5121	0.0200
TBILL (H)	-0.0219	-1.0883	0.0182	-0.0326	-1.8976	0.0469	-0.1830	-0.7995	0.0047	-0.4088	-1.7597	0.0304
TBILL (Y)	-0.0140	-0.9833	0.0154	-0.0165	-1.3177	0.0242	-0.1871	-1.2646	0.0143	-0.2589	-1.6308	0.0256
UEXTBILL(Q)	-4.1122	-0.8852	0.0082	-6.7480	-1.5505	0.0290	-44.0584	-0.8906	0.0037	-73.2156	-1.3469	0.0130
UEXTBILL(H)	-4.4613	-1.0120	0.0198	-6.6198	-1.6927	0.0502	-39.2856	-0.8629	0.0062	-65.2839	-1.3838	0.0190
UEXTBILL(Y)	-3.7053	-0.9635	0.0267	-4.7727	-1.4275	0.0492	-31.2491	-0.8271	0.0080	-46.7509	-1.2320	0.0183
TERM(M)	0.0806	0.2333	-0.0028	0.1503	0.5120	-0.0020	2.9314	0.6807	-0.0011	2.9287	0.6162	-0.0014
TERM(Q)	-0.0575	-0.1730	-0.0026	0.0527	0.1737	-0.0027	1.2527	0.2851	-0.0020	1.3846	0.2795	-0.0020
TERM(H)	-0.0472	-0.1753	-0.0025	0.0202	0.0815	-0.0029	0.3331	0.0922	-0.0029	0.6898	0.1733	-0.0025
TERM(Y)	0.0236	0.1122	-0.0028	-0.0382	-0.1931	-0.0022	1.3720	0.4630	0.0022	-0.2852	-0.1024	-0.0029
UEXTERM(Q)	-0.0217	-0.0501	-0.0030	0.1111	0.2938	-0.0022	2.4430	0.4313	-0.0011	2.6290	0.4131	-0.0011
UEXTERM(H)	-0.0527	-0.1303	-0.0028	0.0670	0.1809	-0.0025	1.3770	0.2559	-0.0020	1.7306	0.2860	-0.0016
UEXTERM(Y)	0.0143	0.0417	-0.0030	0.0059	0.0186	-0.0030	1.5623	0.3382	-0.0005	0.3687	0.0766	-0.0029
DY(M)	-0.0394	-0.9450	0.0001	-0.0288	-0.8998	-0.0013	-0.0790	-0.1062	-0.0030	0.1014	0.1419	-0.0030
DY(Q)	-0.0266	-0.7419	0.0015	-0.0242	-0.7906	0.0009	-0.1213	-0.1789	-0.0026	0.0763	0.1107	-0.0029
DY(H)	-0.0283	-0.8173	0.0089	-0.0156	-0.5187	0.0008	-0.0397	-0.0796	-0.0029	0.3598	0.6336	0.0057
DY(Y)	-0.0126	-0.6235	0.0025	-0.0035	-0.1648	-0.0026	-0.0475	-0.1499	-0.0026	0.3829	0.9847	0.0204
UEXDY(Q)	-1.2326	-0.9790	0.0062	-1.0650	-0.9578	0.0042	-6.3192	-0.3737	-0.0018	0.6190	0.0324	-0.0030
UEXDY(H)	-1.2105	-0.9170	0.0127	-0.8266	-0.6863	0.0047	-3.9010	-0.2433	-0.0022	6.9750	0.3763	-0.0007
UEXDY(Y)	-0.7925	-0.7644	0.0113	-0.3484	-0.3284	-0.0001	-1.4999	-0.1209	-0.0028	11.3341	0.7667	0.0102
EMR(-1)/VMR(-1)	0.0165	2.1673	0.0351	0.0276	1.3264	0.0381	0.2665	2.0681	0.0490	-0.0311	-0.0817	-0.0028
EMR(-2)/VMR(-2)	0.0114	2.2552	0.0426	0.0164	1.2548	0.0390	0.1778	1.9607	0.0550	-0.1286	-0.5559	0.0079
EMR(-3)/VMR(-3)	0.0039	0.7720	0.0087	0.0125	1.5350	0.0597	0.0689	0.9615	0.0158	-0.0608	-0.4252	0.0033
EMR(-4)/VMR(-4)	0.0020	0.5428	0.0032	0.0109	2.2750	0.1024	0.0408	0.7698	0.0111	-0.0060	-0.0714	-0.0029
EMR(-5)/VMR(-5)	0.0008	0.2805	-0.0008	0.0053	1.6866	0.0486	0.0203	0.5890	0.0050	-0.0005	-0.0085	-0.0030
EMR(-6)/VMR(-6)	0.0019	0.9619	0.0226	0.0055	2.4004	0.1020	0.0157	0.6647	0.0060	0.0086	0.2260	-0.0020
EMR(-7)/VMR(-7)	0.0025	1.7425	0.0737	0.0038	2.0335	0.0850	0.0232	1.2732	0.0301	0.0100	0.3456	-0.0005
EMR(-8)/VMR(-8)	0.0038	3.8098	0.2643	0.0045	2.8305	0.2089	0.0406	3.6509	0.1582	0.0299	1.3724	0.0365
EMR(-9)/VMR(-9)	0.0024	4.1941	0.1994	0.0030	2.7602	0.1611	0.0294	3.5708	0.1557	0.0179	1.1073	0.0221
EMR(-10)/VMR(-10)	0.0013	3.2628	0.1172	0.0016	2.0076	0.0733	0.0194	3.3974	0.1286	0.0110	0.9073	0.0128

Note: The table reports parameters of slope coefficient λ, t-stats, and adjusted R-square estimated from univariate regression of value coefficient γ_{pb} and Low/High return R_{lmh} on individual lagged macroeconomic variables from 1980 to 2008, respectively. Decile value portfolios are formed with shares' price-to-book values at the end of each month, and hold for 18 months. Value coefficient γ_{pb} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their mean price-to-book values. Low/High return R_{lmh} is the return spread in 'Low' portfolio and 'High' portfolio. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A reports corresponding parameters for equal-(value-) weighted value coefficient γ_{pb}. Panel B reports corresponding parameters for equal-(value-) weighted Low/High return R_{lmh} .

Table 5.42 Univariate regression of value effect on individual lagged macroeconomic variables (Value-24)

	Panel A Value coefficient γ_{mv}						Panel B Low/High return R_{lmh}					
	Panel A1 Equal-weighted			Panel A2 Value-weighted			Panel B1 Equal-weighted			Panel B2 Value-weighted		
Macroeconomic variable	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t (λ)	Adj-R^2	λ	t(λ)	Adj-R^2
GDP(Y)	0.0030	1.6870	0.0405	0.0041	2.3608	0.0898	0.0304	1.7187	0.0264	0.0294	1.2430	0.0191
UEXGDP(Y)	0.0044	1.8718	0.0365	0.0055	2.3641	0.0701	0.0468	1.8955	0.0269	0.0411	1.1650	0.0156
IP(M)	0.7453	2.0409	0.0090	0.4958	1.5656	0.0031	7.5164	2.1778	0.0051	3.5219	0.7500	-0.0017
IP(Q)	1.0541	2.7259	0.0473	0.6370	1.7236	0.0182	10.5996	2.4685	0.0308	3.6475	0.5951	0.0001
IP(H)	1.0409	3.5097	0.1042	0.6489	2.0995	0.0451	10.5967	3.1874	0.0709	3.6046	0.6539	0.0038
IP(Y)	0.5125	2.6424	0.0583	0.4363	1.8702	0.0484	6.2408	2.5208	0.0576	1.7840	0.3845	0.0009
UEXIP(Q)	0.0055	2.1673	0.0265	0.0032	1.3555	0.0085	0.0560	2.1095	0.0171	0.0166	0.4428	-0.0017
UEXIP(H)	0.0067	2.6415	0.0638	0.0039	1.5489	0.0234	0.0688	2.4921	0.0439	0.0163	0.3828	-0.0010
UEXIP(Y)	0.0050	2.5709	0.0718	0.0034	1.5688	0.0360	0.0551	2.3819	0.0572	0.0095	0.2402	-0.0016
IPM(M)	0.6188	1.6138	0.0058	0.5886	1.5145	0.0062	6.6211	1.8866	0.0036	3.6404	0.7069	-0.0015
IPM(Q)	0.6097	1.8659	0.0165	0.5497	1.4069	0.0153	7.3984	2.0624	0.0161	3.3094	0.5233	0.0000
IPM(H)	0.6559	2.4095	0.0481	0.4938	1.4994	0.0305	8.0672	2.7392	0.0485	3.2722	0.5916	0.0038
IPM(Y)	0.2996	1.6756	0.0266	0.2897	1.2958	0.0291	4.4563	1.9872	0.0407	1.6216	0.4064	0.0016
UEXIPM(Q)	0.0034	1.4932	0.0093	0.0030	1.1931	0.0083	0.0415	1.7782	0.0093	0.0158	0.4062	-0.0017
UEXIPM(H)	0.0041	1.8403	0.0258	0.0031	1.1915	0.0166	0.0504	2.1810	0.0266	0.0141	0.3296	-0.0012
UEXIPM(Y)	0.0029	1.7264	0.0295	0.0023	1.1438	0.0219	0.0387	2.0255	0.0362	0.0098	0.2766	-0.0011
M0 (M)	-0.3629	-0.4819	-0.0026	-0.2076	-0.3451	-0.0029	-10.1772	-0.9884	-0.0007	-0.6543	-0.0704	-0.0031
M0 (Q)	-0.4049	-0.5768	-0.0012	-0.3572	-0.6590	-0.0014	-6.0870	-0.6390	-0.0003	2.9492	0.3677	-0.0026
M0 (H)	-0.6820	-1.0286	0.0080	-0.5817	-1.2335	0.0062	-9.1714	-1.0863	0.0102	2.1363	0.2549	-0.0025
M0 (Y)	-1.0427	-1.9280	0.0615	-0.9309	-2.3715	0.0565	-11.2019	-1.5633	0.0466	-2.0070	-0.2715	-0.0018
UEXM0(Q)	0.0000	-1.2772	0.0172	0.0000	-1.0214	0.0138	-0.0003	-1.0671	0.0139	0.0002	0.5669	0.0017
UEXM0 (H)	0.0000	-1.3980	0.0301	0.0000	-1.0810	0.0245	-0.0002	-1.1350	0.0222	0.0002	0.6191	0.0063
UEXM0 (Y)	0.0000	-1.5226	0.0462	0.0000	-1.2171	0.0414	-0.0002	-1.2245	0.0335	0.0001	0.5969	0.0084
UNE (M)	-0.3300	-0.4982	0.0020	-0.0842	-0.1282	-0.0027	-2.0687	-0.2652	-0.0018	0.1895	0.0200	-0.0031
UNE (Q)	-0.1146	-0.3914	0.0007	-0.0284	-0.0919	-0.0028	-0.4845	-0.1260	-0.0026	-0.1844	-0.0409	-0.0031
UNE (H)	-0.0412	-0.2511	-0.0014	-0.0044	-0.0250	-0.0031	0.0520	0.0225	-0.0031	-0.0512	-0.0196	-0.0031
UNE (Y)	0.0125	0.1409	-0.0026	0.0222	0.2186	-0.0011	0.5328	0.3805	0.0036	0.2385	0.1596	-0.0020
UEXUNE(Q)	-0.0041	-0.1636	-0.0024	0.0033	0.1239	-0.0026	-0.0166	-0.0527	-0.0030	0.0760	0.1961	-0.0018
UEXUNE(H)	-0.0008	-0.0523	-0.0030	0.0031	0.1800	-0.0018	0.0135	0.0656	-0.0030	0.0564	0.2279	-0.0011
UEXUNE(Y)	0.0017	0.1801	-0.0021	0.0034	0.3306	0.0017	0.0395	0.3123	0.0007	0.0522	0.3530	0.0022
CPI (M)	-0.0191	-0.5210	-0.0021	-0.0227	-0.6669	-0.0015	0.0529	0.1107	-0.0031	0.1014	0.1357	-0.0030
CPI (Q)	-0.0224	-0.7746	0.0019	-0.0269	-1.0204	0.0053	0.0079	0.0217	-0.0031	-0.0219	-0.0393	-0.0031
CPI (H)	-0.0303	-1.1681	0.0196	-0.0296	-1.3777	0.0220	-0.1156	-0.4184	-0.0009	-0.1480	-0.3494	-0.0002
CPI (Y)	-0.0358	-1.5974	0.0693	-0.0289	-1.6652	0.0513	-0.3183	-1.6412	0.0350	-0.2049	-0.6806	0.0096
UEXCPI(Q)	-0.0026	-0.4914	0.0006	-0.0030	-0.6426	0.0028	0.0126	0.2644	-0.0025	0.0103	0.1704	-0.0028

Continued

UEXCPI(H)	-0.0041	-0.8929	0.0156	-0.0037	-0.8842	0.0144	-0.0010	-0.0239	-0.0031	-0.0019	-0.0351	-0.0031
UEXCPI(Y)	-0.0054	-1.4828	0.0780	-0.0041	-1.2885	0.0492	-0.0230	-0.7188	0.0066	-0.0175	-0.4621	0.0014
TBILL(M)	-0.0282	-0.9523	-0.0003	-0.0315	-0.8502	0.0010	-0.5004	-1.3739	0.0028	-0.6539	-1.3689	0.0051
TBILL (Q)	-0.0266	-1.1514	0.0055	-0.0315	-1.1333	0.0109	-0.3389	-1.1505	0.0062	-0.4812	-1.3958	0.0120
TBILL (H)	-0.0291	-1.1645	0.0186	-0.0327	-1.4570	0.0285	-0.3042	-1.0755	0.0126	-0.4170	-1.5972	0.0208
TBILL (Y)	-0.0263	-1.1436	0.0347	-0.0262	-1.3880	0.0404	-0.3280	-1.4636	0.0360	-0.3515	-1.7020	0.0331
UEXTBILL(Q)	-5.5393	-1.2188	0.0088	-5.6594	-1.0685	0.0112	-66.2947	-1.3376	0.0082	-71.1897	-1.2046	0.0074
UEXTBILL(H)	-6.0255	-1.2576	0.0211	-6.2613	-1.2918	0.0272	-58.3488	-1.1501	0.0120	-67.1615	-1.3058	0.0131
UEXTBILL(Y)	-6.2633	-1.2800	0.0462	-6.1978	-1.4459	0.0528	-57.7557	-1.2519	0.0248	-63.7168	-1.5366	0.0243
TERM(M)	0.1599	0.4822	-0.0025	0.1768	0.6130	-0.0022	3.6276	0.7466	-0.0009	2.5411	0.4610	-0.0022
TERM(Q)	0.0727	0.2344	-0.0027	0.0537	0.1762	-0.0029	3.4387	0.7010	0.0025	1.6030	0.2977	-0.0021
TERM(H)	-0.0072	-0.0244	-0.0031	0.0229	0.0865	-0.0030	1.4556	0.3056	-0.0010	1.0829	0.2464	-0.0022
TERM(Y)	0.0706	0.2809	-0.0016	0.0377	0.1802	-0.0026	2.4214	0.6407	0.0090	1.3641	0.4364	0.0000
UEXTERM(Q)	0.1226	0.2969	-0.0026	0.1117	0.2903	-0.0026	4.7564	0.7501	0.0025	2.7267	0.3856	-0.0016
UEXTERM(H)	0.0580	0.1436	-0.0029	0.0722	0.1877	-0.0027	3.5084	0.5402	0.0019	2.1224	0.3186	-0.0016
UEXTERM(Y)	0.0741	0.1966	-0.0025	0.0490	0.1487	-0.0028	3.2398	0.5440	0.0049	1.6821	0.3151	-0.0014
DY(M)	-0.0759	-1.2932	0.0037	-0.0380	-0.7987	-0.0011	-0.4088	-0.5773	-0.0018	0.2074	0.2365	-0.0028
DY(Q)	-0.0681	-1.2865	0.0143	-0.0363	-0.8039	0.0026	-0.5066	-0.7930	0.0033	0.1089	0.1289	-0.0029
DY(H)	-0.0648	-1.4323	0.0337	-0.0298	-0.7944	0.0059	-0.4606	-0.9345	0.0093	0.2901	0.4142	0.0009
DY(Y)	-0.0398	-1.3433	0.0297	-0.0174	-0.6137	0.0042	-0.3174	-0.8196	0.0108	0.4202	0.8032	0.0165
UEXDY(Q)	-2.6890	-1.4141	0.0225	-1.3557	-0.8046	0.0044	-17.7547	-0.9282	0.0043	2.1539	0.0885	-0.0030
UEXDY(H)	-2.8373	-1.5743	0.0475	-1.4023	-0.8808	0.0112	-18.0334	-0.9975	0.0105	4.5720	0.1977	-0.0024
UEXDY(Y)	-2.2529	-1.6570	0.0645	-1.0735	-0.8435	0.0147	-14.9481	-1.0434	0.0167	7.1220	0.3812	0.0005
EMR(-1)/VMR(-1)	0.0234	1.9552	0.0415	0.0380	1.1732	0.0466	0.3487	2.1249	0.0631	-0.0424	-0.0845	-0.0028
EMR(-2)/VMR(-2)	0.0131	1.9425	0.0318	0.0246	1.1958	0.0574	0.2079	1.9177	0.0558	-0.1511	-0.4541	0.0075
EMR(-3)/VMR(-3)	0.0049	0.7110	0.0074	0.0201	1.6224	0.1000	0.0856	0.9318	0.0185	-0.0438	-0.2126	-0.0008
EMR(-4)/VMR(-4)	0.0021	0.4062	0.0010	0.0142	1.9222	0.1098	0.0462	0.6527	0.0103	0.0109	0.0888	-0.0028
EMR(-5)/VMR(-5)	0.0012	0.3219	-0.0001	0.0082	1.7221	0.0753	0.0183	0.4340	0.0017	0.0152	0.1940	-0.0019
EMR(-6)/VMR(-6)	0.0028	0.8961	0.0279	0.0064	1.7445	0.0847	0.0188	0.5790	0.0064	0.0043	0.0768	-0.0029
EMR(-7)/VMR(-7)	0.0042	2.0161	0.1179	0.0058	1.9922	0.1204	0.0381	1.5991	0.0622	0.0237	0.5632	0.0065
EMR(-8)/VMR(-8)	0.0055	3.4310	0.3195	0.0060	2.3812	0.2311	0.0576	3.5378	0.2365	0.0378	1.1540	0.0399
EMR(-9)/VMR(-9)	0.0033	3.5553	0.2185	0.0040	2.3790	0.1792	0.0415	3.9979	0.2296	0.0251	1.0278	0.0305
EMR(-10)/VMR(-10)	0.0016	2.8437	0.0961	0.0019	1.6387	0.0686	0.0247	3.1107	0.1541	0.0116	0.6585	0.0090

Note: The table reports parameters of slope coefficient λ, t-stats, and adjusted R-square estimated from univariate regression of value coefficient γ_{pb} and Low/High return R_{lmh} on individual lagged macroeconomic variables from 1980 to 2008, respectively. Decile Value portfolios are formed with shares' price-to-book values at the end of each month, and hold for 24 months. Value coefficient γ_{pb} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their mean price-to-book values. Low/High return R_{lmh} is the return spread in 'Low' portfolio and 'High' portfolio. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A reports corresponding parameters for equal-(value-) weighted value coefficient γ_{pb}. Panel B reports corresponding parameters for equal-(value-) weighted Low/High return R_{lmh} .

Table 5.43 Multivariate regression of value effect on the combination of lagged macroeconomic variables

Panel A 3 months' holding length

	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	8		4		7		7	
Adj-R^2	0.1653		0.2109		0.0680		0.0733	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXTBILL(Y)	-0.9744	-1.3988	-1.3099	-1.9929	-5.4310	-0.6991	-8.1685	-0.9382
UEXDY(H)	-0.8601	-2.4861	-0.8300	-2.8089	-6.8654	-1.9560	-9.1683	-2.3279
EMR/VMR(-8)	0.0004	2.4600	0.0007	3.1855	0.0032	1.8318	0.0066	1.6789

Panel B 6 months' holding length

	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	8		8		7		12	
Adj-R^2	0.2325		0.3108		0.0892		0.1113	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXTBILL(Y)	-2.3917	-1.5954	-3.7346	-2.4620	-11.6825	-0.7108	-28.0779	-1.6671
UEXDY(H)	-1.3725	-2.5143	-1.3074	-2.8807	-10.7742	-1.6781	-11.9846	-1.5242
EMR/VMR(-8)	0.0008	3.2004	0.0015	3.3929	0.0076	2.5169	0.0122	1.6160

Panel C 12 months' holding length

	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	7		8		9		10	
Adj-R^2	0.2236		0.2969		0.0869		0.0723	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXTBILL(Y)	-2.8615	-1.3777	-4.6107	-2.5976	-19.1502	-0.7703	-54.2589	-2.0045
UEXDY(H)	-1.0797	-1.5873	-0.5994	-0.9391	-6.6187	-0.7125	4.4072	0.3393
EMR/VMR(-8)	0.0021	3.8881	0.0029	3.7004	0.0195	3.0229	0.0197	1.5231

Panel D 18 months' holding length

	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	14		15		13		13	
Adj-R^2	0.2922		0.2807		0.1678		0.0501	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	0.0019	2.0429	0.0029	2.7470	0.0170	1.1415	0.0213	1.2310
EMR/VMR(-8)	0.0036	3.8351	0.0041	2.9723	0.0388	3.2194	0.0270	1.2306

Panel E 24 months' holding length

	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	10		20		14		18	
Adj-R^2	0.4087		0.3300		0.2844		0.0617	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	0.0019	1.4245	0.0034	2.3180	0.0175	0.9134	0.0269	1.1615
M0(Y)	-0.3050	-0.7060	-0.1388	-0.4251	-4.0653	-0.5764	4.0182	0.6161
CPI(Y)	-0.0340	-2.0763	-0.0263	-1.5991	-0.2902	-2.0017	-0.2325	-0.8350
EMR/VMR(-8)	0.0051	3.7060	0.0053	2.3641	0.0539	3.3486	0.0363	1.1305

Note: This table presents slope coefficient λ, t-stats, and adjusted R^2 for multivariate regression of value coefficient γ_{pb} and Low/High return R_{lmh} on the combination of lagged macroeconomic variables from January 1980 to December 2008. Decile value portfolios are formed with shares' price-to-book values at the end of each month, and hold for 3, 6, 12, 18, and 24 months, respectively. Value coefficient γ_{pb} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their mean price-to-book values in the formation time. Low/High return R_{lmh} is the return spread between 'Low' portfolio and 'High' portfolio. UEXTBILL(Y) is unexpected change of TBILL in previous 12 months. UEXDY(H) is unexpected change of DY in previous 6 months. EMR/VMR(-8) is equal-(value-) weighted market return in past eight years. GDP(Y) is pervious annual change of GDP. M0(Y) is the previous annual change of M0. CPI(Y) is the previous annual change of CPI. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A to E report corresponding parameters for equal-(value-) weighted value coefficient γ_{pb} and Low/High return R_{lmh} with 3, 6, 12, 18, and 24 months' holding lengths, respectively.

Table 5.44 Multivariate regression of value effect on the combination of lagged macroeconomic variables in subperiods (Value: 3 months' holding length)

Panel A April 1980-December 1989

	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	4		4		6		1	
Adj-R^2	0.3458		0.3637		0.1990		0.2090	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXTBILL(Y)	0.3150	0.3573	-0.5997	-0.6139	0.5518	0.0928	-5.5474	-0.7205
UEXDY(H)	-1.9466	-4.2300	-1.7223	-3.5530	-9.3593	-2.6609	-10.0445	-2.8329
EMR/VMR(-8)	0.0015	3.0155	0.0015	2.8586	0.0111	3.5900	0.0080	2.2018

Panel B January 1990-December 1999

	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	2		2		2		2	
Adj-R^2	0.0873		0.0326		0.0685		0.1488	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXTBILL(Y)	-0.4720	-0.8079	-0.5600	-0.6916	-11.9451	-1.0729	-24.3219	-1.7851
UEXDY(H)	-0.1774	-0.9180	-0.1579	-0.7210	-7.0221	-1.5921	-12.0919	-2.5011
EMR/VMR(-8)	0.0006	2.5234	0.0005	2.1374	0.0063	1.7212	0.0123	2.4359

Panel C January 2000-December 2008

	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	2		4		2		5	
Adj-R^2	0.0164		0.0183		0.0428		0.0887	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXTBILL(Y)	0.0138	0.0064	0.2529	0.2082	-0.4842	-0.0112	67.4495	1.5857
UEXDY(H)	0.1216	0.3579	-0.0322	-0.1409	-3.2037	-0.4747	7.1942	0.6454
EMR/VMR(-8)	0.0007	1.1125	0.0006	1.5395	0.0171	1.2084	0.0362	2.1570

Panel D April 1980-December 2008

	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	8		4		7		7	
Adj-R^2	0.1653		0.2109		0.0680		0.0733	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXTBILL(Y)	-0.9744	-1.3988	-1.3099	-1.9929	-5.4310	-0.6991	-8.1685	-0.9382
UEXDY(H)	-0.8601	-2.4861	-0.8300	-2.8089	-6.8654	-1.9560	-9.1683	-2.3279
EMR/VMR(-8)	0.0004	2.4600	0.0007	3.1855	0.0032	1.8318	0.0066	1.6789

Note: This table presents slope coefficient λ, t-stats, and adjusted R^2 for multivariate regression of value coefficient γ_{pb} and Low/High return R_{lmh} on the combination of lagged macroeconomic variables in the 1980s, the 1990s, and from 2000 to 2008. Decile value portfolios are formed with shares' price-to-book values at the end of each month, and hold for 3months. Value coefficient γ_{pb} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their mean price-to-book values in the formation time. Low/High return R_{lmh} is the return spread between 'Low' portfolio and 'High' portfolio. UEXTBILL(Y) is unexpected change of TBILL in previous 12 months. UEXDY(H) is unexpected change of DY in previous 6 months. EMR/VMR(-8) is equal-(value-) weighted market return in past eight years. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A to D report corresponding parameters for equal-(value-) weighted value coefficient γ_{pb} and Low/High return $R_{lmh.}$ with three subperiods and overall period, respectively.

Table 5.45 Multivariate regression of value effect on the combination of lagged macroeconomic variables in subperiods (Value: 6 months' holding length)

Panel A July 1980-December 1989

	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	4		4		6		3	
Adj-R^2	0.4635		0.4768		0.3198		0.3839	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXTBILL(Y)	-1.3339	-0.9183	-3.9201	-2.4434	-9.1496	-0.9148	-22.7419	-2.4259
UEXDY(H)	-2.7796	-5.0760	-2.2906	-3.5782	-11.8459	-3.0428	-13.5388	-2.9965
EMR/VMR(-8)	0.0029	3.3957	0.0029	2.8192	0.0228	4.2416	0.0173	3.2525

Panel B January 1990-December 1999

	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	3		5		4		4	
Adj-R^2	0.1108		0.0756		0.0488		0.1980	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXTBILL(Y)	-1.1659	-1.1352	-1.5120	-0.9150	-25.9833	-1.1700	-52.7079	-2.0703
UEXDY(H)	-0.0230	-0.1065	-0.1737	-0.5654	-5.8903	-1.0151	-15.3149	-2.2778
EMR/VMR(-8)	0.0009	2.5498	0.0009	2.2063	0.0118	1.7574	0.0266	3.4759

Panel C January 2000-December 2008

	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	8		5		5		9	
Adj-R^2	0.0672		0.0380		0.1174		0.0533	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXTBILL(Y)	3.1923	0.6019	1.2944	0.4606	48.4823	0.5225	65.0089	0.8699
UEXDY(H)	-0.4725	-0.4234	-0.3841	-0.5582	-17.1960	-0.8462	-0.4370	-0.0155
EMR/VMR(-8)	0.0003	0.1998	0.0006	0.9795	0.0173	0.5704	0.0442	1.3903

Panel D July 1980-December 2008

	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	8		8		7		12	
Adj-R^2	0.2325		0.3108		0.0892		0.1113	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXTBILL(Y)	-2.3917	-1.5954	-3.7346	-2.4620	-11.6825	-0.7108	-28.0779	-1.6671
UEXDY(H)	-1.3725	-2.5143	-1.3074	-2.8807	-10.7742	-1.6781	-11.9846	-1.5242
EMR/VMR(-8)	0.0008	3.2004	0.0015	3.3929	0.0076	2.5169	0.0122	1.6160

Note: This table presents slope coefficient λ, t-stats, and adjusted R^2 for multivariate regression of value coefficient γ_{pb} and Low/High return R_{lmh} on the combination of lagged macroeconomic variables in the 1980s, the 1990s, and from 2000 to 2008. Decile value portfolios are formed with shares' price-to-book values at the end of each month, and hold for 6 months. Value coefficient γ_{pb} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their mean price-to-book values in the formation time. Low/High return R_{lmh} is the return spread between 'Low' portfolio and 'High' portfolio. UEXTBILL(Y) is unexpected change of TBILL in previous 12 months. UEXDY(H) is unexpected change of DY in previous 6 months. EMR/VMR(-8) is equal-(value-) weighted market return in past eight years. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A to D report corresponding parameters for equal-(value-) weighted value coefficient γ_{pb} and Low/High return $R_{lmh.}$ with three subperiods and overall period, respectively.

Table 5.46 Multivariate regression of value effect on the combination of lagged macroeconomic variables in subperiods (Value: 12 months' holding length)

Panel A January 1981-December 1989

	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	4		6		7		7	
Adj-R^2	0.3864		0.3935		0.2819		0.2264	
Macroeconomic	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXTBILL(Y)	-0.5862	-0.2034	-4.8487	-1.9684	4.4282	0.1616	-19.3486	-0.8402
UEXDY(H)	-2.8549	-2.2947	-1.0944	-0.9992	-12.5707	-1.2877	0.3686	0.0340
EMR/VMR(-8)	0.0052	3.5327	0.0045	2.4057	0.0465	3.0950	0.0360	2.1629

Panel B January 1990-December 1999

	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	5		7		6		6	
Adj-R^2	0.1655		0.1421		0.1075		0.2682	
Macroeconomic	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXTBILL(Y)	-3.1885	-1.9822	-3.6444	-1.6492	-70.2238	-2.1315	-	-2.6915
UEXDY(H)	0.1844	0.4386	-0.1680	-0.2975	-4.1792	-0.3848	-16.1873	-1.5918
EMR/VMR(-8)	0.0013	3.0410	0.0014	1.9473	0.0228	2.3391	0.0491	3.1700

Panel C January 2000-December 2008

	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	9		8		8		8	
Adj-R^2	0.2166		0.0980		0.2539		0.0488	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXTBILL(Y)	10.3643	1.4359	4.9549	1.3665	211.228	1.4866	118.903	1.2189
UEXDY(H)	1.9151	1.3885	1.3112	1.4507	32.0804	1.1014	50.2162	1.4031
EMR/VMR(-8)	0.0022	1.3341	0.0015	1.6219	0.0706	2.2188	0.0549	1.2510

Panel D January 1981-December 2008

	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	7		8		9		10	
Adj-R^2	0.2236		0.2969		0.0869		0.0723	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
UEXTBILL(Y)	-2.8615	-1.3777	-4.6107	-2.5976	-19.1502	-0.7703	-54.2589	-2.0045
UEXDY(H)	-1.0797	-1.5873	-0.5994	-0.9391	-6.6187	-0.7125	4.4072	0.3393
EMR/VMR(-8)	0.0021	3.8881	0.0029	3.7004	0.0195	3.0229	0.0197	1.5231

Note: This table presents slope coefficient λ, t-stats, and adjusted R^2 for multivariate regression of value coefficient γ_{pb} and Low/High return R_{lmh} on the combination of lagged macroeconomic variables in the 1980s, the 1990s, and from 2000 to 2008. Decile value portfolios are formed with shares' price-to-book values at the end of each month, and hold for 12 months. Value coefficient γ_{pb} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their mean price-to-book values in the formation time. Low/High return R_{lmh} is the return spread between 'Low' portfolio and 'High' portfolio. UEXTBILL(Y) is unexpected change of TBILL in previous 12 months. UEXDY(H) is unexpected change of DY in previous 6 months. EMR/VMR(-8) is equal-(value-) weighted market return in past eight years. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A to D report corresponding parameters for equal-(value-) weighted value coefficient γ_{pb} and Low/High return R_{lmh}, with three subperiods and overall period, respectively.

Table 5.47 Multivariate regression of value effect on the combination of lagged macroeconomic variables in subperiods (Value: 18 months' holding length)

Panel A July 1981-December 1989								
	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	3		7		8		10	
Adj-R^2	0.3975		0.3427		0.4005		0.3257	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	0.0009	0.5524	0.0033	1.8139	0.0073	0.4357	0.0257	1.8931
EMR/VMR(-8)	0.0084	4.4498	0.0052	2.2142	0.0768	4.2253	0.0490	1.8642

Panel B January 1990-December 1999								
	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	9		10		10		10	
Adj-R^2	0.0006		0.0021		-0.0133		-0.0020	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0002	-0.1754	0.0007	0.4773	0.0089	0.3677	-0.0010	-0.0253
EMR/VMR(-8)	0.0005	0.9141	0.0010	1.2503	0.0021	0.1884	0.0219	0.8657

Panel C January 2000-December 2008								
	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	11		11		10		10	
Adj-R^2	0.1365		0.0091		0.2059		-0.0010	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0039	-1.5463	-0.0014	-1.0057	-0.1100	-1.5563	-0.0363	-0.5154
EMR/VMR(-8)	0.0043	1.9307	0.0006	0.3328	0.1493	2.9694	0.0075	0.1083

Panel D July 1981-December 2008								
	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	14		15		13		13	
Adj-R^2	0.2922		0.2807		0.1678		0.0501	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	0.0019	2.0429	0.0029	2.7470	0.0170	1.1415	0.0213	1.2310
EMR/VMR(-8)	0.0036	3.8351	0.0041	2.9723	0.0388	3.2194	0.0270	1.2306

Note: This table presents slope coefficient λ, t-stats, and adjusted R^2 for multivariate regression of value coefficient γ_{pb} and Low/High return R_{lmh} on the combination of lagged macroeconomic variables in the 1980s, the 1990s, and from 2000 to 2008. Decile value portfolios are formed with shares' price-to-book values at the end of each month, and hold for 18 months. Value coefficient γ_{pb} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their mean price-to-book values in the formation time. Low/High return R_{lmh} is the return spread between 'Low' portfolio and 'High' portfolio. GDP(Y) is the previous annual change of GDP. EMR/VMR(-8) is equal-(value-) weighted market return in past eight years. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A to D report corresponding parameters for equal-(value-) weighted value coefficient γ_{pb} and Low/High return $R_{lmh.}$ with three subperiods and overall period, respectively.

Table 5.48 Multivariate regression of value effect on the combination of lagged macroeconomic variables in subperiods (Value: 24 months' holding length)

Panel A January 1982-December 1989

	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	3		13		7		14	
Adj-R^2	0.5918		0.4762		0.4832		0.5133	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0007	-0.4057	0.0043	2.2031	-0.0060	-0.2722	0.0419	2.4237
M0(Y)	0.0267	0.0301	1.4848	1.5146	-2.5803	-0.3163	27.3738	3.8112
CPI(Y)	*-0.0915*	*-2.8903*	-0.0642	-1.5858	-0.1501	-0.4186	-0.6020	-1.6815
EMR/VMR(-8)	0.0122	5.5710	0.0087	2.6189	0.1162	4.5885	0.1068	3.1912

Panel B January 1990-December 1999

	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	5		6		5		7	
Adj-R^2	0.3245		0.4375		0.4158		0.4037	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	0.0002	0.2113	0.0012	0.9536	0.0381	1.7433	0.0071	0.2239
M0(Y)	-0.6383	-1.8897	-1.0298	-2.9588	-20.9065	-2.1538	-16.9163	-1.6260
CPI(Y)	*-0.0131*	*-2.1698*	-0.0179	-1.8436	-0.3237	-2.2235	-0.5996	-2.8848
EMR/VMR(-8)	0.0012	5.5131	0.0014	1.4464	0.0201	2.8125	0.0235	1.0288

Panel C January 2000-December 2008

	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	9		2		8		5	
Adj-R^2	0.5351		0.5739		0.4802		0.4374	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	-0.0072	-2.6175	-0.0067	-5.7135	-0.1899	-2.2890	-0.2048	-2.8089
M0(Y)	0.6693	5.2425	0.9235	6.7369	11.1378	2.5525	31.6682	5.1409
CPI(Y)	*0.0178*	*3.4692*	0.0209	4.9933	0.3835	2.6003	0.9557	4.6061
EMR/VMR(-8)	0.0039	3.2997	-0.0009	-1.1581	0.1719	5.1685	-0.0753	-1.4971

Panel D January 1982-December 2008

	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
Lag length	10		20		14		18	
Adj-R^2	0.4087		0.3300		0.2844		0.0617	
Macroeconomic variables	λ	t(λ)	λ	t(λ)	λ	t(λ)	λ	t(λ)
GDP(Y)	0.0019	1.4245	0.0034	2.3180	0.0175	0.9134	0.0269	1.1615
M0(Y)	-0.3050	-0.7060	-0.1388	-0.4251	-4.0653	-0.5764	4.0182	0.6161
CPI(Y)	-0.0340	-2.0763	-0.0263	-1.5991	-0.2902	-2.0017	-0.2325	-0.8350
EMR/VMR(-8)	0.0051	3.7060	0.0053	2.3641	0.0539	3.3486	0.0363	1.1305

Note: This table presents slope coefficient λ, t-stats, and adjusted R^2 for multivariate regression of value coefficient γ_{pb} and Low/High return R_{lmh} on the combination of lagged macroeconomic variables in the 1980s, the 1990s, and from 2000 to 2008. Decile value portfolios are formed with shares' price-to-book values at the end of each month, and hold for 24 months. Value coefficient γ_{pb} is estimated by monthly-by-monthly cross-sectional regression of portfolios' equal-(value-) weighted returns in the holding period on their mean price-to-book values in the formation time. Low/High return R_{lmh} is the return spread between 'Low' portfolio and 'High' portfolio. GDP(Y) is the previous annual change of GDP. M0(Y) is the previous annual change of M0. CPI(Y) is the previous annual change of CPI. EMR/VMR(-8) is equal-(value-) weighted market return in past eight years. t-stats is adjusted by Newey-West (1987) approach with automatic lag length as the method in Ferson, Sarkissian, and Simin (2003). Panel A to D report corresponding parameters for equal-(value-) weighted value coefficient γ_{pb} and Low/High return $R_{lmh.}$ with three subperiods and overall period, respectively.

Chapter 6 The Recursive out-of-sample Forecasting Model on Style Effects

In Chapter 5, the research investigates what factors offer explanation for the time-variation in style effects in the UK Stock Market by regressing style coefficient γ and Long/Short return R_{lms} on lagged macroeconomic variables in the overall period from 1980 to 2008 and in three subperiods, respectively. It finds that time-varying style effects could be explained by some lagged macroeconomic variables, which are associated with economic conditions and market states. Based on the findings in Chapter 5, the purpose of this chapter is to test the performance of recursive in-sample regression and out-of-sample forecasting model to verify whether the time-variation in style effects is indeed predictable. Section 6.1 describes the background of the recursive out-of-sample forecasting model. Section 6.2 introduces research methods in terms of recursive in-sample regression model and out-of-sample forecasting model, and statistical test on the model in the measure of 'PIS', 'POOS', and 'PSS'. Section 6.3 and Section 6.4 conduct test analysis on the performance of recursive in-sample regression and out-of-sample forecasting model, respectively. Section 6.5 analyzes the performance of forecasting macroeconomic variables in recursive in-sample regression model. Section 6.6 concludes this chapter.

6.1 The recursive out-of-sample forecasting model

There are three reasons for investigating the performance of recursive out-of-sample forecasting model on time-varying style effects. Firstly, Bossaerts and Hillion (1999) show the pitfalls of in-sample predictability. They find the existence of in-sample predictability of dividend yield and short-term interest rate in 14 international stock markets, but the poor performance in the out-of-sample period. A large difference exists between in-sample and out-of-sample adjusted R^2 in these markets. For instance, in-sample adjusted R^2 in Japan and US Stock Market is 12.4% and 8.3%, but out-of-sample one falls to 1.8% and 0.5%. They mention that the non-stationary pattern may be related to the limits of linear forecasting models and learning in the market. Goyal and Welch (2003) argue that in-sample relations conceal a systematic failure of dividend-yield model in out-of-sample ones, and forecasting regression has out-of-sample poor performance. They suggest that studies on market-timing ability should use comparative out-of-sample sum-squared model residuals to diagnose the model performance. Welch and Goyal (2008) investigate predictor variables for US stock market returns and conclude that many of them, such as dividend yield, earnings price ratio, book-to-market ratio, and TBILL, perform poorly in out-of-sample tests although they have significant explanatory power in in-sample tests. They find that the models' forecasting power volatiles over time，and in particular most models perform worse from 1975 to 2005.

Secondly, Welch and Goyal (2008) mention that out-of-sample tests, as one natural and useful diagnostic approach, help to evaluate whether a model is stable and well specified, or changing over time either suddenly or gradually. Lettau and Ludvigson (2010) point out that out-of-sample tests provide one way of assessing whether there has been structural change in a forecasting relation. In Chapter 5, the research finds the variation in explanatory power of lagged macroeconomic variables for time-varying style effects over subperiods. For instance, as Table 5.23 and 5.24 indicate, adjusted R^2 of the regression of time-varying momentum effect with 12 months' formation horizon and 6/12 months' holding horizon on lagged macroeconomic variables declines for equal-weighted case, but rises for value-weighted case over the 1980s, the 1990s, and from 2000 to 2008. The similar volatility exists in adjusted R^2 of the regression of size effect and value effect. In addition, Chapter 5 shows the existence of the variation in significant macroeconomic variables to explain time-varying style effect through time. For instance, as shown in Table 5.23, UEXTBILL(Y) and EMR(-1), GDP(Y), respectively, combining with DY(Q), significantly capture the variation in equal-weighted momentum effect (12/6) in the 1980s and the 1990s. Table 5.35 shows that size coefficient γ_{mv} of size effect with 12 months' holding horizon is significant sensitive to CPI(Y), GDP(Y), UEXTBILL(Y), respectively, in the 1980s, the 1990s, and from 2000 to 2008. More importantly, the same macroeconomic variables offer opposite explanatory power for style effects over three decades. For example, Table 5.35 shows that size effect with 12 months' holding horizon is marginally negatively driven by CPI(Y) in the 1980s, but positive though unsignificant since the 2000. Table 5.48 reflects that value effect with 24 months' holding horizon is significantly negatively associated to MO(Y) and CPI(Y) in the 1990s, but positive and significant since 2000. So, the research compares predicted style coefficient γ and Long/Short return R_{lms} from recursive out-of-sample forecasting model with actual ones to evaluate the performance of predictive model, and details the variation in significant macroeconomic variables.

Thirdly, the signals from recursive out-of-sample model, based on macroeconomic variables at time t-1, can be applied in practice to time style rotation monthly-by-monthly. Campbell and Thompson (2005) argue that actual-world investors would not mechanically run the unrestricted predictive models that are tested in the literature. Instead, they would impose restrictions on the regression coefficient beta to require positive expected risk premium. Some scholars, such as Levis and Liodakis (1999), Cooper, Gulen, and Vassalou (2001), Levis and Tessaromatis (2004), use out-of-sample model to explore the performance of active trading strategy.

In this chapter, the research uses recursive out-of-sample forecasting model to verify the predictability of the model for the time-variation in style effects, to illustrate dynamic pattern of macroeconomic variables to explain the variation, which offers the foundation to explore the application of forecasting model in active trading strategies for timing style rotation in Chapter 7.

6.2 Research methods

The recursive forecasting methodology is similar in spirit to approaches used in Bossaerts and Hillion (1999), and Cooper, Gutierrez，and Hameed (2004) among others. Levis and Liodakis (1999) apply recursive out-of-sample forecasting model to explore the capability of timing small/large-cap rotation and value/growth rotation in the UK Stock Market. Cooper, Gulen, Vassalou (2001) show that the recursive out-of-sample forecast model offers the time of allocating the position in small/medium/large-cap portfolio and high/medium/low book-to-market portfolio in the US Stock Market.

6.2.1 Recursive out-of-sample forecasting model

The chapter uses recursive out-of-sample forecasting model on time-varying style effect in terms of momentum effect (12/6, 12/12), size effect (12), and value effect (24) because their long/short returns are higher than corresponding ones based on 6 months' formation length (momentum) and other holding horizons, and macroeconomic variables offer stronger explanatory power for their time-variation than corresponding style effects based on other formation horizon or holding horizons as shown in Chapter 4 and Chapter 5. Momentum effect (12/6, 12/12) is based on decile portfolios sorted by past 12 months' share returns and hold for 6/12 months. Size effect (12) is based on decile portfolios sorted by shares' market values and hold for 12 months. Value effect (24) is based on decile portfolios sorted by shares' price-to-book ratios and hold for 24 months. The detailed procedures to test recursive out-of-sample forecasting model are described as below:

- The first step: The research uses in-sample regression model (6.1) and (6.1') to estimate the intercept λ_0 and slope coefficient λ_{EV} of forecasting macroeconomic variables (EV) in the initial in-sample period of ten years from January 1980 to December 1989, and obtains the first intercept λ_0 and the first slope coefficient λ_{EV} in June 1990 (December 1990, December 1991) when portfolios are hold for 6 (12, 24) months.

$$\gamma_t = \lambda_{0,t} + \lambda_{EV,t} * EV_{t-L} + \varepsilon_{i,t} \qquad (6.1)$$

and

$$R_{lms,t} = \lambda_{0,t} + \lambda_{EV,t} * EV_{t-L} + \varepsilon_{i,t} \qquad (6.1')$$

Where γ (R_{lms}) is style coefficient (long/short return) estimated in Chapter 4, λ_0 is intercept, EV is (n*1) vector representing macroeconomic variables at lagged length L, which are described in Chapter 5, λ_{EV} is the OLS slope coefficient from the regression of γ (R_{lms}) on lagged macroeconomic variables EV. ε is an error.

- The second step: The intercept λ_0 and slope coefficient λ_{EV} estimated from in-sample regression model (6.1) and (6.1') reflect the relation between style coefficient γ, long/short return R_{lms} and forecasting macroeconomic variables at time point t. It is assumed that this relation would not change in following 3 to 24 months' horizon, and that investors equipped with information from prior period form expectations on style effects at time point t+l, and construct long/short portfolio. The research uses out-of-sample forecasting model (6.2) and (6.2'), the intercept λ_0 and slope coefficient λ_{EV} estimated in in-sample regression model (6.1) and (6.1'), and known lagged macroeconomic variables (EV) in advance in June 1990 (December 1990, December 1991) to calculate first predicted monthly step-ahead style coefficient $\hat{\gamma}$ (long/short return $\hat{R}_{lms}$) when portfolios are hold for 6 (12, 24) months.

$$\hat{\gamma}_{t+1} = \lambda_{0,t} + \lambda_{EV,t} * EV_t \tag{6.2}$$

and

$$\hat{R}_{lms.t+1} = \lambda_{0,t} + \lambda_{EV,t} * EV_t \tag{6.2'}$$

- The third step: The research repeats the procedure in the first and second step, increasing every time in-sample window by one month, until obtaining 216 (204, 180) series out-of-sample predicted style coefficient $\hat{\gamma}$ (long/short return $\hat{R}_{lms}$) that cover the period from July 1990 to June 2008 (from January 1991 to

December 2007, from January 1992 to December 2006) when portfolios are hold for 6 (12, 24) months.

Table 6.1 describes the beginning date on in-sample period and out-of-sample period when long/short portfolios are hold for 6 months. The similar pattern is for portfolios with 12 and 24 months' holding horizons.

[Table 6.1]

6.2.2 Statistic test

The performance of recursive in-sample regression model and out-of-sample forecasting model should be quantitatively measured and compared to the benchmark, that is the historical mean model. Although adjusted R^2 from the regression model offers explanatory power of the forecasting variable for the variation in dependent variable, it can't be used to evaluate the outperformance of the model relative to the unconditional benchmark (the prevailing mean). The research uses the statistics 'PIS' to test the performance of recursive in-sample regression model, and the statistics 'POOS' and 'PSS' to test the performance of recursive out-of-sample forecasting model. The plot of 'PIS' and 'POOS' helps to capture when in-sample regression model and out-of-sample forecasting model perform well or poorly over the historical mean model. 'PSS' reflects the extent that the estimate from the forecasting model is matched by the values actually observed.

The research uses the approach in Welch and Goyal (2008) to examine whether recursive in-sample regression model and out-of-sample forecasting model outperform historical mean model. Based on the root-mean-squared error (RMSE), Welch and Goyal (2008) approach compares cumulative RMSE between recursive in-sample regression model and the historical mean model, between recursive out-of-sample forecasting model and the historical mean model, to reflect the performance of two models relative to historical mean model as the benchmark. For the performance of recursive in-sample regression model, the test statistics, which is labeled 'PIS', is estimated by the cumulative squared demeaned style coefficient γ (Long/Short return R_{lms}) minus the cumulative squared regression residual from in-sample regression model (6.1, 6.1'). For the performance of recursive out-of-sample forecasting model, the test statistics, which is labeled 'POOS', is estimated by the cumulative squared demeaned style coefficient γ (Long/Short return R_{lms}) minus the cumulative squared its prediction error from out-of-sample forecasting model (6.2, 6.2'). This measure is to compare two forecasting methods. One forecasting model is to compute the sample mean style coefficient γ (Long/Short return R_{lms}) from time 1 to time t, and use that sample mean to forecast style coefficient γ (Long/Short return R_{lms}) at time t+1. Another forecasting method is to run a regression from time 1 to time t, and use estimated regression coefficients to forecast style coefficient γ (Long/Short return R_{lms}) at time t+1. The statistics of "POOS" compares the performance in forecasts that use the sample mean with the performance in predicted style coefficient γ (Long/Short return R_{lms}) from regression and forecasting model in the same period.

Welch and Goyal (2008) argue that a well-specified signal would inspire confidence in the model if 'PIS' and 'POOS' had a generally upward drift over time, which occurs not just in one short or unusual sample period. The research uses the first 10 years to estimate first statistics 'PIS', 'POOS' in December 1989, increases window by one month each time, and repeats the estimation of two statistics. It obtains series 'PIS' and 'POOS' over the sample period, and plots 'PIS' and 'POOS' to indicate the performance of recursive in-sample regression model and out-of-sample forecasting model, respectively, relative to the sample mean model. When the lines of 'PIS' and 'POOS' increase, in-sample regression model and out-of-sample forecasting model perform better relative to the historical mean model. When they decrease, the models perform poorly relative to the historical mean model. The lines of 'PIS' and 'POOS' allow diagnosis of time with good or poor performance of recursive in-sample regression and out-of-sample forecasting model.

The statistics 'POOS' is to evaluate the performance of out-of-sample forecasting model relative to the historical mean model by comparing two models' cumulative squared forecasting errors. Additively, the research uses the statistics 'PSS' to measure the predictability of out-of-sample forecasting model by comparing the sign of predicted values and actually observed values. It uses the number (percentage) of observations with same sign of predicted and actual style coefficient γ (Long/Short return R_{lmh}), which is denoted as 'PSS', to indicate the extent that out-of-sample forecasting model offers successful forecasting signals for the time-variation in style *effects*. It is instructive for actual-world investors to apply the model for timing style rotation. The research uses recursive out-of-sample forecasting model (6.2, 6.2') to estimate style coefficient γ (Long/Short return R_{lmh}) from 1990 to 2008, and to calculate 'PSS', the percentage of observation with same sign between predicted and actual style coefficient γ (Long/Short return R_{lmh}). Actual style coefficient γ (Long/Short return R_{lmh}) of momentum, size, and value effect are estimated in Chapter 4. When predicted style coefficient γ (Long/Short return R_{lmh}) from the recursive out-of-sample forecasting model has the same sign (positive or negative) as actual one, the model is successful in offering forecasting signals. When predicted style coefficient γ (Long/Short return R_{lmh}) from the recursive out-of-sample forecasting model has the opposite sign as actual one, the model fails to offer correct forecasting signals. The higher is the statistics 'PSS', the better is the performance of forecasting model. The statistics 'PSS' offers underlying parameter for active trading strategy on style effects, which is in detail analyzed in Chapter 7.

6.3 The test on performance of recursive in-sample regression

In Chapter 5, the research finds dynamic explanatory power of lagged macroeconomic variables for style effects over three decades from 1980 to 2008. For example, Table 5.24 Panel A to C show that the combination of lagged macroeconomic variables, which are GDP(Y), UEXBILL(Y), DY(Q), and CPI(H), can explain 26.37%, 17.13%, and 59.23% of the variation in the return spread between value-weighted ‘Winner’ and ‘Loser’ portfolios with 12 months’ formation length and 12 months’ holding horizon in the 1980s, the 1990s, and the period from 2000 to 2008, respectively. In this section, the research further investigates the performance of recursive in-sample regression on three style effects from 1980 to 2008, which highlights monthly-by-monthly fluctuation pattern of explanatory power of macroeconomic variables for time-varying style effects. The research uses series adjusted R^2 and PIS to evaluate the performance of recursive in-sample regression of style coefficient γ (Long/short return R_{lms}) on lagged macroeconomic variables.

6.3.1 Series adjusted R^2

The research uses in-sample regression model (6.1) and (6.1’) to estimate series explanatory power of lagged macroeconomic variables for time-varying style effects.

The initial in-sample period is set from January 1980 to December 1989. The first adjusted-R^2 of the regression is estimated in June 1990 (December 1990, December 1991) when portfolios are hold for 6 (12, 24) months.

[Table 6.2]

[Figure 6.1, 6.2]

Panel A and B of Table 6.2 detail the results on the performance of series adjusted R^2 in recursive in-sample regression of momentum effect (12/6, 12/12) on macroeconomic variables from 1980 to 2008. When momentum portfolios are formed by previous 12 months' share returns and hold for 6 and 12 months, the combination of four lagged macroeconomic variables, which include GDP(Y), UEXTBILL(Y), DY(Q), and EMR(-1)/CPI(H), could explain average 19.14 to 32.75, and 19.75 to 35.15 percentage of the time-variation in equal-(value-) weighted momentum coefficient γ_{mom} and Winner/Loser return $R_{wml.}$ The explanatory power maintains higher volatile with standard deviation of about 0.10 for equal-weighted case, low volatile with standard deviation of less than 0.05 for value-weighted case. Importantly, the highest (lowest) explanatory power of macroeconomic variables for two cases of momentum effect is 58.06% and 52.61% (11.29% and 15.62%), respectively. Figure 6.1 and Figure 6.2 plot series adjusted R^2 estimated from recursive in-sample regression of momentum coefficient γ_{mom} (Winner/Loser return R_{wml}) with 6 and 12 months' holding horizons on lagged macroeconomic variables from 1980 to 2008, respectively. Adjusted R^2 in equal-weighted pattern exhibits the obvious decline in the early 1990s and the year 2002 and then the stability, but the rise in the early 2000s. Adjusted R^2 in value-weighted pattern experiences three periods, which include the sustaining decline in the 1990s, the rise in the early 2000s, and the stability afterwards.

[Figure 6.3]

Panel C of Table 6.2 reports the performance of series adjusted R^2 in recursive in-sample regression of size effect (12) on lagged macroeconomic variables from 1980 to 2008. When size portfolios are hold for 12 months, the combination of four macroeconomic variables, which includes GDP(Y), CPI(Y), UEXTBILL(Y), and UEXTERM(Y), provides explanatory power with average 21.13 to 24.61 percentage of the time-variation in equal-(value-) weighted size coefficient γ_{mv} and Small/Large return R_{sml}. This explanatory power is stable over time, with low standard deviation of 0.0538 to 0.0557, and the highest (lowest) one of 31.52% to 35.47% (13.44% to 16.69%). Figure 6.3 shows that adjusted R^2 in recursive in-sample regression of size effect (12) is in stable condition over most of time, except for the decline in 1991, 1996, and 2002.

[Figure 6.4]

Panel D of Table 6.2 reports the performance of series adjusted R^2 in recursive in-sample regression of value effect (24) on lagged macroeconomic variables from 1980 to 2008. When price-to-book portfolios are hold for 24 months, the combination of macroeconomic variables, which consists of GDP(Y), M0(Y), CPI(Y), and MR(-8), explains high up to average 25.91 to 48.11 percentage of time-varying equal-(value-) weighted value coefficient γ_{pb} and Low/High return R_{lmh}. Except for vale-weighted Low/High return $R_{lmh,}$ the explanatory power has lower volatility over time, with low standard deviation of 0.0358 to 0.0593. The highest adjusted R^2 is between 0.4236 and 0.5728. Particularly, the lowest adjusted R^2 keeps higher level ranging between 0.2724 and 0.4002. Figure 6.4 graphs declining adjusted R^2 in the early 1990s and 2000s, rising one in the second half of the 1990s, and stable one after 2003.

In summary, recursive in-sample explanatory power of macroeconomic variables for time-varying momentum effect (12/6, 12/12), size effect (12), and value effect (24) are generally higher, but volatiles over time from 1980 to 2008, which consists of the declining, rising, and stable period. This volatility is consistent with the findings in Chapter 5 on the variation in adjusted R^2 of multivariate regression for style effects in three subperiods of the 1980s, the 1990s, and 2000 afterwards. Few macroeconomic variables persistently keep significant impact on the time-variation in style effects in three subperiods, which might lead to the volatility in their explanatory power over time. In addition, the limits of linear regression model and learning in the market, as Bossaerts and Hillion (1999) mention, might cause the unstable explanatory power of macroeconomic variables.

6.3.2 Series test statistics, 'PIS'

The research uses the statistics, 'PIS', to test the performance of recursive in-sample regression of style coefficient γ (Long/Short return R_{lms}) on lagged macroeconomic variables from 1980 to 2008. Similar to the method in Welch and Goyal (2008), 'PIS' is measured by the cumulative squared demeaned style coefficient γ (Long/Short return R_{lms}) minus the cumulative squared regression residual from in-sample regression model (6.1, 6.1') each month. The research estimates series PIS of style coefficient γ (Long/Short return R_{lms}) from 1990 to 2008, and plots their 'PIS' performance.

The research uses the first 10 years to estimate information coefficients from the regression of momentum coefficient γ_{mom} (Winner/Loser return R_{wml}) on lagged macroeconomic variables, which include GDP(Y), UEXTBILL(Y), DY(Q), and EMR(-1)/CPI(H), from January 1980 to December 1989, and calculates the first statistics 'PIS' in December 1989. Increasing in-sample window by one month each time and repeating the regression, the research obtains series 'PIS' over in-sample period. Figure 6.5 and Figure 6.6 graph series 'PIS' for momentum effect (12/6, 12/12), the performance of recursive in-sample regression of momentum coefficient γ_{mom} (Winner/Loser return R_{wml}) on macroeconomic variables from December 1989 to June 2008/December 2007. For equal-weighted momentum portfolios, 'PIS' line (dashed line) increases from 1990 to 1991 and from 1999 to early 2002, indicating performance of in-sample regression in these two periods better than the historical mean model. After two increases, 'PIS' line faces the fall, especially sharp fall from early 2003 to early 2004, showing poor performance of in-sample regression in the period. In other periods, 'PIS' maintains stable condition. For value-weighted momentum portfolios, 'PIS' line exhibits a generally upward trend from 1999 to early 2003, and keeps high horizontal level. Therefore, Figure 6.5 and Figure 6.6 show that in-sample impact of the combination of four macroeconomic variables on time-varying momentum effect had neither good nor bad performance in most sample period, best performance at the end of 1990s and the beginning of 2000s, and poor performance for equal-weighted momentum after experiencing good one. Figure 6.1 and Figure 6.5, Figure 6.2 and Figure 6.6 show similar pattern in equal-weighted momentum effect (12/6, 12/12) between adjusted R^2 and 'PIS'. For value-weighted momentum effect (12/6, 12/12), there is difference in the performance between adjusted R^2 and 'PIS' in the 1990s. Although adjusted R^2 experiences declining condition in the 1990s as shown in Figure 6.1 and Figure 6.2, 'PIS' performs in stable condition.

[Figure 6.5，6.6]

Using the same way in above case of momentum effect, the research estimates series 'PIS' for size effect (12), the performance of recursive in-sample regression of size coefficient γ_{mv}(Small/Large return R_{sml}) on lagged macroeconomic variables, which include GDP(Y), CPI(Y), UEXTBILL(Y), and UEXTERM(Y), from 1980 to 2008 when size portfolios are hold for 12 months. Figure 6.7 shows the 'PIS' pattern of in-sample regression on size effect (12) is volatile. The line of 'PIS' increases during 1990, 1992, 1997 to mid-1999, and 2004 to 2008, indicating that the combination of macroeconomic variables explains time-varying size effect (12) well in these four periods. 'PIS' line exhibits a fall after its four increases. The line of 'PIS' experiences a fall in the periods, consistent with the periods in which adjusted R^2 performs downward in Figure 6.3. But the line of 'PIS' rises in the periods when adjusted R^2 keeps flat.

[Figure 6.7]

The research estimates and graphs series 'PIS', in-sample predictive performance of lagged macroeconomic variables of GDP(Y), MO(Y), CPI(Y), and MR(-8) for the time-variation in value coefficient γ_{pb}(Low/High return R_{lmh}) from 1980 to 2008. As shown in Figure 6.8, the line of 'PIS' performs upward from 1994 to 1998 and then downward until the late 2003, showing superior performance and inferior performance of in-sample regression in two periods over the historical mean model. Especially, for value-weighted Low/High return R_{lmh}, the line of 'PIS' experiences sharp fall from 1999 to early 2005, indicating that macroeconomic variables fail to offer predictive power in that period. The line of 'PIS' presents the similar change of adjusted R^2 as shown in Figure 6.4.

[Figure 6.8]

In summary, the research uses the statistics 'PIS' to examine the performance of recursive in-sample regression of style effects on macroeconomic variables relative to the sample mean model in the UK Stock Market from 1980 to 2008. It finds the volatility in explanatory power of regression model through time, which exhibits its better/and poor performance at some periods. This reflects that time-varying style effects are not always captured by these macroeconomic variables all the time, and that they might be caused by other information in the market.

6.4 The test on performance of recursive out-of-sample forecasting model

As introduced in Section 6.1, recursive out-of-sample forecasting model can evaluate whether the model is indeed predictable, and whether the model is stable or volatile, either suddenly or gradually. In this section, the research uses the statistics 'POOS' to test the performance of out-of-sample forecasting model for the time-variation in style effects relative to historical mean model. Meanwhile, it uses the statistics 'PSS' to examine the predictability of out-of-sample forecasting model, which is measured by the percentage of observations with same sign of predicted and actual Long/Short return R_{lms} (style coefficient γ).

6.4.1 Series test statistics, 'POOS'

Similar to the method of estimating the statistics 'PIS' in subsection 6.3.2, the research uses the statistics 'POOS' to test the performance of out-of-sample forecasting model on expected style coefficient γ (Long/Short return R_{lms}). 'POOS' is measured by the cumulative squared demeaned style coefficient γ (Long/Short return R_{lms}) minus the cumulative squared its prediction error from out-of-sample forecasting model (6.2, 6.2'). The research estimates series out-of-sample predicted style coefficient γ (Long/Short return R_{lms}) and series ‘POOS’ from 1990 to 2008. The line of series ‘POOS’ is used to evaluate the performance of out-of-sample forecasting model relative to sample mean model. The increase in ‘POOS’ line reflects better performance of forecast model relative to sample mean model, and vice versa.

Figure 6.5 and Figure 6.6 graph solid line as the ‘POOS’ for predicted momentum coefficient γ_{mom} (Winner/Loser return R_{wml}) from 1990 to 2008 in the case of momentum effect (12/6, 12/12). They show that ‘POOS’ line is similar to ‘PIS’ for two cases of momentum effect. For equal-weighted momentum portfolios, ‘POOS’ line exhibits stable pattern from 1991 until 1999, and increases from 1999 to early 2002, indicating the better out-of-sample forecasting performance relative to the prevailing sample mean. After the increase, ‘POOS’ line sharply falls from early 2003 to early 2004, showing poor performance of out-of-sample forecasting model during the period. Afterwards, the ‘POOS’ line restores its stable pattern as its performance in the beginning of the sample period. Different from equal-weighted case, ‘POOS’ line for value-weighted momentum portfolios exhibits a generally upward movement from 1999 to early 2003, and keeps at high level. Therefore, Figure 6.5 and Figure 6.6 show that out-of-sample forecasting model had stable performance in most sample period, better performance at the end of 1990s and the beginning of 2000s, and poor performance for equal-weighted momentum portfolios after experiencing good one.

The performance of out-of-sample forecasting model on momentum effect is almost consistent with the performance of its in-sample regression from 1990 to 2008.

Figure 6.7 plots solid line as the 'POOS' for predicted size coefficient γ_{mv}(Small/Large return R_{sml}) from 1990 to 2008 when size portfolios are hold for 12 months. Similar to 'PIS' line, the 'POOS' line is volatile over the period. It exhibits rising or flat pattern from 1992 to 1995, from 1997 to mid-1999, and from 2004 to 2008, indicating that out-of-sample forecasting model offers better or stable predicting signal relative to prevailing sample mean during these periods. The line falls in other periods, showing the poor performance of the forecasting model. So, in-sample regression and out-of-sample forecasting model on size effect (12) keeps the same performance from 1990 to 2008.

Figure 6.8 graphs solid line as the 'POOS' for predicted value coefficient γ_{pb}(Low/Hihg return R_{lmh}) from 1990 to 2008 when value portfolios are hold for 24 months. For predicted value coefficient γ_{pb}, the 'POOS' line exhibits flat pattern even if the 'PIS' line has rising performance from 1994 to 1998. For predicted equal-weigted Low/High return R_{lmh}, the 'POOS' line has similar pattern over sample period as the 'PIS' line, showing the forecasting model's superior performance from 1994 to 1998, inferior performance after that period until the late 2003, and stable performance afterwards. For predicted value-weighted Low/High return R_{lmh}, its

‘POOS’ line fails to follow the increase in ‘PIS’ line and maintains flat from 1994 to 1998. After this period, the POOS line has sharp downward trend until 2006. Except for equal-weighted Low/High return R_{lmh}, out-of-sample forecasting model on value effect (24) performs poorly from 1990 to 2008 although in-sample regression model has good performance in some periods.

6.4.2 Test statistics, ‘PSS’

The research uses the statistics, ‘PSS’, to test whether the recursive out-of-sample forecasting model offers the same signal as actual style effect. ‘PSS’ is measured as the percentage of observation with same sign (PSS) between predicted and actual style coefficient γ (long/short return R_{lms}). Actual style coefficient γ (long/short return R_{lms}) is estimated in Chapter 4. Panel A and B of Table 6.3 indicate ‘+PSS’ and ‘-PSS’, the percentage of observation with same positive and negative sign, respectively, between predicted and actual style coefficient γ (Long/Short return R_{lmh}), for momentum effect (12/6, 12/12), size effect (12), and value effect (24). Panel C reports ‘PSS’, the percentage of observation with the combination of same positive and same negative sign, for corresponding style effects.

[Table 6.3]

Panel A shows that when the recursive out-of-sample forecasting model for momentum effect (12/6, 12/12) offers positive predicted momentum coefficient γ_{mom} (Winner/Loser return R_{wml}), there are 68.07% to 83.50% of forecasts with the same positive sign as actual ones. For value effect (24), 61.54% to 90.0% of predicted positive value coefficient γ_{pb} (Low/High return R_{lmh}) is matched by actual ones. For size effect (12), the forecasting model offers lower percentage in same positive sign between predicted and actual size coefficient γ_{mv} (Small/Large return R_{sml}), ranging between 45.71% and 55.47%.

As indicated in Panel B, when out-of-sample forecasting model offers momentum effect (12/6, 12/12) and value effect (24) high percentage of observation with same positive sign between predicted and actual style coefficient γ (Long/Short return R_{lmh}), the model has lower percentage with the same negative sign, which is less than 56.25% and 28.95% for momentum effect (12/6, and 12/12) and value effect (24), respectively. Conversely, although the forecasting model offers size effect (12) with unsatisfied predictive signals with same positive sign, it has relatively higher percentage with the same negative one, which is more than 64%. Panel C reports the percentage with the combination of same positive and negative sign between predicted and actual style coefficient γ (Long/Short return R_{lms}) to indicate overall the predictability of the model. It is shown that the recursive out-of-sample forecasting model offers momentum effect (12/6, 12/12) higher percentage of observation with the same sign between predicted and actual ones, followed by size effect (12) and value effect (24). The corresponding statistics ‘PSS’ ranges between 60.29% and 81.48%, between 51.47% and 60.29%, and between 45.0% and 58.33%, respectively.

The research further observes the relation between ‘PIS’ and ‘PSS’ from 1990 to 2008. It assigns 1 to ‘Sign’ when predicted and actual style coefficient γ (Long/Short return R_{lms}) has the same positive or negative sign, and assigns -1 to ‘Sign’ when predicted and actual style coefficient γ (Long/Short return R_{lms}) has opposite sign. When the research compares dashed ‘PIS’ and column graph ‘Sign’ for equal-weighted momentum effect (12/6, 12/12), it is found in the Figure 6.5 and Figure 6.6 that ‘1’ sign is likely to appear when ‘PIS’ line is flat or increases. This indicates that the sign of predicted equal-weighted momentum coefficient γ_{mom} (Winner/Loser R_{wml}) is consistent with actual ones when in-sample regression performs in stable or better condition. Conversely, most of ‘-1’ sign appear later 1992 to early 1993, and later 2003 to early 2004 when ‘PIS’ has downward trends. This indicates that the signal from out-of-sample forecasting model is different from actual one when in-sample regression had poor performance. For value-weighted momentum effect, the sign of ‘1’ usually appears when ‘PIS’ line is flat or rises, and the sign of ‘-1’ does in 2002 and 2003 when ‘PIS’ line is volatile although no having obvious decline as one in equal-weighted case. So, the percentage having same sign (‘PSS’) for predicted and actual momentum coefficient γ_{mom} (Winner/Loser R_{wml}) is closely correlated with the performance of in-sample regression (‘PIS’).

As shown in Figure 6.7, the sign of ‘1’ for size effect (12) is likely to appear in a row from early 1992 to 1993 and from mid-1998 to 1999 when the ‘PIS’ line trends obviously upward. Conversely, the sign of ‘-1’ happens in three periods when the ‘PIS’ line trends downward, from early 1991 to early 1992, from mid-1995 to mid-1997, and from 2001 to mid-2003. More than 50 percent of the sign of ‘-1’ are in three periods that account for less than 40 percent of observations. This reflects that the percentage having same sign (‘PSS’) between predicted and actual size coefficient γ_{mv} (Small/Large R_{sml}) is closely correlated with the performance of in-sample regression.

Similar to momentum effect (12/6, 12/12) and size effect (12), Figure 6.8 shows the sign of ‘-1’, the opposite sign between predicted and actual value coefficient γ_{pb} (Low/High Return R_{lmh}) based on 24 months’ holding horizon, appears when in-sample regression performs worse from 2000 to 2003. But the sign of ‘1’, the same sign between predicted and actual ones does not respond to the increase in the line of ‘PIS’ from 1994 to 1998 as the same way in momentum effect (12/6, 12/12) and size effect (12). Although the ‘PIS’ line rises during 1994 to 1998, the ‘PSS’ ranges between 40 and 53 percentage. This pattern is consistent with the poor performance of out-of-sample forecasting model during this period in which the

‘POOS’ line experiences slight decline or flat, except for equal-weighted Low/High Return $R_{lmh.}$

In summary, the research uses two statistics, ‘POOS’ and ‘PSS’, to investigate the performance of recursive out-of-sample forecasting model. Statistic tests show that the performance of out-of-sample forecasting model is volatile through time. The lines of ‘POOS’ and ‘PIS’ reflect that the out-of-sample forecasting model has the same volatile pattern as in-sample regression model for momentum effect (12/6, 12/12) and size effect (12), but difference for value effect (24). As Welch and Goyal (2008) argue, the out-of-sample forecasting model for value effect (24) performs poorly even though in-sample regression model offers high explanatory power for value coefficient γ_{pb} and Low/High Return R_{lmh}. The statistics ‘PSS’ shows that out-of-sample forecasting model offers correct signal to capture momentum effect (12/6, 12/12) in 60.29% to 81.48% of all observations, followed by size effect (12) with 51.47% to 60.29%. However, the percentage ranges between 45.0% and 58.33% for value effect (24). The result in the statistics ‘PSS’ implies the possibility of out-of-sample forecasting model to capture the rotation in both momentum effect and size effect, but its failure for value effect.

6.5 The series performance of macroeconomic variables in recursive in-sample regression

The findings in Chapter 5 show the variation in significant macroeconomic variables on time-varying style effects in three decades from 1980 to 2008. The recursive in-sample regression offers more detailed description on their dynamic performance as sample length monthly extends ahead.

[Table 6.4]

Table 6.4 reports the percentage of observations in which macroeconomic variables are statistically significant in recursive in-sample regression of style coefficient γ (Long/Short return R_{lms}) from 1980 to 2008. Panel A shows that UEXTBILL(Y) and DY(Q) keeps significant pattern in explaining time-varying momentum effect (12/6) in higher percentage of all observations, between 57.4% and 100%, between 59.6% and 91.5%, respectively. The percentage for GDP(Y) and EMR(-1)/CPI(H) is lower than 43% in some cases. Panel B shows that GDP(Y) is one stable significant macroeconomic variable for momentum effect (12/12) in more than 90 percent of observations. But the significance of other macroeconomic variables is volatile over time, with the percentage below 60%.

Panel C indicates that although GDP(Y) and CPI(Y) are two most important variables among four macroeconomic variables to explain time-varying size effect (12), they are statistically significant in 45.6 to 78.8 and 49.8 to 70.5 percentage of observations, respectively. The explanatory power of UEXTBILL(Y) is much volatile, significant in less than 30 percent of observations. When combining other variables, UEXTERM(Y) losses significant impact on time-varying size effect (12) in all observations, as its performance in the regression in a whole period.

As Panel D shows, EMR(-8) is most stable explanatory variable except for value-weighted Low/High return R_{lmh}, and is significant in more than 95.6 percent of observations. This reflects the past long-term market performance is determinant factor in capturing the rotation between value shares and growth shares. CPI(Y) offers significant impact on time-varying value effect (24) in more than 71 percent of observations. GDP(Y) and M0(Y) lose significant explanatory power for value effect (24) in most cases.

Series performance of macroeconomic variables in recursive in-sample regression shows that macroeconomic variables, except GDP(Y) for momentum effect (12/12) and EMR(-8) for value effect (24), might lose explanatory power for time-varying style effects in the UK Stock Market at some time points although they are significant in overall period. This leads to the failure of recursive in-sample regression and out-of-sample forecasting model to capture correct signal for time-varying style effects in the real world.

6.6 Conclusion

Based on the findings in Welch and Goyal (2008) that most equity premium predictive models fail to statistically and economically outperform the unconditional benchmark (the prevailing mean), this chapter focuses on the performance of recursive in-sample regression and out-of-sample forecasting model on time-varying momentum effect (12/6, 12/12), size effect (12), and value effect (24) to verify whether the time-variation in style effects is indeed forecasted in the UK Stock Market from 1980 to 2008. Besides adjusted R^2, the research uses the statistics 'PIS', which is measured by the cumulative squared demeaned style coefficient γ (Long/Short return R_{lms}) minus the cumulative squared regression residual, to test the performance of recursive in-sample regression model. It uses the statistics 'POOS', which is measured by the cumulative squared demeaned style coefficient γ (Long/Short return R_{lms}) minus the cumulative squared its out-of-sample prediction error, to test the performance of recursive out-of-sample forecasting model. Meanwhile, it uses the statistics 'PSS', the percentage of observations with same sign of predicted and actual style coefficient γ (Long/Short return R_{lms}), to evaluate the successful signal from out-of-sample forecasting model.

It is found that recursive in-sample explanatory power of the combination of lagged macroeconomic variables for time-varying momentum effect (12/6, 12/12), size effect (12), and value effect (24) is generally higher, but volatile over time. The statistics ‘PIS’ can be used to measure the performance of recursive in-sample regression through time, and to capture the time with good and poor performance of regression model relative to the prevailing sample mean model.

The test of recursive out-of-sample forecasting model indicates that ‘POOS’ for momentum effect (12/6, 12/12) and size effect (21) keeps the similar performance in out-of-sample period as ‘PIS’, the statistics to test recursive in-sample regression, but exhibits quite difference for value effect (24). The percentage of same sign (‘PSS’) of predicted and actual style coefficient γ (Long/Short R_{lms}) is higher for momentum effect (12/6, 12/12), followed by size effect (12) and value effect (24). The recursive out-of forecasting model offers same sign (positive and negative) between predicted and actual momentum coefficient γ_{mom} (Winner/Loser R_{wml}) in 60 to 82 percent of observations. The percentage falls down to 51 to 61 percent, and 45 to 59 percent for size effect (12) and value effect (24), respectively. The diagnostic test on recursive out-of-sample forecasting model seems to be promising in timing momentum effect (12/6, 12/12) and size effect (12).

The test of recursive in-sample regression and out-of-sample forecasting model, measured by three statistics in terms of ‘PIS’, ‘POOS’, and ‘PSS’, paves the way to explore the outperformance of active trading strategy on style rotation relative to passive trading strategy on one fixed style all the time. The higher statistics 'PSS' in the empirical test of out-of-sample forecasting model is statistically and economically instructive for timing momentum effect (12/6, 12/12) and size effect (12), which is further investigated in the next chapter.

Appendix: tables and figures in Chapter 6

Table 6.1 The beginning date on in-sample period and out-of-sample period when long/short portfolios are hold for 6 months

Date	EV	Long/Short Portfolio	R_{lms}	In-sample Reg	λ_{EV}	Exp R_{lms}
1980/1	EV_{1-L}	LSP_1				
1980/2	EV_{2-L}	LSP_2				
1980/3	EV_{3-L}	LSP_3				
1980/4	EV_{4-L}	LSP_4				
1980/5	EV_{5-L}	LSP_5				
1980/6	EV_{6-L}	LSP_6				
1980/7	EV_{7-L}	LSP_7	$R_{lms,1}$			
1980/8	EV_{8-L}	LSP_8	$R_{lms,2}$			
1980/9	EV_{9-L}	LSP_9	$R_{lms,3}$			
1980/10	EV_{10-L}	LSP_{10}	$R_{lms,4}$			
1980/11	EV_{11-L}	LSP_{11}	$R_{lms,5}$			
1980/12	EV_{12-L}	LSP_{12}	$R_{lms,6}$			
…..	…..	…..	…..			
1990/1	EV_{121-L}	LSP_{121}	$R_{lms,115}$			
1990/2	EV_{122-L}	LSP_{122}	$R_{lms,116}$			
1990/3	EV_{123-L}	LSP_{123}	$R_{lms,117}$			
1990/4	EV_{124-L}	LSP_{124}	$R_{lms,118}$			
1990/5	EV_{125-L}	LSP_{125}	$R_{lms,119}$			
1990/6	EV_{126-L}	LSP_{126}	$R_{lms,120}$	IS Reg_1	$\lambda_{EV,1}$	
1990/7	EV_{127-L}	LSP_{127}	$R_{lms,121}$	IS Reg_2	$\lambda_{EV,2}$	Exp $R_{lms,1}$
1990/8	EV_{128-L}	LSP_{128}	$R_{lms,122}$	IS Reg_3	$\lambda_{EV,3}$	Exp $R_{lms,2}$
1990/9	EV_{129-L}	LSP_{129}	$R_{lms,123}$	IS Reg_4	$\lambda_{EV,4}$	Exp $R_{lms,3}$
1990/10	EV_{130-L}	LSP_{130}	$R_{lms,124}$	IS Reg_5	$\lambda_{EV,5}$	Exp $R_{lms,4}$
1990/11	EV_{131-L}	LSP_{131}	$R_{lms,125}$	IS Reg_6	$\lambda_{EV,6}$	Exp $R_{lms,5}$
1990/12	EV_{132-L}	LSP_{132}	$R_{lms,126}$	IS Reg_7	$\lambda_{EV,7}$	Exp $R_{lms,6}$
1991/1	EV_{133-L}	LSP_{133}	$R_{lms,127}$	IS Reg_8	$\lambda_{EV,8}$	Exp $R_{lms,7}$
1991/2	EV_{134-L}	LSP_{134}	$R_{lms,128}$	IS Reg_9	$\lambda_{EV,9}$	Exp $R_{lms,8}$
1991/3	EV_{135-L}	LSP_{135}	$R_{lms,129}$	IS Reg_{10}	$\lambda_{EV,10}$	Exp $R_{lms,9}$
1991/4	EV_{136-L}	LSP_{136}	$R_{lms,130}$	IS Reg_{11}	$\lambda_{EV,11}$	Exp $R_{lms,10}$
1991/5	EV_{137-L}	LSP_{137}	$R_{lms,131}$	IS Reg_{12}	$\lambda_{EV,12}$	Exp $R_{lms,11}$
1991/6	EV_{138-L}	LSP_{138}	$R_{lms,132}$	IS Reg_{13}	$\lambda_{EV,13}$	Exp $R_{lms,12}$
1991/7	EV_{139-L}	LSP_{139}	$R_{lms,133}$	IS Reg_{14}	$\lambda_{EV,14}$	Exp $R_{lms,13}$
1991/8	EV_{140-L}	LSP_{140}	$R_{lms,134}$	IS Reg_{15}	$\lambda_{EV,15}$	Exp $R_{lms,14}$
1991/9	EV_{141-L}	LSP_{141}	$R_{lms,135}$	IS Reg_{16}	$\lambda_{EV,16}$	Exp $R_{lms,15}$
1991/10	EV_{142-L}	LSP_{142}	$R_{lms,136}$	IS Reg_{17}	$\lambda_{EV,17}$	Exp $R_{lms,16}$
1991/11	EV_{143-L}	LSP_{143}	$R_{lms,137}$	IS Reg_{18}	$\lambda_{EV,18}$	Exp $R_{lms,17}$
…..	…..	…..	…..			

Note: EV stands for macroeconomic variable at lagged length L, LSP stands for long/short portfolio, R_{lms} stands for long/short return, IS Reg stands for in-sample regression, λ_{EV} is the OLS slope coefficient from the regression (6.1') of long/short return R_{lms} on lagged macroeconomic variables. Exp R_{lms} stands for expected long/short return from recursive out-of-sample equation (6.2').

Table 6.2 The performance of series adj-R^2 in recursive in-sample regression of style coefficient γ (Long/Short return R_{lms}) on lagged macroeconomic variables from 1980 to 2008

Panel A Momentum effect (12/6)

	momentum coefficient γ_{mom}		Winner/Loser return R_{wml}	
	Equal-weighted	Value-weighted	Equal-weighted	Value-weighted
Average	0.3275	0.1914	0.2836	0.2057
Std	0.1193	0.0379	0.1013	0.0499
Max	0.5806	0.2656	0.5097	0.2761
Min	0.1741	0.1234	0.1574	0.1129

Panel B Momentum effect (12/12)

	momentum coefficient γ_{mom}		Winner/Loser return R_{wml}	
	Equal-weighted	Value-weighted	Equal-weighted	Value-weighted
Average	0.3515	0.1975	0.3146	0.2284
Std	0.1101	0.0252	0.0966	0.0443
Max	0.5261	0.2464	0.4550	0.3558
Min	0.1818	0.1562	0.1607	0.1636

Panel C Size effect (12)

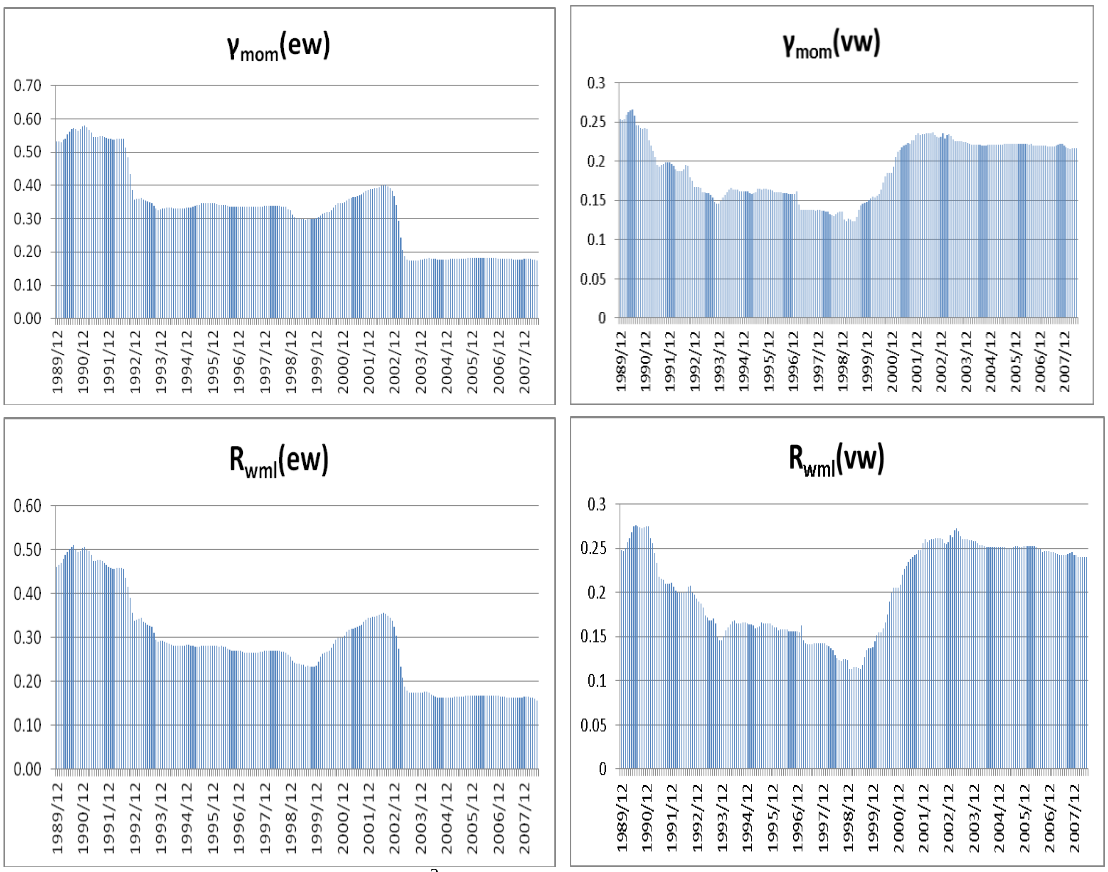
	size coefficient γ_{mv}		Small/Large return R_{sml}	
	Equal-weighted	Value-weighted	Equal-weighted	Value-weighted
Average	0.2314	0.2113	0.2461	0.2137
Std	0.0541	0.0554	0.0557	0.0538
Max	0.3443	0.3263	0.3547	0.3152
Min	0.1542	0.1344	0.1669	0.1372

Panel D Value effect (24)

	value coefficient γ_{pb}		Low/High return R_{lmh}	
	Equal-weighted	Value-weighted	Equal-weighted	Value-weighted
Average	0.4811	0.3826	0.3526	0.2591
Std	0.0524	0.0358	0.0593	0.1107
Max	0.5728	0.4236	0.4420	0.3622
Min	0.4002	0.3169	0.2724	0.0493

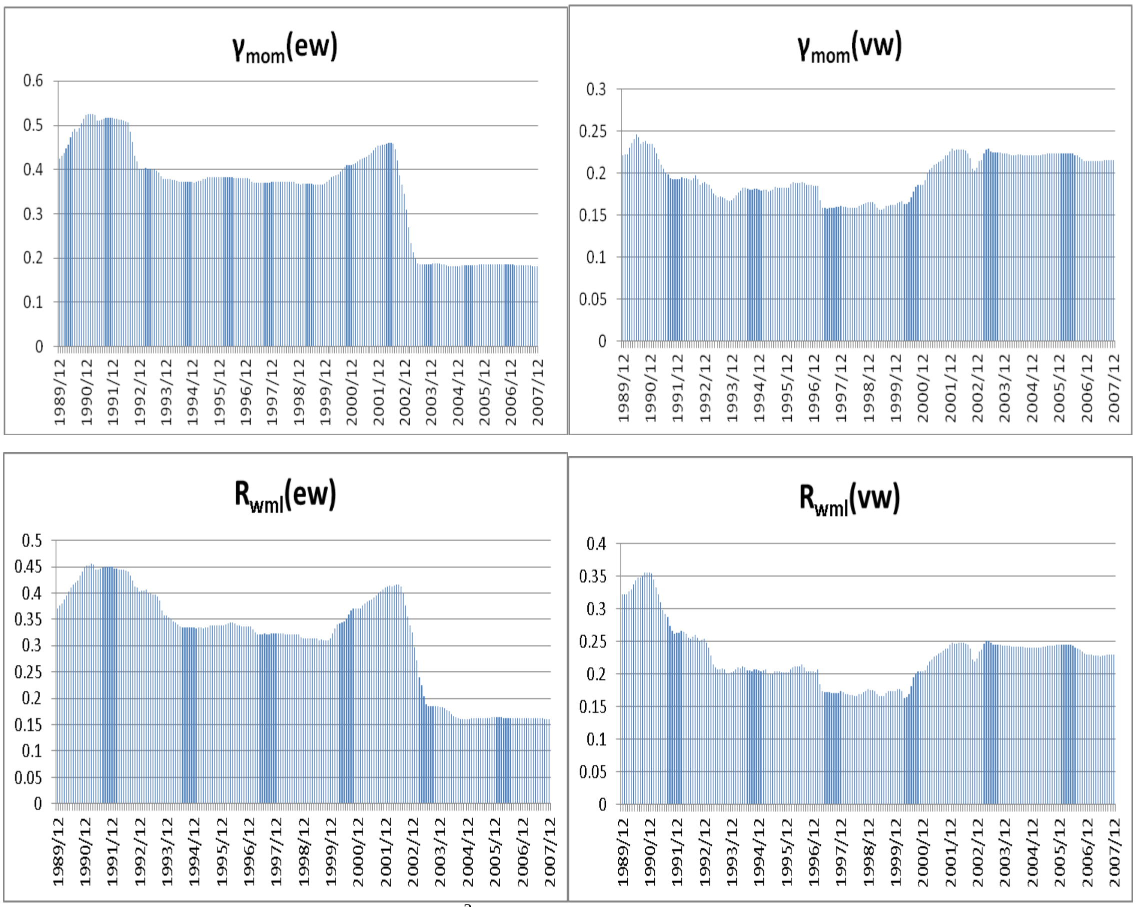
Note: The table offers summary statistics for series adjusted R^2 in recursive in-sample regression of style coefficient γ (Long/Short return R_{lms}) on lagged macroeconomic variables from 1980 to 2008, which include its mean, standard deviation, maximum, and minimum value. Panel A and Panel B include corresponding data for momentum effect based on 12 months' formation length and 6 and 12 months' holding length, respectively. Panel C reports corresponding data for size effect based on 12 months' holding length. Panel D reports corresponding data for value effect based on 24 months' holding length.

Figure 6.1 The performance of series adjusted R^2 in recursive in-sample regression of momentum coefficient γ_{mom} (Winner/Loser return R_{wml}) on lagged macroeconomic variables from December 1989 to June 2008: Momentum effect (12/6)



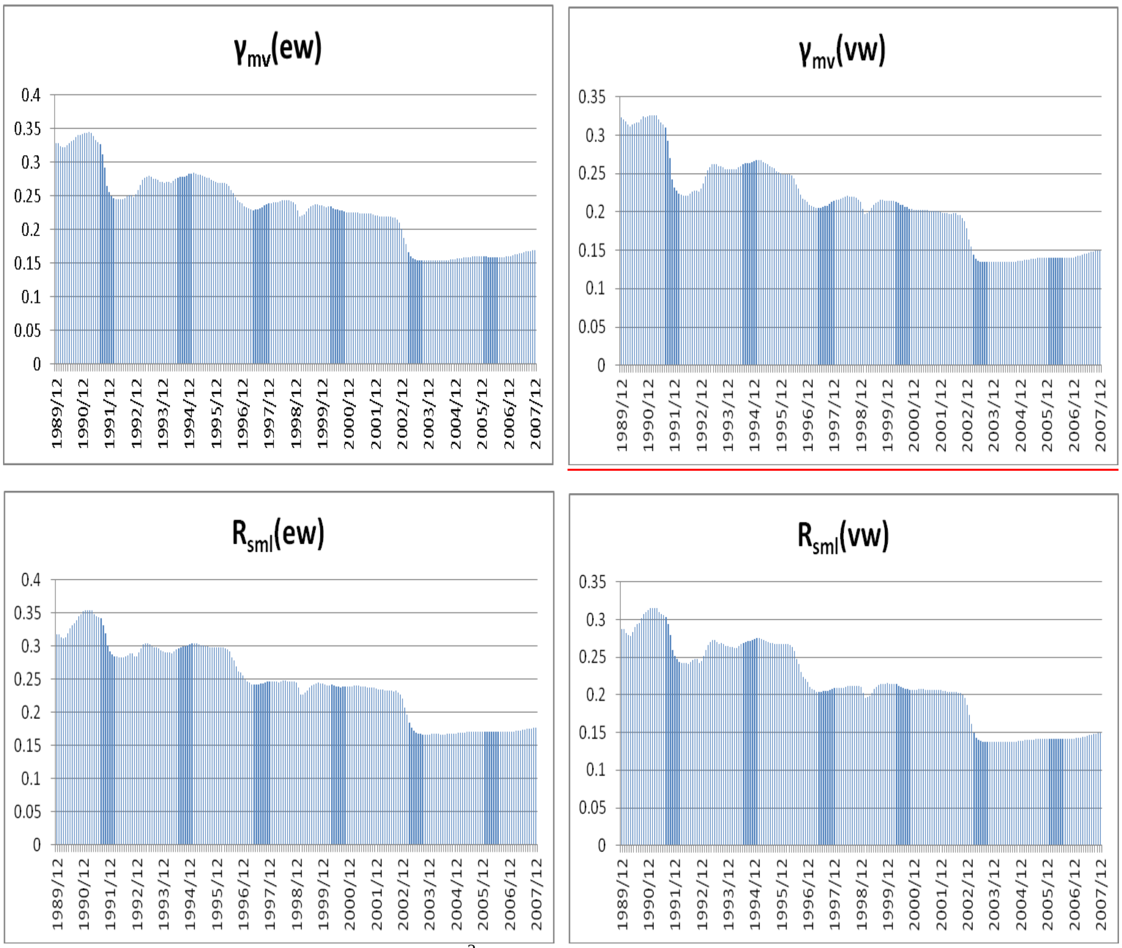
Note: The figure plots series adjusted R^2 estimated from recursive in-sample regression of momentum coefficient γ_{mom} (Winner/Loser return R_{wml}) on macroeconomic variables, including GDP(Y), UEXTBILL(Y), DY(Q), and EMR(-1)/CPI(H), from December 1989 to June 2008. The momentum portfolios are formed on previous 12 months' share returns and hold for 6 months. The initial in-sample period is from January 1980 to December 1989.

Figure 6.2 The performance of series adjusted R^2 in recursive in-sample regression of momentum coefficient γ_{mom} (Winner/Loser return R_{wml}) on lagged macroeconomic variables from December 1989 to December 2007: Momentum effect (12/12)



Note: The figure plots series adjusted R^2 estimated from recursive in-sample regression of style coefficient γ_{mom} (Winner/Loser return R_{wml}) on lagged macroeconomic variables, including GDP(Y), UEXTBILL(Y), DY(Q), and EMR(-1)/CPI(H), from December 1980 to December 2007. The momentum portfolios are formed on previous 12 months' share returns and hold for 12 months. The initial in-sample period is from January 1980 to December 1989.

Figure 6.3 The performance of series adjusted R^2 in recursive in-sample regression of size coefficient γ_{mv} (Small/Large return R_{sml}) on lagged macroeconomic variables from December 1989 to December 2007: Size effect (12)



Note: The figure plots series adjusted R^2 estimated from recursive in-sample regression of size coefficient γ_{mv} (Small/Large return R_{sml}) on lagged macroeconomic variables, including GDP(Y), CPI(Y), UEXTBILL(Y), and UEXTERM(Y), from December 1980 to December 2007. The size portfolios are hold for 12 months. The initial in-sample period is from January 1980 to December 1989.

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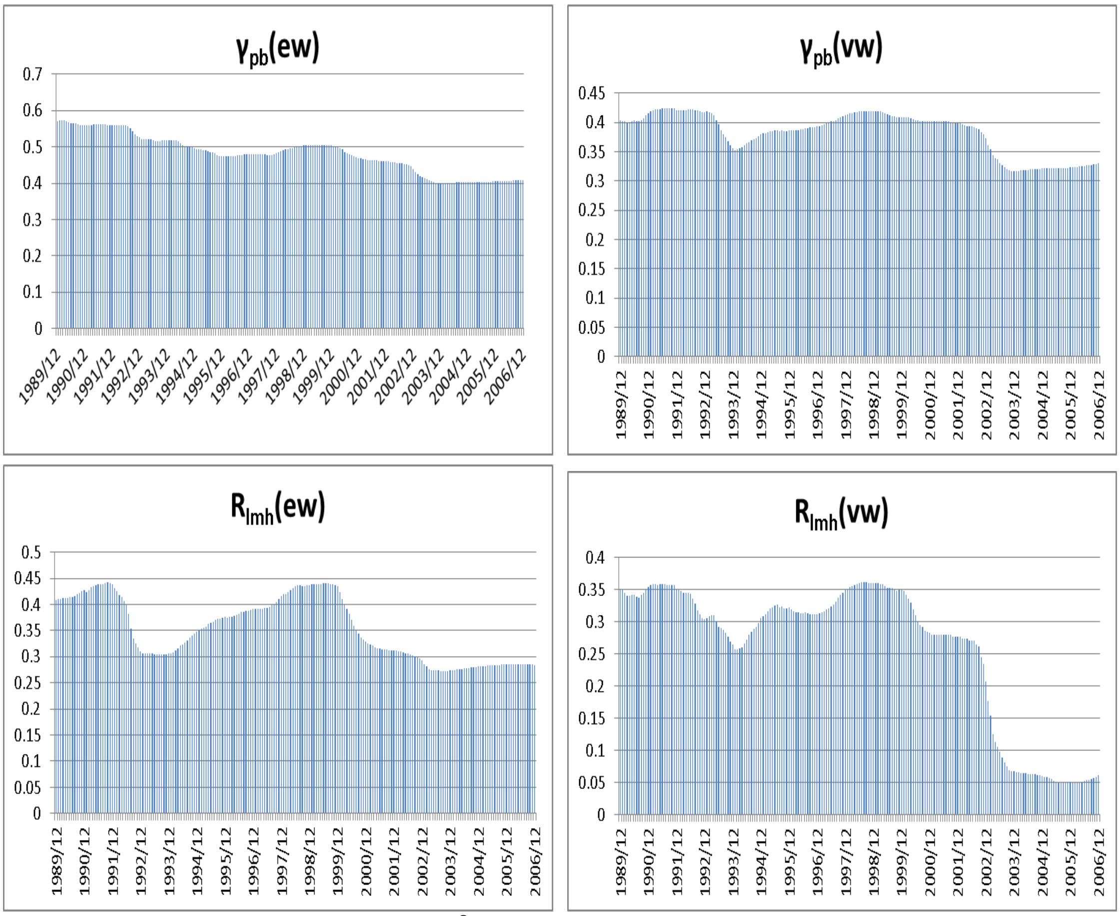
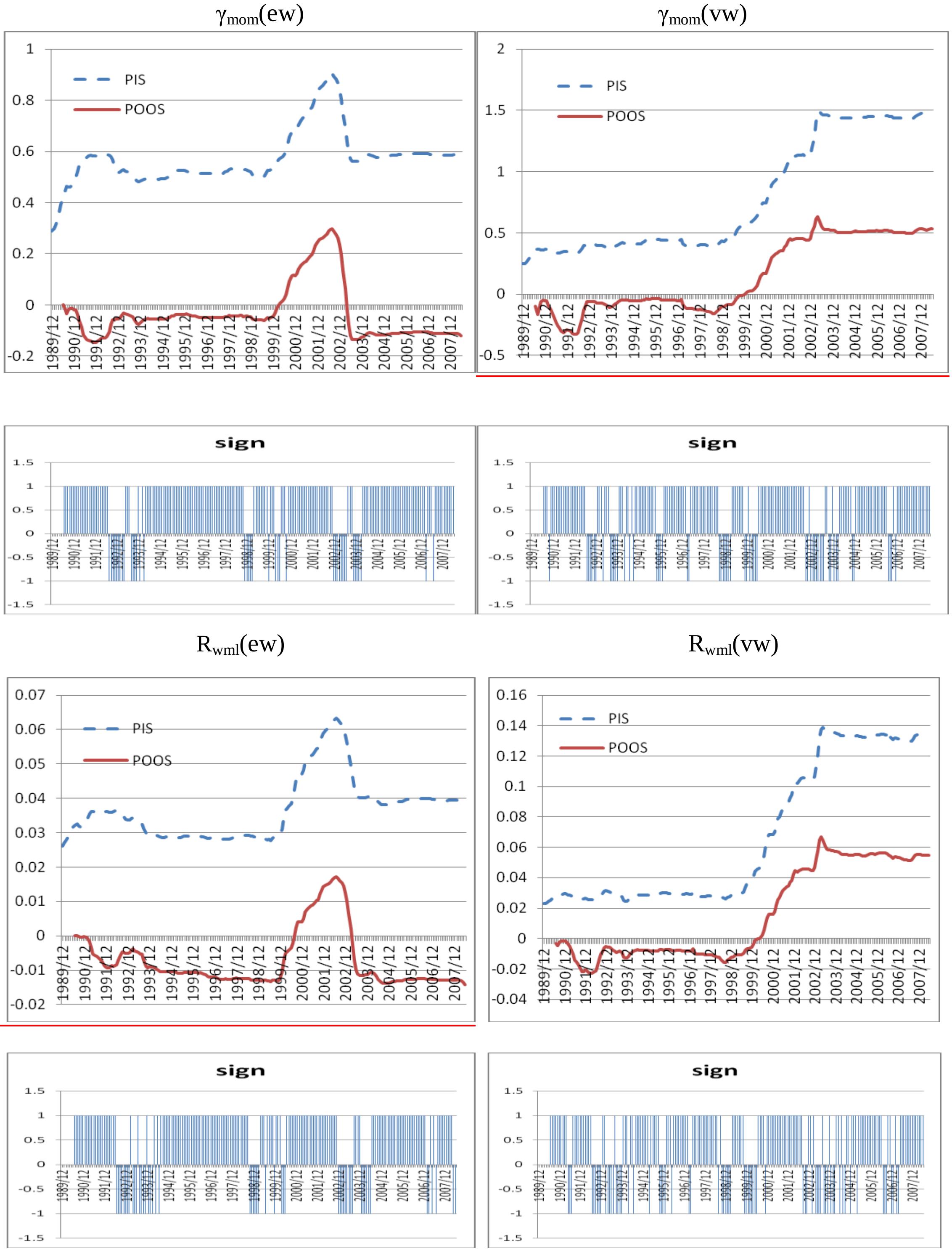
Figure 6.4 The performance of series adjusted R^2 in recursive in-sample regression of value coefficient γ_{pt} (Low/High return R_{lmh}) on lagged macroeconomic variables from December 1989 to December 2006: Value effect (24)



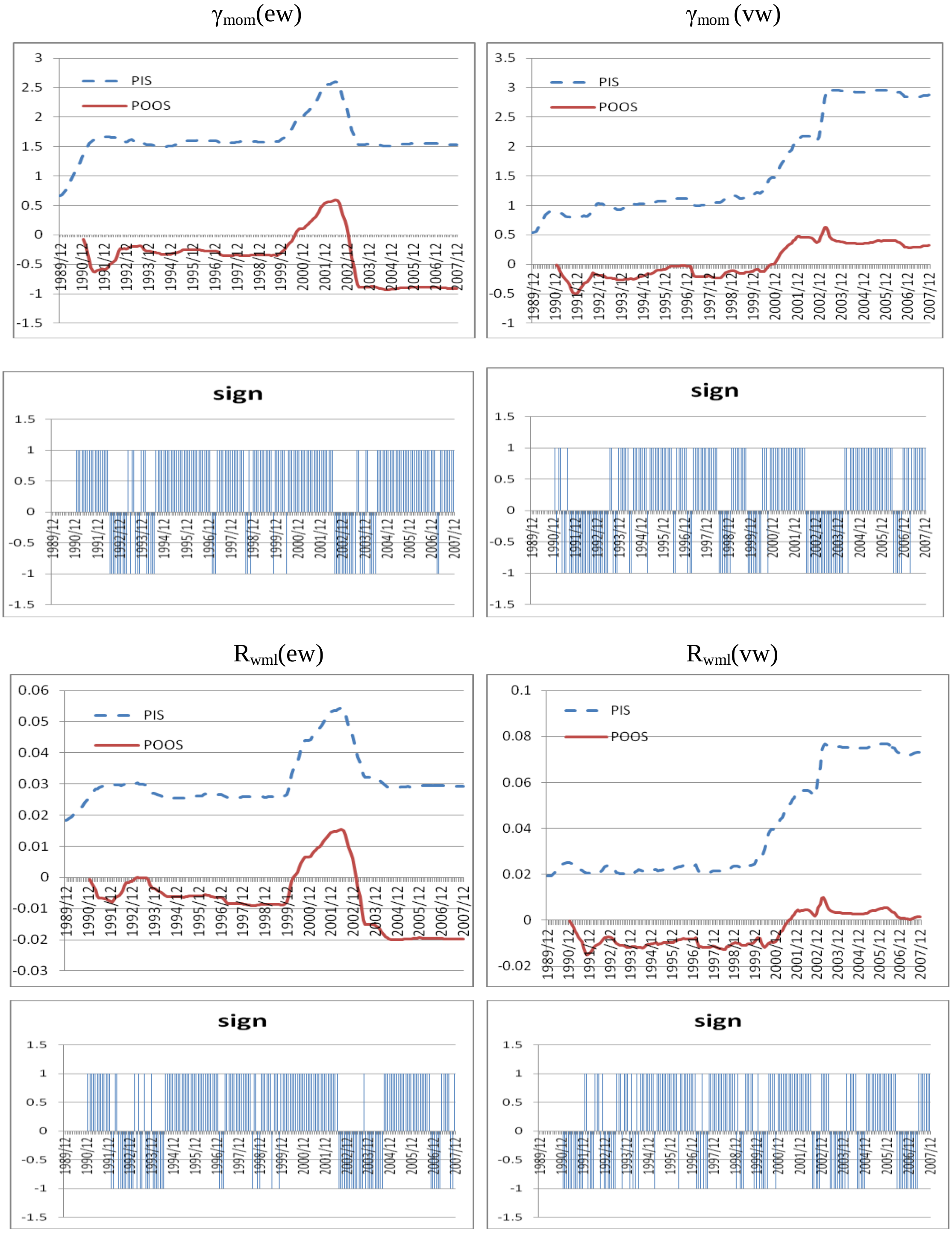
Note: The figure plots series adjusted R^2 estimated from recursive in-sample regression of value coefficient γ_{pb} (Low/High return R_{lmh}) on lagged macroeconomic variables, including GDP(Y), MO(Y), CPI(Y), MR(-8), from December 1980 to December 2006. The value portfolios are hold for 24 months. The initial in-sample period is from January 1980 to December 1989.

Figure 6.5 'PIS', 'POOS', 'Sign', the performance of recursive in-sample regression and out-of-sample forecasting model from December 1989 to 2008: Momentum effect (12/6)



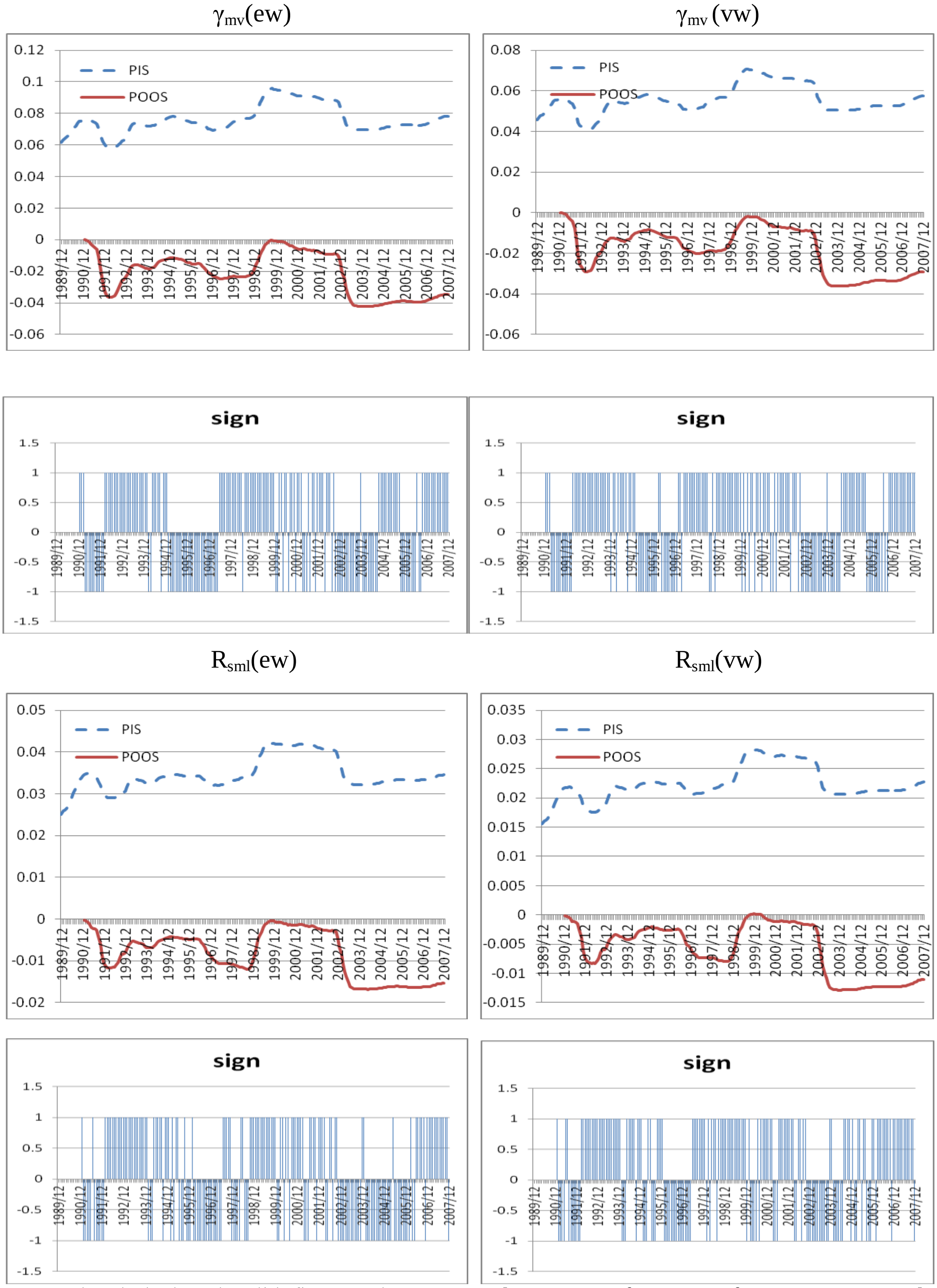
Note: The dashed and solid figures plot 'PIS' and 'POOS', the performance of recursive in-sample regression and out-of-sample forecasting model from December 1989 to June 2008: the case of Momentum effect (12/6). 'PIS' is the cumulative squared demeaned momentum coefficient γ_{mom} (Winner/Loser R_{wml}) minus the cumulative squared in-sample regression residual. 'POOS' is the cumulative squared demeaned momentum coefficient γ_{mom} (Winner/Loser R_{wml}) minus the cumulative squared prediction error from out-of-sample forecasting model. Momentum portfolios are formed by previous 12 months' share returns and hold for 6 months. The figure labeled as 'Sign' assigns 1 (-1) to the observation whose predicted and actual momentum coefficient γ_{mom} (Winner/Loser return R_{wml}) have the same (opposite) sign.

Figure 6.6 ‘PIS’, ‘POOS’, and ‘Sign’, the performance of recursive in-sample regression and out-of-sample forecasting model from December 1989 to 2008: Momentum effect (12/12)



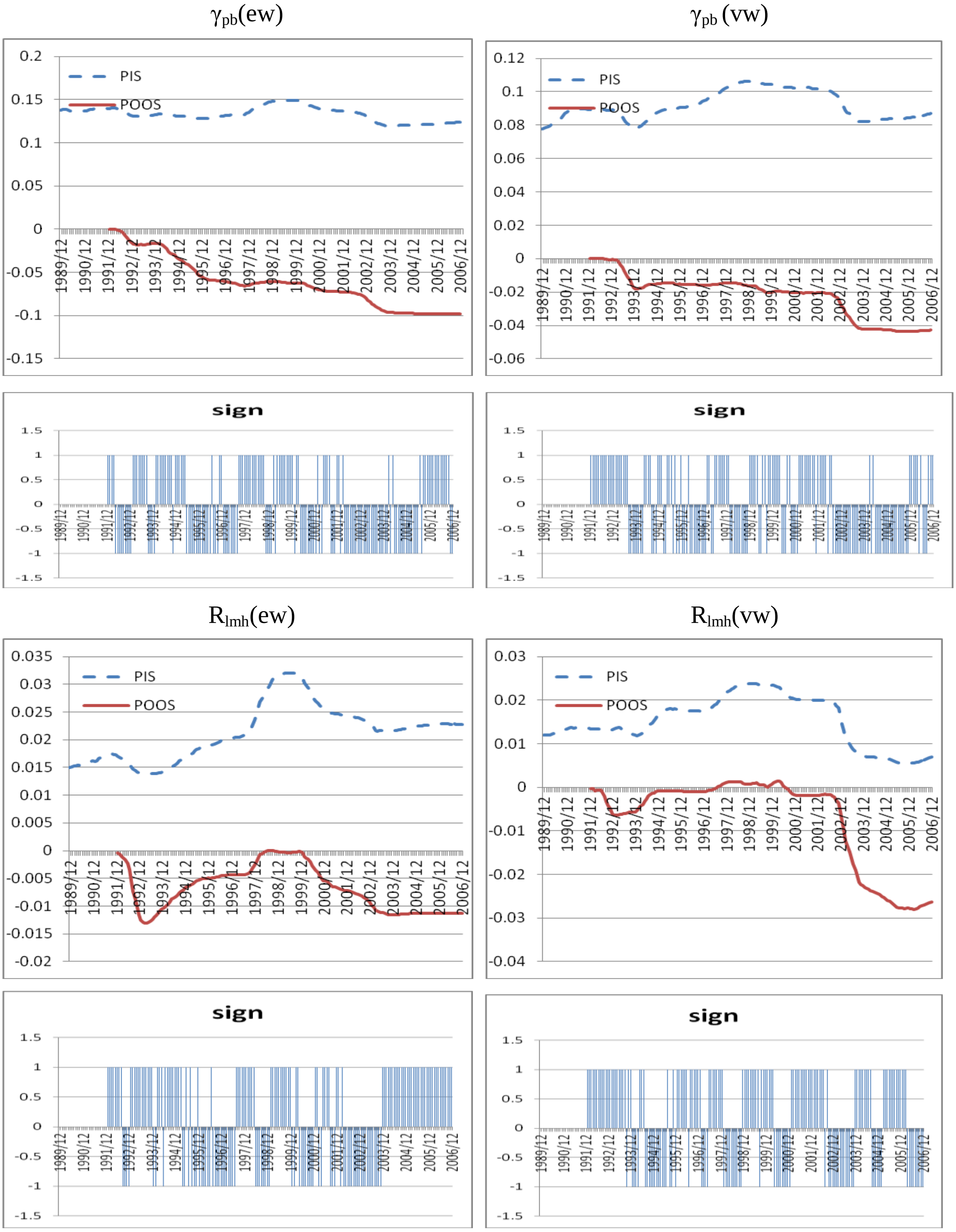
Note: The dashed and solid figures plot ‘PIS’ and ‘POOS’, performance of recursive in-sample regression and out-of-sample forecasting model from December 1989 to December 2007: the case of Momentum effect (12/12). ‘PIS’ is the cumulative squared demeaned momentum coefficient γ_{mom} (Winner/Loser R_{wml}) minus the cumulative squared in-sample regression residual. ‘POOS’ is the cumulative squared demeaned momentum coefficient γ_{mom} (Winner/Loser R_{wml}) minus the cumulative squared prediction error from out-of-sample forecasting model. Momentum portfolios are formed by previous 12 months’ share returns and hold for 12 months. The figure labeled as ‘Sign’ assigns 1 (-1) to the observation whose predicted and actual momentum coefficient γ_{mom} (Winner/Loser return R_{wml}) have the same (opposite) sign.

Figure 6.7 ‘PIS’, ‘POOS’, ‘Sign’, the performance of recursive in-sample regression and out-of-sample forecasting model from December 1989 to 2008: Size effect (12)



Note: The dashed and solid figures plot ‘PIS’ and POSS, performance of recursive in-sample regression and out-of-sample forecasting model from December 1989 to December 2007: the case of Size effect (12). ‘PIS’ is the cumulative squared demeaned size coefficient γ_{mv} (Small/Large R_{sml}) minus the cumulative squared in-sample regression residual. ‘POOS’ is the cumulative squared demeaned size coefficient γ_{mv} (Small/Large R_{sml}) minus the cumulative squared prediction error from out-of-sample forecasting model. Size portfolios are hold for 12 months. The figure labeled as ‘Sign’ assigns 1 (-1) to the observation whose predicted and actual size coefficient γ_{mv} (Small/Large return R_{sml}) have the same (opposite) sign.

Figure 6.8 'PIS', 'POOS', and 'Sign', the performance of recursive in-sample regression and out-of-sample forecasting model from December 1989 to 2008: Value effect (24)



Note: The dashed and solid figures plot 'PIS' and 'POOS', performance of recursive in-sample regression and out-of-sample forecasting model from December 1989 to December 2006: the case of Value effect (24). 'PIS' is the cumulative squared demeaned value coefficient γ_{pb} (Low/High R_{lmh}) minus the cumulative squared in-sample regression residual. 'POOS' is the cumulative squared demeaned value coefficient γ_{pb} (Low/High R_{lmh}) minus the cumulative squared prediction error from out-of-sample forecasting model. Value portfolios are hold for 24 months. The figure labeled as 'Sign' assigns 1 (-1) to the observation whose predicted and actual value coefficient γ_{pb} (Low/High R_{lmh}) have the same (opposite) sign.

Table 6.3 The performance of 'PSS': the percentage having same sign between predicted and actual style coefficient γ (Long/Short return R_{lms}) in out-of-sample period from 1990 to 2008 .

Panel A '+PSS', the percentage having same positive sign

	Style coefficient γ		Long/short return R_{lms}	
	Equal weighted	Value weighted	Equal weighted	Value weighted
Momentum effect (12/6)	0.8350	0.7696	0.8115	0.7414
Momentum effect (12/12)	0.8284	0.6807	0.7702	0.6977
Size effect (12)	0.4775	0.5248	0.4571	0.5547
Value effect (24)	0.8596	0.6154	0.9000	0.6812

Panel B '-PSS', the percentage having same negative sign

	Style coefficient γ		Long/short return R_{lms}	
	Equal weighted	Value weighted	Equal weighted	Value weighted
Momentum effect (12/6)	0.5625	0.4800	0.3600	0.4048
Momentum effect (12/12)	0.4571	0.2632	0.3721	0.4400
Size effect (12)	0.6667	0.6699	0.6406	0.6842
Value effect (24)	0.2602	0.2895	0.2667	0.2619

Panel C 'PSS', the percentage having same positive and same negative sign

	Style coefficient γ		Long/short return R_{lms}	
	Equal weighted	Value weighted	Equal weighted	Value weighted
Momentum effect (12/6)	0.8148	0.7361	0.7593	0.6759
Momentum effect (12/12)	0.7647	0.6029	0.6863	0.6029
Size effect (12)	0.5637	0.5980	0.5147	0.6029
Value effect (24)	0.4500	0.4778	0.5833	0.5833

Note: The table shows the percentage having same sign between predicted and actual style coefficient γ (Long/Short return R_{lms}) for Momentum effect (12/6, 12/12), Size effect (12), and Value effect (24) from 1990 to 2008. Predicted style coefficient γ (Long/Short return R_{lms}) is estimated from recursive out-of-sample forecasting model (6.2, 6.2'). Actual style coefficient γ (Long/Short return R_{lms}) is estimated from the regression of decile portfolios' holding returns on firms' characteristics (the return spread between top/bottom portfolios) in Chapter 4.

Table 6.4 The percentage of observations with significant macroeconomic variables in recursive in-sample regression of style coefficient γ (Long/Short return R_{lms}) from 1980 to 2008

Panel A Momentum effect (12/6)

	Momentum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
	sign. +	sign. -	sign. +	sign. -	sign. +	sign. -	sign. +	sign. -
GDP(Y)	0.0	42.2	0.0	65.0	0.0	36.3	0.0	89.2
UEXTBILL(Y)	61.4	0.0	100.0	0.0	57.4	0.0	100.0	0.0
DY(Q)	78.5	0.0	91.5	0.0	59.6	0.0	88.8	0.0
EMR(-1)/CPI(H)	0.0	71.3	0.0	36.8	0.0	43.0	0.0	42.6

Panel B Momentum effect (12/12)

	Momentum coefficient γ_{mom}				Winner/Loser return R_{wml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
	sign. +	sign. -	sign. +	sign. -	sign. +	sign. -	sign. +	sign. -
GDP(Y)	0.0	91.2	0.0	90.3	0.0	100.0	0.0	90.8
UEXTBILL(Y)	55.3**	0.0	57.1	0.0	50.7	0.0	47.9	0.0
DY(Q)	66.8	0.0	37.3	0.0	60.8	0.0	62.2	0.0
EMR(-1)/CPI(H)	0.0	46.1	0.0	30.9	0.0	50.7	0.0	28.1

Panel C Size effect (12)

	Size coefficient γ_{mv}				Small/Large return R_{sml}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
	sign. +	sign. -	sign. +	sign. -	sign. +	sign. -	sign. +	sign. -
GDP(Y)	45.6	0.0	63.6**	0.0	78.8	0.0	66.8**	0.0
CPI(Y)	0.0	53.0	0.0	49.8	0.0	70.5	0.0	68.2
UEXTBILL(Y)	0.0	23.9	0.0	25.8**	0.0	28.1	0.0	24.9
UEXTERM(Y)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Panel D Value effect (24)

	Value coefficient γ_{pb}				Low/High return R_{lmh}			
	Equal-weighted		Value-weighted		Equal-weighted		Value-weighted	
	sign. +	sign. -	sign. +	sign. -	sign. +	sign. -	sign. +	sign. -
GDP(Y)	0.0	0.0	100.0	0.0	0.0	0.0	26.7	0.5
MO(Y)	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0
CPI(Y)	0.0	100.0	0.0	77.1**	0.0	73.2	0.0	71.0
EMR(-8)	100.0	0.0	95.6	0.0	98.5	0.0	60.4	0.0

Note: This table presents the percentage of observations with significant macroeconomic variables in recursive in-sample regression of style coefficient γ (Long/Short return R_{lms}) from 1980 to 2008. t-stats of macroeconomic variable's coefficient is adjusted with Newey-West (1987) approach with automatic lag length. The symbol ** indicates the 10% significance level. Panel A and Panel B include corresponding data for momentum effect based on 12 months' formation length and 6 and 12 months' holding length, respectively. Panel C reports corresponding data for size effect based on 12 months' holding length. Panel D reports corresponding data for value effect based on 24 months' holding length.

Chapter 7 Active Trading Strategy on Style Rotation

In Chapter 4, the research constructs decile portfolios sorted by firms' characteristics, such as past share return, market value, and price-to-book ratio, and finds negative return spread on Winner/Loser portfolio, Small/Large portfolio, and Low/High portfolio at some time points. This means the failure of traditional zero investment strategy on style effects to achieve good performance all the time. This pattern is especially obvious for the size strategy with 12 months' holding length. Figure 7.1 plots the performance of Small/Large return R_{sml} when long/short position is allocated on equal-weighted Small/Large portfolio for 12 months. It shows that Small/Large return R_{sml} had two bad cycles from 1980 to 2008, each lasting for about three or four years. For example, besides short-lived negative return, there have been two bear markets for Small/Large return R_{sml} since 1980: from 1989 to 1992, and from 1997 to 1999. Given the fact that style-oriented investors could face the style drift in some periods, any forecasting indication of these unefficient periods would be rather useful in style investing.

[Figure 7.1]

The traditional absolute return strategy always goes long/short position on Winner/Loser, Small/Large, and Low/High portfolios each month, labeled as 'passive trading strategy'. Different from passive trading strategy, active trading strategy pays attention to timing style rotation, and holds long/short position according to the signal from out-of-sample forecasting model. Firstly, the research focuses on three kinds of active trading strategy within individual style effect: two ones which go long/short position on the 1st or the 10th portfolio, another which allocates long/short position on any decile portfolio with predicted highest/lowest portfolio return. The third active trading strategy does not limit long/short position in top/bottom portfolio, and instead could go long/short position on Winner, Medium, or Loser (Small, Medium, or Large, and Low, Medium, or High price-to-book) portfolio. Secondly, the research explores active trading strategy within combined two/or three style effects to capture one style effect with predicted highest long/short return, relative to passive trading strategy which distributes average position within two/or three style effects all the time. In Chapter 4, the research finds negative correlation between momentum effect and size effect, momentum effect and value effect, and positive correlation between size effect and value effect. It is expected to yield the potential gains to timing the switch in the allocation of Winner/Loser portfolio, Small/Large portfolio, and Low/High portfolio.

This chapter is organized as four sections. Section 7.1 introduces research methods to develop active trading strategies on style effects. Section 7.2 examines active trading strategies based on top/bottom decile portfolios and any decile portfolio within individual style effect. Section 7.3 explores active trading strategy within combined two/or three style effects. Section 7.4 comes to the conclusion of this chapter.

7.1 Research methods

Style consistency, sticking to a particular style, is likely to be a sub-optimal strategy in the market due to the time-variation in style effects. Style rotation creates a need for active trading strategies to allocate position on shares with special firm characteristics, and to benefit portfolio performance enhancement.

Levis and Liodakis (1999) use recursive out-of-sample logit regression to estimate the sign of the return spread in terms of size effect and value effect in the UK Stock Market. They classify each month as 1 or 0 according to the predicted sign of the return spread. If in a particular month small-cap shares (value shares) perform better than large-cap shares (growth shares), they set this month to 1; otherwise they classify it as 0. Their forecasting model is based on small-cap portfolio and large-cap portfolio for the size strategy, value portfolio and growth portfolio for the value strategy.

Different from the approach in Levis and Liodakis (1999), Cooper, Gulen, and Vassalou (2001) do not impose constraint that the long position should always only include small-cap portfolio or high book-to-price portfolio in the US Share Market, and that the short position should always only include large-cap portfolio or low book-to-price portfolio. Their strategies allocate long and short portfolios on any decile portfolio according to the decile size-sorted and value-sorted portfolio returns predicted by recursive out-of-sample forecasting model. Therefore, the long (short) position can include small-, medium- or large-cap portfolios for the size strategy, and low, medium or high book-to-price portfolios for the value strategy.

Campbell and Thompson (2005) argue that a rational investor would not use a model to forecast a negative equity premium, and apply truncation of such predictions at zero return. They find better out-of-sample forecasting performance when imposing restrictions on the signs of coefficients and return forecasts, and assume that investors rule out a negative predictive equity premium and set the forecast to zero whenever it is negative. Cooper (1999) shows that to impose thresholds for expected return is to boost signal-to-noise ratio of the portfolio. Cooper, Gulen, and Vassalou (2001) document that long (short) position might yield negative (positive) predicted return when not taking into account the magnitude of predicted returns from the forecasting model, and find the increase in the return of active trading strategy after imposing filter rules on return forecasts in the US Stock Market from 1953 to 1998.

Based on statistic tests of recursive out-of-sample forecasting model in Chapter 6, the chapter explores trading strategies on momentum effect (12/6, 12/12), size effect (12), and value effect (24), which has higher long/short return and can be captured by lagged macroeconomic variables much more than style effects with other corresponding formation lengths and holding horizons. The research uses Levis and Liodakis (1999) approach, combining with filter threshold, to develop active trading strategy on ‘Winner’ portfolio and ‘Loser’ portfolio for the momentum strategy, ‘Small’ portfolio and ‘Large’ portfolio for the size strategy, ‘Low’ portfolio and ‘High’ portfolio for the value strategy. It uses Cooper, Gulen, and Vassalou (2001) approach to develop active trading strategy on any decile momentum, size, and value portfolio. In addition, the research investigates active trading strategy within combined two/or three style effects, which holds position with predicted highest long/short return on Winner/Loser portfolio, Small/Large portfolio, and Low/High portfolio.

7.1.1 Active trading strategy on individual style effect

Active trading strategy on individual style effect includes three patterns in momentum effect (12/6, 12/12), size effect (12), and value effect (24), individually: Active trading strategy in single direction, Active trading strategy in double directions, and Active trading strategy on any decile portfolio.

Active trading strategy in single direction The research uses out-of-sample forecasting model (6.2) to predict long/short return for style effects. Using the similar method in Cooper, Gulen, and Vassalou (2001), the research sets up 7 filter thresholds from 0 to 3.0% in increments of 0.5% in active trading strategy on style effects in terms of long/short return. When predicted long/short return from out-of-sample forecasting model meets filter ruler at a certain month, the research assumes allocation of long position on Winner/Small/Low portfolio and short position on Loser/Large/High portfolio. When predicted long/short return from out-of-sample forecasting model would not pass the constraint, the portfolio is gone to TBILL. Because filter threshold in this strategy is set to be only positive value, it is defined as *'Active trading strategy in single direction'*. Because the strategy takes advantage of signal and magnitude from out-of-sample forecasting model, it is expected to hold long/short position with positive return and TBILL, which replaces for long/short position with predicted negative return, and further to enhance return performance of passive trading strategy and reduce the percentage with negative return.

Active trading strategy in double directions Levis and Tessaromatis (2004) propose growth/value rotation strategies that if return spread forecast is positive the strategy goes long (short) position on growth (value) stocks, and if return forecast is negative the strategy goes long (short) position on value (growth) stocks. Using similar method in Levis and Tessaromatis (2004), the research extends long/short trading in single direction to long/short trading in double directions by imposing positive and negative filter thresholds on predicted Long/Short return R_{lms}. When predicted Long/Short return R_{lms} from out-of-sample forecasting model is satisfied with one given positive filter threshold, long position is gone on Winner/Small/Low portfolio, and short position is gone on Loser/Large/High portfolio. When predicted Long/Short return R_{lms} is satisfied with one given negative filter threshold, long position is gone on Loser/Large/High portfolio, and short position is gone on Winner/Small/Low portfolio. Otherwise, the position is allocated in TBILL. This strategy is named as *'Active trading strategy in double directions'*, and is expected to enhance the return performance of active trading strategy in single direction because it is expected capture opposite trading opportunity.

Active trading strategy on any decile portfolio Different from 'Active trading strategy in single/double direction' based on top/bottom portfolio, '*Active trading strategy on any decile portfolio*' explores the strategy which allocates long/short positions on any decile portfolio, instead of top and bottom portfolios, according to predicted decile portfolio returns from out-of-sample forecasting model. This active trading strategy goes long position on the portfolio that has the highest predicted return from forecasting model, and short position on the portfolio that has the lowest predicted return. There is no constraint that long/short position always includes top and bottom decile portfolios. It chooses the allocation of long and short position according to predicted any decile portfolio return from out-of-sample forecasting model. Therefore, long/short position can include Winner, Medium, or Loser portfolios for momentum strategy, Small, Medium, or Large portfolios for size strategy, and Low, Medium, or High price-to-book portfolios for value strategy. Predicted decile portfolio returns are estimated by recursive in-sample regression model (6.1) and out-of-sample forecasting model (6.2).

7.1.2 Active trading strategy on combined style effects

In Chapter 4, the research finds negative correlation between momentum effect and size effect, between momentum effect and value effect, and positive correlation between size effect and value effect. The correlation among style effects is caused by their sensitivity to the same macroeconomic forces. In Chapter 5, the research finds that momentum effect (12/6, 12/12) and size effect (12) are commonly significantly captured by the previous annual change of GDP and unexpected annual change of TBILL with the opposite direction. Meanwhile, in the value-weighted case, momentum effect (12/6, 12/12) and value effect (12) are significant in the opposite TBILL condition, and size effect (12) and value effect (12) are significant in the same TBILL condition.

The existence of correlation among momentum effect, size effect, and value effect motivates the exploration on active trading strategy with combined two/or three style effects. In one case, when one style effect is in favor in one certain economic condition and market state, another style effect might suffer. In another case, although two or three styles are effective at the same time, there is the difference in their strength. This means that to hold position with favorable style effect or style effect with highest long/short return can maximize the investment return.

Table 4.15 in Chapter 4 shows that negative correlation in equal-(value-) weighted long/short return with 12 months' holding horizon between momentum effect and size effect, and between momentum effect and value effect ranges from -0.4529 to -0.5893, the highest magnitude among the cases of five holding horizons. Positive correlation in equal-(value-) weighted long/short return with 12 month's holding horizon between size effect and value effect is 0.1560 (0.45), the third highest magnitude among the cases of five holding horizons. In addition, as found in Chapter 4 and Chapter 5, momentum effect (12/12) and size effect (12) have higher long/short return, and can be much explained by lagged macroeconomic variables relative to the case within corresponding other holding horizons. So, the examination on active trading strategy with combined two/or three style effects focuses on the case with 12 months' holding horizon from 1990 to 2008, which includes 204 observations.

The research sets up 7 filter thresholds from 0 to 3.0% in increments of 0.5% in active trading strategy with combined two/or three style effects. It compares predicted long/short returns of style effects from out-of-sample forecasting model (6.2) with the filter threshold, and makes a choice on position allocation. When predicted monthly long/short returns of two or three style effects from out-of-sample forecasting model are all lower than one filter threshold, the position is allocated on TBILL. Otherwise, the position is allocated on top/or bottom portfolio of one style effect with predicted highest return spread. This means that the position could be allocated in Winner/Loser portfolio, Small/Large portfolio, Low/High portfolio, and TBILL. As the benchmark, passive trading strategy on the combination of two or three style effects allocates average position on momentum effect (12/12), style effect (12), and value effect (12) all the time.

7.2 Active trading strategy on individual style effect

In this section, the research explores three patterns of active trading strategy on individual style effect, which allocates long/short position on top/bottom portfolio in single direction, top/bottom portfolio in double directions, and any decile portfolio, respectively.

7.2.1 Active trading strategy in single direction

Active trading strategy in single direction is to allocate long/short position on top/or bottom decile portfolios when predicted long/short return from recursive out-of-sample forecasting model meets one filter threshold from 0 to 3.0% in increments of 0.5%, or to hold TBILL. As the benchmark, passive trading strategy is to allocate long/short position on top/or bottom decile portfolios each month. The research compares active trading strategy with passive trading strategy in terms of trading return, hit rate, and trading cost.

[Table 7.1, 7.2, 7.3, and 7.4]

Table 7.1, 7.2, 7.3, and 7.4 report the result on the performance of active trading strategy in single direction in terms of trading return, hit rate, and trading cost for momentum effect (12/6), momentum effect (12/12), size effect (12), and value effect (24), respectively. Each column of the table reports the result of the corresponding filter ruler in active trading strategy and passive trading strategy. The first five rows report statistics associated with trading return performance, that is average monthly excess return, standard deviation, Sharpe ratio, the percentage of observations with trading return less than zero (%<0) and monthly TBILL (%<monthly TBILL). The next five rows report the statistics associated with signal-to-noise ratio of trading strategy, that is the number of holding Long/Short portfolio and TBILL according to the signal and magnitude of predicted Long/short return from recursive out-of-sample forecasting model and filter rules, and their corresponding individual and combining percentage of successful implementation, which is labeled 'Hit rate'. 'Hit rate of holding long/short portfolio' indicates the percentage of trading satisfied with a given filter threshold in long/short trading. 'Hit rate of holding TBILL' indicates the percentage of actual return unsatisfied with a given filter threshold in holding TBILL. 'Hit rate of strategy' indicates the percentage of successful holding long/short portfolio and TBILL in observations. The last four rows report statistics, which are associated with trading costs, such as monthly turnover, net average monthly excess return (100bp), net average monthly excess return (200bp), and breakeven trading cost. Monthly turnover is the percentage of holding long/short position in the observations according to predicted long/short return from

out-of-sample forecasting model and filter threshold. Net average monthly excess return (100bp, 200bp) is trading return after reducing trading cost when assuming transaction cost of 100 and 200 basis points for every turnover. Similar to the method in Levis and Tessaromatis (2004), the research defines breakeven transaction cost as the fixed trading cost that makes monthly excess return of one strategy to zero. It is estimated by the following equation: $R^{strategy}-T*C=0$. $R^{strategy}$ is average monthly excess return of one strategy before trading cost, T is the monthly turnover (buys+sells), and C is the average breakeven transaction cost.

- *The trading return*

The empirical data shows that active trading strategy on top and bottom portfolios can improve investment performance in momentum effect (12/6, 12/12) and size effect (12). For example, Table 7.1 Panel A shows that for equal-weighted momentum effect (12/6), the active strategy with filter threshold of 0 and 0.5% earns 0.9135% and 0.8630% of average monthly excess return, respectively, from 1990 to 2008. They are higher than 0.7899% of average monthly excess return of passive trading strategy, which always invests in Winner/Loser portfolio each month. As indicated in Panel B, for value-weighted momentum effect (12/6), the breakeven point for the active Winner/Loser position in terms of average monthly excess return is the 1.5% filter threshold. Before that, the return of active trading strategy is higher than one of passive trading strategy. The second row in the table shows that standard deviation of average monthly excess return of active trading strategy with all filter thresholds is lower than one of passive trading strategy, and that standard deviation decreases as filter threshold rises from 0 to 3.0%. The reason for low volatility is that active trading strategy uses signal and magnitude of predicted Winner/Loser return R_{wml} from out-of-sample forecasting model to successfully time both Winner/Loser portfolio with positive return and TBILL, and reduces the number of long/short trading with negative return. As shown in the fourth and fifth row in the table, the percentages of observations with average monthly trading return less than zero and monthly TBILL in active trading strategy are lower than passive trading strategy. This means that the model with imposing constraints is able to successfully forecast the period with positive and negative Winner/Loser return R_{wml}. Table 7.2 shows the similar findings on enhancement in active trading return with momentum effect (12/12). Relative to 0.1615 and -0.0967 of equal- and value-weighted Winner/Loser return R_{wml} by passive trading strategy, active trading strategy yields 0.2904 to 0.3643 of average monthly excess return when filter threshold is set to 0 and 0.5.

Like momentum effect (12/6, 12/12), the research finds the enhancement in return performance of active trading strategy with top and bottom decile size portfolios relative to passive trading strategy. Table 7.3 presents that passive trading strategy, which always goes long/short position on Small/Large portfolio for 12 months, yields negative monthly excess return from 1990 to 2008. When filter threshold of active trading strategy is set to zero, average monthly excess return is less than 0 due to two reasons. One reason is that predicted equal-(value-) weighted Small/Large return R_{sml} from forecasting model is positive in only 140 (128) among 204 months, taking up 68.6 (62.7) percent of all observations, respectively. Another reason is that 45.71 (55.47) percentage of Small/Large position successfully yields positive R_{sml}, as shown by the statistics 'Hit rate of holding Small/Large portfolio'. Limited number of holding Small/Large position and its low hit rate lead to negative active trading return. If using active trading strategy with filter threshold of 0.5% to 1.5%, average monthly excess equal-(value-) weighted return ranges from 0.1064% to 0.1201% (from 0.0409% to 0.0737%), which increases equal-(value-) weighted return of passive trading strategy by more than 36 (33) basis points. Another advantage of active trading strategy on size effect is to low standard deviation of trading return, which indicates the return performance more stable and percentage of observations with trading return less than zero and TBILL lower than one of the passive strategy. As reported in the fourth row of the table, passive trading equal-(value-) weighted Small/Large portfolio yields negative excess return in 57.35 (53.43) percentage of observations. Correspondingly, active strategy with filter threshold 0.5% to 1.5% earns negative return in 4.41 to 17.16 (2.94 to 8.82） percentage of observations. The similar result is presented by Levis and Liodakis (1999). They find profitable small-cap/large-cap rotation strategy in the UK Stock Market from 1968 to 1997.

However, active trading strategy seems no benefit to the enhancement in passive trading return with top and bottom price-to-book portfolios. Table 7.4 Panel A and B show that average monthly excess return of active trading strategy with all filter thresholds is lower than one of passive trading strategy. One main reason is that the forecasting model offers 90 signals to hold equal-weighted Low/High portfolio in the low percentage (50 percent) of all months when imposing the filter threshold on 0. Another reason is that passive value strategy with 24 months' holding horizon, which always hold Low/High portfolio each month, has higher percentage of observations with positive return spread, 81.67% (69.44%) for equal-(value-) weighted case shown in the 7th row of Panel A and B of Table 7.4. It is difficult for limited number of active trading position to improve passive trading return with high hit rate. As indicated in Figure 6.8 in the previous chapter, the line of POOS on predicted equal-(value-) weighted Low/High return R_{lmh} begins the fall since the year of 2000 and lasts for four (five) years, which indicates the poor performance of out-of-sample forecasting model. Similar findings on active trading strategy with value effect are in other academic work. Levis and Liodakis (1999) find the failure of value/growth rotation strategy in the UK Stock Market from 1968 to 1997. Levis and Tessaromatis (2004) document no benefit in using value/growth forecasting model in UK's large capitalization stocks from 1992 to 2001. Cooper, Gulen, and Vassalou (2001) find that active trading strategy on book-to-price ratio fails to improve the performance of passive trading strategy in the US Stock Market from 1953 to 1998.

It is obvious that recursive out-of-sample forecasting model makes active trading strategy on momentum effect (12/6, 12/12) and size effect (12) more profitable but less volatile as well than corresponding passive trading strategy. But long-term consistency of passive Low/High return R_{lmh} with 24 months' holding length, limited number of active trading position, and poor signal from out-of-sample forecasting model make an attempt to take advantage of the time-variation in value effect rather disappointed.

- *The hit rate*

The research observes the hit rate of active trading strategy in two conditions: before breakeven point in which active trading strategy yields average monthly excess return higher than one of passive trading strategy, and at filter thresholds in which corresponding active trading strategy yields positive excess returns to some extent.

For the case of equal-weighted momentum effect (12/6), as shown in seventh, ninth, and tenth rows of Table 7.1 Panel A, the hit rate of holding Winner/Loser position at 0 and 0.5% filter threshold before breakeven point is 81.15 and 74.72 percent, the percentage of Winner/Loser trading with meeting a given filter threshold. The hit rate of holding TBILL is lower than 40 percent. Because the number of holding Winner/Loser position is much larger than the number of holding TBILL, such as 191 vs 25 and 178 vs 38, the hit rate of active trading strategy combining

Winner/Loser position and TBILL position is high up to 75.93 and 68.52 percent of the observations. The result is similar for the case of equal-weighted momentum effect (12/12) in Table 7.2 Panel A. Before breakeven point of 0.5% filter threshold, the hit rate of active trading strategy is more than 61.76 percent of observations.

For the case of value-weighted momentum effect (12/6) in Table 7.1 Panel B, before breakeven point of 1.5% filter threshold, 64.10 to 74.14 percent of holding Winner/Loser positions yields R_{wml} which meets a given filter threshold. Combining with the hit rate of holding TBILL which ranges between 40.48% and 46.38%, the hit rate of active trading strategy is between 52.78 and 67.59 percent of all observations. For value-weighted momentum effect (12/12) in Table 7.2 Panel B, the hit rate of active strategy before 1.5% filter threshold ranges between 56.37 and 61.27 percent of observations.

As shown in Table 7.3, active trading strategy on size effect (12) outperforms the passive strategy at all filter thresholds. At filter threshold from 0.5% to 1.5% in which average monthly excess equal-weighted return is more than 0.10 per month, 42.5% to 47.17% of holding Small/Large positions is satisfied with a given filter threshold, and more than 80% of actual return when holding TBILL is unsatisfied with a given filter threshold. Although the hit rate of holding Small/Large portfolio is less than 50 percent, the hit rate of active trading strategy is higher up to 0.6569 to

0.7843 due to large number of holding TBILL and its higher hit rate.

For the case of equal-weighted value effect (24), Table 7.4 Panel A shows that the hit rate of passive trading strategy is high up to 0.8167. To outperform passive trading strategy, active trading strategy needs to have large number of holding Low/High portfolio as well as its higher hit rate. Unfortunately, the forecasting model offers 90 signals, 50 percent of observations, to hold Low/High portfolio at 0% filter threshold although it has 90 percent of hit rate. The hit rate of holding TBILL in other 50 percent of observations is only 0.2667%. Two disadvantages lead to 0.5833 of hit rate of the active strategy, and further poor active trading return performance. For the case of value-weighted value effect (24) in Panel B, although having high number of holding Low/High position and its high hit rate at 0% filter threshold, the hit rate of holding TBILL is only 0.2619, which drags down overall hit rate of the active strategy and its return performance. Therefore, active value strategy with all filter thresholds underperforms the passive strategy.

- *The trading cost*

It is rational to regard the trading cost as one measure to test one trading strategy, besides the trading return. The trading cost arises in two ways. Firstly, the trading cost is associated with the turnover, the number of rebalancing long/short position of the trading strategy according to return forecasts. The research estimates monthly turnover by calculating the percentage of holding long/short position in all months from 1990 to 2008. Secondly, the trading strategy needs to update the membership of stocks in long/short portfolio to maintain the characteristics of top and bottom portfolios. The constituents in top and bottom portfolios may change significantly at each rebalancing point.

Bogle (1994) and Carhart (1997) estimate the trading cost to be approximately 1.20 and 0.95 percent for every 100 percent turnover. Studying 10,922 equity funds in one-year's period of 2006, Unified Trust Company concludes that average annual turnover of all equity funds is 92.7 percent, and that average trading cost per 100 percent turnover is 1.47 percent. To maximize the effect of trading cost on return performance of trading strategies, the research assumes that all stocks be updated each rebalance on long/short position. Following Levis and Liodakis (1999), it estimates two kinds of return: trading return after assuming 100 or 200 basis points of transaction costs for each turnover, which is defined as 'net average monthly excess return (100bp, 200bp).

The performance of net average monthly excess return of active trading strategies on momentum effect (12/6, 12/12), size effect (12), and value effect (24) after reducing trading costs in the return spread of Long/Short position is consistent with the performance of average monthly excess return. As Table 7.1 shows, although 100 and 200 basis points of transaction cost per turnover is reduced, net average monthly excess return of active trading strategy on equal-(value-) weigthed momentum effect (12/6) is more than 0.58 (0.72) before 1.0% (2.0%) of ruler threshold. Table 7.2 indicates that when the trading cost is 100 and 200 basis points per turnover, passive trading strategy on annual momentum effect (12/12) becomes unprofitable. But, active trading strategy yields more than 0.18 of net average monthly excess return when filter threshold is set up to 0 and 0.5%. As Table 7.3 shows, when the trading cost is 100 and 200 basis points per turnover, net average monthly excess return drops to below 0.10 at all filter thresholds. As Table 7.4 shows, after reducing trading costs 100bp and 200bp, passive trading strategy on equal- (value-) weighted top and bottom value portfolio yields net excess return of 0.1585 and 0.1169 (0.4843 and 0.4426) per month. The active strategy with 0 of filter threshold earns low net average monthly excess return, below 0.17. So, only active trading strategy with Winner/Loser portfolio maintains higher profitability after considering trading cost.

By comparing active trading strategy with the passive one in Table 7.1, 7.2, and 7.3, the research finds the increase in breakeven transaction cost of active momentum and size strategy with most filter thresholds. The breakeven transaction cost before the active momentum and size strategy becomes unprofitable is higher because they have higher monthly excess returns and lower turnovers than passive strategy. As shown in Table 7.4, active value strategy seems not to have impact on the increase in breakeven trading cost as well as its excess return. Although active value strategy has low turnover than the passive one, the magnitude is much less than the decrease in corresponding excess return, which results in its low breakeven transaction cost.

In short, the empirical result is more promising for timing momentum effect (12/6, 12/12) and size effect (12) by using active trading strategy with top and bottom portfolio before reducing trading cost. It is obvious that recursive out-of-sample forecasting model makes active trading strategy with momentum effect and size effect more profitable but less risky than corresponding passive strategy. The active strategy in momentum effect and size effect succeeds in return enhancement of passive trading strategy due to its high hit rate. After reducing trading costs, only active trading strategy with momentum effect (12/6, 12/12) maintains higher profitability, but active strategy with size effect (12) becomes unprofitable. Long-term consistency of value stocks and poor out-of-sample signal from forecasting model lead to the failure of active trading strategy with value effect (24) to outperform passive strategy.

7.2.2 Active trading strategy in double directions

Based on empirical work in the previous subsection, the research further explores the performance of active trading strategy with top and bottom portfolios in double directions by imposing positive and negative filter thresholds on expected Long/Short return R_{lms}. As the extension of the active strategy with positive filter thresholds, when predicted Long/Short return R_{lms} is satisfied with one given negative filter threshold, long position is gone on Loser/Large/High portfolio, and short position is gone on Winner/Small/Low portfolio. Otherwise, the position is allocated in TBILL.

[Table 7.5, 7.6, 7.7, and 7.8]

The empirical work indicates that active trading strategy in double directions fails to enhance return of active trading strategy in single direction, except for the case of momentum effect (12/6). As indicated in Table 7.5, 7.6, 7.7, and 7.8, average monthly excess return of active trading strategy in double directions for momentum effect (12/12), size effect (12), and value effect (24) is lower than one of active trading strategy in single direction due to two reasons. Firstly, the number of long/short trading on positive filter threshold is much more than the number of long/short trading on negative filter threshold. Secondly, trading return meets a given negative filter threshold at less than 50 percent of trading except for size effect (12) with 0 filter threshold. Limited trading number and lower hit rate of long/short position with negative filter threshold prevent active trading strategy in double directions from enhancing return performance of active trading strategy in single direction.

For momentum effect (12/6), although active strategy in double directions raises trading return of active strategy in single direction, the enhancement is paid off by the increase in trading cost from the allocation of Loser/Winner portfolio. For example, as indicated in Table 7.5 Panel B, active trading strategy with filter threshold of >0.5%, <-0.5% on value-weighted momentum effect (12/6) yields average excess return of 1.3417 per month, only 15 basis points higher than return of active strategy with filter threshold of >0.5%. Because the strategy implements 26 Loser/Winner tradings, the increase in trading cost pays off the increase in trading return. It shortens net average monthly excess return spread from 15 to 13/11 basis points between two active strategies after reducing 100/200 basis points of trading cost every turnover.

The table presents that active trading strategy in double directions performs with breakeven transaction costs lower than corresponding ones in single direction due to two main reasons. Firstly, as mentioned before, most active trading strategies in double directions do not enhance return performance of active trading strategies in single direction. Secondly, due to the implementation of opposite long/short trading even if predicted return spread between top and bottom portfolios from recursive out-of-sample forecasting model is negative, active trading strategy in double directions has monthly turnover higher than active trading strategy in single direction. Therefore, the breakeven transaction cost required before the active strategy in double directions become unprofitable is lower.

In short, active trading strategy in double directions, which implements the opposite trading for predicted negative Long/Short return from forecasting model, fails to further improve return performance of active trading strategy in single direction.

7.2.3 Active trading strategy on any decile portfolio

Different from active trading strategy based on top and bottom portfolios discussed in previous two subsections, this subsection explores active strategy which goes long position on any decile portfolio with predicted highest return, and short position on any decile portfolio with predicted lowest return. This implies that long/short position can be constructed by any decile momentum portfolio, any decile size portfolio, and any decile value portfolio, respectively.

- *The trading return*

The research compares the trading return, in terms of average monthly excess return and net average monthly excess return (100bp and 200bp), of active trading strategy based on any decile portfolio with active trading strategy based on top and bottom decile portfolios and passive trading strategy. It finds that active trading strategy on any equal-weighted decile momentum portfolio significantly outperforms active trading strategy on ‘Winner’ and ‘Loser’ portfolios as well as passive trading strategy. Table 7.9 Panel A shows that the strategy on any equal-weighted momentum portfolio with 6 months’ holding length, which goes long position on one portfolio with predicted highest return and short position on one portfolio with predicted lowest return, yields average monthly excess return ranging between 0.8039 and 1.2004 when filter thresholds are imposed between 0 to 1.5%, net average monthly excess return ranging between 0.7013 and 1.0338 (between 0.5987 and 0.8671) after reducing 100 (200) basis points of transaction cost every turnover. Three kinds of Long/Short return based on any equal-weighted decile momentum portfolio are much higher than corresponding Long/Short return based on top and bottom momentum portfolios by 31% to 70% as shown in Table 7.1 Panel A. Table 7.10 Panel A and Table 7.2 Panel A indicate the same advantage of active trading strategy on any equal-weighted decile momentum portfolio with 12 months’ holding length, which increases Long/Short return of the active strategy on top and bottom momentum portfolios with filter thresholds 0 to 1.0% by 47% to 80%.

[Table 7.9, 7.10, 7.11, and 7.12]

Table 7.9 Panel B shows that active any value-weighted decile momentum portfolio with 6 months' holding length yields average monthly excess return and net average monthly excess return (100bp, 200bp) slightly higher than corresponding returns of passive strategy, but much lower than corresponding returns by active trading strategy based on top and bottom momentum portfolios as shown in Table 7.1 Panel B. For value-weighted portfolios with 12 months' holding length, Long/Short return based on any decile momentum portfolio is negative at most filter thresholds, lower than corresponding ones of passive trading strategy and active trading strategy based on top and bottom momentum portfolios. In short, active trading strategy based on any decile portfolio is no advantage for value-weighted momentum portfolios.

Different from the findings about return enhancement of active strategies on any decile size portfolio and any decial value portfolio in the US Stock Market by Cooper, Gulen, and Vassalou (2001), the empirical work shows that size strategy (12) and value strategy (24) in the UK Stock Market do not obtain the enhancement in Long/Short return based on any decile size and value portfolios. Table 7.11 indicates that active trading strategy on any decile size portfolio with most filter thresholds earns negative Long/Short return. Table 7.12 reports that active trading strategy on any decile value portfolio yields negative Long/Short return before filter thresholds 1.5%.

- *The hit rate*

The performance of active trading strategy on any decile portfolio is associated with the hit rate of holding long/short portfolios with predicted highest/lowest return from forecasting model. Table 7.9 Panel A and Table 7.10 Panel A show that at 0 filter threshold the implementation of going long/short position on any equal-weighted decile momentum portfolio with predicted highest/lowest return in 6 and 12 months' holding length yields positive trading return in 84.72 and 75.49 percent of all implementations, respectively. The higher hit rate of the strategy leads to the good return performance of the active strategy on any equal-weighted decile momentum portfolio. But the condition is quite different for other cases whose hit rate of the strategy on any decile portfolio is no more than 68 percent. For instance, the hit rate of the strategy on any equal-(value-) weighted decile size portfolio with predicted highest/lowest return is 0.4559 (0.5343), as shown in Table 7.11.

The statistics 'PSS' on style coefficient γ in section 6.4 of the previous chapter gives the explanation for performance of active trading strategy on any decile portfolio. Because style coefficient γ includes information of all shares in decile portfolios, it reflects the correlation between decile portfolio returns and their firm characteristics. Table 6.3 Panel C shows that 'PSS', the percentage with same sign (positive and negative) between predicted equal-weighted momentum coefficient γ_{mom} and actual one for 6 and 12 months' holding length is 0.8148 and 0.7647, respectively, which is higher than corresponding ones for other style effects. This indicates that the signal from out-of-sample forecasting model has higher possibility to capture any equal-weighted decile momentum portfolio with highest and lowest return over time, which plays important role in return enhancement of active strategy on any equal-weighted momentum portfolio. But 'PSS' for value-weighted momentum portfolios (12/6, 12/12), size portfolios (12), and value portfolios (24) is below 0.74, 0.60, and 0.48, respectively. This reflects that forecasting model offers low signal-to-noise ratio to capture any value-weighted decile momentum portfolio (12/6, 12/12), any decile size portfolio (12), and any decile value portfolio (24) with highest and lowest return.

- *The return on long and short position*

The research compares the performance in average monthly return on long and short position between active trading strategy on any decile momentum portfolio and passive holding 'Winner' and 'Loser' portfolios all the time. As shown in Table 7.13, average monthly return of the long position on any equal-weighted momentum portfolio (12/6) with predicted highest return is 1.9316, about 11 basis points (bp) per month higher than one of 'Winner' portfolio in passive trading strategy. Average monthly return of the short position on any equal-weighted momentum portfolio (12/6) with predicted lowest return is 0.2322, about 30bp per month lower than one of 'Loser' portfolio in passive trading strategy. The active long and short strategy on any equal-weighted momentum portfolio (12/6) with predicted highest and lowest return creates return spread of 41bp (11bp+30bp) more than passive trading strategy. Similar pattern is in the case of equal-weighted momentum portfolio (12/12). The active long position on any equal-weighted momentum portfolio (12/12) with predicted highest return and short position on any portfolio with predicted lowest return yields 15.7bp and 21.9bp per month higher and lower than return on 'Winner' portfolio and return on 'Loser' portfolio in passive trading strategy, respectively, which enhances return spread of passive trading strategy by 37.6bp (15.7bp+21.9bp). In short, for equal-weighted momentum portfolio, both long position and short position in active trading strategy on any decile portfolio contribute to the increase in return spread of passive trading strategy.

[Table 7.13]

For value-weighted momentum effect (12/6), active long position on any decile portfolio with predicted highest return earns average monthly return of 1.1595, 3.3bp lower than one from passive long position on 'Winner' portfolio. Active short position on any decile portfolio with predicted lowest return earns average monthly return of -0.1934, only 5.4bp lower than one from passive short position on 'Loser' portfolio. As compared to passive strategy of Winner/Loser portfolio, the strategy of active long and short any portfolio has poor and ordinary performance, which leads to the slight increase in return spread of passive trading strategy by 2.1bp (-3.3bp+5.4bp). For value-weighted portfolio (12/12), the active long and short positions yield average monthly return of 0.8543 and 0.5461, 19bp and 11.5bp lower than ones from passive 'Winner' and 'Loser' portfolios, respectively. The performance of active long and short positions on any decile portfolio, that the decline in long return is more than the decline in short return relative to passive trading strategy, results in its failure to enhance return spread of passive trading strategy. So, the poor performance of active long return is blamed for active trading strategy on any value-weighted momentum portfolio not to outperform passive trading strategy.

As Table 7.13 presents, when active trading strategy on any decile size portfolio (12) is applied, to go long position on any equal-(value-) weighted size portfolio with predicted highest return enhances average monthly return of passive 'Small-cap' position by 1.5bp (16.7bp), from 1.0374 to 1.0527 (from 0.9344 to 1.1017). But to go short position on any equal-(value-) weighted size portfolio with predicted lowest return rises average monthly return of passive 'Large-cap' position by 2.3bp (15.4bp), from 0.8187 to 0.8421 (from 0.7426 to 0.8963). The increasing amount in active long return and active short return is almost same, which leads to no obvious difference in return spread between active trading strategy on any decile size portfolio and passive trading strategy on 'Small' and 'Large' portfolios.

As Table 7.13 reports, active long any equal-(value-) weighted price-to-book portfolio (24) with predicted highest return earns average monthly return of 0.9530 (1.2010), 21bp (63bp) lower than one of passive strategy on low price-to-book portfolio. Conversely, active short any value portfolio with predicted lowest return yields average return of 0.8370 (1.1258) per month, 33bp (27.5bp) higher than one of passive strategy on high price-to-book portfolio. The active strategy on any price-to-book portfolio shortens return spread of the passive strategy. Its failure is consistent with the performance of statistics 'POOS' and 'PSS' of value coefficient γ_{pb}, estimated in section 6.4 of the previous chapter. As Figure 6.8 indicates, 'POOS' of value coefficient γ_{pb} is in the decline in most sample period from 1990 to 2008, which reflects poor out-of-sample performance of forecasting model on any value portfolio return. Table 6.3 Panel C shows that its equal-(value-) weighted 'PSS' is 0.4500 (0.4778). The percentage with same sign (positive and negative) between actual and predicted γ_{pb}, which is estimated from the forecasting model, is the lowest among three style coefficients.

The above empirical analysis on active long and short any decile portfolio implies the profitability in the application of long-only position in momentum effect. By using out-of-sample forecasting model, active long any equal-weighted momentum portfolio (12/6, 12/12) with predicted highest return yields return higher than passive 'Winner' position by 11.0 (15.7) basic points per month. The similar advantage is for active long any value-weighted size portfolio (12) with predicted highest return against passive 'Small' portfilio by 16.7 basis points per month.

- *The inclusion number and frequency each decile portfolio*

As mentioned above, in active trading strategy on any decile portfolio the long and short portfolios do not always include top and bottom portfolios all the time, but extends to any one with predicted highest and lowest returns from recursive out-of-sample forecasting model. The research observes active trading strategy on any equal-weighted momentum portfolios (12/6, 12/12) with the enhancement in trading returns against active trading strategy on 'Winner' and 'Loser' portfolios as well as passive trading strategy, to examine how inclusion number and frequency each decile momentum portfolio play role in return enhancement.

[Table 7.14]

Table 7.14 Panel A reports the inclusion number and frequency for each equal-weighted momentum portfolio (12/6) when long and short positions are gone on any decile portfolio with predicted highest and lowest return from recursive out-of-sample forecasting model, respectively. Different from long on 'Winner' portfolio and short on 'Loser' portfolio in both active trading strategy and passive trading strategy all the time, the 2nd to 9th portfolios together with 'Winner' and

'Loser' portfolios share long and short positions. Besides 83.80 percent of long positions on 'Winner' portfolio, 6.48 and 4.63 percent of long positions is taken up by 'Loser' portfolio and the 9th portfolio, respectively. Similarly, 'Loser' portfolio, the 2nd, 3rd, 4th portfolios, and 'Winner' portfolio takes up 39.35, 31.94, 7.87, 10.19 and 7.41 percent of all short positions, respectively. Especially, the active strategy captures the second 'Loser' portfolio in 31.94 percent of all short positions. The inclusion of 'Loser' portfolio and the 9th portfolio in the long position, and the inclusion of 'Winner' portfolio and other three portfolios in the short position benefit return performance in active trading strategy on any decile momentum portfolio.

The similar findings for equal-weighted momentum portfolio (12/12) are shown in Panel B. Following 'Winner' portfolio with 78.43 percent, 'Loser' portfolio takes up 12.25 percent of all long positions. 'Loser' portfolio only accounts for 34.8 percent of all short positions. The 4th, 2nd, and 'Winner' portfolio accounts for 31.37, 14.71, and 14.22 percent of all short positions, respectively. Meanwhile, this reflects that active trading strategy on any decile momentum portfolio allocates 12.25 percent of long positions on 'Loser' portfolio and 14.22 percent of short positions on 'Winner' portfolio due to predicted price reversal in medium run from recursive out-of-sample forecasting model. This prediction is almost consistent with the findings in Table 4.4 in Chapter 4. Among decile momentum portfolios, 'Winner' portfolio yields the lowest return in 8.5 percent of all observations, and 'Loser' portfolio yields the highest return in 17.3 percent of all observations in the UK Stock Market from 1956 to 2008.

Figure 7.2 and 7.3 plot (6, 12) months' moving average of passive Winner/Loser return R_{wml} (solid line), active Winner/Loser return R_{wml} (dashed line), and active long/short return on any decile portfolio (dashed line) for equal-weighted momentum portfolio (12/6, 12/12), respectively. Panel A shows that dashed line overlaps solid line above X axis, which means that active strategy on Winner/Loser portfolio by using out-of-sample forecasting model correctly captures positive 'Winner/Loser' return R_{wml} of passive strategy. Importantly, dashed line is on X axis in 2000 when solid line is below X axis. This reflects that forecasting model offers signal for allocating position on TBILL when passive Winner/Loser portfolio yields negative return. Panel B shows that active strategy on any decile momentum portfolio with expected highest/lowest return by using out-of-sample forecasting model with 0 filter threshold also seize the opportunity to earn positive long/short return as passive trading strategy. Meanwhile, different from active Winner/Loser strategy, it allocates position on non-'Winner' and non-'Loser' portfolios to yield positive long/short return in 2000. Therefore, active Winner/Loser strategy and active strategy on any decile momentum portfolio perform well during the period from 1990 to 2008 because they capture one of three failures of passive momentum strategy, and hold TBILL and allocate position on other long/short portfolios with positive return, respectively. Two active momentum strategies can capture as much upside performance as possible and minimize downside risk.

[Figure 7.2, 7.3]

7.3 Active trading strategy on combined two/or three style effects

In this section, the research further explores active trading strategy on combined two or three style effects with 12 months' holding horizon from 1990 to 2008, and compares it with corresponding passive trading strategy.

7.3.1 Active trading strategy on combined three style effects

The research compares the performance between active trading strategy and passive trading strategy with combining momentum effect (12/12), size effect (12), and value effect (12) from 1990 to 2008. Table 7.15 Panel A and Panel B show that active trading strategy based on the combination of three equal-(value-) weighted style effects yields 0.2092% to 0.3819% (0.1479% to 0.2437%) of average monthly excess return from 1990 to 2008 at the filter threshold of 0 to 1.0%, higher than one of passive trading strategy which always allocates average position on three style effects all the time. Active trading strategy yields return lower than TBILL rate at 16.18 to 36.76 (17.65 to 42.65) percent of observations, relative to 51.96 percent by passive trading strategy. After reducing trading cost (100bp, 200bp), active trading strategy yields positive average monthly excess return, but passive trading strategy becomes unprofitable.

[Table 7.15]

The research further observes the allocation of individual style effect in active trading strategy with 0 of filter threshold. Table 7.16 Panel A shows that the strategy with combined equal-weighted three style effects allocates 54.41%, 28.43%, and 17.16% of long/short positions on Winner/Loser portfolio, Small/Large portfolio, and Low/High portfolio, respectively. Because recursive out-of-sample forecasting model predicts positive long/short return for three style effects, the allocation is gone on corresponding long/short position in all 204 observations all the time. Similar to the performance of individual style strategy, long/short position on value effect (12) yields the highest average monthly return (1.3858%) and negative return in the lowest percentage (14.29%) of observations, followed by long/short position on momentum effect (12/12) and size effect (12). Panel B shows that that the strategy with combined value-weighted three style effects allocates 43.72%, 26.63%, and 29.65% of long/short positions on Winner/Loser portfolio, Small/Large portfolio, Low/High portfolio, respectively. Because the forecasting model predicts negative long/short returns of three style effects in 5 observations, the allocation is gone on corresponding long/short portfolios in 199 observations and TBILL in 5 observations. Long/short position on momentum effect (12/12) yields the highest average monthly return (1.1324%) and negative return in the lowest percentage (27.59%) of observations, followed by size effect (12) and value effect (12). Different from the equal-weighted case, active trading of long/short value-weighted value portfolios yields negative return in 49.15% of observations, much higher than the corresponding percentage of active trading of long/short value-weighted momentum portfolio and size portfolio.

[Table 7.16]

7.3.2 Active trading strategy on combined two style effects

The research further explores active trading strategy on the combination of momentum effect (12/12) and value effect (12) from 1990 to 2008 for two reasons. Firstly, Table 7.16 in the previous subsection shows that active trading strategy on three equal-(value-) weighted style effects allocates 54.41 (43.72) percent of all long/short positions on Winner/Loser portfolio, much higher than percentage of positions on Small/Large portfolio and Low/High portfolio, and that long/short position on equal-(value-) weighted Winner/Loser portfolio yields average monthly return of 0.8330% (1.1324%), the second highest (highest) return among long/short position of three style effects. Secondly, Table 7.16 shows that the position on equal-weighted Low/High portfolio in active trading strategy yields average monthly return of 1.3858%, much higher than the return of long/short position on equal-weighted Winner/Loser portfolio and Small/Large portfolio.

[Table 7.17]

Table 7.17 Panel A and Panel B show that active trading strategy on the combination of equal-(value-) weighted momentum effect (12/12) and value effect (12) yields 0.4445% and 0.3936% (0.4846% and 0.3456%) of average monthly excess return from 1990 to 2008 at the filter threshold of 0 and 0.5%, enhancing the return of passive trading strategy which always allocates average position on two style effects all the time by more than 60% (70%). The return of active trading strategy is lower than TBILL rate at 30.88 and 23.53 (39.22 and 32.84) percent of observations, relative to 29.90 (47.06) percent by passive trading strategy. Because active trading strategy holds TBILL according to signal and magnitude from forecasting model, it reduces the number (turnover) of long/short position on two style effects and trading cost relative to passive trading strategy which always holds long/short position all the time. Net average monthly excess return (100bp, 200bp) of active trading strategy on two equal-(value-) weighted style effects is more than 0.3229% and 0.2522% (0.2785% and 0.2115%), increasing corresponding return of passive trading strategy by more than 98% (134%).

[Table 7.18]

As reported in Panel A and Panel B of Table 7.18, active trading strategy allocates 69.15 and 30.85 (48.74 and 51.26) percent of all long/short positions on equal-(value-) weighted Winner/Loser portfolio and Low/High portfolio, which yields 0.9050% and 0.9926% (1.1414% and 0.8332%) of average monthly return, respectively. Different from active trading strategy on the combination of three value-weighted style effects, the position on long/short value effect (12) in active trading strategy on the combination of two style effects takes up 51.26 percent of all long/short positions, higher than corresponding percentage of the position on long/short momentum effect (12/12). The position of long/short size effect (12) in active strategy on the combination of three style effects is allocated to the position of long/short value effect (12) more than the position of long/short momentum effect (12) in active strategy on the combination of two style effects. As reported in Panel B1 of Table 4.9 and 4.12, the research finds that average value-weighted return spread of size effect (12) and value effect (12) is 0.20 and 1.01 per month from 1979(1980) to 2008, respectively, The position on long/short value effect (12) with higher return spread replaces for the position on long/short size effect (12) with lower return spread, which leads to the large increase in average monthly excess return from 0.1969 to 0.4846 at filter threshold 0, as reported in Panel B of Table 7.17.

7.4 Conclusion

Higher 'PSS', the statistics to measure the performance of recursive out-of-sample forecasting model in Chapter 6, motivates the exploration of active trading strategy on style effects in the UK Stock Market from 1990 to 2008. The empirical result is promising for timing momentum effect and size effect by using active trading strategy on top and bottom portfolios. With signal and magnitude of out-of-sample forecasting model and positive filter threshold, active trading strategy on Winner/Loser portfolio and Small/Large portfolio can capture the time of significant momentum effect (12/6, 12/12) and small effect (12), and is more profitable but less risky than traditional passive strategy which always goes long/short position on Winner/Loser portfolio and Small/Large portfolio each month. The active strategy in momentum effect (12/6, 12/12) and size effect (12) succeeds in return enhancement of passive trading strategy due to its high hit rate. After reducing 100/200 basis points of trading cost each turnover, only active trading strategy on 'Winner/Loser' portfolio maintains advantage, but active trading strategy on 'Small/Large' portfolio becomes unprofitable. Active trading strategy fails to benefit value effect (24). High percentage of observations with positive passive Low/High return R_{lmh}, 81.67% (69.44%) for equal-(value-) weighted case shown in Panel A and B of Table 7.4, offers small space to enhance the return of passive strategy. Meanwhile, poor out-of-sample signal from forecasting model results in disappointed performance of an attempt to capture the time of value effect (24).

Active trading strategy on top/bottom portfolio with imposing positive and negative filter thresholds, which implements opposite trading by using signal and magnitude from out-of-sample forecasting model, fails to improve return performance of active trading strategy with imposing positive filter threshold, except for momentum effect (12/6). This failure is due to the forecasting model not to offer high percentage of successful opposite trading signal (measured by hit rate) for long/short position on Loser/Winner portfolio (12/12), Large/Small portfolio (12), and High/Low portfolio (24). In addition, the inclusion of opposite trading leads to the increase in turnover and trading cost, and further weakens the outperformance of active strategy on momentum effect (12/6) in double directions over active strategy in single direction.

Active trading strategy on any equal-weighted decile momentum portfolio (12/6, 12/12) significantly outperforms active trading strategy on ‘Winner’ and ‘Loser’ portfolios as well as passive trading strategy. The implementation of active long/short position on any equal-weighted decile momentum portfolio with predicted highest/lowest return from out-of-sample forecasting model yields positive return at higher percentage of all observations. The active long position and short position on any equal-weighted decile momentum portfolio has more chance to capture one portfolio whose return is higher than one of passive long ‘Winner’ portfolio, and one portfolio whose return is lower than one of passive short ‘Loser’ portfolio. This leads to the increase (decrease) in the return of active long (short) any momentum portfolio relative to passive long (short) ‘Winner’ (‘Loser’) portfolio. The inclusion of any equal-weighted decile momentum portfolio in the long and short positions outperforms active trading strategy on Winner/Loser portfolio. But return performance of the strategy on any value-weighted decile momentum portfolio (12/6, 12/12), any decile size portfolio (12), and any decile value portfolio (24) is disappointed. The empirical result on active long and short any decile portfolio implies the profitability in the application of long-only position on one style. By using out-of-sample forecasting model, active long any equal-weighted momentum portfolio (12/6, 12/12) and any value-weighted size portfolio (12) outperforms corresponding passive long ‘Winner’ portfolio and ‘Small’ portfolio, respectively.

The empirical work in Chapter 4 presents the negative correlation between momentum effect and size effect, between momentum effect and value effect, the positive correlation between size effect and value effect. It implies the possibility of active trading strategy with combined two/or three style effects to outperform corresponding passive trading strategy which always allocates average position on three/ or two style effects all the time. The research finds that active trading strategy based on the combination of momentum effect (12/12), size effect (12), and value effect (12) yields higher average monthly excess return at the filter threshold of 0 to

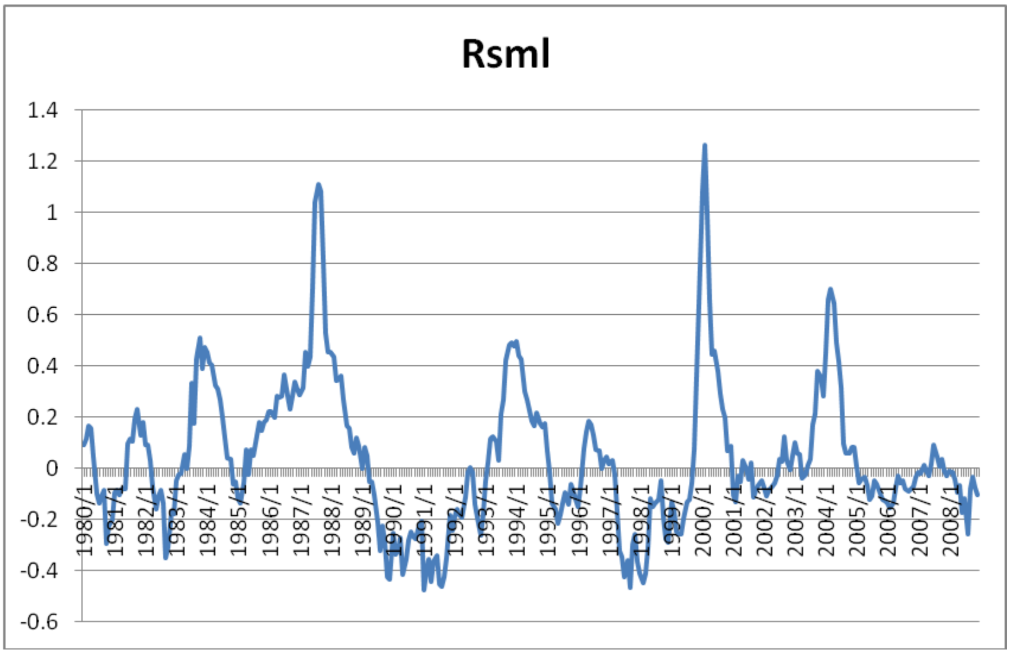
1.0%, and positive return at higher percentage of all observations than passive trading strategy from 1990 to 2008. Relative to active trading strategy with combined three style effects, active strategy on the combination of momentum effect (12/12) and value effect (12) performs better because the long/short position on Winner/Loser portfolio and Low/High portfolio with higher return spread replaces for the position on Small/Large portfolio with lower return spread.

In summary, the research explores the profitability of active trading strategy to combine top-down thematic ideas using economic and market series with bottom-up stock selection using specific share information. It finds that a variety of active trading strategies benefits passive absolute return strategy on momentum effect and size effect in the UK Stock Market from 1990 to 2008. For individual passive style investing, equal-(value-)weighted Winner/Loser portfolio in momentum effect (12/6) yields highest average monthly excess return of 0.7899 (0.8322), followed by Low/High portfolio in value effect (24). Active trading strategy has most significant impact on performance enhancement for momentum effect (12/6). Using recursive out-of-sample forecasting model with macroeconomic variables, such as GDP(Y), UEXTBILL(Y), DY(Q), EMR(-1)/CPI(H), active strategy on any equal-weighted decile momentum portfolio (12/6) with 0 filter threshold increases average monthly excess return of passive strategy from 0.7899 to 1.2004, and decreases the percentage with negative return in observations from 20.83% to 15.28%. Active strategy on value-weighted Winner/Loser portfolio in momentum effect (12/6) with 0.5 filter threshold increases average monthly excess return from 0.8322 of passive strategy to 1.1901, and decreases the percentage with negative return in observations from 28.70% to 15.28%.

Recursive out-of-sample forecasting model has capability to enhance performance of passive trading strategy with average position allocation on three/or two style effects all the time. Although active trading strategy on combined two/or three style effects outperforms corresponding passive strategy, its performance is behind active strategy on momentum effect (12/6). Active trading strategy on combined equal-(value-) weighted momentum effect (12/12) and value effect (12) earns average excess return of 0.4445 (0.4846) per month, and negative return in 22.06 (32.84) percent of observations. Comparatively, active strategy on any equal-weighted decile momentum portfolio (12/6) with 0 filter threshold earns average excess return of 1.2004 per month, and negative return in 15.28 percent of observations. Active strategy on value-weighted Winner/Loser portfolio in momentum effect (12/6) with 0.5 filter threshold earns average excess return of 1.1901 per month, and negative return in 15.28 percent of observations. Therefore, the exploration of active trading strategy on style effects indicates that style-oriented investors in the UK Stock Market are better trying to time momentum effect (12/6), either any equal-weighted decile momentum portfolio or value-weighted Winner/Loser portfolio.

Appendix: tables and figures in Chapter 7

Figure 7.1 Equal-weighted monthly Small/Large return R_{sml} from 1980 to 2008



Note: The figure plots series equal-weighted monthly Small/Large return R_{sml} from 1980 to 2008, which is estimated by the spread in 12 months' holding return between 'Small-cap' portfolio and 'Large-cap' portfolio.

Table 7.1 The performance of active trading strategy on top and bottom momentum portfolios (12/6) with positive filter thresholds

Panel A Equal-weighted

	Active trading strategy							Passive trading strategy
Filter threshold	>0	>0.5	>1.0	>1.5	>2.0	>2.5	>3.0	Nan
Average monthly excess return	0.9135	0.8630	0.7508	0.5252	0.2826	0.1524	0.0365	0.7899
Standard deviation	2.4667	2.4512	2.3782	2.3066	2.0915	1.7600	1.6137	2.7472
Sharpe ratio	0.3703	0.3521	0.3157	0.2277	0.1351	0.0866	0.0226	0.2875
%<0	0.1667	0.1528	0.1296	0.1111	0.0741	0.0509	0.0370	0.2083
%<monthly TBILL	0.2222	0.2037	0.1759	0.1250	0.0833	0.0602	0.0509	0.2685
Number of holding Winner/Loser portfolio	191	178	155	112	66	43	27	216
Hit rate of holding Winner/Loser portfolio	0.8115	0.7472	0.6839	0.6071	0.5455	0.4884	0.4815	0.7917
Number of holding TBILL	25	38	61	104	150	173	189	Nan
Hit rate of holding TBILL	0.3600	0.3947	0.4754	0.5192	0.6333	0.6994	0.7725	Nan
Hit rate of strategy	0.7593	0.6852	0.6250	0.5648	0.6065	0.6574	0.7361	0.7917
Monthly turnover	0.8843	0.8241	0.7176	0.5185	0.3056	0.1991	0.1250	1.0000
Net average monthly excess return (100bp)	0.7661	0.7257	0.6312	0.4388	0.2317	0.1192	0.0157	0.6232
Net average monthly excess return (200bp)	0.6187	0.5883	0.5116	0.3524	0.1807	0.0860	-0.0052	0.4566
Breakeven transaction cost	0.5165	0.5236	0.5232	0.5065	0.4625	0.3828	0.1458	0.3949

Panel B Value-weighted

	Active trading strategy							Passive trading strategy
Filter threshold	>0	>0.5	>1.0	>1.5	>2.0	>2.5	>3.0	Nan
Average monthly excess return	0.9970	1.1901	1.1055	0.8673	0.7068	0.6051	0.2488	0.8322
Standard deviation	4.0093	3.4293	3.1586	2.7957	2.4758	2.0884	1.5366	4.5252
Sharpe ratio	0.2487	0.3470	0.3500	0.3102	0.2855	0.2897	0.1619	0.1839
%<0	0.2083	0.1528	0.1111	0.0741	0.0417	0.0093	0.0093	0.2870
%<monthly TBILL	0.2315	0.1713	0.1296	0.0972	0.0602	0.0278	0.0278	0.3102
Number of holding Winner/Loser portfolio	174	145	111	78	46	26	12	216
Hit rate of holding Winner/Loser portfolio	0.7414	0.7310	0.7027	0.6410	0.6957	0.8077	0.5833	0.713
Number of holding TBILL	42	71	105	138	170	190	204	Nan
Hit rate of holding TBILL	0.4048	0.4507	0.4286	0.4638	0.5529	0.6526	0.6814	Nan
Hit rate of strategy	0.6759	0.6389	0.5694	0.5278	0.5833	0.6713	0.6759	0.7130
Monthly turnover	0.8056	0.6713	0.5139	0.3611	0.2130	0.1204	0.0556	1.0000
Net average monthly excess return (100bp)	0.8628	1.0783	1.0199	0.8072	0.6714	0.5851	0.2396	0.6656
Net average monthly excess return (200bp)	0.7286	0.9664	0.9342	0.7470	0.6359	0.5650	0.2303	0.4989
Breakeven transaction cost	0.6189	0.8864	1.0756	1.2009	1.6595	2.5134	2.2394	0.4161

Note: The table reports the performance of active trading strategy on top and bottom momentum portfolios based on 12 months' formation length and 6 months' holding length from 1990 to 2008. The strategy imposes filter threshold on predicted Winner/Loser return R_{wml} from 0 to 3.0% in increments of 0.5%, from recursive out-of-sample forecasting model. When predicted Winner/Loser return meets filter threshold, the portfolio is gone long position on 'Winner' portfolio and short position on 'Loser' one. Otherwise, it is invested in TBILL. The passive strategy goes long position on 'Winner' portfolio and short position on 'Loser' portfolio each month. The row labeled '%<0' and '%<monthly TBILL' indicate the percentage of trading return less than zero and monthly TBILL in observations. The row labeled 'Hit rate of holding Winner/Loser portfolio' reports the percentage of trading return satisfied with filter threshold in Winner/Loser trading according to signal and magnitude from forecasting model. The row labeled 'Hit rate of holding TBILL' reports the percentage of actual return unsatisfied with filter threshold in holding TBILL. The row labeled 'Hit rate of strategy' reports the percentage of successful holding long/short portfolio and TBILL in observations. 'Monthly turnover' is the percentage of holding long/short position in observations. 'Net average monthly excess return (100bp,200bp)' is trading return after reducing 100 or 200 basis point transaction cost every turnover. 'Breakeven trading cost' is defined as the fixed trading cost that makes monthly excess return of one strategy to zero.

Table 7.2 The performance of active trading strategy on top and bottom momentum portfolios (12/12) with positive filter thresholds

Panel A Equal-weighted

	Active trading strategy							Passive trading strategy
Filter threshold	>0	>0.5	>1.0	>1.5	>2.0	>2.5	>3.0	Nan
Average monthly excess return	0.3643	0.3031	0.1241	0.0011	-0.0982	-0.1576	-0.0408	0.1615
Standard deviation	1.9269	1.8578	1.6884	1.5479	1.4706	1.1936	0.6293	2.3640
Sharpe ratio	0.1890	0.1631	0.0735	0.0007	-0.0668	-0.1320	-0.0648	0.0683
%<0	0.1814	0.1520	0.0833	0.0588	0.0588	0.0490	0.0098	0.2598
%<monthly TBILL	0.2157	0.1863	0.0931	0.0637	0.0637	0.0539	0.0147	0.3235
Number of holding Winner/Loser portfolio	161	137	71	39	27	16	3	204
Hit rate of holding Winner/Loser portfolio	0.7702	0.7153	0.6479	0.5897	0.4815	0.2500	0.3333	0.7402
Number of holding TBILL	43	67	133	165	177	188	201	Nan
Hit rate of holding TBILL	0.3721	0.4179	0.4812	0.6545	0.7571	0.8723	0.9104	Nan
Hit rate of strategy	0.6863	0.6176	0.5392	0.6422	0.7206	0.8235	0.9020	0.7402
Monthly turnover	0.7892	0.6716	0.3480	0.1912	0.1324	0.0784	0.0147	1.0000
Net average monthly excess return (100bp)	0.2985	0.2471	0.0951	-0.0149	-0.1093	-0.1642	-0.0420	0.0781
Net average monthly excess return (200bp)	0.2327	0.1911	0.0661	-0.0308	-0.1203	-0.1707	-0.0433	-0.0052
Breakeven transaction cost	0.2308	0.2257	0.1783	0.0029	-0.3710	-1.0046	-1.3857	0.0808

Panel B Value-weighted

	Active trading strategy							Passive trading strategy
Filter threshold	>0	>0.5	>1.0	>1.5	>2.0	>2.5	>3.0	Nan
Average monthly excess return	0.2904	0.3148	0.2633	0.1579	0.1052	0.0190	0.0000	-0.0967
Standard deviation	2.5600	2.2460	1.9254	1.1725	0.8267	0.4793	0.0000	3.4190
Sharpe ratio	0.1134	0.1401	0.1368	0.1347	0.1273	0.0397	-0.0700	-0.0283
%<0	0.1912	0.1324	0.0686	0.0196	0.0098	0.0049	0.0000	0.3529
%<monthly TBILL	0.2059	0.1422	0.0784	0.0245	0.0147	0.0098	0.0049	0.3725
Number of holding Winner/Loser portfolio	129	92	61	19	10	4	0	204
Hit rate of holding Winner/Loser portfolio	0.6977	0.6957	0.6885	0.7368	0.7000	0.5000	Nan	0.6471
Number of holding TBILL	75	112	143	185	194	200	204	Nan
Hit rate of holding TBILL	0.4400	0.4554	0.5315	0.6000	0.6959	0.7400	0.8382	Nan
Hit rate of strategy	0.6029	0.5637	0.5784	0.6127	0.6961	0.7353	0.8382	0.6471
Monthly turnover	0.6324	0.4510	0.2990	0.0931	0.0490	0.0196	0.0000	1.0000
Net average monthly excess return (100bp)	0.2376	0.2771	0.2384	0.1501	0.1011	0.0173	0.0000	-0.1801
Net average monthly excess return (200bp)	0.1849	0.2395	0.2134	0.1424	0.0970	0.0157	0.0000	-0.2635
Breakeven transaction cost	0.2296	0.3490	0.4403	0.8478	1.0735	0.4852	Nan	-0.0484

Note: The table reports the performance of active trading strategy on top and bottom momentum portfolios with 12 months' formation length and 12 months' holding length from 1990 to 2008. The strategy imposes filter threshold on predicted Winner/Loser return R_{wml} from 0 to 3.0% in increments of 0.5%, from recursive out-of-sample forecasting model. When predicted Winner/Loser return meets filter threshold, the portfolio is gone long position on 'Winner' portfolio and short position on 'Loser' one. Otherwise, it is invested in TBILL. The passive strategy goes long position on 'Winner' portfolio and short position on 'Loser' portfolio each month. The row labeled '%<0' and '%<monthly TBILL' indicate the percentage of trading return less than zero and monthly TBILL in observations. The row labeled 'Hit rate of holding Winner/Loser portfolio' reports the percentage of trading return satisfied with filter threshold in Winner/Loser trading according to signal and magnitude from forecasting model. The row labeled 'Hit rate of holding TBILL' reports the percentage of actuall return unsatisfied with filter threshold in holding TBILL. The row labeled 'Hit rate of strategy' reports the percentage of successful holding long/short portfolio and TBILL in observations. 'Monthly turnover' is the percentage of holding long/short position in observations. 'Net average monthly excess return (100bp,200bp)' is trading return after reducing 100 or 200 basis point transaction cost every turnover. 'Breakeven trading cost' is defined as the fixed trading cost that makes monthly excess return of one strategy to zero.

Table 7.3 The performance of active trading strategy on top and bottom size portfolios (12) with positive filter thresholds

Panel A Equal-weighted

	Active trading strategy							Passive trading strategy
Filter threshold	>0	>0.5	>1.0	>1.5	>2.0	>2.5	>3.0	Nan
Average monthly excess return	-0.1618	0.1064	0.1201	0.1117	0.0466	0.0192	0.0161	-0.2636
Standard deviation	1.9005	1.6974	1.1911	0.8207	0.6083	0.4699	0.2930	2.1711
Sharpe ratio	-0.0851	0.0627	0.1008	0.1360	0.0766	0.0409	0.0549	-0.1214
%<0	0.3725	0.1716	0.0735	0.0441	0.0294	0.0196	0.0049	0.5735
%<monthly TBILL	0.4510	0.2206	0.0980	0.0588	0.0392	0.0294	0.0098	0.6716
Number of holding Small/Large portfolio	140	86	53	40	23	17	6	204
Hit rate of holding Small/Large portfolio	0.4571	0.4535	0.4717	0.4250	0.2174	0.0588	0.0000	0.4265
Number of holding TBILL	64	118	151	164	181	187	198	Nan
Hit rate of holding TBILL	0.6406	0.8051	0.8477	0.8720	0.8619	0.8717	0.8889	Nan
Hit rate of strategy	0.5147	0.6569	0.7500	0.7843	0.7892	0.8039	0.8627	0.4265
Monthly turnover	0.6863	0.4216	0.2598	0.1961	0.1127	0.0833	0.0294	1.0000
Net average monthly excess return (100bp)	-0.2190	0.0712	0.0984	0.0953	0.0372	0.0122	0.0136	-0.3470
Net average monthly excess return (200bp)	-0.2762	0.0361	0.0768	0.0789	0.0278	0.0053	0.0111	-0.4303
Breakeven transaction cost	-0.1179	0.1262	0.2312	0.2847	0.2066	0.1153	0.2735	-0.1318

Panel B Value-weighted

	Active trading strategy							Passive trading strategy
Filter threshold	>0	>0.5	>1.0	>1.5	>2.0	>2.5	>3.0	Nan
Average monthly excess return	-0.1031	0.0409	0.0737	0.0425	-0.0044	0.0035	0.0000	-0.2905
Standard deviation	1.6758	1.1337	0.7406	0.6011	0.4296	0.2652	0.0000	1.9962
Sharpe ratio	-0.0615	0.0361	0.0995	0.0707	-0.0103	0.0130	-0.0700	-0.1455
%<0	0.2794	0.0882	0.0441	0.0294	0.0245	0.0049	0.0000	0.5343
%<monthly TBILL	0.3971	0.1471	0.0833	0.0490	0.0392	0.0098	0.0049	0.6716
Number of holding Small/Large portfolio	128	61	40	24	15	4	0	204
Hit rate of holding Small/Large portfolio	0.5547	0.5082	0.5250	0.2917	0.1333	0.0000	Nan	0.4657
Number of holding TBILL	76	143	164	180	189	200	204	Nan
Hit rate of holding TBILL	0.6842	0.7762	0.8415	0.8444	0.8624	0.8800	0.9020	Nan
Hit rate of strategy	0.6029	0.6961	0.7794	0.7794	0.8088	0.8627	0.9020	0.4657
Monthly turnover	0.6275	0.2990	0.1961	0.1176	0.0735	0.0196	0.0000	1.0000
Net average monthly excess return (100bp)	-0.1554	0.0160	0.0573	0.0326	-0.0106	0.0018	0.0000	-0.3738
Net average monthly excess return (200bp)	-0.2077	-0.0090	0.0410	0.0228	-0.0167	0.0001	0.0000	-0.4572
Breakeven transaction cost	-0.0822	0.0684	0.1880	0.1806	-0.0301	0.0882	Nan	-0.1452

Note: The table reports the performance of active trading strategy on top and bottom size portfolios based on 12 months' holding length from 1990 to 2008. The strategy imposes filter threshold on predicted Small/Large return R_{sml} from 0 to 3.0% in increments of 0.5%, from recursive out-of-sample forecasting model. When predicted Small/Large return meets filter threshold, the portfolio is gone long position on 'Small' portfolio and short position on 'Large' one. Otherwise, it is invested in TBILL. The passive strategy always goes long position on 'Small' portfolio and short position on 'Large' portfolio each month. The row labeled '%<0' and '%<monthly TBILL' indicate the percentage of trading return less than zero and monthly TBILL in observations. The row labeled 'Hit rate of holding Small/Large portfolio' reports the percentage of trading return satisfied with filter threshold in Small/Large trading according to signal and magnitude from recursive out-of-sample forecasting model. The row labeled 'Hit rate of holding TBILL' reports the percentage of actual return unsatisfied with filter threshold in holding TBILL. The row labeled 'Hit rate of strategy' reports the percentage of successful holding Small/Large portfolio and TBILL in observations. 'Monthly turnover' is the percentage of holding long/short position in the observations. 'Net average monthly excess return (100bp,200bp)' is trading return after reducing 100 or 200 basis point transaction cost every turnover. 'Breakeven trading cost' is defined as the fixed trading cost that makes monthly excess return of one strategy to zero.

Table 7.4 The performance of active trading strategy on top and bottom value portfolios (24) with positive filter thresholds

Panel A Equal-weighted

	Active trading strategy							Passive trading strategy
Filter threshold	>0	>0.5	>1.0	>1.5	>2.0	>2.5	>3.0	Nan
Average monthly excess return	0.1414	0.0149	0.0000	0.0000	0.0000	0.0000	0.0000	0.2002
Standard deviation	0.9100	0.2599	0.0000	0.0000	0.0000	0.0000	0.0000	1.3939
Sharpe ratio	0.1554	0.0574	Nan	Nan	Nan	Nan	Nan	0.1437
%<0	0.0500	0.0167	0.0000	0.0000	0.0000	0.0000	0.0000	0.1833
%<monthly TBILL	0.2000	0.0444	0.0000	0.0000	0.0000	0.0000	0.0000	0.4611
Number of holding Low/High portfolio	90	23	0	0	0	0	0	180
Hit rate of holding low/High portfolio	0.9000	0.6087	Nan	Nan	Nan	Nan	Nan	0.8167
Number of holding TBILL	90	157	180	180	180	180	180	Nan
Hit rate of holding TBILL	0.2667	0.5223	0.6944	0.8000	0.8444	0.9000	0.9500	Nan
Hit rate of strategy	0.5833	0.5333	0.6944	0.8000	0.8444	0.9000	0.9500	0.8167
Monthly turnover	0.5000	0.1278	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
Net average monthly excess return (100bp)	0.1205	0.0095	0.0000	0.0000	0.0000	0.0000	0.0000	0.1585
Net average monthly excess return (200bp)	0.0997	0.0042	0.0000	0.0000	0.0000	0.0000	0.0000	0.1169
Breakeven transaction cost	0.1414	0.0584	Nan	Nan	Nan	Nan	Nan	0.1001

Panel B Value-weighted

	Active trading strategy							Passive trading strategy
Filter threshold	>0	>0.5	>1.0	>1.5	>2.0	>2.5	>3.0	Nan
Average monthly excess return	0.2009	0.0709	0.0852	0.0284	0.0082	0.0000	0.0000	0.5260
Standard deviation	1.3423	1.0014	0.4425	0.2505	0.1005	0.0000	0.0000	1.8534
Sharpe ratio	0.1497	0.0708	0.1925	0.1134	0.0811	Nan	Nan	0.2838
%<0	0.2444	0.1500	0.0167	0.0111	0.0000	0.0000	0.0000	0.3056
%<monthly TBILL	0.3111	0.1889	0.0500	0.0389	0.0111	0.0000	0.0000	0.3778
Number of holding Low/High portfolio	138	76	27	16	5	0	0	180
Hit rate of holding low/High portfolio	0.6812	0.5395	0.4444	0.1875	0.0000	Nan	Nan	0.6944
Number of holding TBILL	42	104	153	164	175	180	180	Nan
Hit rate of holding TBILL	0.2619	0.3173	0.4837	0.5976	0.7200	0.8056	0.8500	Nan
Hit rate of strategy	0.5833	0.4111	0.4778	0.5611	0.7000	0.8056	0.8500	0.6944
Monthly turnover	0.7667	0.4222	0.1500	0.0889	0.0278	0.0000	0.0000	1.0000
Net average monthly excess return (100bp)	0.1690	0.0532	0.0789	0.0247	0.0070	0.0000	0.0000	0.4843
Net average monthly excess return (200bp)	0.1370	0.0356	0.0727	0.0210	0.0058	0.0000	0.0000	0.4426
Breakeven transaction cost	0.1311	0.0839	0.2840	0.1598	0.1468	Nan	Nan	0.2630

Note: The table reports the performance of active trading strategy on top and bottom price-to-book portfolios on 24 months' holding length from 1990 to 2008. The strategy imposes filter threshold on predicted Low/High return R_{lmh} from 0 to 3.0% in increments of 0.5%, from recursive out-of-sample forecasting model. When predicted Low/High return meets filter threshold, the portfolio is gone long position on 'Low' portfolio and short position on 'High' one. Otherwise, it is invested in TBILL. The passive strategy goes long position on 'Low' portfolio and short position on 'High' portfolio each month. The row labeled '%<0' and '%<monthly TBILL' indicate the percentage of trading return less than zero and monthly TBILL in observations. The row labeled 'Hit rate of holding Low/High portfolio' reports the percentage of trading return satisfied with filter threshold in Low/High trading according to signal and magnitude from recursive out-of-sample forecasting model. The row labeled 'Hit rate of holding TBILL' reports the percentage of real return unsatisfied with filter threshold in holding TBILL. The row labeled 'Hit rate of strategy' reports the percentage of successful holding Low/High portfolio and TBILL in observations. 'Monthly turnover' is the percentage of holding long/short position in the observations. 'Net average monthly excess return (100bp, 200bp)' is trading return after reducing 100 or 200 basis point transaction cost every turnover. 'Breakeven trading cost' is defined as the fixed trading cost that makes monthly excess return of one strategy to zero.

Table 7.5 The performance of active trading strategy on top and bottom momentum portfolios (12/6) with positive and negative filter thresholds

Panel A Equal-weighted

	Active trading strategy							Passive trading strategy
Filter threshold	>0, <0	>0.5, <-0.5	>1.0, <-1.0	>1.5, <-1.5	>2.0, <-2.0	>2.5, <-2.5	>3.0, <-3.0	Nan
Average monthly excess return	0.9380	0.8980	0.7071	0.4943	0.2720	0.1524	0.0365	0.7899
Standard deviation	2.6671	2.5761	2.4090	2.3273	2.0988	1.7600	1.6137	2.7472
Sharpe ratio	0.3517	0.3486	0.2935	0.2124	0.1296	0.0866	0.0226	0.2875
%<0	0.2407	0.1991	0.1574	0.1296	0.0787	0.0509	0.0370	0.2083
%<monthly TBILL	0.2963	0.2500	0.2037	0.1435	0.0880	0.0602	0.0509	0.2685
Number of holding Winner/Loser portfolio	191	178	155	112	66	43	27	216
Hit rate of holding Winner/Loser portfolio	0.8115	0.7472	0.6839	0.6071	0.5455	0.4884	0.4815	0.7917
Number of holding Loser/Winner portfolio	25	15	6	4	1	0	0	Nan
Hit rate of holding Loser/Winner portfolio	0.3600	0.3333	0.0000	0.0000	0.0000	Nan	Nan	Nan
Number of holding TBILL	0	23	55	100	149	173	189	Nan
Hit rate of holding TBILL	Nan	0.1739	0.2727	0.4100	0.5570	0.6185	0.7090	Nan
Hit rate of strategy	0.7593	0.6574	0.5602	0.5046	0.5509	0.5926	0.6806	0.7917
Monthly turnover	1.00	0.89	0.75	0.54	0.31	0.20	0.13	1.00
Net average monthly excess return (100bp)	0.7714	0.7491	0.5829	0.4048	0.2203	0.1193	0.0157	0.6232
Net average monthly excess return (200bp)	0.6047	0.6002	0.4587	0.3153	0.1686	0.0861	-0.0052	0.4566
Breakeven transaction cost	0.4690	0.5025	0.4743	0.4602	0.4384	0.3828	0.1458	0.3949

Continued

Panel B Value-weighted								
	Active trading strategy							Passive trading strategy
Filter threshold	>0, <0	>0.5, <-0.5	>1.0, <-1.0	>1.5, <-1.5	>2.0, <-2.0	>2.5, <-2.5	>3.0, <-3.0	Nan
Average monthly excess return	0.9835	1.3417	1.1683	0.8915	0.6883	0.6051	0.2488	0.8322
Standard deviation	4.5004	3.8245	3.4035	2.8653	2.4961	2.0884	1.5366	4.5252
Sharpe ratio	0.2185	0.3508	0.3433	0.3111	0.2758	0.2897	0.1619	0.1839
%<0	0.3241	0.2083	0.1481	0.0787	0.0463	0.0093	0.0093	0.2870
%<monthly TBILL	0.3565	0.2315	0.1667	0.1019	0.0648	0.0278	0.0278	0.3102
Number of holding Winner/Loser portfolio	174	145	111	78	46	26	12	216
Hit rate of holding Winner/Loser portfolio	0.7414	0.7310	0.7027	0.6410	0.6957	0.8077	0.5833	0.713
Number of holding Loser/Winner portfolio	42	26	16	3	1	0	0	Nan
Hit rate of holding Loser/Winner portfolio	0.4048	0.5000	0.4375	0.3333	0.0000	Nan	Nan	Nan
Number of holding TBILL	0	45	89	135	169	190	204	Nan
Hit rate of holding TBILL	Nan	0.0667	0.1573	0.2148	0.3669	0.4789	0.5294	Nan
Hit rate of strategy	0.6759	0.5648	0.4583	0.3704	0.4352	0.5185	0.5324	0.7130
Monthly turnover	1.00	0.79	0.59	0.38	0.22	0.12	0.06	1.00
Net average monthly excess return (100bp)	0.8168	1.2098	1.0703	0.8291	0.6521	0.5851	0.2396	0.6656
Net average monthly excess return (200bp)	0.6502	1.0778	0.9723	0.7666	0.6158	0.5650	0.2303	0.4989
Breakeven transaction cost	0.4917	0.8474	0.9935	1.1887	1.5816	2.5134	2.2394	0.4161

Note: The table reports the performance of active trading strategy with positive and negative filter thresholds on top and bottom momentum portfolios (12/6) based on 12 months' formation length and 6 months' holding length from 1990 to 2008. The strategy imposes positive/negative filter threshold on predicted Winner/Loser return R_{wml} from 0 to +/-3.0% in increments of 0.5%, from recursive out-of-sample forecasting model. When predicted Winner/Loser return meets positive filter threshold, the portfolio is gone long position on 'Winner' portfolio and short position on 'Loser' one. When predicted Winner/Loser return meets negative filter threshold, the portfolio is gone long position on 'Loser' portfolio and short position on 'Winner' one. Otherwise, it is invested in TBILL. The passive strategy always goes long position on 'Winner' portfolio and short position on 'Loser' portfolio each month. The row labeled '%<0' and '%<monthly TBILL' indicate the percentage of trading return less than zero and monthly TBILL in observations. The row labeled 'Hit rate of holding Winner/Loser portfolio' reports the percentage of trading return satisfied with positive filter threshold in Winner/Loser trading according to signal from recursive out-of-sample forecasting model. The row labeled 'Hit rate of holding Loser/Winner portfolio' reports the percentage of trading return satisfied with negative filter threshold in Loser/Winner trading. The row labeled 'Hit rate of holding TBILL' reports the percentage of actual return unsatisfied with filter threshold in holding TBILL. The row labeled 'Hit rate of strategy' reports the percentage of successful holding Winner/Loser portfolio, Loser/Winner portfolio, and TBILL in observations. 'Monthly turnover' is the percentage of holding long/short position in the observations. 'Net average monthly excess return (100bp, 200bp)' is trading return after reducing 100 or 200 basis point transaction cost every turnover. 'Breakeven transaction cost' is defined as the fixed trading cost that makes monthly excess return of one strategy to zero.

Table 7.6 The performance of active trading strategy on top and bottom momentum portfolios (12/12) with positive and negative filter thresholds

Panel A Equal-weighted

	Active trading strategy							Passive trading strategy
Filter threshold	>0, <0	>0.5, <-0.5	>1.0, <-1.0	>1.5, <-1.5	>2.0, <-2.0	>2.5, <-2.5	>3.0, <-3.0	Nan
Average monthly excess return	0.3855	0.2916	0.0708	-0.0287	-0.1159	-0.1653	-0.0408	0.1615
Standard deviation	2.2812	2.1159	1.7825	1.5593	1.4772	1.1977	0.6293	2.3640
Sharpe ratio	0.1690	0.1378	0.0397	-0.0184	-0.0785	-0.1380	-0.0648	0.0683
%<0	0.3137	0.2598	0.1471	0.0833	0.0735	0.0539	0.0098	0.2598
%<monthly TBILL	0.3627	0.3039	0.1667	0.0980	0.0784	0.0588	0.0147	0.3235
Number of holding Winner/Loser portfolio	161	137	71	39	27	16	3	204
Hit rate of holding Winner/Loser portfolio	0.7702	0.7153	0.6479	0.5897	0.4815	0.2500	0.3333	0.7402
Number of holding Loser/Winner portfolio	43	31	16	7	3	1	0	Nan
Hit rate of holding Loser/Winner portfolio	0.3721	0.2258	0.0625	0.0000	0.0000	0.0000	Nan	Nan
Number of holding TBILL	0	36	117	158	174	187	201	Nan
Hit rate of holding TBILL	Nan	0.1111	0.3077	0.5253	0.6667	0.7968	0.8209	Nan
Hit rate of strategy	0.6863	0.5343	0.4069	0.5196	0.6324	0.7500	0.8137	0.7402
Monthly turnover	1.0000	0.8235	0.4265	0.2255	0.1471	0.0833	0.0147	1.0000
Net average monthly excess return (100bp)	0.3021	0.2229	0.0352	-0.0476	-0.1282	-0.1723	-0.0420	0.0781
Net average monthly excess return (200bp)	0.2187	0.1543	-0.0004	-0.0664	-0.1405	-0.1792	-0.0433	-0.0052
Breakeven transaction cost	0.1927	0.1770	0.0830	-0.0637	-0.3941	-0.9918	-1.3857	0.0808

Continued

Panel B Value-weighted

	Active trading strategy							Passive trading strategy
Filter threshold	>0, <0	>0.5, <-0.5	>1.0, <-1.0	>1.5, <-1.5	>2.0, <-2.0	>2.5, <-2.5	>3.0, <-3.0	Nan
Average monthly excess return	0.2801	0.1542	0.0217	0.0916	0.0961	0.0190	0.0000	-0.0967
Standard deviation	3.3978	2.7248	2.1376	1.2466	0.8382	0.4793	0.0000	3.4190
Sharpe ratio	0.0824	0.0566	0.0101	0.0735	0.1146	0.0397	-0.0700	-0.0283
%<0	0.3971	0.2549	0.1618	0.0539	0.0147	0.0049	0.0000	0.3529
%<monthly TBILL	0.4461	0.2941	0.1765	0.0588	0.0196	0.0098	0.0049	0.3725
Number of holding Winner/Loser portfolio	129	92	61	19	10	4	0	204
Hit rate of holding Winner/Loser portfolio	0.6977	0.6957	0.6885	0.7368	0.7000	0.5000	Nan	0.6471
Number of holding Loser/Winner portfolio	75	37	21	7	1	0	0	Nan
Hit rate of holding Loser/Winner portfolio	0.4400	0.1892	0.0000	0.0000	0.0000	Nan	Nan	Nan
Number of holding TBILL	0	75	122	178	193	200	204	Nan
Hit rate of holding TBILL	0.0000	0.0667	0.2377	0.3596	0.4819	0.5800	0.7059	Nan
Hit rate of strategy	0.6029	0.3725	0.3480	0.3824	0.4902	0.5784	0.7059	0.6471
Monthly turnover	1.0000	0.6324	0.4020	0.1275	0.0539	0.0196	0.0000	1.0000
Net average monthly excess return (100bp)	0.1968	0.1015	-0.0119	0.0809	0.0915	0.0173	0.0000	-0.1801
Net average monthly excess return (200bp)	0.1134	0.0488	-0.0454	0.0703	0.0870	0.0157	0.0000	-0.2635
Breakeven transaction cost	0.1401	0.1219	0.0270	0.3592	0.8908	0.4852	Nan	-0.0484

Note: The table reports the performance of active trading strategy with positive and negative filter thresholds on top and bottom momentum portfolios (12/12) based on 12 months' formation length and 12 months' holding length from 1990 to 2008. The strategy imposes positive/negative filter threshold on expected Winner/Loser return R_{wml} from 0 to +/-3.0% in increments of 0.5%, from recursive out-of-sample forecasting model. When predicted Winner/Loser return meets positive filter threshold, the portfolio is gone long position on 'Winner' portfolio and short position on 'Loser' one. When predicted Winner/Loser return meets negative filter threshold, the portfolio is gone long position on 'Loser' portfolio and short position on 'Winner' one. Otherwise, it is invested in TBILL. The passive strategy always goes long position on 'Winner' portfolio and short position on 'Loser' portfolio each month. The row labeled '%<0' and '%<monthly TBILL' indicate the percentage of trading return less than zero and monthly TBILL in observations. The row labeled 'Hit rate of holding Winner/Loser portfolio' reports the percentage of trading return satisfied with positive filter threshold in Winner/Loser trading according to signal from recursive out-of-sample forecasting model. The row labeled 'Hit rate of holding Loser/Winner portfolio' reports the percentage of trading return satisfied with negative filter threshold in Loser/Winner trading. The row labeled 'Hit rate of holding TBILL' reports the percentage of actual return unsatisfied with filter threshold in holding TBILL. The row labeled 'Hit rate of strategy' reports the percentage of successful holding Winner/Loser portfolio, Loser/Winner portfolio, and TBILL in observations. 'Monthly turnover' is the percentage of holding long/short position in the observations. 'Net average monthly excess return (100bp, 200bp)' is trading return after reducing 100 or 200 basis point transaction cost every turnover. 'Breakeven transaction cost' is defined as the fixed trading cost that makes monthly excess return of one strategy to zero.

Table 7.7 The performance of active trading strategy on top and bottom size portfolios (12) with positive and negative filter thresholds

Panel A Equal-weighted								
	Active trading strategy							Passive trading strategy
Filter threshold	>0, <0	>0.5, <-0.5	>1.0, <-1.0	>1.5, <-1.5	>2.0, <-2.0	>2.5, <-2.5	>3.0, <-3.0	Nan
Average monthly excess return	-0.3465	-0.0601	-0.0405	0.0501	0.0267	0.0192	0.0161	-0.2636
Standard deviation	2.1402	1.9380	1.4765	0.9929	0.6725	0.4699	0.2930	2.1711
Sharpe ratio	-0.1619	-0.0310	-0.0274	0.0505	0.0398	0.0409	0.0549	-0.1214
%<0	0.4853	0.2304	0.1225	0.0588	0.0343	0.0196	0.0049	0.5735
%<monthly TBILL	0.6225	0.2990	0.1667	0.0784	0.0441	0.0294	0.0098	0.6716
Number of holding Small/Large portfolio	140	86	53	40	23	17	6	204
Hit rate of holding Small/Large portfolio	0.4571	0.4535	0.4717	0.4250	0.2174	0.0588	0.0000	0.4265
Number of holding Large/Small portfolio	64	27	18	7	1	0	0	Nan
Hit rate of holding Large/Small portfolio	0.6406	0.4074	0.0556	0.0000	0.0000	Nan	Nan	Nan
Number of holding TBILL	0	91	133	157	180	187	198	Nan
Hit rate of holding TBILL	Nan	0.3187	0.5564	0.7325	0.7667	0.8128	0.8535	Nan
Hit rate of strategy	0.5147	0.3873	0.4902	0.6471	0.7010	0.7500	0.8284	0.4265
Monthly turnover	1.0000	0.5539	0.3480	0.2304	0.1176	0.0833	0.0294	1.0000
Net average monthly excess return (100bp)	-0.4299	-0.1063	-0.0696	0.0309	0.0169	0.0122	0.0136	-0.3470
Net average monthly excess return (200bp)	-0.5133	-0.1524	-0.0986	0.0117	0.0071	0.0053	0.0111	-0.4303
Breakeven transaction cost	-0.1733	-0.0542	-0.0582	0.1088	0.1137	0.1153	Nan	-0.1318

Continued

Panel B Value-weighted

	Active trading strategy							Passive trading strategy
Filter threshold	>0, <0	>0.5, <-0.5	>1.0, <-1.0	>1.5, <-1.5	>2.0, <-2.0	>2.5, <-2.5	>3.0, <-3.0	Nan
Average monthly excess return	-0.2584	-0.1389	-0.0625	0.0195	-0.0044	0.0035	0.0000	-0.2905
Standard deviation	1.9524	1.4417	1.0628	0.6794	0.4296	0.2652	0.0000	1.9962
Sharpe ratio	-0.1323	-0.0964	-0.0588	0.0287	-0.0103	0.0130	-0.0700	-0.1455
%<0	0.3971	0.1520	0.0833	0.0343	0.0245	0.0049	0.0000	0.5343
%<monthly TBILL	0.5833	0.2500	0.1471	0.0588	0.0392	0.0098	0.0049	0.6716
Number of holding Small/Large portfolio	128	61	40	24	15	4	0	204
Hit rate of holding Small/Large portfolio	0.5547	0.5082	0.5250	0.2917	0.1333	0.0000	Nan	0.4657
Number of holding Large/Small portfolio	76	28	14	2	0	0	0	Nan
Hit rate of holding Large/Small portfolio	0.6842	0.2143	0.0000	0.0000	Nan	Nan	Nan	Nan
Number of holding TBILL	0	115	150	178	189	200	204	Nan
Hit rate of holding TBILL	Nan	0.3826	0.6067	0.7022	0.7619	0.8250	0.8578	Nan
Hit rate of strategy	0.6029	0.3971	0.5490	0.6471	0.7157	0.8088	0.8578	0.4657
Monthly turnover	1.0000	0.4363	0.2647	0.1275	0.0735	0.0196	0.0000	1.0000
Net average monthly excess return (100bp)	-0.3418	-0.1753	-0.0846	0.0088	-0.0106	0.0018	0.0000	-0.3738
Net average monthly excess return (200bp)	-0.4251	-0.2117	-0.1066	-0.0018	-0.0167	0.0001	0.0000	-0.4572
Breakeven transaction cost	-0.1292	-0.1592	-0.1180	0.0765	-0.0301	0.0882	Nan	-0.1452

Note: The table reports the performance of active trading strategy with positive and negative filter thresholds on top and bottom size portfolios (12) based on 12 months' holding length from 1990 to 2008. The strategy imposes positive/negative filter threshold on predicted Small/Large return R_{sml} from 0 to +/-3.0% in increments of 0.5%, from recursive out-of-sample forecasting model. When predicted Small/Large return meets positive filter threshold, the portfolio is gone long position on 'Small' portfolio and short position on 'Large' one. When predicted Small/Large return meets negative filter threshold, the portfolio is gone long position on 'Large' portfolio and short position on 'Small' one. Otherwise, it is invested in TBILL. The passive strategy always goes long position on 'Small' portfolio and short position on 'Large' portfolio each month. The row labeled '%<0' and '%<monthly TBILL' indicate the percentage of trading return less than zero and monthly TBILL in observations. The row labeled 'Hit rate of holding Small/Large portfolio' reports the percentage of trading return satisfied with positive filter threshold in Small/Large trading according to signal from recursive out-of-sample forecasting model. The row labeled 'Hit rate of holding Large/Small portfolio' reports the percentage of trading return satisfied with negative filter threshold in Large/Small trading. The row labeled 'Hit rate of holding TBILL' reports the percentage of actual return unsatisfied with filter threshold in holding TBILL. The row labeled 'Hit rate of strategy' reports the percentage of successful holding Small/Large, Large/Small, and TBILL in observations. 'Monthly turnover' is the percentage of holding long/short position in the observations. 'Net average monthly excess return (100bp, 200bp)' is trading return after reducing 100 or 200 basis point transaction cost every turnover. 'Breakeven transaction cost' is defined as the fixed trading cost that makes monthly excess return of one strategy to zero.

Table 7.8 The performance of active trading strategy on top and bottom value portfolios (24) with positive and negative filter thresholds

Panel A Equal-weighted

	Active trading strategy							Passive trading strategy
Filter threshold	>0, <0	>0.5, <-0.5	>1.0, <-1.0	>1.5, <-1.5	>2.0, <-2.0	>2.5, <-2.5	>3.0, <-3.0	Nan
Average monthly excess return	-0.3711	-0.1621	-0.0131	0.0000	0.0000	0.0000	0.0000	0.2002
Standard deviation	1.5269	0.6429	0.1226	0.0000	0.0000	0.0000	0.0000	1.3939
Sharpe ratio	-0.2430	-0.2522	-0.1068	Nan	Nan	Nan	Nan	0.1437
%<0	0.4167	0.1278	0.0111	0.0000	0.0000	0.0000	0.0000	0.1833
%<monthly TBILL	0.6500	0.1778	0.0167	0.0000	0.0000	0.0000	0.0000	0.4611
Number of holding Low/High portfolio	90	23	0	0	0	0	0	180
Hit rate of holding low/High portfolio	0.9000	0.6087	Nan	Nan	Nan	Nan	Nan	0.8167
Number of holding High/Low portfolio	90	24	3	0	0	0	0	Nan
Hit rate of holding High/Low portfolio	0.2667	0.0000	0.0000	Nan	Nan	Nan	Nan	Nan
Number of holding TBILL	Nan	133	177	180	180	180	180	Nan
Hit rate of holding TBILL	0.0000	0.4436	0.6158	0.7389	0.7889	0.8611	0.9278	Nan
Hit rate of strategy	0.5833	0.4056	0.6056	0.7389	0.7889	0.8611	0.9278	0.8167
Monthly turnover	1.0000	0.2611	0.0167	0.0000	0.0000	0.0000	0.0000	1.0000
Net average monthly excess return (100bp)	-0.4128	-0.1731	-0.0138	0.0000	0.0000	0.0000	0.0000	0.1585
Net average monthly excess return (200bp)	-0.4545	-0.1839	-0.0145	0.0000	0.0000	0.0000	0.0000	0.1169
Breakeven transaction cost	-0.1856	-0.3105	-0.3926	Nan	Nan	Nan	Nan	0.1001

Continued

Panel B Value-weighted

	Active trading strategy							Passive trading strategy
Filter threshold	>0, <0	>0.5, <-0.5	>1.0, <-1.0	>1.5, <-1.5	>2.0, <-2.0	>2.5, <-2.5	>3.0, <-3.0	Nan
Average monthly excess return	-0.3184	-0.2382	-0.0299	-0.0003	0.0082	0.0000	0.0000	0.5260
Standard deviation	2.0340	1.5496	0.9082	0.4618	0.1005	0.0000	0.0000	1.8534
Sharpe ratio	-0.1565	-0.1537	-0.0329	-0.0007	0.0811	Nan	Nan	0.2838
%<0	0.4167	0.2278	0.0389	0.0167	0.0000	0.0000	0.0000	0.3056
%<monthly TBILL	0.4833	0.2667	0.0722	0.0444	0.0111	0.0000	0.0000	0.3778
Number of holding Low/High portfolio	138	76	27	16	5	0	0	180
Hit rate of holding low/High portfolio	0.6812	0.5395	0.4444	0.1875	0.0000	Nan	Nan	0.6944
Number of holding High/Low portfolio	42	15	4	1	0	0	0	Nan
Hit rate of holding High/Low portfolio	0.2619	0.0667	0.0000	0.0000	Nan	Nan	Nan	Nan
Number of holding TBILL	0	89	149	163	175	180	180	Nan
Hit rate of holding TBILL	Nan	0.0899	0.2617	0.4908	0.7086	0.8056	0.8500	Nan
Hit rate of strategy	0.5833	0.2778	0.2833	0.4611	0.6889	0.8056	0.8500	0.6944
Monthly turnover	1.0000	0.5056	0.1722	0.0944	0.0278	0.0000	0.0000	1.0000
Net average monthly excess return (100bp)	-0.3601	-0.2593	-0.0371	-0.0043	0.0070	0.0000	0.0000	0.4843
Net average monthly excess return (200bp)	-0.4018	-0.2804	-0.0443	-0.0083	0.0058	0.0000	0.0000	0.4426
Breakeven transaction cost	-0.1592	-0.2356	-0.0867	Nan	Nan	Nan	Nan	0.2630

Note: The table reports the performance of active trading strategy with positive and negative filter thresholds on top and bottom price-to-book portfolios based on 24 months' holding length from 1990 to 2008. The strategy imposes positive/negative filter threshold on predicted Low/High return R_{lmh} from 0 to +/-3.0% in increments of 0.5%, from recursive out-of-sample forecasting model. When predicted Low/HIgh return meets positive filter threshold, the portfolio is gone long position on 'Low' portfolio and short position on 'High' one. When predicted Low/High return meets negative filter threshold, the portfolio is gone long position on 'High' portfolio and short position on 'Low' one. Otherwise, it is invested in TBILL. The passive strategy always goes long position on 'Low' portfolio and short position on 'High' portfolio each month. The row labeled '%<0' and '%<monthly TBILL' indicate the percentage of trading return less than zero and monthly TBILL in observations. The row labeled 'Hit rate of holding Low/High portfolio' reports the percentage of trading return satisfied with positive filter threshold in Low/High trading according to signal from recursive out-of-sample forecasting model. The row labeled 'Hit rate of holding High/Low portfolio' reports the percentage of trading return satisfied with negative filter threshold in High/Low trading. The row labeled 'Hit rate of holding TBILL' reports the percentage of actual return unsatisfied with filter threshold in holding TBILL. The row labeled 'Hit rate of strategy' reports the percentage of successful holding Low/High portfolio, High/Low portfolio, and TBILL in observations. 'Monthly turnover' is the percentage of holding long/short position in the observations. 'Net average monthly excess return (100bp, 200bp)' is trading return after reducing 100 or 200 basis point transaction cost every turnover. 'Breakeven transaction cost' is defined as the fixed trading cost that makes monthly excess return of one strategy to zero.

Table 7.9 The performance of active trading strategy on any decile momentum portfolio (12/6)

Panel A Equal-weighted

	Active trading strategy							Passive trading strategy
Filter threshold	>0	>0.5	>1.0	>1.5	>2.0	>2.5	>3.0	Nan
Average monthly excess return	1.2004	1.1962	1.0828	0.8039	0.4388	0.3423	0.1625	0.7899
Standard deviation	2.0097	2.0110	1.9939	1.8262	1.6007	1.3239	1.1406	2.7472
Sharpe ratio	0.5973	0.5949	0.5431	0.4402	0.2741	0.2585	0.1425	0.2875
%<0	0.1528	0.1528	0.1343	0.0972	0.0648	0.0324	0.0278	0.2083
%<monthly TBILL	0.2407	0.2361	0.1991	0.1296	0.0787	0.0417	0.0417	0.2685
Number of holding portfolio with predicted highest/Lowest	216	214	182	133	73	50	32	216
Hit rate of holding portfolio with predicted highest/Lowest return	0.8472	0.7617	0.7033	0.5940	0.5479	0.5400	0.4375	0.7917
Number of holding TBILL	0	2	34	83	143	166	184	Nan
Hit rate of holding TBILL	NaN	0.5000	0.4412	0.5301	0.6224	0.6988	0.7772	Nan
Hit rate of strategy	0.8472	0.7593	0.6620	0.5694	0.5972	0.6620	0.7269	0.7917
Monthly turnover	1.0000	0.9907	0.8426	0.6157	0.3380	0.2315	0.1481	1.00
Net average monthly excess return (100bp)	1.0338	1.0312	0.9425	0.7013	0.3825	0.3037	0.1378	0.6232
Net average monthly excess return (200bp)	0.8671	0.8660	0.8020	0.5987	0.3262	0.2651	0.1131	0.4566
Breakeven transaction cost	0.6002	0.6037	0.6426	0.6528	0.6491	0.7393	0.5484	0.3949

Panel B Value-weighted

	Active trading strategy							Passive trading strategy
Filter threshold	>0	>0.5	>1.0	>1.5	>2.0	>2.5	>3.0	Nan
Average monthly excess return	0.8539	0.8757	0.7781	0.8191	0.6841	0.5823	0.2213	0.8322
Standard deviation	3.9881	3.9432	3.6555	2.9920	2.5909	2.0083	1.3991	4.5252
Sharpe ratio	0.2141	0.2221	0.2129	0.2737	0.2640	0.2899	0.1582	0.1839
%<0	0.3333	0.3194	0.2315	0.1296	0.0787	0.0139	0.0093	0.2870
%<monthly TBILL	0.3796	0.3657	0.2546	0.1481	0.0926	0.0278	0.0231	0.3102
Number of holding portfolio with predicted highest/Lowest	216	208	160	107	68	28	12	216
Hit rate of holding portfolio with predicted highest/Lowest return	0.6667	0.6154	0.5688	0.5234	0.5735	0.7857	0.5833	0.713
Number of holding TBILL	0	8	56	109	148	188	204	Nan
Hit rate of holding TBILL	NaN	0.3750	0.5357	0.5780	0.6419	0.7287	0.7353	Nan
Hit rate of strategy	0.6667	0.6065	0.5602	0.5509	0.6204	0.7361	0.7269	0.7130
Monthly turnover	1.0000	0.9630	0.7407	0.4954	0.3148	0.1296	0.0556	1.0000
Net average monthly excess return (100bp)	0.6873	0.7153	0.6547	0.7365	0.6317	0.5607	0.2121	0.6656
Net average monthly excess return (200bp)	0.5206	0.5548	0.5312	0.6540	0.5792	0.5391	0.2028	0.4989
Breakeven transaction cost	0.4270	0.4547	0.5252	0.8267	1.0865	2.2460	1.9919	0.4161

Note: The table reports the performance of active trading strategy on any decile momentum portfolio based on 12 months' formation length and 6 months' holding length from 1990 to 2008. The strategy imposes filter threshold on predicted highest/lowest portfolio return from 0 to 3.0% in increments of 0.5%, from recursive out-of-sample forecasting model. When predicted highest/lowest portfolio return meets filter threshold, the portfolio is gone long position on the portfolio with highest predicted return and short position on the portfolio with predicted lowest return. Otherwise, it is invested in TBILL. The row labeled '%<0' and '%<Monthly TBILL' indicate the percentage of trading return less than zero and monthly TBILL in observations. The row labeled 'Hit rate of holding portfolio with predicted highest/lowest return' reports the percentage of trading return satisfied with filter threshold in the trading of predicted highest/lowest return according to signal from recursive out-of-sample forecasting model. The row labeled 'Hit rate of holding TBILL' reports the percentage of actual return unsatisfied with filter threshold in holding TBILL. The row labeled 'Hit rate of strategy' reports the percentage of successful holding long/short portfolio and TBILL in observations. 'Monthly turnover' is the percentage of holding long/short position in observations. 'Net average monthly excess return (100bp, 200bp)' is trading return after reducing 100 or 200 basis point transaction cost every turnover. 'Breakeven trading cost' is defined as the fixed trading cost that makes monthly excess return of one strategy to zero.

Table 7.10 The performance of active trading strategy on any decile momentum portfolio (12/12)

Panel A Equal-weighted

	Active trading strategy							Passive trading strategy
Filter threshold	>0	>0.5	>1.0	>1.5	>2.0	>2.5	>3.0	Nan
Average monthly excess return	0.5373	0.4639	0.2079	-0.0871	-0.1064	-0.1781	-0.0309	0.1615
Standard deviation	1.9991	1.9498	1.7810	1.3617	1.3240	1.1662	0.6456	2.3640
Sharpe ratio	0.2688	0.2379	0.1168	-0.0640	-0.0804	-0.1527	-0.0478	0.0683
%<0	0.2451	0.2255	0.1569	0.0931	0.0735	0.0539	0.0098	0.2598
%<monthly TBILL	0.3137	0.2941	0.1863	0.1225	0.0882	0.0637	0.0196	0.3235
Number of holding portfolio with predicted highest/Lowest	204	187	109	51	34	17	4	204
Hit rate of holding portfolio with predicted highest/Lowest return	0.7549	0.6684	0.5413	0.4118	0.3824	0.1176	0.2500	0.7402
Number of holding TBILL	0	17	95	153	170	187	200	Nan
Hit rate of holding TBILL	NaN	0.2353	0.4421	0.6078	0.7294	0.8235	0.8800	Nan
Hit rate of strategy	0.7549	0.6324	0.4951	0.5588	0.6716	0.7647	0.8676	0.7402
Monthly turnover	1.0000	0.9167	0.5343	0.2500	0.1667	0.0833	0.0196	1.0000
Net average monthly excess return (100bp)	0.4539	0.3875	0.1634	-0.1080	-0.1204	-0.1851	-0.0326	0.0781
Net average monthly excess return (200bp)	0.3706	0.3111	0.1188	-0.1289	-0.1343	-0.1921	-0.0342	-0.0052
Breakeven transaction cost	0.2687	0.2530	0.1946	-0.1743	-0.3193	-1.0687	-0.7871	0.0808

Panel B Value-weighted

	Active trading strategy							Passive trading strategy
Filter threshold	>0	>0.5	>1.0	>1.5	>2.0	>2.5	>3.0	Nan
Average monthly excess return	-0.1740	-0.0548	-0.0973	-0.2444	-0.0093	0.0080	-0.0014	-0.0967
Standard deviation	2.7495	2.6487	2.2083	1.8576	1.1684	0.8260	0.0194	3.4190
Sharpe ratio	-0.0633	-0.0207	-0.0441	-0.1316	-0.0080	0.0097	-0.0700	-0.0283
%<0	0.4167	0.3382	0.2059	0.1471	0.0637	0.0196	0.0000	0.3529
%<monthly TBILL	0.4951	0.4069	0.2696	0.1863	0.0833	0.0343	0.0098	0.3725
Number of holding portfolio with predicted highest/Lowest	204	176	107	60	27	11	1	204
Hit rate of holding portfolio with predicted highest/Lowest return	0.5833	0.5341	0.3925	0.3000	0.2963	0.3636	0.0000	0.6471
Number of holding TBILL	0	28	97	144	177	193	203	Nan
Hit rate of holding TBILL	NaN	0.6786	0.5670	0.6458	0.7345	0.8187	0.8719	Nan
Hit rate of strategy	0.5833	0.5539	0.4755	0.5441	0.6765	0.7941	0.8676	0.6471
Monthly turnover	1.0000	0.8627	0.5245	0.2941	0.1324	0.0539	0.0049	1.0000
Net average monthly excess return (100bp)	-0.2574	-0.1268	-0.1410	-0.2690	-0.0204	0.0035	-0.0018	-0.1801
Net average monthly excess return (200bp)	-0.3407	-0.1987	-0.1848	-0.2935	-0.0314	-0.0010	-0.0022	-0.2635
Breakeven transaction cost	-0.0870	-0.0318	-0.0927	-0.4155	-0.0351	0.0746	-0.1383	-0.0484

Note: The table reports the performance of active trading strategy on any decile momentum portfolio based on 12 months' formation length and 12 months' holding length from 1990 to 2008. The strategy imposes filter threshold on predicted highest/lowest portfolio return from 0 to 3.0% in increments of 0.5%, from recursive out-of-sample forecasting model. When predicted highest/lowest portfolio return meets filter threshold, the portfolio is gone long position on the portfolio with highest predicted return and short position on the portfolio with predicted lowest return. Otherwise, it is invested in TBILL. The row labeled '%<0' and '%<Monthly TBILL' indicate the percentage of trading return less than zero and monthly TBILL in observations. The row labeled 'Hit rate of holding portfolio with predicted highest/lowest return' reports the percentage of trading return satisfied with filter threshold in the trading on predicted highest/lowest return according to signal from recursive out-of-sample forecasting model. The row labeled 'Hit rate of holding TBILL' reports the percentage of actual return unsatisfied with filter threshold in holding TBILL. The row labeled 'Hit rate of strategy' reports the percentage of successful holding long/short portfolio and TBILL in observations. 'Monthly turnover' is the percentage of holding long/short position in observations. 'Net average monthly excess return (100bp, 200bp)' is trading return after reducing 100 or 200 basis points transaction cost every turnover. 'Breakeven trading cost' is defined as the fixed trading cost that makes monthly excess return of one strategy to zero.

Table 7.11 The performance of active trading strategy on any decile size portfolio (12)

Panel A Equal-weighted

	Active trading strategy							Passive trading strategy
Filter threshold	>0	>0.5	>1.0	>1.5	>2.0	>2.5	>3.0	Nan
Average monthly excess return	-0.2716	-0.2290	-0.0470	-0.0405	0.0232	-0.0041	-0.0228	-0.2636
Standard deviation	1.7624	1.7121	1.4483	1.0112	0.8753	0.7064	0.5419	2.1711
Sharpe ratio	-0.1541	-0.1338	-0.0324	-0.0400	0.0265	-0.0057	-0.0421	-0.1214
%<0	0.5441	0.4706	0.2108	0.1078	0.0637	0.0392	0.0196	0.5735
%<monthly TBILL	0.6324	0.5539	0.2500	0.1275	0.0735	0.0490	0.0294	0.6716
Number of holding portfolio with predicted highest/Lowest	204	177	94	54	36	21	11	204
Hit rate of holding portfolio with predicted highest/Lowest return	0.4559	0.3559	0.3298	0.3148	0.2778	0.1905	0.0000	0.4265
Number of holding TBILL	0	27	110	150	168	183	193	Nan
Hit rate of holding TBILL	NaN	0.6296	0.7636	0.8533	0.9345	0.9399	0.9534	Nan
Hit rate of strategy	0.4559	0.3922	0.5637	0.7108	0.8186	0.8627	0.9020	0.4265
Monthly turnover	1.0000	0.8676	0.4608	0.2647	0.1765	0.1029	0.0539	1.0000
Net average monthly excess return (100bp)	-0.3550	-0.3014	-0.0854	-0.0626	0.0084	-0.0127	-0.0273	-0.3470
Net average monthly excess return (200bp)	-0.4383	-0.3737	-0.1238	-0.0846	-0.0063	-0.0213	-0.0318	-0.4303
Breakeven transaction cost	-0.1358	-0.1320	-0.0510	-0.0765	0.0657	-0.0197	-0.2115	-0.1318

Panel B Value-weighted

	Active trading strategy							Passive trading strategy
Filter threshold	>0	>0.5	>1.0	>1.5	>2.0	>2.5	>3.0	Nan
Average monthly excess return	-0.2768	-0.1889	-0.1476	-0.0782	-0.0513	-0.0154	-0.0215	-0.2905
Standard deviation	1.6742	1.5717	1.0913	0.9064	0.7295	0.4638	0.3075	1.9962
Sharpe ratio	-0.1653	-0.1202	-0.1352	-0.0863	-0.0703	-0.0331	-0.0700	-0.1455
%<0	0.4657	0.3382	0.1520	0.0833	0.0392	0.0098	0.0049	0.5343
%<monthly TBILL	0.5490	0.4167	0.1814	0.0980	0.0490	0.0147	0.0098	0.6716
Number of holding portfolio with predicted highest/Lowest	204	152	70	43	20	6	1	204
Hit rate of holding portfolio with predicted highest/Lowest return	0.5343	0.4276	0.2857	0.2558	0.2500	0.0000	0.0000	0.4657
Number of holding TBILL	0	52	134	161	184	198	203	Nan
Hit rate of holding TBILL	NaN	0.5962	0.7313	0.8323	0.9076	0.9495	0.9704	Nan
Hit rate of strategy	0.5343	0.4706	0.5784	0.7108	0.8431	0.9216	0.9657	0.4657
Monthly turnover	1.0000	0.7451	0.3431	0.2108	0.0980	0.0294	0.0049	1.0000
Net average monthly excess return (100bp)	-0.3602	-0.2510	-0.1762	-0.0958	-0.0595	-0.0179	-0.0220	-0.3738
Net average monthly excess return (200bp)	-0.4435	-0.3131	-0.2048	-0.1134	-0.0677	-0.0203	-0.0224	-0.4572
Breakeven transaction cost	-0.1384	-0.1267	-0.2150	-0.1855	-0.2615	-0.2611	-2.1963	-0.1452

Note: The table reports the performance of active trading strategy on any decile size portfolio based on 12 months' holding length from 1990 to 2008. The strategy imposes filter threshold on predicted highest/lowest portfolio return from 0 to 3.0% in increments of 0.5%, from recursive out-of-sample forecasting model. When predicted highest/lowest portfolio return meets filter threshold, the portfolio is gone long position on the portfolio with highest predicted return and short position on the portfolio with predicted lowest return. Otherwise, it is invested in TBILL. The passive strategy always goes long position on 'Small' portfolio and short position on 'Large' portfolio each month. The row labeled '%<0' and '%<Monthly TBILL' indicate the percentage of trading return less than zero and monthly TBILL in observations. The row labeled 'Hit rate of holding portfolio with predicted highest/lowest return' reports the percentage of trading return satisfied with filter threshold in the trading of predicted highest/lowest return according to signal from recursive out-of-sample forecasting model. The row labeled 'Hit rate of holding TBILL' reports the percentage of actual return unsatisfied with filter threshold in holding TBILL. The row labeled 'Hit rate of strategy' reports the percentage of successful holding long/short portfolio and TBILL in observations. 'Monthly turnover' is the percentage of holding long/short position in observations. 'Net average monthly excess return (100bp, 200bp)' is trading return after reducing 100 or 200 basis point transaction cost every turnover. 'Breakeven trading cost' is defined as the fixed trading cost that makes monthly excess return of one strategy to zero.

Table 7.12 The performance of active trading strategy on any decile value portfolio (24)

Panel A Equal-weighted

	Active trading strategy							Passive trading strategy
Filter threshold	>0	>0.5	>1.0	>1.5	>2.0	>2.5	>3.0	Nan
Average monthly excess return	-0.3386	-0.2883	-0.0173	-0.0068	0.0000	0.0000	0.0000	0.2002
Standard deviation	0.7585	0.6738	0.2125	0.0522	0.0000	0.0000	0.0000	1.3939
Sharpe ratio	-0.4465	-0.4279	-0.0813	-0.1299	Nan	Nan	Nan	0.1437
%<0	0.3278	0.2944	0.0389	0.0111	0.0000	0.0000	0.0000	0.1833
%<monthly TBILL	0.6944	0.6111	0.1222	0.0167	0.0000	0.0000	0.0000	0.4611
Number of holding portfolio with predicted highest/Lowest	180	157	35	4	0	0	0	180
Hit rate of holding portfolio with predicted highest/Lowest return	0.6722	0.2611	0.1143	0.0000	Nan	Nan	Nan	0.8167
Number of holding TBILL	0	23	145	176	180	180	180	Nan
Hit rate of holding TBILL	Nan	0.8261	0.9517	0.9773	0.9889	1.0000	1.0000	Nan
Hit rate of strategy	0.6722	0.3333	0.7889	0.9556	0.9889	1.0000	1.0000	0.8167
Monthly turnover	1.0000	0.8722	0.1944	0.0222	0.0000	0.0000	0.0000	1.0000
Net average monthly excess return (100bp)	-0.3803	-0.3247	-0.0254	-0.0077	0.0000	0.0000	0.0000	0.1585
Net average monthly excess return (200bp)	-0.4220	-0.3610	-0.0335	-0.0087	0.0000	0.0000	0.0000	0.1169
Breakeven transaction cost	-0.1693	-0.1653	Nan	Nan	Nan	Nan	Nan	0.1001

Panel B Value-weighted

	Active trading strategy							Passive trading strategy
Filter threshold	>0	>0.5	>1.0	>1.5	>2.0	>2.5	>3.0	Nan
Average monthly excess return	-0.3794	-0.3355	-0.0910	0.1019	0.0475	0.0156	0.0000	0.5260
Standard deviation	1.4916	1.4615	1.1929	0.6071	0.2804	0.1219	0.0000	1.8534
Sharpe ratio	-0.2544	-0.2296	-0.0763	0.1679	0.1695	0.1282	Nan	0.2838
%<0	0.4611	0.4389	0.1889	0.0167	0.0056	0.0000	0.0000	0.3056
%<monthly TBILL	0.5667	0.5444	0.2444	0.0333	0.0222	0.0000	0.0000	0.3778
Number of holding portfolio with predicted highest/Lowest	180	175	97	36	18	5	0	180
Hit rate of holding portfolio with predicted highest/Lowest return	0.5389	0.4286	0.3196	0.3889	0.1111	0.0000	Nan	0.6944
Number of holding TBILL	0	5	83	144	162	175	180	Nan
Hit rate of holding TBILL	Nan	0.8000	0.8313	0.8819	0.9383	0.9657	0.9944	Nan
Hit rate of strategy	0.5389	0.4389	0.5556	0.7833	0.8556	0.9389	0.9944	0.6944
Monthly turnover	1.0000	0.9722	0.5389	0.2000	0.1000	0.0278	0.0000	1.0000
Net average monthly excess return (100bp)	-0.4212	-0.3761	-0.1135	0.0936	0.0433	0.0144	0.0000	0.4843
Net average monthly excess return (200bp)	-0.4628	-0.4166	-0.1359	0.0852	0.0391	0.0133	0.0000	0.4426
Breakeven transaction cost	-0.1897	-0.1725	-0.0844	0.2548	0.2376	Nan	Nan	0.2630

Note: The table reports the performance of active trading strategy on any decile price-to-book portfolio based on 24 months' holding length from 1990 to 2008. The strategy imposes filter threshold on predicted highest/lowest portfolio return from 0 to 3.0% in increments of 0.5%, from recursive out-of-sample forecasting model. When predicted highest/lowest portfolio return meets filter threshold, the portfolio is gone long position on the portfolio with highest predicted return and short position on the portfolio with predicted lowest return. Otherwise, it is invested in TBILL. The passive strategy always goes long position on low PE/BE portfolio and short position on high PE/BE portfolio each month. The row labeled '%<0' and '%<Monthly TBILL' indicate the percentage of trading return less than zero and monthly TBILL in observations. The row labeled 'Hit rate of holding portfolio with predicted highest/lowest return' reports the percentage of trading return satisfied with filter threshold in the trading of predicted highest/lowest return according to signal from recursive out-of-sample forecasting model. The row labeled 'Hit rate of holding TBILL' reports the percentage of actual return unsatisfied with filter threshold in holding TBILL. The row labeled 'Hit rate of strategy' reports the percentage of successful holding long/short portfolio and TBILL in observations. 'Monthly turnover' is the percentage of holding long/short position in observations. 'Net average monthly excess return (100/200bp)' is trading return after reducing 100/200 basis point transaction cost every turnover. 'Breakeven trading cost' is defined as the fixed trading cost that makes monthly excess return of one strategy to zero.

Table 7.13 Average monthly long return and short return of active trading strategy on any decile portfolio and passive trading strategy on top and bottom portfolio

		Active trading strategy		Passive trading strategy	
		Long	Short	Long	Short
Momentum effect (12/6)	EW	1.9316	0.2322	1.8220	0.5333
	VW	1.1595	-0.1934	1.1923	-0.1390
Momentum effect (12/12)	EW	1.8017	0.7821	1.6451	1.0013
	VW	0.8543	0.5461	1.0467	0.6612
Size effect (12)	EW	1.0527	0.8421	1.0374	0.8187
	VW	1.1017	0.8963	0.9344	0.7426
Value effect (24)	EW	0.9530	0.8370	1.1616	0.5067
	VW	1.2010	1.1258	1.8312	0.8505

Note: The table reports average monthly return on long position and short position for active trading strategy on any decile portfolio and passive trading strategy on top and bottom portfolio. Active trading strategy on any decile portfolio goes long/short position on any decile portfolio with expected highest/lowest return which is estimated by recursive out-of-sample forecasting model. The passive strategy always goes long/short on top/or bottom decile portfolios each month. Momentum effect (12/6, 12/12) represents decile momentum portfolios with 12 months' formation length and 6, 12 months' holding length, respectively. Size effect (12) represents decile size portfolios with 12 months' holding length. Value effect (24) represents decile value portfolios with 24 months' holding length

Table 7.14 Inclusion number and frequency each portfolio in active trading strategy on any equal-weighted decile momentum portfolio (12/6, 12/12)

Panel A Momentum effect (12/6)

	Portfolio	P_1(Loser)	P_2	P_3	P_4	P_5	P_6	P_7	P_8	P_9	P_{10}(Wiinner)
Long position	Number	14	0	4	4	1	0	1	1	10	181
	Frequency	0.0648	0.0000	0.0185	0.0185	0.0046	0.0000	0.0046	0.0046	0.0463	0.8380
Short position	Number	85	69	17	22	4	2	0	1	0	16
	Frequency	0.3935	0.3194	0.0787	0.1019	0.0185	0.0093	0.0000	0.0046	0.0000	0.0741

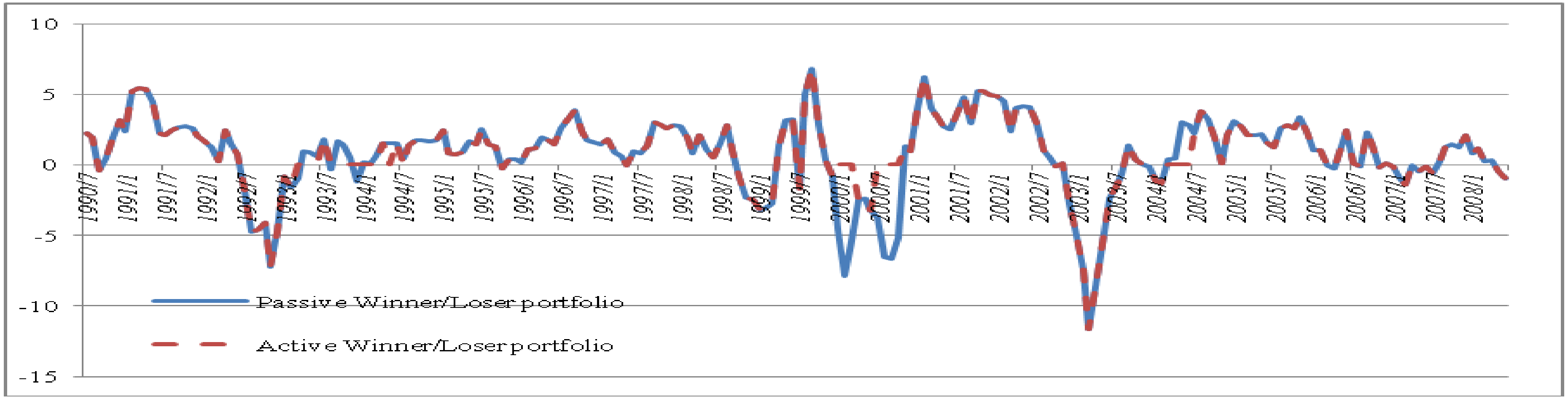
Panel B Momentum effect (12/12)

	Portfolio	P_1(Loser)	P_2	P_3	P_4	P_5	P_6	P_7	P_8	P_9	P_{10}(Wiinner)
Long position	Number	25	3	2	2	11	0	0	0	1	160
	Frequency	0.1225	0.0147	0.0098	0.0098	0.0539	0.0000	0.0000	0.0000	0.0049	0.7843
Short position	Number	71	30	0	64	0	3	0	6	1	29
	Frequency	0.3480	0.1471	0.0000	0.3137	0.0000	0.0147	0.0000	0.0294	0.0049	0.1422

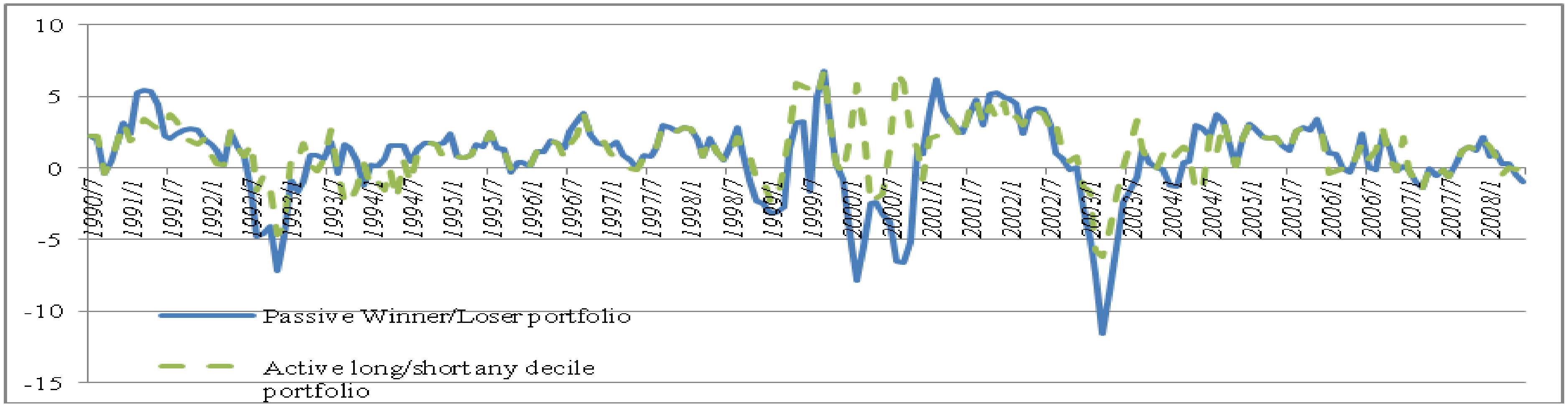
Note: This table reports the inclusion number and frequency each equal-weighted decile momentum portfolio which is included in the long and short positions by using the active trading strategy on any decile portfolio. Long position is gone on one portfolio with predicted highest return, and short position is gone on one portfolio with predicted lowest return according to estimation of portfolio returns from recursive out-of-sample forecasting model. Panel A reports corresponding data on equal-weighted decile portfolios with 12 months' formation length and 6 months' holding length. Panel B reports corresponding data on equal-weighted decile portfolios with 12 months' formation length and 12 months' holding length.

Figure 7.2 The performance of 6 months' moving average passive and active long/short return for equal-weighted momentum effect (12/6)

Panel A Active Winner/Loser return R_{wml} and passive Winner/Loser return R_{wml}



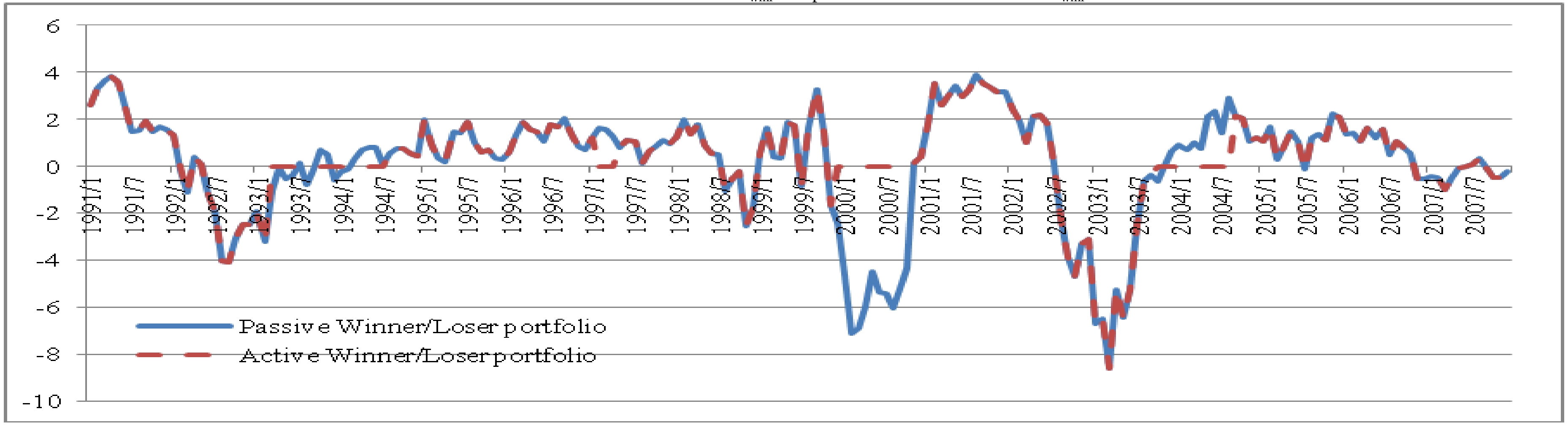
Panel B Active long/short return on any decile momentum portfolio and passive Winner/Loser return R_{wml}



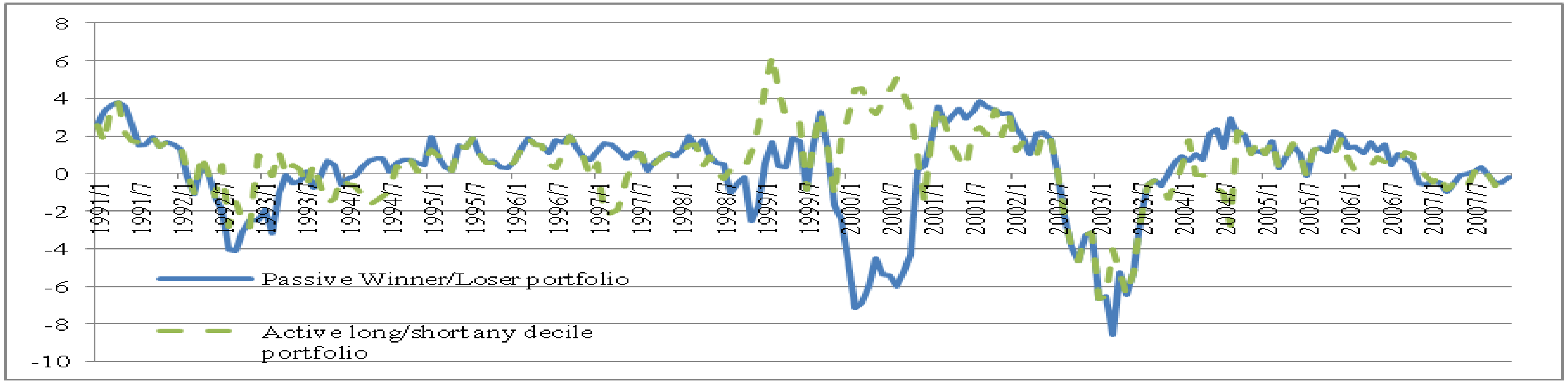
Note: The dashed line and solid line in Panel A plot series 6 months' moving average of active Winner/Loser return R_{wml} and passive Winner/Loser return R_{wml} from 1990 to 2008. The dashed line and solid line in Panel B plot series 6 months' moving average active long/short return on any decile momentum portfolio and passive Winner/Loser return R_{wml}. Equal-weighted momentum portfolios are formed with past 6 months' share returns and hold for 6 months. Passive Winner/Loser return R_{wml} is estimated by the return spread between 'Winner' portfolio and 'Loser' portfolio each month. Active Winner/Loser return R_{wml} is estimated by the return spread between 'Winner' portfolio and 'Loser' portfolio by using recursive out-of-sample forecasting model with 0 filter threshold. Active long/short return based on any decile momentum portfolio is estimated by the return spread between one portfolio with predicted highest return and one portfolio with predicted lowest return by using recursive out-of-sample forecasting model with 0 filter threshold.

Figure 7.3 The performance of 12 months' moving average passive and active long/short return for equal-weighted momentum effect (12/12)

Panel A Active Winner/Loser return R_{wml} and passive Winner/Loser return R_{wml}



Panel B Active long/short return on any decile momentum portfolio and passive Winner/Loser return R_{wml}



Note: The dashed line and solid line in Panel A plot series 12 months' moving average of active Winner/Loser return R_{wml} and passive Winner/Loser return R_{wml} from 1990 to 2008. The dashed line and solid line in Panel B plot series 12 months' moving average active long/short return on any decile momentum portfolio and passive Winner/Loser return R_{wml}. Equal-weighted momentum portfolios are formed with past 12 months' share returns and hold for 12 months. Passive Winner/Loser return R_{wml} is estimated by the return spread between 'Winner' portfolio and 'Loser' portfolio each month. Active Winner/Loser return R_{wml} is estimated by the return spread between 'Winner' portfolio and 'Loser' portfolio by using recursive out-of-sample forecasting model with 0 filter threshold. Active long/short return on any decile momentum portfolio is estimated by the return spread between one portfolio with predicted highest return and one portfolio with predicted lowest return by using recursive out-of-sample forecasting model with 0 filter threshold.

Table 7.15 The performance of active trading strategy on the combination of momentum, size, and value effect with 12 months' holding length

Panel A Equal-weighted								
	Active trading strategy							Passive trading strategy
Filter threshold	>0	>0.5	>1.0	>1.5	>2.0	>2.5	>3.0	Nan
Average monthly excess return	0.3819	0.3459	0.2092	0.0996	-0.0521	-0.1384	-0.0247	0.0076
Standard deviation	2.2763	2.2562	2.0310	1.7444	1.5943	1.2852	0.6951	0.7332
Sharpe ratio	0.1678	0.1533	0.1030	0.0571	-0.0327	-0.1077	-0.0355	0.1040
%<0	0.2696	0.2549	0.1373	0.1029	0.0882	0.0686	0.0147	0.2108
%<Monthly TBILL	0.3676	0.3235	0.1618	0.1127	0.0931	0.0735	0.0147	0.5196
Number of holding Long/Short portfolio	204	188	111	75	49	33	9	204
Hit rate of holding long/short portfolio	0.7304	0.6436	0.5946	0.5200	0.3673	0.1515	0.1111	0.7892
Number of holding TBILL	0	16	93	129	155	171	195	Nan
Hit rate of holding TBILL	NaN	0.6250	0.6129	0.7054	0.7613	0.8129	0.8359	Nan
Hit rate of strategy	0.7304	0.6422	0.6029	0.6373	0.6667	0.7059	0.8039	0.7892
Monthly turnover	1.0000	0.9216	0.5441	0.3676	0.2402	0.1618	0.0441	1.0000
Net average monthly excess return (100bp)	0.2985	0.2690	0.1638	0.0689	-0.0721	-0.1519	-0.0284	-0.0071
Net average monthly excess return (200bp)	0.2152	0.1922	0.1185	0.0383	-0.0921	-0.1654	-0.0321	-0.0905
Breakeven transaction cost	0.1910	0.1877	0.1923	0.1355	-0.1084	-0.4277	-0.2796	0.0038
Panel B Value-weighted								
	Active trading strategy							Passive trading strategy
Filter threshold	>0	>0.5	>1.0	>1.5	>2.0	>2.5	>3.0	Nan
Average monthly excess return	0.1969	0.1479	0.2437	0.1789	0.1008	0.0225	0.0000	0.0380
Standard deviation	2.6099	2.5148	2.0408	1.2826	0.9321	0.5477	0.0000	1.0905
Sharpe ratio	0.0754	0.0588	0.1194	0.1395	0.1082	0.0411	-0.0700	0.0349
%<0	0.3431	0.2990	0.1275	0.0490	0.0343	0.0098	0.0000	0.3284
%<Monthly TBILL	0.4265	0.3578	0.1765	0.0637	0.0441	0.0049	0.0000	0.5196
Number of holding Long/Short portfolio	199	170	101	41	25	8	0	204
Hit rate of holding long/short portfolio	0.6482	0.5647	0.5743	0.4878	0.3600	0.2500	NaN	0.6716
Number of holding TBILL	5	34	103	163	179	196	204	Nan
Hit rate of holding TBILL	0.2000	0.4706	0.6505	0.6810	0.7151	0.7602	0.8235	Nan
Hit rate of strategy	0.6373	0.5490	0.6127	0.6422	0.6716	0.7402	0.8235	0.6716
Monthly turnover	0.9755	0.8333	0.4951	0.2010	0.1225	0.0392	0.0000	1.0000
Net average monthly excess return (100bp)	0.1156	0.0784	0.2024	0.1621	0.0906	0.0192	0.0000	-0.0453
Net average monthly excess return (200bp)	0.0343	0.0089	0.1612	0.1454	0.0803	0.0159	0.0000	-0.1287
Breakeven transaction cost	0.1009	0.0887	0.2461	0.4451	0.4113	0.2867	Nan	0.0190

Note: The table reports the performance of active trading strategy based on the combination of momentum, size, value effect with 12 months' holding length from 1990 to 2008. The active strategy imposes filter threshold on the predicted long/short return from 0 to 3.0% in increments of 0.5%. When predicted monthly long/short returns of three style effects from out-of-sample forecasting model are all lower than one filter threshold, the position is allocated on TBILL. Otherwise, the position is allocated on top/or bottom portfolio of one style effect with predicted highest return spread. The passive strategy allocates average position on long/short portfolios of three style effects all the time. The row labeled '%<0' and '%<Monthly TBILL' indicate the percentage of trading return less than zero and monthly TBILL in observations. The row labeled 'Hit rate of holding Long/Short portfolio' reports the percentage of trading return satisfied with filter threshold in Long/Short position. The row labeled 'Hit rate of holding TBILL' reports the percentage of actual return unsatisfied with filter threshold in holding TBILL. The row labeled 'Hit rate of strategy' reports the percentage of successful holding long/short portfolio and TBILL in observations. 'Monthly turnover' is the percentage of holding long/short position in observations. 'Net average monthly excess return (100bp, 200bp)' is trading return after reducing 100 or 200 basis point transaction cost every turnover. 'Breakeven trading cost' is defined as the fixed trading cost that makes monthly excess return of one strategy to zero.

Table 7.16 The long/short position performance in active trading strategy on the combination of momentum, size, and value effect with 12 months' holding length (Filter threshold=0)

	Panel A Equal-weighted					Panel B Value-weighted			
	Overall	Winner/Loser	Small/Large	Low/High		Overall	Winner/Loser	Small/Large	Low/High
Number of Long/Short position	204	111	58	35	Number of Long/Short position	199	87	53	59
% Long/Short position	1.0000	0.5441	0.2843	0.1716	% Long/Short position	1.0000	0.4372	0.2663	0.2965
Average monthly return R_{lms}	0.8642	0.8330	0.6091	1.3858	Average monthly return R_{lms}	0.6885	1.1324	0.4537	0.2449
Standard deviation of R_{lms}	2.2914	2.4076	2.3643	1.6822	Standard deviation of R_{lms}	2.6380	3.3257	2.0404	1.7546
Sharp ratio	0.3771	0.3460	0.2576	0.8238	Sharp ratio	0.2610	0.3405	0.2224	0.1396
Number of $R_{lms}<0$	55	27	23	5	Number of $R_{lms}<0$	70	24	17	29
% $R_{lms}<0$	0.2696	0.2432	0.3966	0.1429	% $R_{lms}<0$	0.3518	0.2759	0.3208	0.4915

Note: The table reports the long/short position performance in active trading strategy on the combination of momentum, size, and value effect with 12 months' holding length when filter threshold is set to 0. The active strategy imposes filter threshold on the predicted long/short return. When predicted monthly long/short returns of three style effects from out-of-sample forecasting model are all lower than filter threshold, the position is allocated on TBILL. Otherwise, the position is allocated on top/or bottom portfolio of one style effect with predicted highest return spread. The row labeled '% Long/Short position' indicates the percentage of long/short position on one style effect with predicted highest return spread from out-of-sample forecasting model. The row labeled '% $R_{lms}<0$' indicates the percentage of trading return less than 0

Table 7.17 The performance of active trading strategy on the combination of momentum and value effect with 12 months' holding length

Panel A Equal-weighted

	Active trading strategy							Passive trading strategy
Filter threshold	>0	>0.5	>1.0	>1.5	>2.0	>2.5	>3.0	Nan
Average monthly excess return	0.4445	0.3936	0.1372	0.0011	-0.0982	-0.1576	-0.0408	0.2462
Standard deviation	2.1369	2.0696	1.6915	1.5479	1.4706	1.1936	0.6293	1.1627
Sharpe ratio	0.2080	0.1902	0.0811	0.0007	-0.0668	-0.1320	-0.0648	0.2118
%<0	0.2206	0.1863	0.0833	0.0588	0.0588	0.0490	0.0098	0.1961
%<Monthly TBILL	0.3088	0.2353	0.0931	0.0588	0.0588	0.0490	0.0098	0.2990
Number of holding Long/Short portfolio	201	173	74	39	27	16	3	204
Hit rate of holding Long/Short portfolio	0.7761	0.7168	0.6486	0.5897	0.4815	0.2500	0.3333	0.8049
Number of holding TBILL	3	31	130	165	177	188	201	Nan
Hit rate of holding TBILL	0.0000	0.5161	0.5000	0.6303	0.7345	0.8351	0.8657	Nan
Hit rate of strategy	0.7647	0.6863	0.5539	0.6225	0.7010	0.7892	0.8578	0.8049
Monthly turnover	0.9853	0.8480	0.3627	0.1912	0.1324	0.0784	0.0147	1.0000
Net average monthly excess return (100bp)	0.3623	0.3229	0.1069	-0.0149	-0.1093	-0.1642	-0.0420	0.1628
Net average monthly excess return (200bp)	0.2802	0.2522	0.0767	-0.0308	-0.1203	-0.1707	-0.0433	0.0795
Breakeven transaction cost	0.2256	0.2321	0.1891	0.0029	-0.3710	-1.0046	-1.3857	0.1231

Panel B Value-weighted

	Active trading strategy							Passive trading strategy
Filter threshold	>0	>0.5	>1.0	>1.5	>2.0	>2.5	>3.0	Nan
Average monthly excess return	0.4846	0.3456	0.1642	0.1579	0.1052	0.0190	0.0000	0.2024
Standard deviation	2.6925	2.5355	1.9772	1.1725	0.8267	0.4793	0.0000	1.4018
Sharpe ratio	0.1800	0.1363	0.0830	0.1347	0.1273	0.0397	-0.0700	0.1434
%<0	0.3284	0.2892	0.1275	0.0196	0.0098	0.0049	0.0000	0.3137
%<Monthly TBILL	0.3922	0.3284	0.1569	0.0196	0.0098	0.0049	0.0000	0.4706
Number of holding Long/Short portfolio	199	164	80	19	10	4	0	204
Hit rate of holding Long/Short portfolio	0.6633	0.5915	0.5375	0.7368	0.7000	0.5000	Nan	0.6863
Number of holding TBILL	5	40	124	185	194	200	204	Nan
Hit rate of holding TBILL	0.2000	0.3750	0.5242	0.6378	0.6856	0.7300	0.8039	Nan
Hit rate of strategy	0.6520	0.5490	0.5294	0.6471	0.6863	0.7255	0.8039	0.6863
Monthly turnover	0.9755	0.8039	0.3922	0.0931	0.0490	0.0196	0.0000	1.0000
Net average monthly excess return (100bp)	0.4032	0.2785	0.1314	0.1501	0.1011	0.0173	0.0000	0.1190
Net average monthly excess return (200bp)	0.3219	0.2115	0.0987	0.1424	0.0970	0.0157	0.0000	0.0356
Breakeven transaction cost	0.2484	0.2149	0.2093	0.8478	1.0735	0.4852	#DIV/0!	0.1012

Note: The table reports the performance of active trading strategy on the combination of momentum and value effect with 12 months' holding length from 1990 to 2008. The active strategy imposes filter threshold on the predicted long/short return from 0 to 3.0% in increments of 0.5%. When predicted monthly long/short returns of two style effects from out-of-sample forecasting model are both lower than one filter threshold, the position is allocated on TBILL. Otherwise, the position is allocated on top/or bottom portfolio of one style effect with predicted highest return spread. The passive strategy always allocates average position on long/short portfolios of two style effects all the time. The row labeled '%<0' and '%<Monthly TBILL' indicate the percentage of trading return less than zero and monthly TBILL in observations. The row labeled 'Hit rate of holding Long/Short portfolio' reports the percentage of trading return satisfied with filter threshold in Long/Short position. The row labeled 'Hit rate of holding TBILL' reports the percentage of actual return unsatisfied with filter threshold in holding TBILL. The row labeled 'Hit rate of strategy' reports the percentage of successful holding long/short portfolio and TBILL in observations. 'Monthly turnover' is the percentage of holding long/short position in observations. 'Net average monthly excess return (100bp, 200bp)' is trading return after reducing 100 or 200 basis point transaction cost every turnover. 'Breakeven trading cost' is defined as the fixed trading cost that makes monthly excess return of one strategy to zero.

Table 7.18 The long/short position performance in active trading strategy on the combination of momentum and value effect with 12 months' holding length (Filter threshold=0)

	Panel A Equal-weighted				Panel B Value-weighted		
	Overall	Winner/Loser	Low/High		Overall	Winner/Loser	Low/High
Number of Long/Short position	201	139	62	Number of Long/Short position	199	97	102
% Long/Short position	1.0000	0.6915	0.3085	% Long/Short position	1.0000	0.4874	0.5126
Average monthly return R_{lms}	0.9320	0.9050	0.9926	Average monthly return R_{lms}	0.9834	1.1414	0.8332
Standard deviation of R_{lms}	2.1883	2.3376	1.8256	Standard deviation of R_{lms}	2.7279	3.3077	2.0354
Sharp ratio	0.4259	0.3871	0.5437	Sharp ratio	0.3605	0.3451	0.4093
Number of R_{lms}<0	45	35	10	Number of R_{lms}<0	68	28	39
% R_{lms} <0	0.2239	0.2518	0.1613	% R_{lms} <0	0.3417	0.2887	0.3824

Note: The table reports the long/short position performance in active trading strategy on the combination of momentum and value effect with 12 months' holding length from 1990 to 2008 when filter threshold is set to 0. The active strategy imposes filter threshold on the predicted long/short return. When predicted monthly long/short returns of two style effects from out-of-sample forecasting model are both lower than filter threshold, the position is allocated on TBILL. Otherwise, the position is allocated on top/or bottom portfolio of one style effect with predicted highest return spread. The row labeled '% Long/Short position' indicates the percentage of long/short position on one style effect with predicted highest return spread from out-of-sample forecasting model. The row labeled '% R_{lms} <0' indicates the percentage of trading return less than 0

Chapter 8 Conclusions to the Research

The thesis investigates the time-variation in style effects in the UK Stock Market. It focuses on four research questions which are empirically analyzed in four chapters. In Chapter 4, the thesis uses two indicators, style coefficient γ and long/short return R_{lms}, to examine time-varying momentum effect, size effect, and value effect with 3, 6, 12, 18, and 24 months' holding horizon. It further examines the correlation among style effects. In Chapter 5, the thesis discusses whether the time-variation in style effects can be captured by lagged macroeconomic variables, which are associated with macroeconomic conditions and market states. In Chapter 6, with three statistics PIS, POOS, and PSS, the thesis tests the performance of recursive in-sample regression and out-of-sample forecasting model, and examines whether dynamic style effects can be indeed predicted by lagged macroeconomic variables. In Chapter 7, the thesis explores active trading strategy on individual style effect and combined two/or three style effects to time style rotation. As the ending part of the thesis, this chapter presents overall conclusions in section 8.1, contributions and implications of the research in section 8.2, and limitations and future research in the section 8.3.

8.1 Summary of findings

The overall conclusions of the thesis are described in the form of individual style effect and combined style effects. It proceeds with the empirical findings on time-varying pattern of style effect, the impact of macroeconomic variables on the variation, the test of recursive in-sample regression model and out-of-sample forecasting model, and active trading strategy on style effects.

- Momentum effect

Firstly, when decile momentum portfolios are formed by previous 6/12 months' share returns and hold for 6 and 12 months, momentum effect is strong from 1956 to 2008. As holding horizon grows more than 12 months, momentum effect becomes weaker and unsignificant. Two indicators, Winner/Loser return R_{wml} and momentum coefficient γ_{mom}, are volatile over time, and show the strongest momentum effect in the 1990s and the weakest in the 1970s. This volatility leads to positive (negative) Winner/Loser return R_{wml} in 53 to 70 (30 to 47) percent of all observations.

Secondly, lagged macroeconomic variables explain 15 to 25 percent of the time-variation in momentum effect (12/6, 12/12) with 12 months' formation length and 6/12 months' holding length from 1980 to 2008. The decline in annual change of GDP (GDP(Y)) and the increase in unexpected annual change of TBILL (UEXTBILL(Y)) implies stronger momentum effect (12/6, 12/12).

Thirdly, two statistics 'POOS' and 'PSS' in the test of recursive out-of-sample forecasting model for momentum effect (12/6, 12/12) keep the similar performance as the statistics 'PIS' in the test of recursive in-sample regression of momentum effect on lagged macroeconomic variables from 1990 to 2008. Series 'PSS' indicates that the recursive out-of forecasting model offers same sign (positive and negative) between predicted and actual momentum coefficient γ_{mom} (Winner/Loser return R_{wml})

in 60 to 82 (60 to 76) percent of all observations. High ‘PSS’ implies promising capability of the forecast model to time momentum effect.

Fourthly, with the signal of recursive out-of-sample forecasting model and filter threshold, active trading strategy on momentum effect (12/6) outperforms passive trading strategy which always holds Winner/Loser portfolio all the time. Active trading strategy on any equal-weighted momentum effect (12/6), which holds long/short portfolio with predicted highest/lowest return, enhances average monthly excess return on passive Winner/Loser portfolio from 0.7899% to 1.2004% during 1990 to 2008. Active trading strategy on value-weighted Winner/Loser portfolio (12/6) enhances average monthly excess return on passive Winner/Loser portfolio from 0.8322% to 1.1901%.

- Size effect

Firstly, there is no significant size effect in the UK Stock Market from 1979 to 2008 due to size rotation over three subperiods, which exhibits (marginally) significant small-cap effect in the 1980s, marginally significant large-cap effect in the 1990s, and unsignificant small-cap effect afterwards. This rotation between small-cap effect and large-cap effect leads to positive (negative) Small/Large return R_{sml} in 44 to 62 (38 to 56) percent of all observations.

Secondly, the explanatory power of lagged macroeconomic variables for the time-variation in size effect with five holding horizons exhibits ‘Λ’ pattern from 1980 to 2008. When decile size portfolios are hold for 12 months, denoted as size effect (12), macroeconomic variables captures 14.93 to 17.64 percent of the variation in size effect from 1980 to 2008. The increase in GDP(Y) and the decline in UEXTBILL(Y) imply stronger small-cap effect.

Thirdly, two statistics 'POOS' and 'PSS' to test recursive out-of-sample forecasting model for size effect (12) have the similar performance of the statistics 'PIS' to test recursive in-sample regression of size effect on lagged macroeconomic variables. As 'PSS' shows, predicted and actual size coefficient γ_{mv} (Small/Large return R_{sml}) have same sign in 51 to 61 percent of all observations, which is below the corresponding 'PSS' for momentum effect (12/6, 12/12).

Fourthly, active trading strategy on 'Small' and 'Large' portfolios with 12 months' horizon before reducing trading cost performs better than passive trading strategy which always holds 'Small/Large' position all the time. When filter threshold is set to 0.5% to 1.5%, active trading strategy improves passive strategy from negative average monthly excess return to positive one. However, after considering trading costs, active trading strategy on Small/Large portfolio becomes unprofitable.

- Value effect

Firstly, value effect is significant from 1980 to 2008, and stronger as the holding horizon extends from 5 month to 24 months. The outperformance of shares with low price-to-book ratio over shares with high price-to-book ratio is persistent in the 1980s, the 1990s, and 2000 afterwards. Persistent value premium leads to positive (negative) Low/High return R_{lmh} in 60 to 82 (18 to 40) percent of all observations.

Secondly, as holding horizon extends from 5 months to 24 months, the percentage of the time-variation in value effects driven by lagged macroeconomic variables increases to higher level, ranging 28.44 and 40.87, except for value-weighted Low/High return R_{lmh}. The decline in annual change of CPI (CPI(Y)) and higher lagged 8-year's market return imply strong value effect (24) with 24 months' holding horizon from 1980 to 2008.

Thirdly, the performance of two statistics 'POOS' and 'PSS' in the test of recursive out-of-sample forecasting model for value effect (24) is quite different from the performance of the statistics 'PIS' in the test of recursive in-sample regression of value effect on lagged macroeconomic variables. Out-of-sample forecasting model for value effect (24) performs poorly relative to the historical mean model even though its in-sample regression model does better. As 'PSS' indicates, the recursive out-of forecasting model offers same sign (positive and negative) between predicted and actual value coefficient γ_{pb} and Low/High return R_{lmh} in 45 to 59 percent of all observations, which are lower than corresponding 'PSS' for momentum effect (12/6, 12/12) and size effect (12).

Fourthly, different from momentum effect and size effect, long-term persistent performance of return spread between 'Low' and 'High' portfolios and poor performance of out-of-sample forecasting model lead to the failure of active trading strategy on value effect (24) to outperform its passive trading strategy which always allocates long/short position on Low/High portfolio all the time.

- Combined style effects

The empirical work finds negative correlation between momentum effect and size effect, between momentum effect and value effect, and positive correlation between size effect and value effect from 1980 to 2008. It is found that momentum effect (12/6, 12/12) and size effect (12) are significantly sensitive to GDP(Y) and UEXTBILL(Y). The coefficient signs of GDP(Y) and UEXTBILL(Y) in the multivariate regression of momentum effect (12/6, 12/12) are opposite to ones in the regression of size effect (12). This means that momentum effect and size effect are significant in the opposite macroeconomic conditions. Similarly, momentum effect (12/6, 12/12) and value effect (12) are significant in the opposite TBILL condition, and size effect (12) and value effect (12) are significant in the same TBILL condition. The sensitivity of style effects to same economic forces offers reasonable explanation for the correlation among three style effects.

The correlation among style effects implies the possibility of active trading strategy on combined style effects to perform better than passive strategy which allocates average long/short position on style effects all the time. The research finds that active trading strategy with predicted highest return spread within momentum effect (12/12), size effect (12), and value effect (12) yields higher return than passive strategy from 1990 to 2008. Active strategy with predicted highest return spread within momentum effect (12/12) and value effect (12) performs better because the position on Small/Large portfolio with lower return spread is replaced by the position on Winner/Loser portfolio and Low/High portfolio with higher return spread.

8.2 Contributions and implications of the research

Based on the empirical findings in the previous chapters, the thesis deepens understanding on not only time-varying style effects but also forecasting factors for their dynamic patterns. It makes contributions to studies on style effects, and offers implications for researchers in the academic field and practitioners in the market.

8.2.1 Contributions of the research

Firstly, different from most previous studies on individual style effect, or two style effects with one certain holding horizon, such as 6 or 12 months, the thesis examines three style effects in one empirical work, and finds negative correlation between momentum effect and size effect, between momentum effect and vale effect, and positive correlation between size effect and vale effect. In addition, the thesis investigates style effects with 3, 6, 12, 18, and 24 months' holding horizons, and sheds light on the pattern of style effects with short-/medium-/long-term horizon, and the variation in significant explanatory factors for style effects through holding horizons.

Secondly, besides traditional indicator long/short return R_{lms} based on top/bottom decile portfolios in much literature, the thesis uses style coefficient γ to examine time-varying style effects. Estimated by cross-sectional regression of decile portfolios' returns in the holding period on their average values of firm characteristics in the formation period, style coefficient γ contains the information of all shares in decile portfolios. So, it could capture the relation between share return and firm characteristics more than long/short return R_{lms}. This pattern is salient in examining value effect, in which other decile value portfolios, following 'Low' portfolio and 'High' portfolio, are likely to yield highest/lowest return. Meanwhile, the test on the impact of lagged macroeconomic variables on the time-variation in style coefficient γ helps us to diagnose the efficiency of active trading strategy which allocates long position and short position on any decile portfolio.

Thirdly, all previous studies only investigate the time-variation in style effects and explain their dynamic property in the context of macroeconomic conditions and market states in the overall sample period. The thesis extends these empirical analysis in the overall period to ones in subperiods, which shows the stability/or volatility of significant macroeconomic variables to explain the time-variation in style effects. For example, UEXTBILL(Y) and EMR(-1), GDP(Y), respectively, combining with DY(Q), significantly explain the variation in equal-weighted momentum effect (12/6) in the 1980s and the 1990s.

Fourthly, although some previous studies find significant explanatory power of macroeconomic factors for the time-variation in style effects, they do not undertake out-of-sample test to observe the reliability/or pitfall of in-sample predictability on style effects. The thesis uses statistics PIS, POOS, and PSS to test the performance of recursive in-sample regression and out-of-sample forecasting model on style effects relative to historical mean model, and investigates whether macroeconomic factors and market factors indeed offer predictive power for the time-variation in style effects.

8.2.2 Implications of the research

Empirical findings offer implications for researchers in academic field. The thesis finds the variation in significant macroeconomic variables to explain style effects through holding horizons and over time. This implies that to use one macroeconomic variable in time-series forecasting regression might lead to biased and inconsistent estimators in different holding horizons and different sample periods. Researchers, who undertake studies on series return predictability, should examine empirical work over different holding horizons and subperiods. In addition, the thesis finds that out-of-sample forecasting model on value effect (24) underperforms the sample mean model although its in-sample regression model performs well. This means that researchers should conduct out-of-sample model test to examine the reliability/or pitfall of in-sample predictability.

Empirical findings have implications for style-oriented investors in the market. The thesis finds the existence of biased and inconsistent significant macroeconomic variables for the time-variation in style effects with short-/medium-/long-horizons and over subperiods. This implies that style-oriented investors should be cautious to use forecasting variables to capture style rotation according to their holding horizons and macroeconomic conditions. In addition, the thesis develops active trading strategies on long/short portfolio for individual style effect and combined style effects. Active trading strategies, which combines top-down perspective using economic and market series with bottom-up view using specific share information, benefit style-oriented investors to time the switch among style effects, and enhance the performance of traditional absolute return alternative strategies with long/short position all the time. Active trading strategy on either any equal-weighted decile momentum portfolio (12/6) or value-weighted Winner/Loser portfolio (12/6) might be one good choice for style-oriented investors in the UK Stock Market.

8.3 Limitations and future research

As far as the author is aware, the investigation on time-varying style effects is at the beginning stage in academic field although some studies have focused on the dynamic pattern since the 2000. As overall research, the thesis is subject to some limitations in the empirical work on the time-variation in style effects in the UK Stock Market. It is these limitations, as well as empirical findings in the thesis, that drives me to conduct further relevant research in the future.

8.3.1 Limitations of the research

In Chapter 3, the research constructs decile size portfolios and finds that 'Small' portfolio includes average 41.3 percent of all shares but accounts for only 1 percent of overall market value from 1980 to 2008. Returns of these small-cap shares might not reflect actual trading prices in the market due to the existence of their wider bid-ask spread and low trading volume. Size decile portfolio formation with the inclusion of these small-cap shares might lead to biased result on size effect.

In Chapter 4, the research establishes size portfolios and value portfolios at the beginning of 1979 and 1980, respectively, due to relevant data available from LSPD and Datastream, and estimates their style coefficient γ and long/short return R_{lms}. In Chapter 5, the research examines the impact of lagged macroeconomic variables on the time-variation in style effects from 1980 to 2008. In Chapter 6, after excluding first 10-year's initial in-sample period, the test on recursive in-sample regression model and out-of-sample forecasting model is conducted at the beginning of 1990 until 2008. The empirical result might be biased due to shorter sample period from 1980 to 2008, in which there is less style rotation and cyclical pattern in macroeconomic conditions and market states. This might lead to the similar limitation in the exploration of active trading strategy on style effects from 1990 to 2008 in Chapter 7.

In Chapter 5, the research finds the variation in significant macroeconomic variables for time-varying style effects over three subperiods. This means that significant/unsignificant macroeconomic variables screened in univariate regression with overall sample period from 1980 to 2008 might be biased and inconsistent through time. It is possible that one unsignificant variable in overall period might be significant in the initial 10-year's period but unsignficant in later periods, and that it might be unsigificant in the initial 10-year's period but significant afterwards. This might lead to the inclusion of biased significant variables and the exclusion of significant variables in the recursive regression model because investors in the market do not know unbiased forecasting factors at the end of the initial period.

In Chapter 5, the research finds some macroeconomic variables, such as M0(Y) and CPI(Y), have opposite explanatory power for style effects in different subperiods although they are significant in the period from 1980 to 2008. Therefore, the research with volatile forecasting factors might have biased and inconsistent result as the sample period expends.

8.3.2 Future research

Based on limitations discussed in previous subsection and empirical findings in the research, there are several intriguing directions and possible avenues in which this study could be extended in future as followings:

Firstly, the empirical work in Chapter 5 shows significant impact of lagged long-term market return on the time-variation in value effect. It is worthwhile to explore the correlation between style effects and their lagged performance in measure of long/short return R_{lms}. This offers another dimension to document the time-variation in style effects, and exhibit the pattern of their persistence and reversal.

Secondly, the empirical analysis in Chapter 5 finds different macroeconomic variables to explain time-varying style effects over time. It implies that recursive forecasting model with macroeconomic variables might offers biased and inconsistent signal on style effects over time. In addition, the research finds that most adjusted R^2 of the regression of style effects on lagged macroeconomic variables in 10-years' subperiods are higher than ones in the overall sample period. This means that the same macroeconomic variables have explanatory power in one subperiod stronger than in the overall period. So, in order to lower the biased effect due to time-variant forecasting macroeconomic variables and increase the forecasting power of macroeconomic variables, it is instructive to examine out-of-sample forecasting model and explore active trading strategy based on the regression with fixed in-sample window (for example 10-year's length) instead for the regression with increasing in-sample window by one month each time, or lagged-weighted regression instead for equal-weighted regression.

Thirdly, the thesis explores active trading strategy on momentum effect (12/6, 12/12), size effect (12), and value effect (24), which has stronger style effect and can be much more explained by macroeconomic variables relative to style effects with other holding horizons. Because style-oriented investors in the market have different investing horizons, it is instructive to investigate active trading strategy on short-/medium-/long-term horizon. Meanwhile, economic conditions and market states are much volatile at some times. This means the variation in significant style effects with different horizons through time. To optimize return performance, it is necessary to explore active trading strategy on style effects within short-/medium-/long-term investing horizons.

Fourthly, it is found in Chapter 4 that equal-(value-) weighted 2^{nd} size portfolio with the second smallest market share yields the lowest or second lowest average monthly return among decile size portfolios, and that equal-(value-) weighted 8^{th} portfolio earns the highest or second highest return. In addition, because small-cap shares (the 1^{st} size portfolio) always have wider bid-ask spread as well as low trading volume, their share returns might not actually reflect trading prices in the market. It is instructive to explore active trading strategy which allocates long and short positions on the 8^{th} size portfolio and the 2^{nd} size portfolio.

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