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Empirical analysis of value and momentum strategies in BRIC stock markets

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Writing this thesis has been challenging due to the acquisition and processing of large amounts of dataset in connection with our analysis, it is however very educational at the same time, we have been able to deepen our knowledge in this interesting topic.

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Abstract

Our Master's thesis examines whether value and momentum strategy has been profitable in each of the BRIC countries, in the ten cross - BRIC country sectors and in BRIC as a whole from January 2002 to June 2019. We find that value strategy outperforms momentum strategy and premiums are higher in the sector level than in the country level. The highest value premium obtained is 2,10%, in oil and gas sector and the highest momentum premium obtained is 1,49%, in consumer services sector using overlapping holding periods. Furthermore, by conducting analysis between momentum premium and business cycles, we find that momentum strategy works better during expansionary periods than during recessionary period. Besides, it is possible to limit the losses by switching from a pure momentum strategy to a combination of value and momentum strategy during periods of momentum crashes. Using different asset pricing models, we find that some of the value, momentum strategies and the combination of value and momentum strategies generate positive and statistically significant alphas. We further conduct Fama-MacBeth two step regressions and find that risk premium related to small minus big factor is positive and risk premium related to liquidity factor is negative.

We have contributed to the literature by examining value and momentum strategies for cross-BRIC country-sectors and by conducting volatility adjusted residual return momentum strategy for BRIC as a whole and for China. We find that in general, residual momentum strategy generates higher excess returns and Sharpe ratios compared with total return momentum strategy. Residual momentum strategy MOM9X3 for BRIC as a whole yields an excess return of 0.81% and residual momentum strategy MOM12X3 for China generates an excess return of 0.49%.

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1 Introduction

Investors and portfolio managers aim to find profitable trading strategies which generate excess returns. The relationship between risk and return is one of the most debated topics in finance. CAPM is the first model that describes the relationship between expected returns and systematic risks of risky assets; riskier securities, meaning assets with a beta higher than one should offer investors higher returns than the market return. However, CAPM is not sufficient to explain the relationship between risk and returns. The Fama and French three factors model is a further development of CAPM; it adds two additional risk factors to the market risk factor in CAPM, which are size and value risk factors. This model has found that stocks of small firms and firms with a low book-to-market ratio tend to outperform large-capitalization stocks and stocks of growth firms. Studies conducted by Fama and French have shown that this model could explain about 95% of the returns in a diversified portfolio. In 1997, Mark Carhart proposed the Carhart 4 factors model, including an additional risk factor, cross-sectional momentum factor. However, the relationship between risk and return is not always proportional and it is possible to generate excess returns without taking excess risk, this violates the efficient market hypothesis (EMH).

The efficient market hypothesis says that stock prices already reflect all available information. Therefore, it is impossible to beat the market, in other words, to obtain consistently higher risk-adjusted returns than the market, because market prices should only react to new information. However, the observations of market anomalies indicate that the efficient market hypothesis does not always hold in practice, and it is possible to profit from these market anomalies and beat the market.

The first anomaly is value investing. This was first written by Benjamin Graham and David Dodd (1934). It involves buying stocks of a firm with prices lower than its intrinsic value (value stocks with high book-to-market ratio) and short selling stocks for which prices are higher than their intrinsic value (growth stocks with low book-to-market ratio). Previous studies have provided evidence that value stocks outperform growth stocks (Lakonishok, Shleifer Vishny 1994, Fama and French 1996, Chan and Lakonishok 2004). The second anomaly is momentum investing, which consists of buying past winners (stocks

with higher past returns) and short selling past losers (stocks with lower past returns). A study has shown that the trading strategy consisting of buying past winners and short selling past losers earns a higher risk-adjusted return in the US market (Jegadeesh and Titman 1993).Asness, Moskowitz and Pedersen (2013) found that the combination of value and momentum strategy outperforms value and momentum strategy alone. Daniel and Moskowitz (2016) further confirmed that it is possible to partially avoid momentum crashes by using the combination of value and momentum strategy. Blitz, Huij and Martens (2013) found that residual momentum generates higher risk-adjusted returns than the total return momentum. Recently, value and momentum investing has become more and more popular. Some mutual funds and hedge funds dedicate to the generation of value and momentum premium.

The primary purpose of this thesis is to investigate whether we could find positive and significant value and momentum premium for BRIC countries, both in the country level and in a cross-country sector level. If we succeed in generating excess returns, this might provide further evidence that efficient market hypothesis does not hold. We follow the paper of Fama and French (1992) to examine the value strategy and the paper of Jegadeesh and Titman (1993) to study the momentum strategy. We construct portfolios sorted on Book-to-Market ratio and previous accumulated monthly average returns in order to investigate the value and momentum strategy separately. Besides, we examine if the combination of value and momentum strategy could beat value or momentum strategy alone by using two different approaches: value and momentum 5x5 double sorted portfolios and the weighted combination of value and momentum portfolios. We further study if the performance of the momentum strategy depends on the business cycles. We then use residual returns instead of total returns to find out if we could get higher momentum premium. And finally, we test whether we could generate positive and statistically significant alphas using different asset pricing models.

This paper is organized in 5 sections. Section 2 is a literature review of the related papers. Section 3 describes the collection of data, data choice and the construction of data sets. Section 4 describes our research methods used in our analysis. Section 5 discuss the main results obtained in our paper. Section 6 presents some limitations and further improvements of our study.

2 Literature Review

2.1 Value

Value investing is credited to Graham and Dodd in 1934. Value investors do not believe that the market is efficient, stated by the Efficient Market Hypothesis (EMH). According to EMH, all the information is already priced in the stock prices, it is therefore impossible to generate risk-adjusted excess returns or alpha consistently. On the contrary, value investors believe that it is possible to beat the market by right market timing or expert stock selection.

The estimation of the intrinsic value is essential for value investors. The purpose of value strategy is to buy undervalued stocks, and short sell overvalued stocks. The following financial ratios are the five most essential ratios in selecting the value portfolio: Price-to-Earnings ratio, Price-to-Book ratio, Debt-to-Equity ratio, Free Cash Flow and Price to Growth ratio. Top-down and bottom-up are the two major investing processes. Top-down investors begin by analyzing macroeconomic level indicators in order to identify a particular sector to invest in and finally to individual companies. Bottom-up investors take the opposite approach, and they begin by analyzing micro-level attributes and then the sector level and country level fundamentals.

Based on the study of Basu, Stattman found the book-to-market ratio related anomaly in 1980. He found that high book to market ratio stocks realizes on average higher risk-adjusted returns than the low book to market ratio stocks. Other studies conducted on the US and Japanese stock markets confirm this finding (Rosenberg, Reid 8 Lanstein 1985, Chan, Hamas Lakonishok 1991). The most important research concerning this anomaly is the paper " The cross-section of expected stock returns" (Fama French 1992). In this paper, Fama and French found that book-to-market ratio, and size is two critical proxies for risk because they provide potent explanations in the cross-section of expected stock returns for the US stocks during the period 1963 and 1990. Their further research suggests that the value premium is to be found internationally (Fama French, 1998).

Some research has tried to explain why the value premium exists. Chan et al. (1996) and Chen and Zhang (1998) tried to explain the value premium with risk; they wrote

that higher returns of the value stocks are a result of higher distress risk of the value companies. Fama and French 1992 suggested that the reason why value stocks outperform growth stocks is that the investors are too optimistic about the growth potential and too pessimistic about the prospects of value firms. This would indicate that mispricing is behind the book-to-market anomaly rather than the higher risk related returns. Another paper has proposed that value stocks offer a higher risk-adjusted return than growth stocks because investors overestimate the growth rate of growth stocks. They argued that value stocks have been underpriced relative to their risk level, and thus we could obtain higher risk-adjusted returns by investing in these stocks (Lakonishok, Shleifer and Vishny 1991). Lakonishok et al. (1994) and Capaul et al., (1993) stated that the irrational behaviour of investors explains the existence of the risk premium, the value stocks are priced lower by the market and the growth stocks are priced higher.

2.2 Momentum

The momentum strategy consists of buying stocks which have a higher return than the historical average returns of the stocks and short selling stocks which have the lowest historical returns. It is expected that the best-performing stocks should continue to outperform the market, and the worst-performing stocks should continue to underperform the market.

Jegadeesh and Titman (1993) have proved the existence of excess returns by following the trading strategy of buying past winners and short selling past losers for the US stocks between 1965 and 1989. Based on their results, investors and fund managers could construct different momentum portfolios, which could potentially yield higher returns than the market index. Moskowitz and Pedersen (2011) found significant time-series momentum when they invested in past winner stocks according to their past performance rather than based on cross-sectional stock returns. Besides, this time series momentum proved to be significant and consistent across assets. Moskowitz et al.(2012) found a significant momentum premium using futures and forward contracts which include currencies, commodities, equity indexes, and sovereign bonds from 1985 to 2009. Asness, Moskowitz, and Pedersen (2013) concluded further that time-series strategy provides better performance than the cross-sectional strategy. Cakici and Tan (2013) found

that momentum is more highly correlated internationally, and momentum returns are less affected by funding liquidity risk compared to value. Grinblatt and Titman (1993) concluded that the majority of mutual fund managers use momentum as their investment strategies. Grundy and Martin (2001) and Blitz, Huij, and Martens (2011) showed that conditional, time-varying factor exposures could explain about 50% of the risk of a conventional momentum strategy. However, these exposures seem to be mostly unrewarded as the fact that momentum strategies can achieve higher returns only if the factors that had positive returns in the past persist, but the past returns cannot guarantee future returns. Griffin, Ji and Martin (2003) concluded that macroeconomic risk and business cycles impact the momentum premium internationally. Grinblatt and Moskowitz (2014) reported energetic seasonal patterns in reversal momentum returns momentum premium is found to be particularly high in January due to the tax-loss selling effect.

What are the explanations behind the momentum strategy? Asness, Frazzini, Israel, and Moskowitz (2014) wrote that both risk and behavioural reasons provide explanations for the existence of the momentum premium. However, behavioural reasons are not as consistent as risk-based reasons. They think that high-momentum stocks have more significant cash-flow risks and face a higher cost of capital. Another study has found out that firm-specific risks contribute to explain the momentum premium. Firms with high revenue growth volatility, low costs, or valuable growth options tend to have better momentum premium than other traditional firms (Sagi and Seasholes 2007). Another explanation is underreaction or overreaction of stocks to new information. Jegadeesh and Titman (1993) wrote that the rise of the momentum premium is due to the underreaction of stock prices to new information. Stock prices do not react immediately to reflect their fundamental values, thus making it possible to exploit undervalued stocks before the prices are adjusted to their actual values. Daniel and Moskowitz (2006) wrote that the momentum premium is correlated with the volatility risk, but the time-varying exposure to volatility risk can not explain the time variational momentum premium. Asness, Moskowitz and Pedersen (2013) concluded that momentum returns could be partly explained as a compensation for exposure to liquidity risk because momentum has a favourable loading to liquidity shocks and liquidity risk has a positive risk premium.

2.3 Value and Momentum in combination

By combining value and momentum strategies, investors get exposures to the two factors; this helps to smooth performance and reduce volatility in the long term, mainly because of the performance of these two strategies depending on the business cycles and the negative correlation between them. More specifically, momentum premium occurs when prices evolve in the same direction, and value premium occurs when prices move in the opposite direction. Low momentum stocks are usually the ones with high book-to-market value because negative returns diminish the value of market equity. High momentum stocks are the ones with low book-to-market values because positive returns increase the value of market equity. Hence, the combination of these two strategies can mitigate the risk caused either by value crashes or momentum crashes. For example, the most significant recent value crash happened in 1999 in the US market just before the burst of the dotcom bubble, value portfolios lost more than 30% of its value, but the combination of value and momentum portfolio made a gain of more than 4%; the worst momentum crash happened in 2009, during the financial crisis, momentum strategy lost more than 30% of its value, and the combination of value and momentum lost only 15%. For the construction of weighted combination portfolios of these two strategies, we could choose an equal-weighted combination or weight the one which delivers higher returns more heavily in order to achieve higher excess returns.

It has been proved in previous studies that value and momentum strategies generate higher risk-adjusted returns (Jegadeesh and Titman 1993). Daniel and Titman (1999) have found that the value premium is more significant for loser stocks, and the momentum premium is bigger for growth stocks. Asness, Moskowitz and Pedersen (2013) have shown that value and momentum strategies are negatively correlated, and value premiums are smaller for large-capitalization stocks. However, momentum premiums are much less related to firm size. Furthermore, the correlation of value and momentum strategies are positive globally, in fact, their study found that the momentum applied internationally does not provide a much higher Sharpe ratio than the average Sharpe ratio across markets. The fact that Sharpe ratio is proper to measure the performance of the combination of value and m momentum strategies has been stated in the study by Asness, Frazzini, Israel and Moskowitz (2015). Asness, Moskowitz and Pedersen (2013) found out that

the 50/50 combination of value and momentum strategy performs better than either value or momentum alone for all the markets in their research. They further found that value and momentum strategy is not only negatively correlated within the same asset class but also among different asset classes. Besides, Asness et al. (2014) concluded that the combination of value and momentum strategy helps investors to avoid significant losses in times of extreme events, such as momentum crashes. They thought this could partially be explained by the fact that value and momentum have inverse correlations with liquidity risk. More specifically, value strategy has a negative correlation with liquidity risk, and momentum strategy has a positive correlation with it, at times of liquidity shocks, investors want to get rid of their momentum positions mostly but less of their value positions. Barroso and Santa-Clara (2015) and Daniel and Moskowitz (2016) found that the risk of momentum is highly time-varying and predictable. It is possible to predict and manage the risk in periods of momentum crashes; risk management improves Sharpe ratios in all the markets they studied. Fisher et al. (2016) used long-only portfolios in US markets. They found that portfolios of simple 50/50 combination and more complicated combinations of value and momentum strategies obtain higher Sharpe ratios than either value and momentum separately. Bird and Casavecchia (2007) have further found out that value premiums can be improved if momentum indicators are used to time stock purchases.

2.4 Residual returns and momentum premium

Gutierrez and Pirinsky (2007), Blitz et al. (2011, 2017) and Chang et al. (2018) found that the volatility of the momentum strategy is significantly reduced when they used the residual stock returns rather than the total returns in constructing the momentum portfolios, this can be explained by the fact that a large part of the risk of the momentum premium is due to the momentum strategy's time-varying exposures to the Fama and French factors. Da et al. (2010) and Hameed et al. (2010) found out that profits earned using residual returns are higher within industries than across industries. Lin (2018), using the Chinese A-share stock markets, found that the momentum strategy using the residual returns is much more profitable than the momentum strategy using total returns. Even after controlling for the risk factors in the Carhart (1997) model, the author found the residual momentum strategy to generate positive and significant alphas, while the

traditional momentum strategy has nearly zero risk-adjusted returns. Besides, the residual momentum strategy lasts for more than two years and generates a higher Sharpe ratio due to its low volatility. Also, Blitz et al. (2017) found out that the conventional momentum strategies' dynamic exposures to the Fama French factors increases the strategy's risk and harm its profitability, on the other hand, residual returns neutralize the dynamic factor exposures present in the momentum strategies using total returns. They found further that residual momentum strategy has lower trading costs than the traditional momentum strategy because the residual reversal strategy ends up with less volatile and small stocks which are expensive to trade in the long-short extreme decile portfolios than the traditional reversal strategy.

3 Data

3.1 Collection of data

3.1.1 Choice of market

In this paper, we examine the value and momentum portfolios of individual stocks for the BRIC countries. BRIC is a grouping acronym referring to the countries of Brazil, Russia, India, and China. In 2012, South Africa was added, and the countries were called BRICS. We have chosen not to include South Africa in our study due to the lack of data for South Africa.

There are several reasons why we have chosen to study the BRIC countries. Most of the earlier studies on the subject have focused on the US market. Developed countries in Europe and other countries in the world have also been thoroughly analyzed. There are not many studies focusing on the BRIC countries due to a lack of data, even though the stock markets in these countries have an increasing importance in the past years. Therefore, it is interesting to investigate if there are more market anomalies to be found in these markets compared with other developed markets.

3.1.2 Collection of data

We have collected most of our data from Datastream, which is the preferred data source for studies outside of the US market. The stocks we have taken are the ones from the major stock exchanges in these countries. The exchanges consist of Sao Paulo (BMF BOVESPA), Russia Trading System (RTS), MECEX and MOSCOW exchange, BSE Ltd, National India, Shanghai Stock Exchange (SSE) and Shenzhen Stock Exchange. These stock exchanges are chosen because they cover most of the important stock constituents in the BRIC countries.

3.1.3 Choice of time period and currency

We have chosen to study the recent period from 2002 to 2019 and for all of the BRIC countries, we restrict the universe in each market using the same criteria consistently. On

average, over the sample period (Including delisted stocks) for Brazil, Russia, India and China, the number of stocks are distributed as follows: 10,6%, 9,7%, 28,4% and 51,3% of the total number of stocks. Hence, our sample of Chinese equities is significantly larger than the other countries. For example, for the Chinese stock market, at the beginning of the sample period (July 2002),in our universe consists of 623 firms, and by the end of our sample period (June 2019), the universe comprises 3198 Chinese stocks.

Foreign investments in stocks and bonds will typically produce returns in local currency. Investors must then convert this local currency back to their domestic currency. For instance, investors who purchase an Indian stock in India will have to buy and sell securities using Indian Rupees. This also applies to the other BRIC countries in our sample. Therefore, currency fluctuations can impact the total return of the investment. In this paper, we have ignored risks related to transaction- and currency conversion. We wanted to look from a US Investor's perspective. Thus, all prices, market values, and common equity are denominated in dollar. However, when we calculate the Amihud illiquidity measure, due to a lack of data in US dollar, daily prices and daily trading volumes are taken in local currency.

3.2 Construction of data set

3.2.1 Filtering data and error handling

To carry out a credible analysis, our data must be reliable. Therefore, one of the first issues we addressed was to make sure that our data gathering methodology is correct. Thus, we cannot just take raw data from Thomsons Reuters datastream without taking some precautions.

By default, Datastream classifies equities in 44 sub-sectors. We excluded Close-End Funds, Exchange-Traded Fund (ETF), an exchange-traded note (ETN), preference share and warrants. Thus, the primary equity instrument is the only instrument we use in this study. Further, we included both dead and alive companies in our sample to avoid survivorship bias. We included both large and small stocks, meaning our sample consists of both liquid and illiquid stocks. We do not make any further restrictions to our dataset. We collected monthly adjusted prices, market value and common equity (book value) for all active and

dead stocks. We included dead stocks to avoid survivorship bias.

When downloading data from Thomson Reuters Datastream, "Errors" occur for companies with missing data for one of our three variables: Price, Market Value and Common Equity, in the chosen period. We have removed all companies with "Errors". The problem is most severe for India. In India, a total of 3736 (70,62%) of the companies were excluded due to errors. For Brazil and Russia, we removed 591 (54,1%) and 648 (52,5%) companies due to errors. This problem did not apply to China since the total errors were only 9,9% of the total sample.

After the data handling, the total sample has decreased from 11.209- to 5.852 companies, meaning 5357 (47,8%) companies of our original sample were excluded. The lack of available data could potentially lead to a bias in our results.

3.2.2 Defining industries

Thomsons Reuters Datastream does not classify the major industries on an aggregate level. Therefore, we used the Thomson Reuters Business Classification (TRBC) to link the sub-industries to the ten major industries. A similar methodology for classification was used by Bessler (2019), where the author used the ten major industries in the WORLD-DS dataset created by Thomson Reuters in Datastream. We used the WORLD-DS datasets to validate that we had classified the sub-sector correctly according to the TRBC.

The ten major industries which are a part of the WORLD-DS industry indices: Oil Gas, Basic Materials, Technology, Utilities, Telecom, Industrials, Utilities, Consumer Goods, Consumer Service, Financials and Health Care.

Downloading and creating the dataset correctly is essential when comparing the value and momentum strategies between countries and sectors. To avoid any selection bias, we use the same companies in both sectors and country indices. In the first step, we download all the ten major industry indices for each country, leaving us with a total of 40 indices. Secondly, we aggregate all the country-specific stocks separately into four country indices. For the sector indices, we aggregate stocks in the same sectors for different countries. Thus, we end up with ten cross-country sector indices. All aggregated portfolios are equal-weighted. Consequently, we ensure that we have the same number of constitutes in the country and sector levels.

Table 3.1: Industry classification

Table 3.1 summarizes which sub-industries the ten major industry indices are comprised of.

Oil and Gas	Basic Materials	Technology	Utilities	Telecom
- Alternative Energy	- Chemicals	- Software and Computer Services	- Electricity	- Fixed Line Telecommunication
- Oil and Gas Producers	- Forestry and Papers	- Technology Hardware and Equipment	- Gas, Water and Multi-utilities	
- Oil Equipment and Services	- Industrial Metals and Mining			
Industrials	**Consumer Goods**	**Consumer Services**	**Financials**	**Healthcare**
- Aerospace and Defense	- Automobiles and Parts	- Food and Drug Retailers	- Banks	- Healthcare Equipment and Services
- Construction and Materials	- Beverages	- General Retailers	- Financial Services (Sectors)	- Pharmaceuticals and Biotechnology
- Electronic and Electrical Equipment	- Food Producers	- Travel and Leisure	- Life Insurance	
- General Industries	- Leisure Goods	- Media	- Non-life Insurances	
- Industrial Engineering	- Personal Goods		- Real Estate Investment and Services	
- Industrial Transportation	- Household Goods and Home Construction			
- Support Services				

Table 3.2: Data overview

Table 3.2 gives an overview of the initial number of stocks downloaded from Datastream and the number of stocks left after the data handling process.

Country	Stock exchange	Companies	Excluding errors	Error rate	Of total
Brazil	Sao Paulo (BM&F BOVESPA)	1091	501	54.08 %	8.56 %
Russia	Russian Trading System MICEX - RTS, Moscow (MOSCOW)	1234	586	52.51 %	10.01 %
India	BSE ltd and National India	5334	1567	70,62%	26.78 %
China	Shanghai Stock Exchange (SSE) Shenzhen Stock Exchange	3550	3198	9,92%	54.65 %
Total	8 Indicies	11209	5852	47.79 %	100%

4 Methodology

In this section, we describe the methods that we have used in our thesis. R is used to conduct our analysis. We studied one value strategy following the paper of Fama and French (1992), and we constructed 16 momentum strategies, following the paper of Jegadeesh and Titman (1993), based on different overlapping and non-overlapping holding and formation periods, for each country in the BRIC and the ten cross-sectional sectors within the BRIC countries. We further divide the whole period into three sub-periods to find out the impact of business cycles on the momentum premium.

Furthermore, we analyze the combination of value and momentum strategies for BRIC in two methods. Firstly, we construct a 5x5 cross-sectional strategy by double sorting the portfolios based on the Book-to-Market ratio and the cumulative past returns. Through this, we want to find out if we could gain extra excess returns by investing in past winner stocks and value stocks simultaneously. Secondly, we try different weight combinations of the value and momentum strategy, 50/50, 25/75, 75/25, the weighted combination that maximizes the Sharpe ratio and the one that minimizes the variance in order to figure out if the weighted combination of the value and momentum strategies outperforms the value and momentum strategy alone and if we could avoid huge losses due to value or momentum crashes. We continue our momentum strategy analysis by using residual returns instead of total returns in classifying the portfolios in order to check if these could lead to better performance. Next, we conduct the Fama French 3 factors, Carhart 4 factors and Carhart 4 factors plus the illiquidity factor to find out if we could generate positive and significant alphas. Finally, we conduct the Fama Macbeth two-step regressions in order to find out risk premiums related to factors that eventually explain the momentum premium.

4.1 Summary Statistics

The summary statistics of the country and sector indices are reported in Table 4.1 and Table 4.2. Table 4.1 panel A below shows that the mean of the returns ranges from 0,35% to 0,97% with the lowest mean returns for China and the highest mean returns for India and Russia. We observe that all the values of the Jarque-Bera are very high, indicating

that the distribution of the returns is not normal. The highest value of the Jarque-Bera test is for Russia. Besides, Russia has the highest value of kurtosis and standard deviation as well, meaning the distribution of the returns has fat tails and returns are much more volatile in Russia compared with other countries. Also, we observe that the correlation between the BRIC countries is relatively low, the highest correlation between Russia and Brazil is 59%, the lowest correlation is 42% between Russia and India. The low correlation indicates that we eventually could achieve better performance by combining the value and momentum strategies and investing in cross-country sectors of these countries. We expect to get a higher correlation between China and Russia than between China and Brazil due to the proximity geographic, however, this is not the case, the correlation between China and Russia is 42%, which is lower than the 56% correlation between China and Brazil.

For the sector indices, we observe that the sector with the highest monthly average return is Industrials which is 0,99% and the lowest is Telecom, which is -0.14%. We could see that the highest return in the sector indices is higher than the highest in the country indices and the lowest return in the sector indices is lower than the lowest return in the country indices as well. Furthermore, the standard deviation for the sector indices is higher than that for the country indices, meaning that the sector indices are more volatile. The most volatile sector is the technology sector with a standard deviation of 11.21%, this is much higher than the most volatile country, Russia, with 9.58% of standard deviation. The lowest standard deviation is consumer services, with 6.80%, which is slightly higher than the country with the lowest deviation, Brazil with 6.57%. We observe further that the value of the Jarque-Bera test is also the highest for the most volatile sector, so the technology sector with a value of 178.13, which is even higher than that of Russia, which is 131.02, meaning that the distribution of stock returns might not be a normal distribution. We tackle this problem by using log returns instead of normal returns. Also, we observe that the correlations between the sectors are higher than the correlations between the countries. Utility sector and telecom sector have the highest correlation of 83%, this is much higher than the highest correlation between country indices, which is Russia and Brazil with a correlation of 59%. The lowest correlation is between consumer services and technology, which is only 41%, this is almost the same as the lowest correlation between country indices, which is Russia and India with 42%.

Table 4.1: Summary statistics

Panel A is the summary statistics, and Jarque-Bera test of the four formed country indices and BRIC indices for the period from July 2002 until June 2019. Each index contains 246 monthly value-weighted observations. Panel B shows the correlation matrix between these country indices for the same period.

	Brazil	Russia	India	China	BRIC
Mean (%)	0.86	0.97	0.97	0.35	0.57
Median (%)	1.04	1.24	1.01	1.13	1.06
Max (%)	15.90	46.29	27.07	33.30	25.15
Min (%)	-26.74	-38.50	-24.87	-29.99	-32.08
Std. Dev. (%)	6.57	9.58	7.35	8.07	7.54
Skewness	-0.33	-0.23	-0.29	-0.30	-0.42
Kurtosis	3.68	6.54	4.25	4.85	4.77
Jarque-Bera	9.34	131.02	19.55	38.80	39.32
(p-value)	0.0096	0.0000	0.0001	0.0000	0.0000
Periods N=	246	246	246	246	246

Panel B: Correlation matrix

	Brazil	Russia	India	China	BRIC
Brazil	1.00				
Russia	0.59	1.00			
India	0.56	0.42	1.00		
China	0.56	0.45	0.45	1.00	
BRIC	0.84	0.70	0.75	0.75	1.00

Table 4.2: Panel A: Summary statistics

Panel A is the summary statistics and Jarque-Bera tests of the 10 formed sector indices for the period from July 2002 until June 2019. Each index contains 246 monthly value-weighted observations. Panel B shows the correlation matrix between these sector indices for the same period.

	Basic Mats	Consumer Gds	Consumer Svs	Financials	Industrials	Healthcare	Oil and Gas	Technology	Telecom	Utilities
Mean (%)	0.71	0.90	0.76	0.91	0.99	0.80	0.73	0.88	-0.14	0.30
Median (%)	1.14	1.32	1.00	1.38	1.44	1.17	0.68	0.76	0.22	0.81
Max (%)	36.78	23.97	17.05	24.09	33.31	19.07	27.68	56.44	28.31	22.98
Min (%)	-42.99	-30.81	-26.69	-30.25	-32.02	-28.28	-40.18	-43.15	-26.62	-26.59
Std. Dev. (%)	8.97	7.15	6.80	8.17	9.10	7.28	9.23	11.19	8.19	8.04
Skewness	-0.57	-0.52	-0.48	-0.36	-0.42	-0.46	-0.43	0.12	-0.33	-0.39
Kurtosis	6.41	5.06	3.90	4.01	4.29	4.35	4.14	7.16	4.11	3.17
Jarque-Bera	132.61	54.63	17.71	15.60	24.42	27.10	20.77	178.13	17.23	11.38
(p-value)	0.0001	0.0001	0.0002	0.0004	0.0001	0.001	0.0005	0.0001	0.0001	0.0035
Periods N=	246	246	246	246	246	246	246	246	246	246

Panel B: Correlation matrix

	Basic Mats	Consumer Gds	Consumer Svs	Financials	Industrials	Healthcare	Oil and Gas	Telecom	Telecom	Utilities
Basic Mats	1.00									
Consumer Goods	0.67	1.00								
Consumer Services	0.57	0.76	1.00							
Financials	0.78	0.74	0.65	1.00						
Industrials	0.79	0.75	0.70	0.80	1.00					
Health Care	0.58	0.61	0.64	0.54	0.69	1.00				
Oil and Gas	0.78	0.59	0.47	0.74	0.63	0.47	1.00			
Technology	0.47	0.43	0.41	0.49	0.53	0.50	0.44	1.00		
Telecom	0.67	0.66	0.58	0.81	0.68	0.42	0.71	0.52	1.00	
Utilities	0.74	0.70	0.65	0.85	0.75	0.49	0.75	0.42	0.83	1.00

4.2 Value

Investors buy stocks with high past book-to-market value and short sell stocks with low book-to-market value. Typically, value strategies do not work very well in bull markets but are more profitable in bear markets. We follow the papers of Fama French (1992, 2012) in constructing our value portfolios.

Stocks are assigned into ten deciles at the end of June year t according to their book-to-market ratio measured in December year t-1. We use the accounting data in December t-1. According to Fama and French (1992), the minimum gap of half-year for the market value and book value between the fiscal year-end and the return tests makes sure that accounting data is available when we calculate the book-to-market ratio. Returns are calculated for the ten decile portfolios from July year t to June t+1. We obtain ten portfolios in total; the first one is the portfolio constructed based on the lowest decile of the past book-to-market ratio, called LBM (low book to market); the last one is constructed based on the highest decile, called HBM (high book to market). We also construct a zero-cost portfolio, this is constructed by going equally long in the portfolio of high B/M and going short in the portfolio of low B/M, this is called HML (high minus low) portfolio. All of these portfolios are from July 2002 until June 2019, and we have 18 years of portfolio formation and 216 monthly returns. We do these calculations separately for each country, for all the BRIC countries as a whole and the ten cross country sectors.

Measure of returns: firstly, after classifying all the stocks into ten decile monthly portfolios, we calculate these 216 average equal-weighted monthly returns of all the stocks within these 10 portfolios; secondly, we calculate the average returns of these 216 monthly returns for each portfolio through the entire period. The returns for the portfolio of High minus Low is obtained by taking the difference between the HBM and LBM portfolios.

4.3 Momentum

Momentum investors buy past winners and short sell past losers, thus get the zero-cost winners minus losers portfolio. We follow the paper of Jegadeesh and Titman (1993) in constructing the momentum portfolios. Just like the value strategy, we divide the stocks into decile portfolios based on the past cumulative returns. We obtain ten portfolios;

decile one is formed by stocks with the lowest past cumulative returns, called the losers; stocks form decile ten with the highest past cumulative returns, called the winners. We construct further the zero-cost portfolio by taking an equally long position in the winner portfolio, and a short position in the loser portfolio called winners minus losers (WML). We use different formation periods and holding periods, which are 3, 6, 9 and 12 months, respectively. In this way, we construct 4x4, so 16 momentum portfolios in total for each BRIC country, BRIC as a whole and the ten different cross-country sectors.

Furthermore, the gap between our formation period and holding period is one month, we do this in order to avoid the problem of one-month reversal, price pressure and lagged reaction effects (Jegadeesh and Titman 1993). Besides, there exist two types of holding periods, overlapping holding period and non-overlapping holding period. According to Jegadeesh and Titman (1993), overlapping holding periods could improve the power of the tests. Despite this, we use both methods to compare the results. For the overlapping holding periods, if F represents the formation period, H represents the holding period, and M represents the month, for any month M, the momentum strategy holds portfolios that are formed in the current month and the previous M-1 months. For example, this means that for the portfolio (MOM 6X3) with the formation period of six months and holding period of three months, the portfolio is formed at the beginning of October year t based on the cumulative returns of the stocks during the period from march to august of year t, and the formed portfolio is held for three months until December of year t. In October of year t, we buy winner portfolios and short sell the loser portfolios and keep the position for three months. We close our previous position formed in July year t, in month (M-H) basically. In this way, we rebalance 1/H of the stocks each month in our portfolios and hold the rest of the stocks formed in previous months. For the non-overlapping holding period, the difference compared with the overlapping holding period is that each month we rebalance the whole portfolio instead of the only 1/H of the stocks in the portfolio.

We follow the method of Jegadeesh and Titman (1993) and choose to equal weight all the stocks in each portfolio when we calculate the returns. We consider that this is more appropriate compared with value weighting because we do not want to mix the size effect in our results since stocks with significant market capitalization should be valued more heavily with value weighting.

Figure 4.1: Overlapping holding periods

Figure 4.1 is an illustration of the momentum 3X3 strategy with 3 months holding period and 3 months formation period. Other momentum strategies follow the same logic.

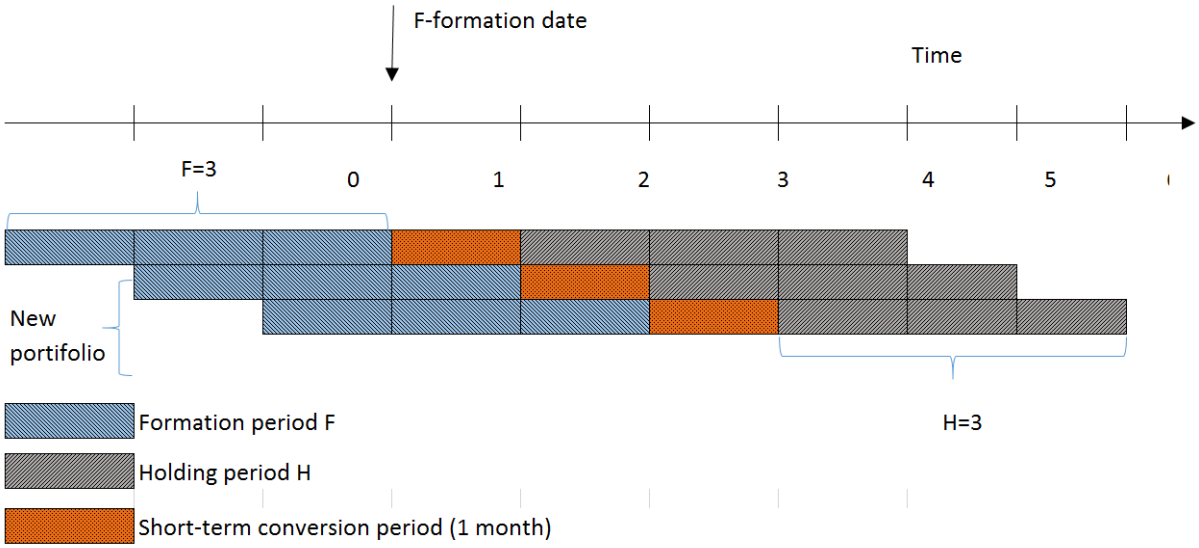
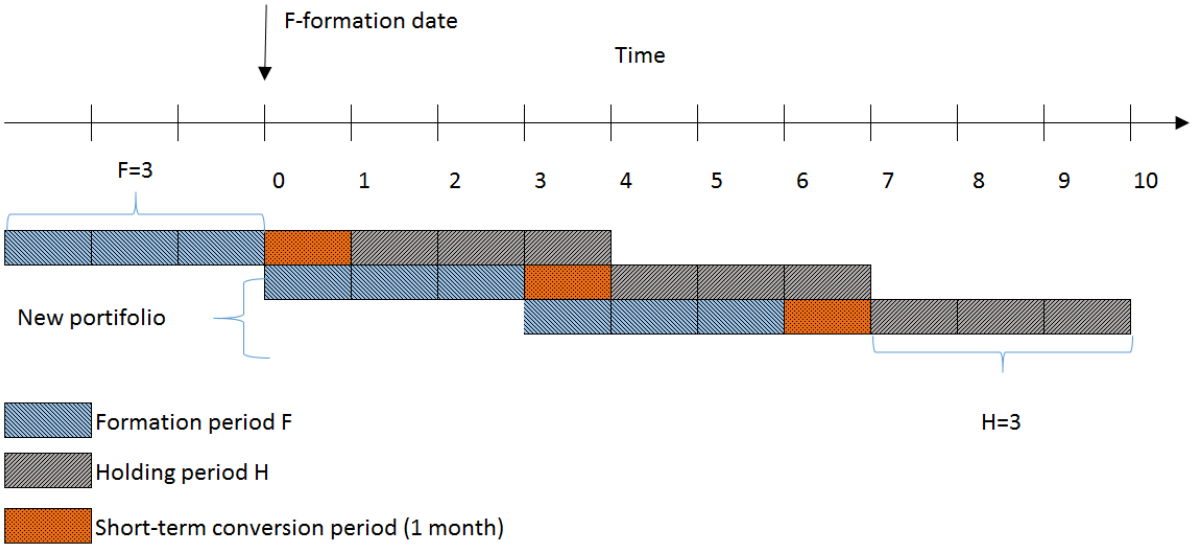


Figure 4.2: Non-overlapping holding periods

Figure 4.2 is an illustration of the momentum 3X3 strategy with 3 months holding period and 3 months formation period. Other momentum strategies follow the same logic.



4.4 Momentum and business cycles

We focus on the relationship between momentum strategy and business cycles due to the fact that momentum strategy has worse performance compared with value strategy, and some previous research found that momentum strategy and business cycles are closely related. Chordia and Shivakumar (2002) found that the momentum premium is affected by the business cycles, and some lagged macroeconomic variables could explain the momentum premium. Typically, momentum crashes happen after a bear market, the recent biggest momentum crash happened in 2009, just during the 2008 financial crisis, this phenomenon was explained by Daniel and Moskowitz (2013) as a result of the high level of market exposure of the short leg of the momentum portfolio. Sheth and Lim (2017) have conducted the analysis using two recession measurements, the recession stages determined by NBER and the predictive power of the term spread (the inversion of the yield curve). They have further divided the business cycles into four stages, recession, the early stage of recovery, late stage of recovery and very late stage of recovery and they found that the factors' performances are impacted by the business cycles. Therefore, we have decided to investigate the relationship between business cycles and the profitability of momentum strategies. We divide the whole periods into expansionary and recessionary sub-periods determined by NBER because we have found that the business cycles of the BRIC countries and those of the developed countries are almost the same. The first sub-period is from July 2002 to April 2007; this is the expansionary period; the second one is from May 2007 to July 2009, this is the recessionary period; the last one is from August 2009 to June 2019, this is the expansionary period.

We conduct the analysis for each country in BRIC, BRIC as a whole and the ten cross-country sectors using both overlapping and non-overlapping periods. Instead of only focusing on the momentum strategy, which is the best for the whole period, we focus on different momentum strategies which are the best performer in each of the four sub-periods. In this way, we could also determine if there is one strategy which dominates in each of the sub-period for all the countries and all the sectors.

4.5 5X5 cross-sectional portfolio

4.5.1 correlations

In this section, we want to study whether the combination of value and momentum strategy could outperform either the value or the momentum strategy alone. We use two methods to conduct our analysis. Firstly, we follow the paper of Fama French (1993) and construct five-by-five cross-sectional double sorted portfolios on value and momentum. Secondly, we follow the paper of Asness, Moskowitz and Pedersen (2013) and construct portfolios of a weighted combination of value and momentum strategies. We follow their methods because we find some correlations between value and momentum strategies to be negative and the rest to be shallow, thus, the combination of these two strategies which have positive returns and negative or very low correlations should generate higher Sharpe ratios.

Table 4.3 below shows the correlations between value and all the 16 momentum strategies for BRIC during the whole period and during the three sub-periods. We observe that in 11 out of 16 of the cases, correlations decrease over time, this is in line with the findings of Asness, Moskowitz and Pedersen (2013). For example, for the correlations between value strategy and the MOM 9X3 strategy, the correlations decrease from 0.18 in the first expansion period to only 0.01 in the second expansion period. The very low correlations mean that we could obtain a higher Sharpe ratio by combining value and momentum strategy.

Table 4.3: Correlations between value and momentum strategy for BRIC

Table 4.3 shows the correlations between value and the 16 momentum strategies for BRIC during the whole period and during the 3 sub-periods. H represents holding period, which is 3,6,9 and 12 months and F represents formation period, which is 3,6,9 and 12 months.

	Period	Correlation	$\rho(val, MOM)$		
	H=	Expansion 1	Recession	Expansion 2	2002-2019
F=3	3	0,16	-0,02	0,01	0,08
	6	0,13	-0,01	-0,02	0,06
	9	-0,05	0,51	0,10	0,15
	12	0,24	0,39	-0,05	0,20
F=6	3	0,19	0,34	0,01	0,20
	6	0,18	-0,01	-0,03	0,08
	9	0,18	0,33	0,00	0,18
	12	0,21	-0,31	0,02	0,05
F=9	3	0,18	0,01	0,01	0,09
	6	-0,07	-0,26	0,13	-0,04
	9	-0,03	-0,04	0,19	0,05
	12	0,05	0,09	0,00	0,05
F=12	3	0,00	-0,07	0,23	0,08
	6	0,08	0,50	-0,06	0,21
	9	-0,02	-0,06	0,18	0,06
	12	0,39	0,11	0,11	0,24

4.5.2 Construction of cross-sectional portfolios

We construct 5x5 cross-sectional double sorted portfolios formed on book-to-market value and past cumulative returns following Fama French (1993). We have decided to focus on BRIC as a whole because the results are more reliable because some of the 5X5 double sorted portfolios for individual countries and sectors have zero or very few observations.

In the first step, we sort stocks based on value and divide them into five deciles (L, 2, 3, 4, H) according to their book-to-market ratio in December of the previous year; in the second step, we sort stocks based on momentum and divide them into five deciles (L', 2, 3, 4, W) according to their past cumulative returns. In this way, we create 5x5, 25 double sorted portfolios on value and momentum. In July of year t, stocks are divided to one of the five decile portfolios based on their book-to-market ratio in December year t-1, stocks within each of the five decile portfolios are again sorted into five decile portfolios based on their past cumulative returns over the period July year t-1 to May year t. In this way, there is one month of conversion period between the formation period and the holding period. For

example, the L/L' portfolio comprises stocks which have the lowest book-to-market ratio and the lowest past cumulative returns. The formed portfolios are held for 12 months, we calculate equal-weighted monthly returns and rebalance the portfolios at the end of the holding period. Only stocks that have available prices in December year t-1, June year t and value of common equity in year t-1 are taken into considerations in the portfolio construction.

4.6 Weighted combination portfolios

In this section, we form portfolios of 3 different weighted combinations of value and momentum strategies (50/50, 75/25, 25/75) for BRIC, India, Consumer Services sector and financial sector, these are the ones which have relatively high and significant momentum premiums. We form further portfolios which maximize Sharpe ratio and which minimize the variance. We have found in the previous section that the performance of momentum strategy is strongly influenced by business cycles, value strategy works better in bear markets, momentum strategy works better in bull markets and momentum crashes could happen in recessionary periods. Therefore, we divide again the whole period into the same sub-periods as in the previous section so that we could better analyze the performance of pure value, pure momentum strategy and the weighted combination of these two strategies in different states of the market. Our goal is to find out if the portfolio of weighted combination of value and momentum strategy generates higher Sharpe ratio than value and momentum strategy alone and if this portfolio could be used as a hedge during periods of momentum crashes. In fact, if we can time momentum crashes before hand and if the weighted combination portfolio of value and momentum strategy outperforms the pure momentum portfolio, we could change from the pure momentum portfolio to the weighted combination portfolio of value and momentum just before the momentum crash to avoid potential losses.

4.7 Value and momentum strategy and asset pricing models

In this section, we want to figure out whether the excess returns generated above the market index by the value and momentum strategies could all be explained by risk factors, in other words, if we could generate positive alpha.

The three-factor pricing models of Fama French 1993 which explains stocks' excess returns, contains three risk factors: market risk factor (market return minus risk-free rate), size factor (small minus big, SMB) and book-to-market factor (high minus low, HML). The following equation 1 presents Fama and French 3 factors model.

$$\mathrm{r}_{i,t} - \mathrm{r}_{f,t} = \alpha_i + \beta_i(\mathrm{r}_{m,t} - \mathrm{r}_{f,t}) + \gamma_i SMB_t + \delta_i HML_t + \epsilon_{i,t} \quad (1)$$

$(\mathrm{r}_{m,t} - \mathrm{r}_{f,t})$ explains part of the excess returns which compensates for the higher systematic risk of the stocks compared to the market portfolio; SMB explains part of the excess returns which compensates for the risk caused by investing in small capitalization firms; HML explains part of the excess returns which compensates for the risk caused by investing in value firms.

The four factors model of Carhart 1997 has an additional risk factor compared with the Fama French 3 factors model, the momentum factor, up minus down (UMD), this factor explains part of the excess returns which compensates for the upside and downside risks caused by investing in the up minus down momentum portfolio. The following equation 2 presents Carhart 4 factors model.

$$\mathrm{r}_{i,t} - \mathrm{r}_{f,t} = \alpha_i + \beta_i(\mathrm{r}_{m,t} - \mathrm{r}_{f,t}) + \gamma_i SMB_t + \delta_i HML_t + \theta_i UMD_t + \epsilon_{i,t} \quad (2)$$

4.7.1 Liquidity risk

Liquidity risk is the risk associated with the fact that we are not always able to sell or buy stocks at any point in time, this could have a massive impact on prices at which a buyer/seller can buy/sell financial assets. Viral V. Acharya, Lasse Heje Pedersen (2004) found that the level of liquidity harms the returns of the financial assets. When an investor invests in an asset with higher liquidity risk, he /she should demand a higher return as compensation for this risk. Liquidity risk is particularly high during the financial crisis

and recession periods since risk-averse investors prefer to invest in financial assets which are less risky and more liquid if they anticipate an economic recession, because this allows them to sell quickly in case of a choc in the financial markets. The impact of liquidity in the pricing of financial assets has been a studied continuously subject (Korajczyk and Sadka (2008), Chordia, Roll and Subrahmanyam (2008), Pastor and Stambaugh (2002)). Pastor and Stambaugh (2002) and Sadka (2006) found out that measures of liquidity risk have a positive correlation with momentum for stocks in the US. Asness, Moskowitz and Pedersen(2013) found that liquidity risk has a negative correlation with value strategy and a positive correlation with the momentum strategy. We consider thus that liquidity risk is a significant risk factor, and we add it in the Carhart 4 factors model to get a 5-factor asset pricing model. In total, we use three asset pricing models to check if we could generate abnormal returns which cannot be explained by the risk factors. The following equation 3 presents Carhart 4 factors plus liquidity factor model.

$$\mathrm{r}_{i,t} - \mathrm{r}_{f,t} = \alpha_i + \beta_i(\mathrm{r}_{m,t} - \mathrm{r}_{f,t}) + \gamma_i SMB_t + \delta_i HML_t + \theta_i UMD_t + \zeta_i ILLIQ_t + \epsilon_{i,t} \qquad (3)$$

4.7.2 Measure of liquidity

Illiquidity can be calculated in different methods, for example, the Amihud illiquidity measure (2002), the bid-ask spread and the trading volume.

Bid-Ask spread

Bid-ask spread is the difference between the sale price of a stock and its repurchase price, in other words, it is the lowest price at which a market maker is ready to sell minus the highest price at which a market maker is ready to buy. The spread is positive because the selling price is supposed to be inferior to the buying price of the same stock. In the opposite case, it would be possible to make a profit only by buying and reselling of stock without any risk, and this would violate the theory of absence of arbitrage opportunity. The larger the spread is, the more illiquid the market is. Adverse selection and inventory costs could affect the bid-ask spread (Amihud and Mendelson, 1980; Glosten and Milgrom, 1985). Kyle (1985) stated that market makers increase spread to protect themselves because they could not distinguish between orders placed by informed traders and the ones placed by traders that provide liquidity to the market.

Even though the bid-ask spread is the most straightforward method to calculate illiquidity,

it faces the problem that the data is not available for a more extended period in most of the markets in the world. Besides, this method does not calculate correctly the costs of selling a considerable quantity of financial assets (Acharya and Pedersen, 2004). These are the reasons why we have chosen to use another illiquidity measure, Amihud illiquidity measure; this allows us to construct the time series of illiquidity during more prolonged periods.

Amihud illiquidity measure

The Amihud illiquidity measure is the daily ratio of the absolute value of returns divided by trading volume. We could interpret it as a daily reaction of the price associated with one unit of the trading volume.

For a particular category of a financial asset, using daily returns, the average monthly illiquidity for month t is defined by:

$$ILLIQ_{it} = \frac{1}{D_t^i} \sum_{d=1}^{D_i^t} \frac{\left|r_{d,t}^i\right|}{V_{d,t}^i}$$

$r_{d,t}^i$ and $V_{d,t}^i$ are the daily return and trading volume of stock i in day d and month t. D_t^i is the number of observations in month t. We use this method to calculate illiquidity for all the selected stocks in BRIC.

4.7.3 Factors construction

We perform the three previously mentioned asset pricing regressions for the momentum strategies which have relatively high and statistically significant momentum premiums, some of the value strategies which have significant premiums, and the 5x5 cross-sectional portfolios for the period during July 2002 and June 2019. We have constructed the four risk factors following the method used in the website of Ken French.

The market risk factor is constructed by taking the difference between market return and the risk-free rate: We have taken MSCI BRIC Index from Datastream as market index; the risk-free rate for each country in BRIC is taken from the FRED economic research website, and we calculate a value-weighted risk-free rate for BRIC as a whole. The SMB factor is constructed by taking the difference between returns of portfolios consisting of

small-capitalization stocks and returns of portfolios consisting of large-capitalization stocks. The HML factor is constructed by taking the difference between returns of portfolios consisting of value stocks and returns of portfolios consisting of growth stocks.

2X3 sorts are conducted for the construction of the SMB factors. Following the paper of Liu, Stambaugh and Yuan (2018), we eliminate the smallest 20% of the stocks and use the remaining stocks to form the portfolio. More specifically, in June each year t, stocks are sorted in the first stage into two groups, small market capitalization stocks and large market capitalization stocks. Large market capitalization stocks (L-large) are the ones which are in the top 50% ranked by market capitalization, small market capitalization stocks (S-small) are the ones who are in the bottom 50%. Stocks within each of the large market capitalization and small market capitalization groups are sorted in the second stage into three portfolios (G-growth, N-neutral, and V-value) based on their book to market value in December year t-1, 30th and 70th percentile breakpoints are used. In total, we get six portfolios, SG, SN, SV, LG, LN and LV.

We calculate monthly equal-weighted average returns of all the six formed portfolios from June 2002 until June 2019. The SMB factor is the average of equal-weighted returns of the three portfolios comprised of small market capitalization stocks minus that of the three portfolios comprised of large market capitalization stocks. The HML factor is the average of equal-weighted returns of the two portfolios consisting of value stocks minus that of the portfolios consisting of growth stocks. We measure the performance of SMB and HML factor over a one-year holding period.

SMB = Average (SG + SN + SV) - Average (LG + LN + LV)
HML = Average (SV + LV) - Average (SG + LG)

Monthly 2x3 double sorted portfolios on size and lagged momentum are constructed to calculate the momentum winners minus losers factor (WML) At the end of month M, stocks are sorted in the first stage into two groups based on size, big market capitalization stocks and small market capitalization stocks. Large market capitalization stocks are the ones in the top 50% ranked by monthly market capitalization, and small market cap stocks are those in the bottom 50%. Stocks within each of the broad market capitalization and small market capitalization groups are sorted in the second stage into three portfolios (L'-losers, N-neutral and W-winners) based on their lagged momentum, 30th and 70th

percentile breakpoints are used. In total, we get six portfolios, SL', SN, SW, LL', LN, and LW.

We calculate the monthly equal-weighted average returns of all the six portfolios from July 2002 until June 2019. The WML factor is the average of equal-weighted returns of the two portfolios consisting of winners stocks minus that of the two portfolios consisting of losers stocks:

WML = Average (SW + LW) - Average (SL' + LL')

4.8 Fama MacBeth and momentum premiums

In this section, we want to figure out risk premiums of the factors which explain momentum premiums. We use several measures of macroeconomic risks: GDP growth, TERM (Fama French 1993 bond returns factor, capturing term spread), recession indicator and funding liquidity risk (Brunnermeier and Pedersen 2009), we do not take market liquidity risk into consideration because Asness, Moskowitz and Pedersen (2013) found that it is fragile related to value and momentum returns. Asness, Moskowitz and Pedersen (2013) found out that US stock values are negatively related to recessions and GDP growth, but not significantly. Momentum is significantly negatively related to recessions. Funding liquidity risk is negatively related to value and significantly positively related to momentum returns.

We construct equal-weighted liquidity sorted portfolios to calculate the liquidity risk factor (ILLIQ) factor. Stocks are firstly sorted into 2 groups based on their market values, stocks with market capitalization bigger than the median are sorted into the big market cap group and stocks with market capitalization smaller than the median are sorted into the small market cap groups; stocks within each of these two groups are again sorted into 3 groups, low liquidity, medium liquidity and high liquidity, based on their liquidity calculated using the Amihud illiquidity measure, using 30th and 70th quintiles as breaking points. 6 portfolios are created in this way. The liquidity factor is constructed by using the average returns of the two most illiquid portfolios minus the average returns of the two most liquid portfolios. GDP growth is calculated as the value-weighted GDP growth rate based on the GDP of each country for BRIC as a whole. TERM is taken from Datastream for the US since we could not find data for BRIC countries as a whole, this is the spread between 10 year government bonds and 3 month treasury bills. Recession

indicator is a dummy variable which equals 1 for recessionary periods and which equals to 0 for expansionary periods. We use Swap-T-bill, the spread between interest rate swaps and three months US T bills rate as funding liquidity risk variable since we could not find data for BRIC countries as a whole. We take the negative of this spread such that it captures liquidity because a high spread symbolizes worse liquidity.

We use monthly return data for BRIC from the period 2002 to 2019. The first period of the rolling window is from July 1999 to June 2000; the last period is from June 2016 to May 2019. Each time we slide our rolling window for one month in order to get the next rolling period. In the first step, we run a time series regression, so we regress the returns of all the stocks for BRIC on the five risk factors, market risk premium (MktRF), small minus big (SMB), high minus low (HML), winners minus losers (WML), liquidity risk (ILLIQ), plus macroeconomic factors, funding liquidity risk, GDP growth. After the first stage, we obtain betas for these different factors.

$$\mathrm{R}_{1,t} = \alpha_i + \beta_{1,MktRf}\mathrm{F}_{MktRf,t} + \beta_{1,SMB}F_{SMB,t} + \beta_{1,HML}F_{HML,t} + \beta_{1,WML}F_{WML,t} + \beta_{1,ILLIQ}F_{ILLIQ,t} + \epsilon_{1,t}$$

$$\mathrm{R}_{2,t} = \alpha_i + \beta_{2,MktRf}\mathrm{F}_{MktRf,t} + \beta_{2,SMB}F_{SMB,t} + \beta_{2,HML}F_{HML,t} + \beta_{2,WML}F_{WML,t} + \beta_{2,ILLIQ}F_{ILLIQ,t} + \epsilon_{2,t}$$

$$\vdots$$

$$\mathrm{R}_{n,t} = \alpha_i + \beta_{n,MktRf}\mathrm{F}_{MktRf,t} + \beta_{n,SMB}F_{SMB,t} + \beta_{n,HML}F_{HML,t} + \beta_{n,WML}F_{WML,t} + \beta_{n,ILLIQ}F_{ILLIQ,t} + \epsilon_{n,t}$$

$R_{i,t}$ is the return of the stock i at time t, $F_{MktRf,t}$, $F_{SMB,t}$, $F_{HML,t}$, $F_{WML,t}$ and $F_{ILLIQ,t}$ are the risk factors at time t, $\beta_{i,MktRf}$, $\beta_{i,SMB}$, $\beta_{i,HML}$, $\beta_{i,WML}$ and $\beta_{i,ILLIQ}$ are the sensibilities of the returns of stock i to the five risk factors. The date t of the regression is from 1 to T, i is the total number of stocks used. T is the number of the months from 10/2002 to 06/2019.

The second step of Fama Macbeth regression is a cross-sectional regression. There exists two possibilities for this second step, the first one is to calculate the T cross-sectional regressions of the returns on the betas obtained from the first stage.

$$\mathrm{R}_{i,t} = \lambda_{1,0} + \lambda_{1,1}\hat{\beta}_{i,F_{MktRf}} + \lambda_{1,2}\hat{\beta}_{i,F_{SMB}} + \lambda_{1,3}\hat{\beta}_{i,F_{HML}} + \lambda_{1,4}\hat{\beta}_{i,F_{WML}} + \lambda_{1,5}\hat{\beta}_{i,F_{ILLIQ}} + \epsilon_{i,1}$$

$$\mathrm{R}_{i,2} = \lambda_{2,0} + \lambda_{2,1}\hat{\beta}_{i,F_{MktRf}} + \lambda_{2,2}\hat{\beta}_{i,F_{SMB}} + \lambda_{2,3}\hat{\beta}_{i,F_{HML}} + \lambda_{2,4}\hat{\beta}_{i,F_{WML}} + \lambda_{2,5}\hat{\beta}_{i,F_{ILLIQ}} + \epsilon_{i,2}$$

⋮

$$R_{i,T} = \lambda_{T,0} + \lambda_{n,1}\hat{\beta}_{i,F_{MktRf}} + \lambda_{n,2}\hat{\beta}_{i,F_{SMB}} + \lambda_{n,3}\hat{\beta}_{i,F_{HML}} + \lambda_{n,4}\hat{\beta}_{i,F_{WML}} + \lambda_{n,5}\hat{\beta}_{i,F_{ILLIQ}} + \epsilon_{i,T}$$

R are the same returns as in the first stage, λs are the primes of each risk factors.

The second method is to do a simple cross-sectional regression by using the average of the returns for each period.

$$E(R_i) = \lambda_0 + \lambda_1\hat{\beta}_{i,F_{MktRf}} + \lambda_2\hat{\beta}_{i,F_{SMB}} + \lambda_3\hat{\beta}_{i,F_{HML}} + \lambda_4\hat{\beta}_{i,F_{WML}} + \lambda_5\hat{\beta}_{i,F_{ILLIQ}} + \epsilon_i$$

$E(R_i)$ is the average of the returns of all the stocks during each period. βs are estimated from the first step regression. λs are the risk premiums, for example, if F_{SMB} is 5%, λ_{SMB} = 3%, this means that investor will need to be compensated for 0.03% if the sensibility to the risk facteur F_{SMB} increases 1%.

We use the second possibility for the second step of Fama MacBeth regression. However, in doing this, the risk is that the errors contain heteroscedasticity. The problem of heteroscedasticity appears in the cross-sectional regression while the autocorrelation problem is associated with the time series regression. While using the OLS (ordinary least square) regression, one of the hypothesis is that the variance of the errors should be constant over time (homoscedasticity): $V(\epsilon_i) = \sigma^2$. When this is not the case, there is the problem of heteroscedasticity. The parameters estimated are not biased in the presence of heteroscedasticity, however, the variance of the errors are not constant and this biases the matrix of the variance and covariance of the estimated parameters. Thus, the variance of the parameters estimated are biased and are not anymore equal to $\sigma_\mu^2(X'X)^{-1}$, and as a consequence, all the inferences statistiques based on the result of the variance of the parameters estimated are biased. Among these inferences, the test of the significance and the test of the null hypothesis $\beta_i = 0$ are the most common. Under the null hypothesis, we calculate the statistique of the test like this: $t_{\hat{\beta}_i} = \frac{\hat{\beta}_i}{\hat{\sigma}_{\hat{\beta}_i}}$, when there exists the problem of heteroscedasticity for the errors, the variance of the parameters estimated are: $\Omega_{\hat{\beta}} = (X'X)^{-1}X'\Omega_\mu X(X'X)^{-1} \neq \sigma_\mu^2(X'X)^{-1}$. The method which allows us to correct for heteroscedasticity is very important in order to do inferences statistiques.

In order to test for heteroscedasticity, we use the Breusch-Pagan test. The null hypothesis is that the variance of the errors is identical, the alternative hypothesis says that the

variance of the errors is a multiple functions of one or more variables. With this test, we have found that we have the heteroscedasticity problem, and we have corrected it with the method of heteroscedasticity consistent standard errors (HCO).

Regressions are run in the style of Fama MacBeth regression. In the first step, we use a three month rolling window to estimate betas, positive and statistically significant average returns of 40 momentum strategy portfolios using overlapping holding periods are regressed on seven factors. The obtained beta coefficient represents a risk premium for each of these factors. These seven factors are small minus big factor (SMB); high minus low factor (HML); two liquidity factors: the constructed liquidity risk factor (ILLIQ); one funding liquidity risk factor which is the interest rate swap minus T-bills spread (IRSTB); term spread, which is the yield of 10 year US government bonds minus three months US T-Bills (TS); two macroeconomic factors: the GDP growth rate (GDP) and the recession factor (REC). We use the negative of the funding liquidity risk in the regression such that it captures liquidity. In the second step of Fama MacBeth regression, we regress cross-sectional average momentum premium on those seven beta estimates obtained from the first step. We run this in 4 regressions: firstly, we run the regression with beta estimates of small minus big and high minus low factor; secondly, we run the regression with one additional beta estimates related to liquidity; thirdly, we run the regression with another additional beta estimate related to the term spread; fourthly, we run the regression with all the factors.

4.9 Residual returns and momentum premiums

We use the residual returns instead of the total cumulative returns in classifying the decile portfolios for the momentum strategy. Besides, there is a link between momentum and volatility, this means that momentum stocks with low volatility should be preferred than up-moving stocks with high volatility, the further offers higher risk-adjusted momentum value.

We construct residual returns following Blitz et al. (2011, 2017). The general rule is to use an estimation window of 5 years, but we have decided to follow Groenewold and Fraser (2000) and use a rolling window of 3 years for the two regressions. Firstly, for every stock i and in every formation month t-1, we regress the excess stock returns on

Fama French (1993) factors model using a monthly rolling window from month t-36 to t-1. We correct the problem of heteroscedasticity and autocorrelation using the Newey-West heteroskedasticity and autocorrelation robust t-statistics. We only include stocks which have all the returns over the past three years rolling window period.

$$\mathrm{r}_{i,t} - \mathrm{r}_{f,t} = \alpha_i + \beta_i(\mathrm{r}_{m,t} - \mathrm{r}_{f,t}) + \gamma_i SMB_t + \delta_i HML_t + \epsilon_{i,t} \tag{1}$$

The residual returns are calculated as the following:

$$\epsilon_{i,t} = \mathrm{r}_{i,t} - \mathrm{r}_{f,t} - \alpha_i - \hat{\beta}_i(\mathrm{r}_{m,t} - \mathrm{r}_{f,t}) - \hat{\gamma}_i SMB_t - \hat{\delta}_i HML_t \tag{2}$$

Secondly, we standardize residual returns by dividing them by their standard deviations over the past 36 months. We do the same analysis for the residual momentum strategy as with the total return momentum strategy, the winner portfolio comprises stocks in the top ten deciles classified by volatility adjusted residual returns, and the loser portfolio comprises stocks in the bottom ten decile.

5 Results

5.1 Value

We study whether the value strategy yields higher risk-adjusted returns in the BRIC countries and the ten cross-country sectors. In other words, we would like to check if the HML (high minus low) portfolio has positive and statistically significant returns. We report our results of average returns and t-statistics in table 5.1 below.

We observe that almost all the ten decile portfolios and the HML portfolio for all the countries, BRIC as a whole and the ten cross-country sectors generate positive returns and the majority of these returns are statistically significant as well. Only the portfolio with the lowest book-to-market value for the oil and gas sector has negative returns. However, this return is not statistically significant. Besides, we see that there is an increasing trend of the returns from the portfolio with the lowest book-to-market ratio to the portfolio with the highest book-to-market ratio. However, this does not mean that the return of a portfolio in a lower decile is necessarily lower than the return of a portfolio in a higher decile, for example, the returns of the portfolios with the highest book-to-market ratio is lower than that of the portfolios in the 90th decile for Brazil, China, financials sector and telecom sector. In 11 out of 15 of the cases, we can say that the portfolio with the highest book-to-market ratio is the one that generates the highest return with the highest statistical significance. Our findings are following the findings of Fama and French (1992), they also found that stocks with high book-to-market value yield better returns than those with low book-to-market value. We observe that Russia and India have the highest returns of 3,62% among the 15 portfolios in the highest book-to-market group. This gives us the first indication that buying the stocks with high book-to-market value and short selling stocks with the low book-to-market value could be a profitable trading strategy.

What interests us the most is the level and the significance of the HML portfolios. We observe that all the fifteen HML portfolios generate positive returns, and for twelve out fifteen of them, the returns are statistically significant. India has the highest return among all the BRIC countries, and the oil and gas sector has the highest return among all sectors, and it has the highest return among all the countries and all the sectors as

well. For example, we could make a monthly return of up to 1.91% if we invest in the HML portfolio in India and up to 2.10% in the cross-sectional Oil and Gas sector, we could say that the value strategy is profitable before deducting transaction costs and commissions into account. Furthermore, we could see that the returns of the stocks in the portfolio with the highest book-to-market ratio is higher than the HML portfolio, it is natural to think that we would be better off by just investing in stocks with the highest book-to-market ratio. However, we should be aware that we need to consider the excess returns, that is to say, the returns after deducting the market returns for the decile portfolios, including the portfolio with the highest book-to-market value and the one with the lowest book-to-market value. This problem does not apply to the HML portfolio because we buy the HBM portfolio and short sell the LBM portfolio, the market return is thus being cancelled off.

We notice that the value premium in BRIC countries is relatively high compared with Fama and French (1992) study for the US market during the period 1963 to 1990. Our findings further confirm previous studies which stated that value strategy works better in BRIC countries compared with the US. Hong, Lim, and Stein (2000), Grinblatt and Moskowitz (2004), Fama and French (2012), and Israel and Moskowitz (2012) found out that size factor is negatively related to value and momentum premium. However, Israel and Moskowitz (2012) further show that the relationship between size and momentum is not robust using other periods. Since the size of stocks is inversely related to value premiums, we have done the robust check by eliminating 30% of the smallest market capitalization stocks in order to avoid the size bias. We found that the value premiums are slightly lower when we use only the big market capitalization stocks. This proves that the size factor explains the value anomaly to a certain degree.

Table 5.1: Average returns for the value portfolios

Table 5.1 shows equal-weighted average monthly returns (in percentage) of the decile portfolios and the zero-cost portfolio (HML) formed on previous fiscal year's book-to-market value for the period from January 2002 to June 2019. Low represents the portfolio with the lowest book-to-market value and High represents the portfolio with the highest book-to-market value. 2 represents the stocks that fall into the 2nd decile in the ranking of the book-to-market value, and so on. HML is the zero-cost portfolio that is constructed by buying stocks in the highest decile and short selling stocks in the lowest decile. Panel A presents the returns for each country in BRIC and BRIC as a whole. Panel B presents the returns for the 10 cross-country sectors. In the end of June year t, stocks are divided into deciles based on their book-to-market value in December year t-1. These decile portfolios are held for one year and equal-weighted returns are calculated at then end of the holding period. T-statistics are presented in the bracket under the value of the returns. * means that the return is statistically significant at the 10% level; ** means that the return is statistically significant at the 5% level, *** means that the return is statistically significant at the 1% level.

Panel A

	Low	2	3	4	5	6	7	8	9	High	HML
BRIC	0.94	0.82	0.99	1.20	1.18	1.21	1.20	1.38	1.98	2.64	1.70***
	(2.21)	(1.42)	(1.65)	(2.03)	(1.99)	(2.14)	(2.28)	(2.80)	(4.13)	(5.56)	(4.53)
Brazil	0.87	0.44	0.79	1.04	0.83	1.33	1.24	1.57	1.63	1.59	0.72**
	(1.68)	(0.81)	(1.44)	(1.92)	(1.48)	(2.42)	(2.48)	(2.89)	(3.20)	(3.16)	(2.20)
Russia	1.09	0.61	1.00	0.94	1.50	1.51	1.54	2.05	2.17	2.02	0.93***
	(3.11)	(0.86)	(1.62)	(1.46)	(2.34)	(2.37)	(2.18)	(3.20)	(2.89)	(1.83)	(2.71)
India	2.30	0.87	1.03	1.82	2.09	2.47	2.38	2.68	3.07	4.21	1.91***
	(2.43)	(1.17)	(1.55)	(2.59)	(3.01)	(3.42)	(3.42)	(3.46)	(3.80)	(4.97)	(3.92)
China	1.08	1.18	1.36	1.40	1.28	1.24	1.55	1.47	1.48	1.47	0.39
	(1.75)	(1.76)	(2.00)	(2.06)	(1.91)	(1.84)	(2.23)	(2.15)	(2.22)	(2.27)	(1.18)

Panel B

Basic Mats	1.44	0.74	1.16	1.08	1.31	1.22	1.22	1.43	2.09	2.87	1.43***
	(2.72)	(1.18)	(1.71)	(1.62)	(2.04)	(2.05)	(2.20)	(2.73)	(3.98)	(4.78)	(2.76)
Consumer Gds	1.03	0.84	0.82	1.18	1.26	1.13	1.26	1.53	1.70	2.38	1.34***
	(2.40)	(1.44)	(1.36)	(1.89)	(2.05)	(1.92)	(2.18)	(2.82)	(3.36)	(4.62)	(3.01)
Consumer Svs	0.90	0.60	0.75	1.10	1.30	1.30	1.25	1.74	1.40	2.33	1.43***
	(1.73)	(0.91)	(1.16)	(1.66)	(1.99)	(1.97)	(1.99)	(2.70)	(2.56)	(4.16)	(2.56)
Healthcare	1.26	0.70	0.90	0.83	1.85	1.69	1.50	1.23	1.83	1.98	0.72
	(1.95)	(1.11)	(1.43)	(1.28)	(2.68)	(2.69)	(2.33)	(2.02)	(2.88)	(3.92)	(1.17)
Industrials	0.98	0.84	0.91	1.15	1.24	1.40	1.09	0.76	1.68	2.38	1.40***
	(2.04)	(1.34)	(1.43)	(1.89)	(1.93)	(2.18)	(1.89)	(1.42)	(3.38)	(5.15)	(2.92)
Financials	0.44	0.89	0.82	0.91	1.44	1.17	0.94	1.73	2.45	2.40	1.96***
	(0.87)	(1.42)	(1.37)	(1.42)	(2.29)	(1.98)	(1.65)	(3.23)	(4.32)	(4.44)	(3.41)
Oil and Gas	-0.07	1.45	0.83	0.59	0.70	0.71	0.79	2.16	2.19	2.02	2.10**
	(-0.11)	(1.09)	(1.21)	(0.84)	(1.03)	(1.07)	(1.48)	(2.89)	(2.77)	(2.61)	(2.23)
Technology	1.05	1.53	1.31	1.66	1.82	1.92	1.49	1.13	1.55	2.13	1.09
	(1.78)	(1.90)	(1.66)	(2.03)	(2.25)	(2.50)	(2.02)	(1.71)	(2.15)	(2.62)	(1.42)
Telecom	1.19	0.71	1.11	0.93	0.66	0.97	1.63	2.03	2.38	1.83	0.64
	(1.44)	(0.82)	(1.49)	(1.09)	(0.94)	(1.27)	(2.39)	(2.74)	(2.68)	(2.03)	(0.61)
Utilities	0.89	0.66	1.18	0.66	0.43	0.74	1.30	1.78	1.72	2.56	1.67**
	(1.81)	(1.13)	(2.02)	(1.28)	(0.83)	(1.37)	(2.34)	(2.81)	(3.13)	(4.08)	(2.54)

5.2 Momentum

We study whether the momentum strategy generates higher risk-adjusted returns, in other words, whether the winners minus losers portfolio (WML) yields positive and statistically significant returns. The following table 3 shows the monthly average returns of the winners, losers and winners minus losers portfolios of the 16 momentum portfolios for the period 2002 to 2019 for each of BRIC country, BRIC as a whole and the ten cross-country sectors.

The following table 5.2 - 5.6 using non-overlapping holding periods shows that for each of the BRIC countries, BRIC countries as a whole and all the ten cross-country sectors, the majority of the returns for the losers and the winners portfolios are positive and statistically significant, the statistical significance is higher for the winners portfolio than that of the losers portfolio. However, there is hardly any momentum premium for the zero-cost portfolio, which is positive and statistically significant. The following table 5.7 - 5.11 using overlapping holding periods shows that the results are different compared with the ones using non-overlapping periods. We obtain more positive and statistically significant momentum premiums, the scale of the momentum premium is more significant for the positive ones but lower as well for the negative ones using overlapping holding periods but the sign remains almost the same. For example, some strategies in Russia and the underlying material sector has a negative and statistically significant momentum premium using both overlapping and non-overlapping holding periods. India is the country which has the best momentum premium and consumer service sector is the sector in which momentum premium works best.

Jegadeesh and Titman (1993) found the MOM 12x3 strategy to be the best performer in the US market; our results show that we do not have one strategy that is dominant across all the countries and all the sectors, rather each country and each sector has its own most profitable strategy. However, the MOM12X3 strategy for the consumer services sector is the one which has the highest momentum premium among all the countries and all the sectors, with 1.56% monthly returns. Jegadeesh and Titman (1993)'s findings mean implicitly that the strategy with the most extended formation period and the shortest holding period is the most profitable one for the zero-cost portfolio. In our data, using overlapping holding periods, we observe that the momentum premium decreases with the

length of the holding period and increases with the length of the formation periods, the momentum strategies that lead to relatively better results are the ones with relatively short holding periods and long formation periods.

Besides, Jegadeesh and Titman (1993) found positive and statistically significant returns for all the 16 momentum portfolios for the US market. Our results are less optimistic. We consider that there might exist several reasons: Firstly, our study period is the recent 17 years, this is not the period during which momentum strategy performs the best momentum has relatively lousy performance due to some high-risk episodes during this period; Secondly, Asness (2012) stated that the absence of momentum premium in Japan is due to the very high performance of the value strategy. We consider that this explanation might apply to BRIC countries as well; Thirdly, Blitz et al. (2011,2017) found that sorting stocks based on their residual returns after adjusting for their systematic risk instead of sorting stocks based on their total returns generates higher and more stable momentum premium and Sharpe ratio over time; Another possible explanation is that the momentum premium is affected by the business cycles to a great extent. We would thus like to analyze the residual momentum strategy and study in details the relationship between momentum premiums and business cycles in the following sections.

Table 5.2: Average monthly returns of 16 momentum strategies - Non-overlapping periods

Table 5.2 - 5.6 shows the equal weighted average monthly returns (in percentage) of the 16 momentum strategies, formed on past cumulative returns during the period from January 2002 to June 2019, for each country in BRIC, BRIC as a whole and the 10 cross-country sectors. These 16 portfolios are constructed with different formation periods(F= 3,6,9,12) and holding periods (H=3,6,9,12). At the end of month M, stocks are divided into deciles based on their past F months' cumulative returns, we skip one month between the formation and the holding period. With the non-overlapping holding periods, we rebalance each month the total portfolio. The formed portfolios are held for H months and equal weighted returns are calculated at the end of the holding period. Losers represent portfolios consisting of stocks with the lowest past cumulative returns and winners represent portfolios consisting of stocks with the highest past cumulative returns. WML portfolio (winners minus losers) is constructed by buying stocks in the winners portfolio and short selling stocks in the losers portfolio. T-statistics are presented in the bracket under the value of the returns. * means that the return is statistically significant at 10% level; ** means that the return is statistically significant at 5% level, *** means that the return is statistically significant at 1% level.

		Brazil					Russia					India			
F	H =	3	6	9	12	H =	3	6	9	12	H =	3	6	9	12
3 Sell (Losers)		1,48	1,23	1,83	1,61		2,56	3,09	2,44	2,75		3,41	3,36	3,32	3,24
		(2,35)	(1,92)	(2,76)	(2,52)		(3,66)	(3,98)	(3,59)	(3,79)		(4,10)	(3,89)	(4,01)	(3,98)
3 Buy (Winners)		1,66	1,41	1,29	1,30		2,06	2,27	2,16	1,73		3,12	3,02	3,15	3,29
		(3,00)	(2,49)	(2,44)	(2,33)		(3,47)	(4,01)	(3,81)	(2,88)		(4,40)	(4,45)	(4,44)	(4,33)
3 Buy-sell		0,18	0,18	-0,54	-0,31		-0,50	-0,82	-0,28	-1,01		-0,29	-0,34	-0,17	0,05
		(0,53)	(0,51)	(-1,51)	(-1,16)		(-0,77)	(-1,26)	(-0,51)	(-1,63)		(-0,57)	(-0,68)	(-0,38)	(0,12)
6 Sell (Losers)		1,39	1,39	1,26	1,29		3,52	3,79	3,14	3,87		3,42	3,23	3,24	3,11
		(2,11)	(2,17)	(1,94)	(2,17)		(4,59)	(5,07)	(4,34)	(5,19)		(4,26)	(3,91)	(3,73)	(3,69)
6 Buy (Winners)		1,05	0,92	1,27	1,39		2,23	2,38	1,96	2,50		2,59	3,00	2,66	2,98
		(2,00)	(1,74)	(2,33)	(2,64)		(3,51)	(3,61)	(3,18)	(3,75)		(4,08)	(4,64)	(3,94)	(4,20)
6 Buy-sell		-0,35	-0,47	0,01	0,10		-1,29*	-1,40**	-1,17	-1,38**		-0,83	-0,23	-0,58	-0,13
		(-0,93)	(-1,34)	(0,03)	(0,33)		(-1,73)	(-2,07)	(-1,61)	(-2,03)		(-1,61)	(-0,46)	(-1,26)	(-0,30)
9 Sell (Losers)		1,44	2,00	0,97	2,97		3,50	3,47	(2,23)	6,35		3,41	3,34	2,00	3,68
		(2,13)	(2,95)	(2,34)	(3,65)		(4,75)	(4,54)	(4,47)	(2,97)		(4,09)	(3,89)	(3,66)	(3,93)
9 Buy (Winners)		0,87	1,23	0,75	2,11		1,80	1,77	1,25	3,38		2,87	2,73	1,78	3,18
		(1,70)	(2,43)	(2,29)	(2,62)		(3,21)	(2,73)	(3,12)	(3,38)		(4,47)	(4,01)	(4,00)	(4,25)
9 Buy -sell		-0,56*	-0,78*	-0,22	-0,87*		-1,70**	-1,70**	-0,99*	-2,97		-0,55	-0,61	-0,22	-0,51
		(-1,53)	(-1,97)	(-0,93)	(-1,68)		(-2,40)	(-2,15)	(-1,96)	(-1,32)		(-0,98)	(-1,13)	(-0,63)	(-0,92)
12 Sell (Losers)		1,85	1,57	1,65	2,78		3,39	3,64	3,60	7,29		3,15	2,78	2,52	3,69
		(2,83)	(2,60)	(2,57)	(3,53)		(4,26)	(4,67)	(4,51)	(2,49)		(3,77)	(3,39)	(3,12)	(3,85)
12 Buy (Winners)		1,03	0,94	0,94	2,10		1,52	1,54	1,70	3,14		2,48	2,45	2,49	2,62
		(2,07)	(1,87)	(1,92)	(2,47)		(2,56)	(2,39)	(3,12)	(2,86)		(3,82)	(3,66)	(3,58)	(3,44)
12 Buy-sell		-0,82**	-0,63*	-0,71*	-0.67		-1.87***	-2,09***	-1,90***	-0.41		-0,68	-0,33	-0,03	-1,07*
		(-2,16)	(-1,83)	(-1,91)	(-1,29)		(-2,76)	(-2,97)	(-2,70)	(-1,43)		(-1,14)	(-0,64)	(-0,06)	(-1,92)

Table 5.3: Non-overlapping - continued

	Country momentum				Countries combined momentum				Sector momentum			
	China				BRIC				Basic Mats			
F	H = 3	6	9	12	H = 3	6	9	12	H = 3	6	9	12
3 Sell (Losers)	1,09	1,12	1,27	1,00	1,93	2,00	2,03	2,05	2,25	2,41	2,18	2,33
	(1,66)	(1,64)	(1,96)	(1,54)	(3,27)	(3,22)	(3,21)	(3,32)	(3,36)	(3,46)	(3,23)	(3,29)
3 Buy (Winners)	1,09	1,22	1,17	1,02	2,03	2,20	2,30	2,48	2,09	2,13	2,07	2,35
	(1,87)	(2,02)	(1,96)	(1,59)	(3,64)	(4,03)	(4,04)	(4,37)	(3,35)	(3,49)	(3,31)	(3,80)
3 Buy-sell	0,00	0,10	-0,10	0,02	0,10	0,20	0,28	0,43	-0,16	-0,28	-0,11	0,03
	(0,00)	(0,32)	(-0,33)	(0,06)	(0,19)	(0,37)	(0,50)	(0,83)	(-0,26)	(-0,46)	(-0,18)	(0,04)
6 Sell (Losers)	0,94	0,97	1,08	1,20	2,21	2,12	2,48	2,64	2,58	2,63	2,90	3,02
	(1,44)	(1,49)	(1,73)	(1,93)	(3,83)	(3,56)	(3,91)	(4,12)	(4,05)	(4,02)	(4,19)	(4,16)
6 Buy (Winners)	1,06	1,14	1,19	1,12	1,90	2,22	1,92	1,89	1,99	1,93	1,85	1,68
	(1,82)	(1,90)	(2,02)	(1,67)	(3,57)	(4,13)	(3,65)	(3,41)	(3,39)	(3,32)	(3,08)	(2,69)
6 Buy-sell	0,12	0,17	0,11	-0,09	-0,31	0,10	-0,56	-0,74	-0,59	-0,70	-1,05*	-1,34**
	(0,33)	(0,46)	(0,34)	(-0,25)	(-0,60)	(0,18)	(-1,00)	(-1,46)	(-1,03)	(-1,25)	(-1,70)	(-2,22)
9 Sell (Losers)	0,98	1,08	0,82	1,39	2,15	2,18	1,43	3,08	2,89	2,64	1,65	3,98
	(1,51)	(1,64)	(1,87)	(2,10)	(3,59)	(3,55)	(3,78)	(4,60)	(4,38)	(4,03)	(4,00)	(4,28)
9 Buy (Winners)	1,04	1,27	0,78	1,12	1,98	2,16	1,32	2,32	2,06	2,02	1,30	1,92
	(1,79)	(2,11)	(1,87)	(1,68)	(3,88)	(4,17)	(3,74)	(3,89)	(3,59)	(3,49)	(3,22)	(2,88)
9 Buy -sell	0,06	0,19	-0,04	-0,27	-0,16	-0,02	-0,12	-0,76	-0,83	-0,62	-0,35	-2,06**
	(0,16)	(0,51)	(-0,15)	(-0,74)	(-0,31)	(-0,05)	(-0,36)	(-1,33)	(-1,41)	(-1,11)	(-0,90)	(-2,47)
12 Sell (Losers)	1,02	1,03	1,16	1,12	2,24	2,00	1,77	2,90	2,75	2,50	2,10	3,22
	(1,59)	(1,56)	(1,84)	(1,67)	(3,71)	(3,36)	(2,93)	(4,33)	(4,23)	(3,93)	(3,28)	(4,31)
12 Buy (Winners)	1,08	1,08	1,06	1,09	1,74	1,85	1,83	2,39	1,56	1,60	1,78	2,61
	(1,86)	(1,75)	(1,64)	(1,59)	(3,32)	(3,33)	(3,14)	(3,77)	(2,75)	(2,68)	(2,78)	(3,66)
12 Buy-sell	0,06	0,05	-0,10	-0,02	-0,50	-0,16	0,06	-0,51	-1,20*	-0,91	-0,32	-0,61
	(0,15)	(0,13)	(-0,24)	(-0,05)	(-0,91)	(-0,29)	(0,10)	(-0,86)	(-1,94)	(-1,48)	(-0,50)	(-0,88)

Table 5.4: Non-overlapping - continued

		Consumer Gds					Consumer Svs					Healthcare			
F	H =	3	6	9	12	H =	3	6	9	12	H =	3	6	9	12
3 Sell (Losers)		1,68	1,65	1,90	2,17		1,04	0,95	1,12	1,09		2,08	2,15	2,05	2,04
		(2,79)	(2,60)	(3,01)	(3,49)		(1,77)	(1,54)	(1,76)	(1,78)		(3,27)	(3,14)	(2,99)	(3,31)
3 Buy (Winners)		1,89	2,14	2,43	2,37		1,79	1,97	2,08	2,10		2,11	2,31	2,66	2,36
		(3,40)	(4,00)	(4,18)	(4,17)		(3,10)	(3,45)	(3,46)	(3,47)		(3,35)	(3,92)	(4,20)	(3,72)
3 Buy-sell		0,21	0,49	0,52	0,19		0,75	1,01	0,96	1,01*		0,03	0,16	0,61	0,32
		(0,39)	(0,84)	(0,91)	(0,39)		(1,26)	(1,61)	(1,53)	(1,74)		(0,04)	(0,24)	(0,89)	(0,48)
6 Sell (Losers)		2,21	2,10	2,44	2,80		1,41	1,25	1,68	1,76		2,71	2,37	2,73	2,64
		(3,71)	(3,42)	(3,70)	(4,13)		(2,40)	(2,07)	(2,70)	(2,90)		(4,13)	(3,52)	(3,84)	(4,06)
6 Buy (Winners)		1,65	1,97	1,76	1,75		1,65	2,14	1,67	1,94		1,74	2,41	1,79	1,62
		(3,08)	(3,68)	(3,33)	(3,15)		(2,90)	(3,75)	(2,90)	(3,14)		(2,75)	(3,82)	(2,92)	(2,50)
6 Buy-sell		-0,56	-0,13	-0,68	-1,05*		0,25	0,90	-0,01	0,18		-0,97	0,04	-0,95	-1,02
		(-1,00)	(-0,23)	(-1,10)	(-1,94)		(0,39)	(1,44)	(-0,02)	(0,29)		(-1,40)	(0,06)	(-1,27)	(-1,45)
9 Sell (Losers)		1,89	1,97	1,35	3,53		1,09	1,41	0,89	2,07		2,32	2,10	1,36	2,72
		(3,03)	(3,08)	(3,50)	(4,45)		(1,83)	(2,26)	(2,33)	(3,10)		(3,49)	(3,17)	(3,32)	(3,22)
9 Buy (Winners)		1,66	2,09	1,34	2,12		2,02	2,08	1,20	1,85		2,13	2,09	1,21	2,01
		(3,28)	(4,03)	(3,71)	(3,64)		(3,60)	(3,68)	(3,40)	(3,03)		(3,33)	(3,18)	(2,85)	(2,77)
9 Buy -sell		-0,23	0,12	-0,01	-1,40**		0,93	0,67	0,31	-0,22		-0,19	-0,01	-0,15	-0,71
		(-0,40)	(0,21)	(-0,03)	(-2,00)		(1,44)	(1,05)	(0,84)	(-0,33)		(-0,28)	(-0,01)	(-0,34)	(-0,84)
12 Sell (Losers)		2,16	1,90	1,57	2,63		1,15	1,09	1,28	2,55		1,96	1,82	1,51	2,18
		(3,41)	(3,07)	(2,52)	(3,72)		(1,90)	(1,75)	(2,10)	(2,83)		(3,20)	(2,94)	(2,42)	(3,17)
12 Buy (Winners)		1,68	1,75	1,86	2,33		2,01	2,04	1,65	2,02		1,79	2,09	1,84	2,41
		(3,22)	(3,14)	(3,13)	(3,53)		(3,40)	(3,50)	(2,71)	(3,16)		(2,79)	(3,18)	(2,62)	(3,11)
12 Buy-sell		-0,48	-0,16	0,29	-0,30		0,86	0,95	0,37	-0,52		-0,18	0,26	0,33	0,23
		(-0,80)	(-0,26)	(0,47)	(-0,44)		(1,35)	(1,52)	(0,57)	(-0,58)		(-0,25)	(0,35)	(0,42)	(0,27)

Table 5.5: Non-overlapping - continued

		Financials					Industrials					Oil and Gas			
F	H =	3	6	9	12	H =	3	6	9	12	H =	3	6	9	12
3 Sell (Losers)		2,04	1,92	2,37	2,04		2,02	2,10	1,96	1,87		0,64	1,26	1,76	1,20
		(3,43)	(3,09)	(3,45)	(3,23)		(3,31)	(3,26)	(3,00)	(2,89)		(1,01)	(1,70)	(2,57)	(1,85)
3 Buy (Winners)		2,43	2,44	2,48	2,25		1,83	2,02	2,36	2,54		1,89	1,88	1,49	2,30
		(4,02)	(4,14)	(4,16)	(3,54)		(3,05)	(3,31)	(3,87)	(4,29)		(2,67)	(2,65)	(2,39)	(3,15)
3 Buy-sell		0,38	0,52	0,11	0,22		-0,19	-0,08	0,40	0,67		1,25	0,62	-0,27	1,10
		(0,66)	(0,86)	(0,18)	(0,37)		(-0,33)	(-0,12)	(0,66)	(1,16)		(1,58)	(0,70)	(-0,35)	(1,40)
6 Sell (Losers)		2,28	2,10	2,39	2,59		2,43	2,17	2,47	2,80		1,30	1,58	1,27	1,88
		(3,76)	(3,28)	(3,36)	(3,94)		(4,02)	(3,50)	(3,75)	(4,21)		(1,77)	(2,20)	(1,83)	(2,77)
6 Buy (Winners)		2,32	2,39	1,99	1,87		1,86	2,34	2,04	2,02		1,30	1,02	2,38	1,87
		(3,96)	(4,15)	(3,47)	(3,29)		(3,32)	(4,10)	(3,62)	(3,53)		(1,96)	(1,44)	(3,16)	(2,70)
6 Buy-sell		0,04	0,28	-0,40	-0,72		-0,57	0,18	-0,43	-0,78		0,00	-0,56	1,12	-0,01
		(0,07)	(0,47)	(-0,56)	(-1,30)		(-0,96)	(0,29)	(-0,69)	(-1,40)		(0,00)	(-0,64)	(1,25)	(-0,01)
9 Sell (Losers)		2,36	2,40	1,53	3,55		2,04	1,98	1,25	3,29		1,24	1,45	0,81	2,52
		(3,53)	(3,63)	(3,59)	(4,32)		(3,32)	(3,22)	(3,26)	(4,40)		(1,70)	(2,02)	(1,85)	(2,46)
9 Buy (Winners)		2,04	1,89	1,39	2,23		1,99	2,25	1,31	2,24		1,61	2,17	1,67	2,58
		(3,76)	(3,49)	(3,74)	(3,77)		(3,51)	(4,07)	(3,57)	(3,60)		(2,17)	(2,80)	(3,31)	(3,31)
9 Buy -sell		-0,32	-0,51	-0,14	-1,32*		-0,05	0,27	0,06	-1,05		0,38	0,72	0,86	0,06
		(-0,51)	(-0,82)	(-0,35)	(-1,74)		(-0,08)	(0,46)	(0,18)	(-1,50)		(0,41)	(0,79)	(1,48)	(0,05)
12 Sell (Losers)		2,70	2,23	2,04	3,59		2,16	2,02	1,79	3,70		1,28	1,98	0,95	3,86
		(4,06)	(3,36)	(3,13)	(4,02)		(3,61)	(3,39)	(2,94)	(3,04)		(1,88)	(2,81)	(1,37)	(3,20)
12 Buy (Winners)		1,98	1,87	1,93	2,21		1,64	1,92	1,80	2,23		1,47	1,63	2,16	2,32
		(3,42)	(3,09)	(3,07)	(3,33)		(2,90)	(3,21)	(2,93)	(3,41)		(2,05)	(2,26)	(3,00)	(3,16)
12 Buy-sell		-0,72	-0,36	-0,11	-1,39*		-0,52	-0,10	0,01	-1,47		0,19	-0,35	1,21	-1,54
		(-1,14)	(-0,55)	(-0,17)	(-1,65)		(-0,85)	(-0,16)	(0,02)	(-1,27)		(0,23)	(-0,43)	(1,39)	(-1,20)

Table 5.6: Non-overlapping - continued

		Technology					Utilities					Telecom			
F	H =	3	6	9	12	H =	3	6	9	12	H =	3	6	9	12
3 Sell (Losers)		1,91	2,06	1,75	1,47		1,89	1,82	2,36	2,16		1,79	1,90	1,38	1,33
		(2,18)	(2,27)	(2,02)	(1,90)		(3,04)	(2,72)	(3,23)	(3,36)		(2,29)	(2,36)	(1,71)	(1,67)
3 Buy (Winners)		2,43	2,18	2,82	2,68		1,57	1,32	1,77	2,27		1,31	2,16	2,20	1,23
		(3,27)	(2,96)	(3,58)	(3,27)		(2,83)	(2,49)	(3,12)	(3,66)		(1,82)	(2,73)	(2,75)	(1,70)
3 Buy-sell		0,51	0,12	1,07	1,21		-0,32	-0,50	-0,59	0,11		-0,48	0,26	0,82	-0,10
		(0,63)	(0,14)	(1,27)	(1,44)		(-0,48)	(-0,72)	(-0,75)	(0,15)		(-0,56)	(0,29)	(0,86)	(-0,10)
6 Sell (Losers)		1,93	1,35	3,05	1,96		2,50	1,77	2,01	2,70		1,12	1,43	2,25	1,97
		(2,23)	(1,61)	(3,16)	(2,18)		(3,75)	(2,78)	(3,29)	(4,32)		(1,39)	(1,64)	(2,84)	(2,51)
6 Buy (Winners)		1,73	2,34	1,89	1,81		1,62	2,15	1,55	1,72		1,91	1,70	0,36	1,88
		(2,41)	(3,13)	(2,69)	(2,31)		(3,04)	(3,80)	(2,74)	(3,07)		(2,35)	(2,02)	(0,53)	(2,50)
6 Buy-sell		-0,21	0,99	-1,16	-0,15		-0,87	0,38	-0,46	-0,97		0,79	0,27	-1,89**	-0,09
		(-0,23)	(1,13)	(-1,24)	(-0,17)		(-1,28)	(0,57)	(-0,69)	(-1,56)		(0,85)	(0,29)	(-2,34)	(-0,11)
9 Sell (Losers)		2,06	1,76	1,41	2,78		1,93	2,30	1,50	2,34		1,62	2,27	1,09	2,59
		(2,33)	(1,92)	(2,47)	(2,60)		(2,90)	(3,39)	(3,27)	(3,48)		(1,94)	(2,68)	(2,07)	(2,91)
9 Buy (Winners)		2,55	2,58	1,55	2,01		1,38	1,96	1,22	2,45		1,36	1,58	1,16	2,36
		(3,34)	(3,49)	(3,22)	(2,35)		(2,57)	(3,42)	(3,27)	(3,38)		(1,73)	(1,98)	(2,09)	(2,66)
9 Buy -sell		0,49	0,82	0,13	-0,77		-0,55	-0,33	-0,28	0,11		-0,26	-0,70	0,07	-0,23
		(0,53)	(0,93)	(0,25)	(-0,75)		(-0,79)	(-0,43)	(-0,56)	(0,14)		(-0,27)	(-0,73)	(0,11)	(-0,22)
12 Sell (Losers)		1,80	1,91	1,65	2,74		2,05	1,62	2,00	2,61		1,81	1,72	1,72	2,23
		(2,02)	(2,14)	(1,97)	(2,75)		(2,86)	(2,28)	(2,85)	(3,24)		(2,21)	(2,03)	(2,04)	(2,52)
12 Buy (Winners)		1,66	1,67	1,94	2,51		1,36	1,84	1,54	2,60		2,09	2,11	1,02	6,47
		(2,34)	(2,40)	(2,66)	(2,97)		(2,47)	(3,22)	(2,64)	(3,45)		(2,50)	(2,78)	(1,34)	(1,51)
12 Buy-sell		-0,14	-0,24	0,29	-0,22		-0,70	0,23	-0,46	-0,01		0,28	0,39	-0,70	4,24
		(-0,16)	(-0,28)	(0,35)	(-0,22)		(-0,92)	(0,31)	(-0,60)	(-0,01)		(0,29)	(0,43)	(-0,79)	(0,99)

Table 5.7: Average monthly returns of 16 momentum strategies - Overlapping periods

Table 5.7 - 5.11 shows the equal weighted average monthly returns (in percentage) of the 16 momentum strategies formed on past cumulative returns during the period from January 2002 to June 2019, for each country in BRIC, BRIC as a whole and the 10 cross-country sectors. These 16 portfolios are constructed with different formation periods(F= 3,6,9,12) and holding periods (H=3,6,9,12). At the end of month M, stocks are divided into deciles based on their past F months' cumulative returns, we skip one month between the formation and the holding period. With the overlapping holding periods, we rebalance each month 1/H of the total portfolios and hold the rest of stocks formed in the previous months. The formed portfolios are held for H months and equal weighted returns are calculated at the end of the holding period. Losers represent portfolios consisting of stocks with the lowest past cumulative returns and winners represent portfolios consisting of stocks with the highest past cumulative returns. WML portfolio (winners minus losers) is constructed by buying stocks in the winners portfolio and short selling stocks in the losers portfolio. T-statistics are presented in the bracket under the value of the returns. * means that the return is statistically significant at 10% level; ** means that the return is statistically significant at 5% level, *** means that the return is statistically significant at 1% level. .

		Brazil					Russia				India		
F	H =	3	6	9	12	H =	3	6	9	12	H =	3	6	9	12
3 Sell (Losers)		1.38	0.72	0.48	0.37		1.95	1.05	0.65	0.46		3.28	1.53	1.04	0.74
		(3.53)	(5.18)	(6.16)	(7.32)		(5.06)	(7.25)	(8.13)	(8.87)		(6.47)	(8.51)	(10.25)	(11.45)
3 Buy (Winners)		1.8	0.86	0.53	0.4		1.48	0.94	0.61	0.39		3.31	1.62	1.11	0.76
		(5.19)	(7.08)	(7.81)	(8.88)		(4.26)	(7.42)	(8.49)	(8.5)		(7.7)	(10.48)	(12.49)	(13.08)
3 Buy-sell		0.42**	0.14*	0.05	0.03		-0.47	-0.11	-0.04	-0.07*		0.04	0.09	0.07	0.02
		(2.2)	(1.95)	(1.38)	(1.16)		(-1.54)	(-0.92)	(-0.61)	(-1.85)		(0.15)	(0.99)	(1.58)	(0.76)
6 Sell (Losers)		1.58	0.78	0.51	0.38		2.07	1.07	0.69	0.52		2.95	1.39	0.96	0.69
		(3.81)	(5.34)	(6.35)	(7.6)		(5)	(7.17)	(8.26)	(9.54)		(5.76)	(7.69)	(10.55)	(10.55)
6 Buy (Winners)		1.55	0.75	0.51	0.39		1.46	0.84	0.54	0.37		3.3	1.56	1.04	0.71
		(4.78)	(6.55)	(7.8)	(9.19)		(4.59)	(7.11)	(8.21)	(8.35)		(7.98)	(10.62)	(12.18)	(12.66)
6 Buy-sell		-0.03	-0.03	0.00	0.01		-0.62*	-0.23*	-0.15**	-0.16***		0.36	0.17	0.08	0.02
		(-0.11)	(-0.32)	(-0.01)	(0.11)		(-1.76)	(-1.86)	(-2.21)	(-3.44)		(1.21)	(1.63)	(1.52)	(0.57)
9 Sell (Losers)		1.42	0.76	0.5	0.37		2.14	1.1	0.73	0.56		2.49	1.22	0.85	0.63
		(3.51)	(5.22)	(6.43)	(7.29)		(4.93)	(6.93)	(8.11)	(9.61)		(4.72)	(6.73)	(8.54)	(9.74)
9 Buy (Winners)		1.47	0.7	0.47	0.38		1.53	0.68	0.42	0.32		3.32	1.39	0.88	0.65
		(4.45)	(6.16)	(7.54)	(9.11)		(4.69)	(5.96)	(6.48)	(7.31)		(8.07)	(9.47)	(10.58)	(11.5)
9 Buy -sell		0.05	-0.06	-0.03	0.02		-0.62*	-0.42***	-0.31***	-0.23***		0.84**	0.17	0.03	0.03
		(0.2)	(-0.74)	(-0.66)	(0.3)		(-1.66)	(-3.21)	(-3.97)	(-4.57)		(2.28)	(1.5)	(0.5)	(0.7)
12 Sell (Losers)		1.5	0.69	0.48	0.35		2.06	1.08	0.8	0.61		2.03	0.99	0.73	0.59
		(3.54)	(4.69)	(5.94)	(6.89)		(4.42)	(6.47)	(8.7)	(10.48)		(4.02)	(5.58)	(7.51)	(9.18)
12 Buy (Winners)		1.34	0.73	0.48	0.35		1.01	0.54	0.35	0.25		2.59	1.24	0.77	0.55
		(4.23)	(6.49)	(7.66)	(8.49)		(3.3)	(4.82)	(5.34)	(5.87)		(6.27)	(8.29)	(9.14)	(9.81)
12 Buy-sell		-0.16	0.04	0	0		-1.04***	-0.54***	-0.45***	-0.35***		0.56	0.24**	0.04	-0.03
		(-0.64)	(0.48)	(0.05)	(-0.2)		(-2.57)	(-3.62)	(6.47)	(-6.87)		(1.64)	(2.07)	(0.68)	(-0.69)

Table 5.8: Overlapping - continued

		Country momentum				Countries combined momentum				Sector momentum			
		China				BRIC				Basic Mats			
F	H =	3	6	9	12	H = 3	6	9	12	H = 3	6	9	12
3 Sell (Losers)		1.21	0.57	0.4	0.31	2.14	1.04	0.71	0.53	2.29	1.14	0.77	0.56
		(2.83)	(3.76)	(4.71)	(5.64)	(5.58)	(7.71)	(9.26)	(10.66)	(5.4)	(7.59)	(9.13)	(10.22)
3 Buy (Winners)		0.99	0.59	0.41	0.31	2.16	1.11	0.77	0.56	2.22	1.09	0.78	0.56
		(2.48)	(4.15)	(4.96)	(5.71)	(5.91)	(8.64)	(10.49)	(11.52)	(5.47)	(7.56)	(9.51)	(10.44)
3 Buy-sell		-0.23	0.03	0	0	0.02	0.07	0.06	0.03	-0.07	-0.05	0.01	0.01
		(-1.03)	(0.35)	(0.09)	(0.07)	(0.07)	(0.62)	(0.92)	(0.7)	(-0.17)	(-0.36)	(0.12)	(0.17)
6 Sell (Losers)		1.17	0.52	0.39	0.31	2.05	0.99	0.67	0.51	2.33	1.14	0.77	0.56
		(2.75)	(3.43)	(4.57)	(5.71)	(5.34)	(7.13)	(8.67)	(10.09)	(5.57)	(7.51)	(9.13)	(10.22)
6 Buy (Winners)		1.03	0.56	0.39	0.29	2.19	1.11	0.75	0.53	2.27	1.06	0.72	0.51
		(2.67)	(3.93)	(4.8)	(5.41)	(6.15)	(8.87)	(10.56)	(11.42)	(5.72)	(7.58)	(9.03)	(9.74)
6 Buy-sell		-0.14	0.04	0	-0.02	0.14	0.12	0.08	0.02	-0.06	-0.08	-0.04	-0.05
		(-0.57)	(0.45)	(0.02)	(-0.7)	(0.42)	(0.96)	(1.24)	(0.56)	(-0.16)	(-0.58)	(-0.59)	(-0.96)
9 Sell (Losers)		1.04	0.58	0.43	0.35	1.63	0.86	0.62	0.47	2	1.02	0.72	0.53
		(2.32)	(3.77)	(5.14)	(6.39)	(4.14)	(6.23)	(8.24)	(9.66)	(4.68)	(6.89)	(8.83)	(10.01)
9 Buy (Winners)		1.17	0.57	0.38	0.29	2.28	1.01	0.66	0.49	2.31	0.95	0.62	0.47
		(2.95)	(3.91)	(4.63)	(5.31)	(6.56)	(8.19)	(9.54)	(10.61)	(5.92)	(6.9)	(8.01)	(8.99)
9 Buy -sell		0.13	-0.01	-0.05	-0.06*	0.65*	0.16	0.04	0.02	0.31	-0.07	-0.1	-0.06
		(0.48)	(-0.17)	(-1.1)	(-1.94)	(1.81)	(1.28)	(0.54)	(0.36)	(0.78)	(-0.49)	(-1.36)	(-1.39)
12 Sell (Losers)		1.37	0.63	0.47	0.35	1.42	0.76	0.54	0.43	1.72	0.89	0.63	0.49
		(3.17)	(4.19)	(5.71)	(6.74)	(3.73)	(5.51)	(7.32)	(8.93)	(4.32)	(6.19)	(8.13)	(9.72)
12 Buy (Winners)		1.1	0.57	0.37	0.28	1.91	0.97	0.62	0.46	1.74	0.89	0.57	0.43
		(2.75)	(3.93)	(4.41)	(5.06)	(5.42)	(7.7)	(8.77)	(9.81)	(4.5)	(6.34)	(7.16)	(8.2)
12 Buy-sell		-0.27	-0.06	-0.1*	-0.07**	0.5	0.21	0.08	0.03	0.02	-0.05	-0.07	-0.06
		(-0.97)	(-0.64)	(-1.91)	(-2.3)	(1.39)	(1.63)	(1.15)	(0.56)	(0.06)	(-0.38)	(-0.86)	(-1.42)

Table 5.9: Overlapping - continued

		Consumer Gds					Consumer Svs					Healthcare			
F	H =	3	6	9	12	H =	3	6	9	12	H =	3	6	9	12
3 Sell (Losers)		2.11	1	0.67	0.5		1.43	0.66	0.49	0.37		2.35	1.15	0.74	0.55
		(5.28)	(7.18)	(8.44)	(9.8)		(3.66)	(4.77)	(6.19)	(7.19)		(5.7)	(7.88)	(9.19)	(10.4)
3 Buy (Winners)		1.82	0.97	0.73	0.53		1.87	0.97	0.68	0.51		2.05	1.05	0.75	0.54
		(4.87)	(7.34)	(9.62)	(10.61)		(4.85)	(7.21)	(8.89)	(10.01)		(5.28)	(7.58)	(9.53)	(10.3)
3 Buy-sell		-0.28	-0.03	0.06	0.02		0.45	0.3**	0.19**	0.14***		-0.31	-0.1	0.01	-0.01
		(-0.78)	(-0.24)	(0.77)	(0.53)		(1.15)	(2.18)	(2.5)	(2.95)		(-0.77)	(-0.68)	(0.17)	(-0.012)
6 Sell (Losers)		1.95	0.92	0.62	0.47		1.19	0.5	0.37	0.32		2.42	1.05	0.7	0.53
		(4.87)	(6.37)	(7.76)	(9.07)		(3.05)	(3.62)	(4.84)	(6.31)		(5.91)	(7.4)	(8.96)	(10.25)
6 Buy (Winners)		1.86	1.03	0.73	0.04		2.25	1.07	0.72	0.51		1.89	1.07	0.71	0.52
		(5.12)	(8.03)	(9.96)	(10.66)		(5.82)	(7.92)	(9.5)	(10.41)		(4.9)	(7.92)	(9.22)	(10.16)
6 Buy-sell		-0.09	0.11	0.11	0.04		1.06***	0.57***	0.35***	0.19***		-0.52	0.02	0.01	-0.01
		(-0.25)	(0.81)	(1.47)	(0.75)		(2.55)	(3.9)	(4.46)	(3.88)		(-1.26)	(0.13)	(0.17)	(-0.09)
9 Sell (Losers)		1.4	0.76	0.54	0.42		0.89	0.46	0.4	0.34		1.89	0.99	0.64	0.5
		(3.45)	(5.32)	(6.92)	(8.39)		(2.2)	(3.28)	(5.28)	(6.76)		(4.49)	(6.85)	(8.33)	(10.05)
9 Buy (Winners)		2.06	0.97	0.63	0.46		2.38	1.06	0.67	0.49		2.45	1.02	0.66	0.47
		(5.85)	(7.72)	(9.03)	(9.76)		(6.24)	(7.85)	(9.01)	(9.85)		(6.41)	(7.53)	(8.63)	(9.24)
9 Buy -sell		0.66*	0.21	0.09	0.04		1.49***	0.60***	0.26***	0.15***		0.56	0.03	0.02	-0.03
		(1.68)	(1.58)	(1.21)	(0.6)		(3.53)	(4.21)	(3.49)	(2.86)		(1.37)	(0.22)	(0.22)	(-0.91)
12 Sell (Losers)		1.23	0.65	0.46	0.38		0.7	0.45	0.38	0.33		1.64	0.76	0.54	0.44
		(2.99)	(4.41)	(5.83)	(7.56)		(1.78)	(3.21)	(4.96)	(6.53)		(4.31)	(5.65)	(7.31)	(9.4)
12 Buy (Winners)		1.77	0.93	0.59	0.44		2.27	1.05	0.68	0.49		1.94	1.03	0.65	0.47
		(4.98)	(7.27)	(8.28)	(9.22)		(5.83)	(7.69)	(8.92)	(9.85)		(4.89)	(7.25)	(8.11)	(8.76)
12 Buy-sell		0.54	0.28**	0.13*	0.05		1.56***	0.60***	0.30***	0.17***		0.3	0.26*	0.12	0.02
		(1.33)	(1.96)	(1.74)	(0.95)		(3.69)	(3.98)	(3.74)	(3.14)		(0.7)	(1.73)	(1.39)	(-0.02)

Table 5.10: Overlapping - continued

		Financials					Industrials					Oil and Gas			
F	H =	3	6	9	12	H =	3	6	9	12	H =	3	6	9	12
3 Sell (Losers)		2.18	1.07	0.73	0.54		2.22	1.08	0.75	0.55		0.83	0.51	0.25	0.20
		(5.58)	(7.62)	(9.1)	(10.48)		(5.52)	(7.61)	(9.39)	(10.55)		(2.00)	(3.52)	(3.17)	(4.01)
3 Buy (Winners)		2.92	1.4	0.89	0.62		2.12	1.14	0.81	0.57		1.42	0.8	0.54	0.40
		(7.71)	(10.51)	(11.84)	(12.54)		(5.34)	(8.16)	(10.16)	(10.91)		(3.33)	(5.32)	(6.38)	(7.30)
3 Buy-sell		0.74**	0.33	0.15	0.08		-0.09	0.05	0.06	0.02		0.59	0.29*	0.29***	0.20***
		(2.08)	(2.63)	(2.14)	(1.70)		(-0.25)	(0.39)	(0.8)	(0.37)		(1.25)	(1.74)	(3.18)	(3.32)
6 Sell (Losers)		2.13	1.06	0.73	0.55		2.1	1.01	0.69	0.54		0.21	0.54	0.29	0.24
		(5.15)	(7.03)	(8.66)	(10.19)		(5.3)	(7.05)	(8.69)	(10.2)		(2.59)	(3.66)	(3.56)	(4.34)
6 Buy (Winners)		2.78	1.29	0.83	0.5		2.22	1.18	0.79	0.56		1.33	0.68	0.48	0.36
		(7.5)	(9.97)	(11.22)	(12.25)		(5.81)	(8.77)	(10.39)	(11.27)		(3.17)	(4.57)	(5.73)	(6.6)
6 Buy-sell		0.65*	0.23	0.1	0.03		0.12	0.17	0.1	0.02		1.12	0.14	0.19**	0.12**
		(1.69)	(1.61)	(1.25)	(0.75)		(0.3)	(1.2)	(1.33)	(0.56)		(0.43)	(0.84)	(2.11)	(2.18)
9 Sell (Losers)		1.77	0.96	0.71	0.54		1.69	0.88	0.64	0.49		0.74	0.36	0.24	0.14
		(4.11)	(6.36)	(8.7)	(10.15)		(4.16)	(6.21)	(8.24)	(9.67)		(1.74)	(2.44)	(3.02)	(2.92)
9 Buy (Winners)		2.73	1.18	0.75	0.57		2.33	1.07	0.71	0.52		1.37	0.71	0.45	0.36
		(7.34)	(8.94)	(10.27)	(11.46)		(6.17)	(8.03)	(9.66)	(10.64)		(3.15)	(4.58)	(5.29)	(6.43)
9 Buy -sell		0.96**	0.22	0.04	0.04		0.65	0.19	0.07	0.04		0.63	0.36**	0.21**	0.22***
		(2.32)	(1.55)	(0.52)	(0.44)		(1.57)	(1.34)	(0.89)	(0.7)		(1.25)	(2.06)	(2.25)	(3.37)
12 Sell (Losers)		1.68	0.9	0.64	0.48		1.45	0.77	0.56	0.43		0.57	0.27	0.13	0.1
		(4.15)	(6.11)	(7.93)	(9.19)		(3.84)	(5.66)	(7.66)	(9.01)		(1.4)	(1.82)	(1.69)	(1.89)
12 Buy (Winners)		2.45	1.19	0.73	0.53		1.97	1.06	0.7	0.51		1.37	0.7	0.43	0.32
		(6.46)	(8.78)	(9.54)	(10.56)		(5.14)	(7.78)	(9.15)	(10.18)		(3.06)	(4.44)	(5.05)	(5.84)
12 Buy-sell		0.76*	0.29*	0.09	0.05		0.53	0.28*	0.13*	0.08		0.79	0.43**	0.3***	0.22***
		(1.92)	(1.95)	(1.15)	(0.91)		(1.3)	(1.91)	(1.66)	(1.52)		(1.6)	(2.42)	(3.11)	(3.52)

Table 5.11: Overlapping - continued

		Technology					Utilities					Telecom			
F	H =	3	6	9	12	H =	3	6	9	12	H =	3	6	9	12
3 Sell (Losers)		1.96	0.98	0.71	0.5		2.24	1.02	0.64	0.48		1.29	0.7	0.45	0.35
		(4.09)	(5.98)	(7.65)	(8.38)		(5.51)	(7.11)	(8.21)	(9)		(3.02)	(4.57)	(5.25)	(6.12)
3 Buy (Winners)		1.97	1.07	0.71	0.52		1.47	0.83	0.59	0.44		1.51	0.79	0.44	0.36
		(4.4)	(6.58)	(7.79)	(8.69)		(4.34)	(6.72)	(8.19)	(9.47)		(3.59)	(5.1)	(5.12)	(6.39)
3 Buy-sell		0.01	0.08	0	0.02		-0.77*	-0.19	-0.05	-0.04		0.22	0.1	-0.01	0.01
		(0.02)	(0.5)	(-0.01)	(0.41)		(-1.95)	(-1.34)	(-0.69)	(-0.32)		(0.48)	(0.57)	(-0.14)	(0.14)
6 Sell (Losers)		1.77	0.98	0.65	0.46		1.92	0.87	0.56	0.44		1.6	0.76	0.53	0.4
		(3.8)	(5.82)	(6.94)	(7.66)		(4.91)	(6.26)	(7.2)	(8.38)		(3.55)	(4.45)	(5.76)	(6.58)
6 Buy (Winners)		1.66	0.9	0.65	0.47		1.49	0.9	0.57	0.42		1.62	0.67	0.46	0.35
		(3.71)	(5.75)	(7.42)	(8.19)		(4.39)	(7.11)	(7.91)	(9.09)		(3.67)	(4.45)	(5.62)	(6.46)
6 Buy-sell		-0.11	-0.08	0.01	0.01		-0.43	0.03	0.01	-0.02		0.03	-0.09	-0.06	-0.05
		(-0.23)	(-0.47)	(0.07)	(0.1)		(-1.07)	(0.22)	(0.16)	(-0.17)		(0.05)	(-0.49)	(-0.63)	(-0.65)
9 Sell (Losers)		1.87	0.96	0.64	0.49		1.37	0.77	0.53	0.41		1.57	0.75	0.54	0.37
		(3.84)	(5.7)	(6.88)	(8.26)		(3.53)	(5.37)	(6.73)	(7.6)		(3.19)	(4.43)	(5.75)	(5.79)
9 Buy (Winners)		2.05	0.96	0.67	0.51		1.51	0.73	0.46	0.37		1.13	0.55	0.4	0.35
		(4.69)	(6.16)	(7.71)	(8.75)		(4.23)	(5.74)	(6.63)	(7.85)		(2.64)	(3.77)	(5.02)	(6.48)
9 Buy -sell		0.18	0	0.03	0.02		0.13	-0.03	-0.07	-0.04		-0.44	-0.2	-0.14	-0.02
		(0.37)	(0.01)	(0.31)	(0.16)		(0.3)	(-0.22)	(-0.84)	(-0.68)		(-0.88)	(-1.12)	(-1.39)	(0.17)
12 Sell (Losers)		1.36	0.74	0.52	0.41		1.46	0.76	0.52	0.4		1.43	0.92	0.58	0.39
		(2.94)	(4.44)	(5.7)	(7.05)		(3.43)	(4.9)	(6.12)	(7.13)		(3.06)	(5.2)	(5.86)	(5.65)
12 Buy (Winners)		1.67	0.87	0.58	0.45		1.15	0.7	0.42	0.31		1.02	0.52	0.36	0.29
		(3.9)	(5.62)	(6.6)	(7.71)		(3.22)	(5.47)	(5.89)	(6.71)		(2.38)	(3.55)	(4.41)	(5.21)
12 Buy-sell		0.31	0.13	0.06	0.04		-0.31	-0.06	-0.1	-0.09		-0.41	-0.4**	-0.22**	-0.1
		(0.67)	(0.79)	(0.66)	(0.56)		(-0.71)	(-0.36)	(-1.13)	(-1.45)		(-0.83)	(-2.16)	(-2.08)	(-1)

5.3 Momentum and business cycles

From table 5.12 - 5.13 using non-overlapping holding period, we could observe that compared with the results obtained for the whole period, we generate positive and significant returns both for country indices and sector indices in some of the sub-periods. Furthermore, the momentum strategies have a higher performance during periods of expansions, all the countries and sectors except the utility sector generate positive and significant momentum premiums in one or another or two of the expansion periods. However, only the MOM 3X12 generates positive and significant returns for China and Oil Gas sector during the recession period; this is in line with the findings of Chordia and Shivakumar (2002) and Daniel and Moskowitz (2016). Daniel and Moskowitz (2016) found out that momentum strategies can have persistent negative returns in periods when market volatility is high. We see that there is no single strategy which is the best performer in all of the three sub-periods for all the country and sector indices and there is no strategy which dominates in one of the three sub-period across all the country and sector indices. We observe further that the sector indices have higher momentum premium compared with the country indices, indicating that momentum strategy works better for sectors than countries. The best sub-period of the momentum strategy for sector indices is the expansion period from July 2002 to April 2007. For example, the MOM 3x6 for the technology sector yields 4.36%, which is the highest momentum premium across all the country and sector indices in this sub-period. What draws our attention is that Oil and Gas sector is the only sector which generates a very positive and significant momentum premium, 5.54%, during the recession period between May 2007 and July 2009, furthermore, it is also the highest momentum premium ever generated across all the country and sector indices in all the sub-periods. This is probably due to the quick rebound of oil and gas prices after the financial crisis.

Table 5.14 - 5.15 using overlapping periods shows very different results than what we obtained using non-overlapping period. First of all, there is no momentum strategy which generates positive and significant returns during the recession period for all the countries and sector indices. This further confirms the fact that the momentum strategy works better in a bull market. Second of all, we observe that the MOM 9X3 is the dominant strategy during the second expansion period and MOM12X3 is the dominant strategy

during the first expansion period. This indicates that the momentum strategy, which has a short holding period and long formation period has better performance, this is since risk increases with the length of the holding period. Our findings are also in line with the findings of Newfound research (July 2018) and HIMCO quantitative insight (May 2018), which found out that the best momentum strategy's performance is obtained when the sum of the formation period and the holding period is equal to 12-14 months and 14-18 months respectively.

Comparing the momentum premium in the sub-periods and the whole period, we see that the performance of the momentum strategy is affected by business cycles in no small extent. In the modern theory of portfolio management developed by Harry Markowitz in the 1950s, Moskowitz stated that we should select stocks which are negatively correlated with each other in the portfolio in order to minimize the risk. We assume therefore that it might be beneficial to combine value and momentum strategy so that we could mitigate the negative momentum premium during the momentum crash periods and minimize risk if the value and momentum strategies are negatively correlated or have a very low correlation. This would enable us to get higher risk-adjusted returns and Sharpe ratios. In the next section, we would like to study the correlation between the value and momentum strategy and the combination of the two strategies.

Table 5.12: Momentum strategy and business cycles - non-overlapping holding periods

Panel A presents the equal weighted average monthly returns (in percentage)of the best momentum strategy portfolios, formed on the formation periods' past cumulative return, in each of the 3 sub periods from January 2002 to June 2019, for each country in BRIC and BRIC as a whole. Panel B presents the equal weighted average monthly returns (in percentage) of the best momentum strategy portfolios, formed on the formation periods' past cumulative return, in each of the 3 sub periods from January 2002 to June 2019, for all the 10 cross-country sectors. The 3 sub periods are the subperiods classified by NBER. Losers represents portfolios consisting of stocks with the lowest past cumulative returns and winners represents portfolios consisting of stocks with the highest past cumulative returns. The WML (winners minus losers) portfolio is constructed by buying stocks in the winners portfolio and short selling stocks in the losers portfolio. At the end of month M, stocks are divided into deciles based on their past F months' cumulative returns. We skip one month between the formation period and holding period. The formed portfolios are held for H months and we rebalance each month the whole portfolio. Equal weighted returns are calculated at the end of the holding period. T-statistics are presented in the bracket under the value of the returns. * means that the return is statistically significant at 10% level; ** means that the return is statistically significant at 5% level, *** means that the return is statistically significant at 1% level.

Panel A: Countries

Subperiods according to NBER

Period		07/02-04/07			05/07-07/09			08/09-06/19	
		Expansion			Recession			Expansion	
	Losers	Winners	WML	Losers	Winners	WML	Losers	Winners	WML
		MOM12x12			MOM3x3			MOM6x9	
Brazil	6.47	6.66	0.19	1.00	1.84	0.84	-0.23	0.84	1.07 **
	(3.19)	(2.53)	(0.15)	(0.54)	(0.83)	(0.96)	(-0.24)	(1.21)	(2.40)
		MOM3x9			MOM3x3			MOM3x6	
Russia	3.2	4.65	1.46	1.07	1.34	0.27	0.17	1.14	0.97*
	(3.43)	(3.59)	(1.14)	(0.61)	(0.79)	(0.16)	(0.23)	(1.48)	(1.80)
		MOM9x9			MOM3x12			MOM9X3	
India	4.32	3.73	-0.59	1.73	3.45	1.72	0.85	2.44	1.59 ***
	(3.62)	(3.23)	(-0.79)	(0.63)	(1.01)	(1.53)	(1.28)	(3.94)	(3.69)
		MOM9x9			MOM3x12			MOM6x6	
China	0.19	2.21	2.03 **	0.7	2.79	2.09 *	0.78	0.98	0.2
	(0.26)	(2.15)	(2.02)	(0.46)	(0.83)	(1.74)	(1.03)	(1.16)	(0.43)
		MOM9x9			MOM6x12			MOM6x6	
BRIC	2.95	5.20	2.25	1.67	1.5	-0.17	0.74	1.64	0.91
	(2.55)	(3.90)	(1.46)	(0.57)	(0.57)	(-0.09)	(1.22)	(2.72)	(1.51)

Table 5.13: Continued

Panel B: Sectors

Subperiods according to NBER									
Period		07/02-04/07			05/07-07/09			08/09-06/19	
		Expansion			Recession			Expansion	
	Losers	Winners	WML	Losers	Winners	WML	Losers	Winners	WML
		MOM3x9			MOM3x12			MOM3x6	
Basic Mats	2.54	5.33	2.78**	1.39	2.25	0.86	1.06	1.38	0.32
	(2.19)	(3.4)	(2.01)	(0.64)	(0.74)	(0.43)	(1.83)	(1.95)	(0.54)
		MOM3x9			MOM3x12			MOM9x6	
Consumer Gds	2.50	5.20	2.70**	0.93	2.97	2.03	0.8	1.58	0.78
	(2.46)	(3.8)	(2.26)	(0.45)	(1.05)	(1.23)	(1.29)	(2.51)	(1.33)
		MOM12x3			MOM3x12			MOM6x6	
Consumer Svs	1.54	5.21	3.67**	0.5	2.59	2.09	0.27	2.08	1.81**
	(1.08)	(3.41)	(2.25)	(0.36)	(0.95)	(1.61)	(0.36)	(2.93)	(2.41)
		MOM3x6			MOM3x12			MOM3x6	
Financials	3.22	4.24	1.02	2.83	3.15	0.32	0.44	2.55	2.11***
	(2.46)	(3.4)	(0.7)	(1.18)	(1.12)	(0.33)	(0.92)	(3.7)	(3.61)
		MOM12x12			MOM6x12			MOM9x6	
Healthcare	2.00	6.3	4.29*	-1.05	2.17	3.22	1.30	1.66	0.37
	(1.74)	(3.43)	(1.93)	(-0.17)	(0.74)	(1.36)	(2.41)	(2.03)	(-0.40)
		MOM3x6			MOM3x12			MOM6x6	
Industrials	3.17	6.01	2.85*	1.38	3.34	1.96	0.67	1.36	0.70
	(2.2)	(4.47)	(1.72)	(0.7)	(1.3)	(1.61)	(1.02)	(2.05)	(1.02)
		MOM3x3			MOM3x12			MOM9x6	
Oil and Gas	-0.03	2.25	2.28	-1.26	4.28	5.54**	-0.18	1.62	1.79*
	(-0.05)	(1.81)	(1.43)	(-0.55)	(1.21)	(2.08)	(-0.14)	(1.78)	(1.74)
		MOM3x6			MOM3x12			MOM6x6	
Technology	1.13	5.48	4.36**	0.6	3.48	2.88	0.99	1.48	0.48
	(0.69)	(3.41)	(2.47)	(0.43)	(1.05)	(1.31)	(1.32)	(1.89)	(0.59)
		MOM9x3			MOM6x12			MOM6x3	
Telecom	2.06	3.77	1.71	-1.04	0.11	1.15	-0.31	2.00	2.32**
	(1.03)	(2.51)	(0.95)	(-0.33)	(0.05)	(0.51)	(-0.29)	(2.06)	(2.36)
		MOM9x12			MOM3x12			MOM6x6	
Utilities	3.56	6.81	3.25	0.96	0.52	-0.44	0.6	1.64	1.04
	(2.07)	(4.11)	(1.44)	(0.5)	(0.22)	(-0.19)	(0.88)	(2.15)	(1.35)

Table 5.14: Momentum strategy and business cycles - overlapping holding periods

Panel A presents the equal weighted average monthly returns (in percentage) of the best momentum strategy portfolios, formed on the formation periods' past cumulative return, in each of the 3 sub periods from January 2002 to June 2019, for each country in BRIC and BRIC as a whole. Panel B presents the equal weighted average monthly returns (in percentage) of the best momentum strategy portfolios, formed on the formation periods' past cumulative return, in each of the 3 sub periods from January 2002 to June 2019, for all the 10 cross-country sectors. The 3 sub periods are the subperiods classified by NBER. Losers represents portfolios consisting of stocks with the lowest past cumulative returns and winners represents portfolios consisting of stocks with the highest past cumulative returns. The WML (winners minus losers) portfolio is constructed by buying stocks in the winners portfolio and short selling stocks in the losers portfolio. At the end of month M, stocks are divided into deciles based on their past F months' cumulative returns. We skip one month between the formation period and holding period. The formed portfolios are held for H months, and we rebalance each month 1/H stocks in the total portfolio and hold the rest of the stocks formed in previous months. Equal weighted returns are calculated at the end of the holding period. T-statistics are presented in the bracket under the value of the returns. * means that the return is statistically significant at 10% level; ** means that the return is statistically significant at 5% level, *** means that the return is statistically significant at 1% level.

Panel A: Countries

Subperiods according to NBER

Period		07/02-04/07			07/02-04/07			08/09-06/19	
		Expansion			Recession			Expansion	
	Losers	Winners	WML	Losers	Winners	WML	Losers	Winners	WML
		MOM3x3			MOM3x3			MOM9x3	
Brazil	4.76	4.97	0.22	1.14	1.94	0.8	-0.5	0.73	1.23***
	(8.28)	(9.20)	(0.58)	(0.83)	(1.41)	(1.43)	(-0.92)	(1.8)	(4.16)
		MOM9x12			MOM3x3			MOM9x3	
Russia	1.14	1.17	0.04	0.24	0.75	0.51	0.69	1.16	0.47
	(11.41)	(12.18)	(0.27)	(0.22)	(0.69)	(0.60)	(1.5)	(3.16)	(1.29)
		MOM9x12			MOM3x3			MOM9x3	
India	1.78	1.63	-0.14	2.82	3.26	0.44	0.29	2.52	2.23***
	(12.14)	(11.21)	(-1.42)	(1.41)	(1.94)	(0.47)	(0.74)	(6.82)	(6.67)
		MOM12x3			MOM3x3			MOM9x3	
China	1.23	2.68	1.45***	1.36	1.77	0.4	0.63	0.83	0.2
	(1.29)	(4.02)	(2.29)	(0.88)	(1.13)	(0.43)	(1.37)	(1.73)	(0.69)
		MOM12x6			MOM3x3			MOM9x3	
BRIC	1.56	2.79	1.23***	0.67	0.26	-0.41	0.29	1.49	1.19***
	(3.57)	(6.13)	(2.88)	(1.40)	(1.12)	(-0.57)	(0.88)	(4.2)	(3.47)

Table 5.15: Continued

Panel B: Sectors

Subperiods according to NBER									
Period		07/02-04/07			05/02-05/07			08/09-06/19	
		Expansion			Recession			Expansion	
	Losers	Winners	WML	Losers	Winners	WML	Losers	Winners	WML
		MOM12x3			MOM3x3			MOM9x3	
Basic Mats	2.83	4.93	2.1**	2.38	1.69	-0.69	0.8	1.47	0.67*
	(3.56)	(5.24)	(2.27)	(1.36)	(1.08)	(-0.48)	(2.14)	(3.89)	(1.72)
		MOM12x3			MOM3x6			MOM9x3	
Consumer Gds	2.35	4.52	2.17**	1.42	0.2	-1.23***	0.31	1.39	1.08***
	(2.93)	(5.04)	(2.12)	(2.35)	(0.40)	(-2.69)	(0.87)	(3.79)	(2.79)
		MOM9x3			MOM3x12			MOM9x3	
Consumer Svs	1.89	5.73	3.84**	0.42	0.1	-0.32*	-0.12	1.66	1.79***
	(2.47)	(6.50)	(3.91)	(1.96)	(0.51)	(-1.87)	(-0.34)	(4.12)	(4.16)
		MOM12x3			MOM3x3			MOM9x3	
Financials	3.49	6.51	3.02***	3.08	2.82	-0.27	-0.12	2	2.12***
	(3.87)	(6.47)	(2.73)	(1.94)	(1.90)	(-0.22)	(-0.25)	(5.42)	(5.48)
		MOM12x3			MOM3x12			MOM9x3	
Healthcare	1.96	4.68	2.72**	0.67	0.38	-0.29*	0.85	1.85	1.0**
	(2.41)	(4.52)	(2.34)	(3.25)	(1.97)	(-1.67)	(2.3)	(4.83)	(2.49)
		MOM12x3			MOM3x12			MOM9x3	
Industrials	2.76	6.3	3.54***	0.69	0.22	-0.47***	0.24	1.02	0.78**
	(3.55)	(6.42)	(3.23)	(3.31)	(1.17)	(-2.80)	(0.7)	(2.65)	(2.14)
		MOM12x3			MOM3x12			MOM9x3	
Oil and Gas	1.23	3.49	2.26*	0.28	0.08	-0.21	-0.59	1.22	1.81***
	(1.44)	(3.62)	(1.86)	(1.64)	(0.39)	(-1.13)	(-1.13)	(2.48)	(3.32)
		MOM12x3			MOM3x12			MOM3x3	
Technology	2.46	4.47	2.01*	0.52	0.15	-0.36**	0.92	1.27	0.35
	(2.19)	(4.49)	(1.65)	(2.07)	(0.76)	(-2.03)	(2.24)	(2.59)	(0.7)
		MOM3x6			MOM3x3			MOM6x3	
Telecom	1.67	1.75	0.08	-0.67	-0.7	-0.03	-0.06	1.67	1.73**
	(6.08)	(6.01)	(0.23)	(-0.38)	(-0.50)	(-0.02)	(-0.3)	(2.15)	(2.37)
		MOM9x3			MOM3x12			MOM9x3	
Utilities	3.24	4.14	0.91	0.48	-0.01	-0.49**	0.18	1	0.82*
	(4.97)	(6.65)	(1.12)	(2.25)	(-0.04)	(-2.49)	(0.43)	(2.38)	(1.8)

5.4 5X5 cross-sectional portfolio

The following table 5.16 shows the monthly average returns of the 25 cross-sectional portfolios constructed by the double sorts on value and momentum during the period July 2002 to June 2019 for BRIC. We observe that all the cross-sectional portfolios generate positive returns; the returns are also statistically significant for 23 out of them. Asness, Moskowitz and Pedersen (2013) have found that the combination of value and momentum strategy yields higher returns than value and momentum strategy alone. Firstly, comparing the returns of the cross-sectional portfolios with those of the portfolios constructed by pure value strategy, we find that for portfolios which are in the same value quantile, the returns in the cross-sectional portfolios are higher. Besides, all the cross-sectional portfolios in the highest value quantile outperform the High Minus Low

(HML) value portfolio. However, the return of the pure value portfolio with the highest book-to-market ratio is higher than all the cross-sectional portfolios. Secondly, comparing the returns of the cross-sectional portfolios with those of the portfolios constructed by pure momentum strategy, we observe that all the returns of the cross-sectional portfolios are higher than the pure momentum portfolios. We cannot conclude with certainty that the cross-sectional portfolios have better performance than the pure value portfolio and pure momentum portfolio because we could be better off by just investing in the pure value portfolio with the highest book-to-market ratio.

We observe the general trend that returns increase from losers portfolios to winners portfolios within the same value quantile and returns increase from portfolios with low book-to-market ratio to portfolios with high book-to-market ratio within the same momentum quantile. In contrary to Fama and French (2012) and Jegadeesh and Titman (1993), the High X Winners portfolio, the one consisting of stocks in the highest value quantile and the highest momentum quantile should generate the highest return; we find the High X 4 portfolio, the one in the highest value quantile and the 4th momentum quantile is the one with the best performance among all the cross-sectional portfolios. Also, we see that for portfolios in the losers and the 3rd momentum quantile, both returns and statistical significance increase from portfolios with low book-to-market ratio to portfolios with high book-to-market ratio, this indicates that there is value effect for portfolios sorted by momentum.

Table 5.16: Returns of 5X5 cross-sectional portfolios

The following table 5.16 shows the monthly average returns of the 25 double sorted portfolios on value and momentum from July 2002 to June 2019 for BRIC as a whole. At the beginning of month M in year t, stocks are firstly sorted into 5 quintile portfolios based on their book-to-market value at the end of December year t-1. Within each of these quintile portfolios, stocks are sorted a second time based on their past cumulative returns from M -12 to M -1. We get thus 25 double sorted portfolios, these formed portfolios are held for one year and equal-weighted returns of each portfolio are calculated at the end of the holding period. T-statistics are presented in the bracket under the value of the returns. * means that the return is statistically significant at 10% level; ** means that the return is statistically significant at 5% level, *** means that the return is statistically significant at 1% level.

Value	Momentum quantile				
quantile	Losers	2	3	4	Winners
Low	0.87	1.23**	0.99*	1.26**	1.18**
	(1.53)	(2.09)	(1.99)	(2.12)	(2.00)
2	1.20*	1.29*	1.37**	1.21*	1.00
	(1.75)	(1.94)	(2.10)	(1.82)	(1.46)
3	1.14*	1.51**	1.36**	1.53**	1.45**
	(1.77)	(2.29)	(2.16)	(2.31)	(2.27)
4	1.34**	1.46***	1.31**	1.18**	1.65**
	(2.04)	(2.59)	(2.42)	(2.09)	(2.77)
High	2.17***	2.03***	2.24***	2.43***	2.34***
	(3.40)	(3.51)	(4.40)	(4.57)	(4.25)

5.5 Weighted combination portfolios

We will compare performance of portfolios of weighted combinations of value and momentum strategy with that of value and momentum strategy alone, for the whole period and for the 3 sub-periods classified as expansionary and recessionary periods. Expansionary period I is from July 2002 to April 2007; recessionary period is from May 2007 to July 2009; expansionary period II is from August 2009 to June 2019. We focus on the MOM9X3 strategy because we have found from the previous section that this strategy is the one that generates relatively more positive and significant premium across all the countries and sectors compared with other momentum strategies.

We observe from table 5.17 - 5.18 that in terms of sharpe ratios for BRIC, India, Consumer Services sector and financial sector in the whole period and in each of the 3 sub-periods, all the portfolios of weighted combination of value and momentum strategy outperform the pure momentum portfolio, this means that the weighted combination of the value and

momentum strategy can be used as a hedge in periods of momentum crashes. For example, the sharpe ratio is increased by more than 57% if we switch from the pure momentum portfolio to the 25/75 portfolio during the recession period for BRIC. Our findings are in line with the findings of Asness, Moskowitz and Pedersen (1992).

Furthermore, we find that portfolios of weighted combination of value and momentum strategy generate higher sharpe ratio than pure value strategy as well, especially during expansion periods, this confirms the fact that value strategy performs better in bear market and this indicates that we could also use the weighted combination portfolios as a hedge at times of value crashes or at times when value strategy has a low performance. For example, the sharpe ratio is increased by more than 33% if we switch from a pure value portfolio to the 25/75 portfolio during the second expansionary period for consumer services sector. In terms of average returns and cumulative returns, we observe the same pattern as for sharpe ratio.

Table 5.17: Sharpe ratio: weighted combination of value and momentum strategy

Table 5.17 presents the average monthly returns (in percentage), sharpe ratio and cumulative returns (in percentage) for the 3 portfolios of weighted combination of value and momentum (50/50, 25/75, 75/25), sharpe ratio and minimum variance portfolios and the pure value and momentum portfolios, during the whole period and during the 3 sub periods. Panel A is for BRIC and India and panel B is for Consumer Services and financial sector. The value portfolio is the High minus Low (HML) portfolio and the momentum portfolio is the MOM 9X3 Winners minus Losers (WML) portfolio with a formation period of 9 months and a holding period of 3 months. 50/50 portfolio is constructed with 50% of weight in value and 50% of weight in momentum. 75/25 portfolio is constructed with 75% of weight in momentum and 25% of weight in value. 25/75 is constructed with 25% of weight in momentum and 75% of weight in value. The sharpe ratio portfolio maximizes the sharpe ratio and the minimum variance portfolio minimizes the variance, the weights of value and momentum strategies for these two portfolios are updated in each sub-period.

Panel A

Portfolio		Financials					Consumer Svs			
	Expantion 1	Recession	Expantion 2	2002-2019	t.stat	Expantion 1	Recession	Expantion 2	2002-2019	t.stat
MOM9x3										
Average returns	1.56	-4.77	1.99	0.96	2.32	3.86	-3.9	1.79	1.49	
Sharpe ratio	0.1	-0.43	0.23	0.05		0.31	-0.39	0.18	0.12	3.53
Cummulative return	0.75	-1.29	2.36	1.82		1.85	-1.05	2.13	2.89	
Value										
Average returns	2.13	0.8	2.65	2.26	3.41	3.97	1.13	0.45	1.41	
Shape ratio	0.15	0.04	0.43	0.24		0.4	0.06	0	0.12	2.56
Cummulative return	1.02	0.22	3.15	0.24		1.91	0.31	0.53	2.74	
50/50										
Average returns	1.84	-1.98	2.32	1.6	5.6	3.91	-1.38	1.12	1.45	
Sharpe ratio	0.16	-0.35	0.45	0.18		0.42	-0.26	0.15	0.16	5.74
Cummulative return	0.88	-0.54	2.76	3.11		1.88	-0.37	1.33	2.82	
75/25										
Average returns	1.7	-3.38	2.15	1.27	4.92	0.04	-0.03	0.01	0.01	
Sharpe ratio	0.13	-0.42	0.33	0.11		0.37	-0.37	0.18	0.14	5.59
Cummulative return	0.82	-0.91	2.56	2.46		1.87	-0.71	1.73	2.85	
25/75										
Average returns	1.99	-0.59	2.48	1.93	5.44	3.94	-0.12	0.78	1.43	
Sharpe ratio	0.16	-0.16	0.48	0.23		0.43	-0.08	0.07	0.15	4.78
Cummulative return	0.95	-0.16	2.95	3.75		1.89	-0.03	0.93	2.78	
Maximum sharpe ratio										
Momentum	0.32	0	0.3	0.07		0.3	0	0.82	0.45	
Value	0.68	1	0.7	0.93		0.7	1	0.18	0.55	
Average return	1.94	0.8	2.45	2.17	3.67	3.94	1.13	1.55	1.45	5.64
Sharpe	0.16	0.04	0.48	0.24		0.43	0.06	0.18	0.16	
Cummelative return	0.93	0.22	2.92	4.22		1.89	0.31	1.85	2.81	
Minimum variance										
Momentum	0.5	0.3	0.38	0.39		0.31	0.46	0.45	0.45	
Value	0.5	0.7	0.62	0.61		0.69	0.54	0.55	0.55	
Average return	1.84	-0.89	2.4	1.75	5.54	3.94	-1.21	1.05	1.45	5.64
Sharpe ratio	0.16	-0.21	0.48	0.21		0.43	-0.24	0.14	0.16	
Cummelative return	0.89	-0.24	2.85	3.39		1.89	-0.33	1.24	1.72	

Table 5.18: Continued

Panel B

Portfolio		BRIC					India			
	Expantion 1	Recession	Expantion 2	2002-2019	t.stat	Expantion 1	Recession	Expantion 2	2002-2019	t.stat
MOM9x3										
Average returns	1.21	-2.7	1.19	0.64		-1.98	-0.45	2.26	0.83	
Sharpe ratio	0.08	-0.28	0.06	0.02	1.81	-0.25	-0.07	0.31	0.05	2.28
Cummulative return	0.58	-0.73	1.42	1.25		-0.95	-0.12	2.69	1.62	
Value										
Average returns	3.11	0.86	1.31	1.69		2.43	2.48	1.7	1.99	
Shape ratio	0.38	0.05	0.21	0.22	4.53	0.16	0.33	0.42	0.22	3.92
Cummulative return	1.49	0.23	1.55	3.28		1.16	0.67	2.03	3.86	
50/50										
Average returns	2.16	-0.92	1.24	1.17		0.23	1.02	1.98	1.41	
Sharpe ratio	0.25	-0.24	0.23	0.14	6.21	-0.03	0.07	0.43	0.17	6.07
Cummulative return	1.04	-0.25	1.48	2.26		0.11	0.27	2.36	2.74	
75/25										
Average returns	1.68	-1.81	1.21	0.9		-0.88	0.28	2.12	1.12	
Sharpe ratio	0.15	-0.28	0.16	0.07	5.36	-0.17	-0.02	0.36	0.1	5.43
Cummulative return	0.81	-0.49	1.44	1.76		-0.42	0.08	2.52	2.18	
25/75										
Average returns	2.63	-0.03	1.27	1.43		1.33	1.75	1.84	1.7	
Sharpe ratio	0.34	-0.09	0.25	0.21	6.01	0.01	0.2	0.48	0.22	5.74
Cummulative return	1.26	-0.01	1.51	2.77		0.64	0.47	2.19	3.3	
Maximum sharpe ratio										
Momentum	0	0	0.31	0.07		0	0	0.23	0.11	
Value	1	1	0.69	0.93		1	1	0.77	0.89	
Average return	3.11	0.86	1.27	1.61	4.93	2.43	2.48	1.83	1.86	5.74
Sharpe	0.38	0.05	0.25	0.22		0.16	0.33	0.48	0.23	
Cummelative return	1.49	0.23	1.51	3.13		1.16	0.67	2.18	3.62	
Minimum variance										
Momentum	0.28	0.86	0.33	0.32		0.6	0.05	0.14	0.4	
Value	0.72	0.14	0.67	0.68		0.4	0.95	0.86	0.6	
Average return	2.57	-2.19	1.26	1.34	6.12	-0.22	2.34	1.78	1.53	5.91
Sharpe ratio	0.33	-0.28	0.25	0.19		-0.09	0.31	0.47	0.2	
Cummelative return	1.24	-0.59	1.5	2.6		-0.11	0.63	2.12	2.97	

5.6 Value strategy and asset pricing model

In the following three tables 5.19 - 5.21, the results of the eight regressions of the value strategy for BRIC and seven sectors are presented. We run regressions using Fama French three factors model, Carhart 4 factors model, and Carhart 4 factors plus liquidity factor model from July 2002 until June 2019 for the ten decile portfolios and zero cost HML portfolios.

The following tables show that the majority of the decile value portfolios yield positive and significant alphas. For example, alpha for BRIC is 1.1% from all the three asset pricing models, meaning that investment on this sector has generated 1.1% higher return than the market, MSCI BRIC index in our case, during the period July 2002 to June 2019. Furthermore, 3 out of 8 alphas of the HML portfolios are statistically significant, indicating that these 3 zero cost portfolios generate abnormal returns, the rest of the HML portfolios do not generate excess returns above the compensation for the risk exposures. For example, Oil and Gas sector generates an alpha of 1.6%; this is a joint result of the positive and significant value premium generated by the high book-to-market value portfolio and the negative and non-significant value premium generated by the low book-to-market value portfolio. Also, the general trend is that the majority of the alphas obtained from Fama French 3 factors model, Carhart 4 factors model, and Carhart 4 factors plus liquidity factor model are the same and the statistical significance for alphas increase with additional factors. However, there are minor differences for certain alphas, they become either bigger or smaller with additional factors. For example, among the three zero-cost HML portfolios which generate positive and significant alphas with the Fama French 3 factors asset pricing model, the alpha remains positive and significant only for one HML portfolio with the Carhart 4 factors model plus liquidity factor asset pricing model, this indicates that additional risk factors capture excess returns not explained by the existing risk factors. We could not conclude for sure that the efficient market hypothesis (EMH) does not hold and market prices do not incorporate all available information, there might be some unknown risk factors which explain these positive and significant alphas obtained.

We divide further the whole period into the three sub-periods stated in previous sections to check whether the alphas generated change over time, the results show that no one of the 8 HML portfolios generate alphas with all the three asset pricing factor models

during the recession period, however, for some sectors which do not generate positive and significant alphas, they generate alphas during one of the expansion periods, this further confirms the fact that value strategy has better performance in bull market.

Table 5.19: Fama French 3 factors model

Table 5.19 shows alphas issued from Fama French 3 factors model regression on the excess returns of the ten decile value portfolios plus the HML value portfolio for BRIC and eight cross-country sectors during the period July 2002 to June 2019. Table 5.20 shows alphas issued from Carhart 4 factors model regression on the excess returns of the ten decile value portfolios plus the HML value portfolio for BRIC and eight cross-country sectors during the period from July 2002 to June 2019. Table 5.21 shows alphas issued from Carhart 4 factors plus liquidity factor model regression on the excess returns of the ten decile value portfolios plus the HML value portfolio for BRIC and eight cross-country sectors during the period July 2002 to June 2019. At the end of June year t, stocks are divided into ten decile portfolios based on their book-to-market ratio at December year t-1. HML is the zero-cost portfolio that is constructed by buying stocks in the highest decile and short selling stocks in the lowest decile. T-statistics are presented in the bracket under the value of the alphas. * means that alpha is statistically significant at 10% level; ** means that alpha is statistically significant at 5% level, *** means that alpha is statistically significant at 1% level.

	Low	2	3	4	5	6	7	8	9	High	HML
BRIC	0.6	1.3**	1.6***	1.7	1.7	1.4**	0.9*	0.6	0.6**	1.1***	0.5*
	(1.63)	(2.33)	(2.76)	(3.00)	(2.97)	(2.57)	(1.90)	(1.56)	(2.24)	(3.73)	(1.72)
Basic Mats	0.8*	1.2**	1.8***	1.9***	1.9***	1.2**	1.0**	0.6	0.5	1.1***	0.3
	(1.76)	(1.98)	(2.70)	(2.88)	(3.10)	(2.13)	(1.97)	(1.41)	(1.32)	(2.90)	(0.79)
Consumer Gds	0.5	1.2**	1.4**	1.8***	1.9***	1.4**	1.0*	0.5	0.3	0.8**	0.3
	(1.49)	(2.14)	(2.37)	(2.85)	(3.11)	(2.33)	(1.76)	(1.05)	(0.99)	(2.29)	(0.80)
Consumer Svs	0.7	0.8	1.0*	1.3**	1.6***	1.7***	1.3**	1.5**	0.7	0.8**	0.1
	(1.53)	(1.48)	(1.72)	(2.20)	(2.81)	(2.68)	(2.15)	(2.42)	(1.49)	(2.14)	(0.26)
Industrials	0.8*	1.6***	1.6***	1.8***	1.8***	1.8***	1.3**	0,6	0.8*	1.1***	0.3
	(1.93)	(2.60)	(2.71)	(3.15)	(2.85)	(2.98)	(2.33)	(1.29)	(1.82)	(3.22)	(0.79)
Financial	-0.03	1.2**	1.4**	1.5**	1.6***	1.4**	0,7	0.8*	1.3***	1.0***	1.1**
	(-0.05)	(2.02)	(2.45)	(2.46)	(2.81)	(2.38)	(1.33)	(1.69)	(3.46)	(3.00)	(2.32)
Oil and Gas	-0.3	1.2**	1.2**	0.9	0.7	0.5	0.2	1.5**	1.5**	1.3*	1.6*
	(-0.46)	(2.06)	(2.05)	(1.41)	(1.14)	(0.91)	(0.45)	(2.58)	(2.14)	(1.88)	(1.65)
Utilities	1.1**	1.1**	1.6***	1.6***	0.8	1**	1.0*	1.0*	1.1**	1.7***	0.6
	(2.27)	(2.05)	(2.74)	(2.74)	(1.62)	(1.99)	(1.92)	(1.92)	(2.13)	(3.20)	(1.02)

Table 5.20: Carhart 4 factors model

	Low	2	3	4	5	6	7	8	9	High	HML
BRIC	0.6*	1.3**	1.6***	1.7***	1.7***	1.4***	0.9**	0.7	0.6**	1.1***	0.5*
	(1.73)	(2.40)	(2.82)	(3.05)	(3.03)	(2.64)	(2.00)	(1.64)	(2.25)	(3.75)	(1.79)
Basic Mats	0.8*	1.2**	1.8***	1.9***	1.9***	1.2**	1.0**	0.6	0.5	1.1***	0.3
	(1.82)	(2.03)	(2.74)	(2.94)	(3.15)	(2.19)	(2.02)	(1.46)	(1.34)	(2.92)	(0.79)
Consumer Gds	0.5	1.2**	1.4**	1.8***	1.9***	1.4**	1.0*	0.5	0.3	0.8**	0.3
	(1.54)	(2.19)	(2.44)	(2.91)	(3.17)	(2.39)	(1.84)	(1.11)	(1.00)	(2.29)	(0.80)
Consumer Svs	0.7	0.9	1.0*	1.3**	1.6***	1.7***	1.3**	1.5**	0.7	0.8**	0.1
	(1.57)	(1.52)	(1.78)	(2.26)	(2.87)	(2.72)	(2.18)	(2.47)	(1.54)	(2.14)	(0.26)
Industrials	0.8**	1.6***	1.6***	1.9***	1.8***	1.8***	1.3**	0.7	0.8*	1.1***	0.3
	(2.09)	(2.66)	(2.76)	(3.18)	(2.90)	(3.03)	(2.42)	(1.34)	(1.89)	(3.22)	(0.82)
Financial	-0.02	1.2**	1.4**	1.5**	1.6***	1.4**	0,7	0.8*	1.3***	1.0***	1.1**
	(-0.05)	(2.09)	(2.53)	(2.54)	(2.90)	(2.48)	(1.43)	(1.78)	(3.50)	(3.00)	(2.38)
Oil and Gas	-0.3	1.2**	1.2**	0,9	0.7	0.5	0.2	1.5**	1.5**	1.3*	1.6*
	(-0.48)	(2.10)	(2.06)	(1.42)	(1.17)	(0.92)	(0.46)	(2.58)	(2.14)	(1.90)	(1.75)
Utilities	1.1**	1.1**	1.6***	1.6***	0.8*	1.0**	1.0*	1.0*	1.1**	1.7***	0.6
	(2.33)	(2.12)	(2.76)	(2.76)	(1.65)	(2.04)	(1.92)	(1.92)	(2.1)	(3.19)	(1.03)

Table 5.21: Carhart 4 factors plus liquidity factor model

	Low	2	3	4	5	6	7	8	9	High	HML
BRIC	0.7*	1.4**	1.7***	1.8***	1.8***	1.4**	0.9*	0,7	0.7**	1.1***	0.4
	(1.96)	(2.54)	(2.93)	(3.15)	(3.09)	(2.57)	(1.95)	(1.63)	(2.33)	(3.77)	(1.59)
Basic Mats	0.9**	1.3**	1.8***	2.0***	1.9***	1.2**	1.0*	0.6	0.6	1.2***	0.4
	(2.08)	(2.10)	(2.73)	(3.11)	(3.03)	(2.14)	(1.97)	(1.44)	(1.53)	(3.13)	(0.83)
Consumer Gds	0.6*	1.3**	1.5***	2.0***	2.0***	1.4**	1.0*	0.5	0.4	0.8**	0.2
	(1.87)	(2.40)	(2.62)	(3.13)	(3.25)	(2.31)	(1.73)	(1.15)	(1.16)	(2.25)	(0.57)
Consumer Svs	0.8*	1.0*	1.1*	1.5**	1.7***	1.7***	1.4**	1.4**	0.8	0.8**	0.04
	(1.84)	(1.84)	(1.97)	(2.51)	(2.96)	(2.72)	(2.34)	(2.30)	(1.58)	(1.97)	(0.08)
Industrials	0.8**	1.7***	1.7***	1.9***	1.9***	1.9***	1.3**	0.7	0.8*	1.2***	0.3
	(2.12)	(2.78)	(2.94)	(3.21)	(2.95)	(3.06)	(2.35)	(1.37)	(1.84)	(3.39)	(0.83)
Financial	-0.02	1.2**	1.3**	1.5**	1.6***	1.3**	0.7	0.7	1.3***	1.0***	1.1**
	(-0.05)	(2.03)	(2.35)	(2.48)	(2.71)	(2.39)	(1.32)	(1.62)	(3.67)	(3.00)	(2.38)
Oil and Gas	-0.03	1.3**	1.3**	1.1*	0.6	0.5	0.2	1.4**	1.6**	1.0	1.3
	(-0.04)	(2.22)	(2.23)	(1.66)	(1.09)	(0.91)	(0.54)	(2.29)	(2.20)	(1.39)	(1.45)
Utilities	1.1**	1.2**	1.6***	1.6**	0.8	1.1**	0.8	0.8	1.2**	1.7***	0.6
	(2.34)	(2.27)	(2.69)	(2.69)	(1.54)	(2.04)	(1.54)	(1.54)	(2.35)	(3.13)	(0.98)

5.7 Momentum strategy and asset pricing model

In the following three tables 5.22 - 5.24, results of the regressions of the momentum strategy on the three asset pricing models for BRIC, Brazil, India and two other sectors are presented, these countries and sectors obtain the highest momentum premium. We run asset pricing model regressions using Fama French three factors model, Carhart 4 factors and Carhart 4 factors plus illiquidity factor model from July 2002 until June 2019 for the ten decile portfolios and zero cost HML portfolio.

The three tables below show that most of the alphas generated from all the three asset pricing models, by the portfolios in the 4th decile and above are positive and statistically significant. Alphas generated by all the 6 HML portfolios are positive and statistically

significant using Fama French 3 factors and Carhart 4 factors pricing model. When the illiquidity factor model is included, only 3 out of the six alphas generated remain positive and statistically significant. For example, alpha for the financial sector decreases from 1.3% using Fama French 3 factors model to 1.1% using Carhart 4 factors model and to 0.80% using Carhart 4 factors plus illiquidity factor model due to the decrease of momentum premium of the portfolio that we long and the increase of momentum premium of the portfolio that we short sell. This further indicates that momentum investing in the financial sector has risk exposures to the two additional risk factors and the momentum premium is not only a compensation for the risk factors, the momentum strategy for financial sector generates abnormal returns.

We divide further the whole period into the three sub-periods stated in previous sections to check whether the alphas generated change over time. As with the value strategy, the results show that no one of the six Winners minus Losers portfolios generate alphas using all the three asset pricing factor models during the recession period. Most of the portfolios generate alphas during the second expansion periods, indicating that the stock prices move in the same direction during this period.

Table 5.22: Fama French 3 factors model

Table 5.22 shows alphas issued from Fama French 3 factors model regression on the excess returns of the ten decile momentum portfolios plus the WML portfolio for BRIC, Brazil, India, and three sectors during the period from July 2002 to June 2019. Table 5.23 shows alphas issued from Carhart 4 factors model regression on the excess returns of the ten decile momentum portfolios plus the WML momentum portfolio for BRIC, Brazil, India and three sectors during the period July 2002 to June 2019. Table 5.24 shows alphas issued from Carhart 4 factors plus liquidity factor model regression on the excess returns of the ten decile momentum portfolios plus the WML momentum portfolio for BRIC, Brazil, India and three sectors during the period July 2002 to June 2019. All the portfolios are constructed using overlapping holding period, at each month M in year t, for the 3 MOM 9X3 portfolios, stocks are divided into ten deciles based on their past nine months' cumulative returns, and formed portfolios are held for three months; for the MOM 12X3 portfolio, stocks are divided into ten deciles based on their past 12 months' cumulative return and formed portfolios are held for three months; for the MOM 3X3 portfolio, stocks are divided into ten deciles based on their past three months' cumulative returns and formed portfolios are held for three months, one month is skipped between the holding period and the formation period. WML is the zero-cost portfolio that is constructed by buying stocks in the highest decile and short selling stocks in the lowest decile. T-statistics are presented in the bracket under the value of the alphas. * means that the return is statistically significant at the 10% level; ** means that the return is statistically significant at the 5% level, *** means that the return is statistically significant at the 1% level.

	Losers	2	3	4	5	6	7	8	9	Winners	WML
MOM9x3											
BRIC	0.6	0.5	0.5	0.7**	1.1**	1.5***	1.7***	1.7***	1.7***	1.7***	1.1*
	(1.3)	(1.04)	(1.18)	(1.98)	(3.14)	(3.72)	(4.01)	(3.74)	(3.42)	(3.53)	(1.77)
Consumer Gds	0.3	0.2	0.4	0.6*	1.1***	1.5***	1.8***	1.6***	1.8***	1.4***	1.1*
	(0.62)	(0.51)	(1.03)	(1.78)	(3.01)	(3.75)	(4.24)	(3.24)	(3.43)	(2.91)	(1.79)
Financials	0.7	0.4	0.4	0.7	0.8**	1.3***	1.3***	1.6***	1.4***	2.0***	1.3*
	(1.25)	(0.78)	(0.97)	(1.63)	(2.14)	(3.07)	(3.23)	(3.89)	(3.09)	(3.96)	(1.94)
India	0.3	0.2	0.4	0.6*	1.1***	1.5***	1.8***	1.6***	1.8***	1.4***	1.1*
	(0.62)	(0.51)	(1.03)	(1.78)	(3.01)	(3.75)	(4.24)	(3.24)	(3.43)	(2.91)	(1.79)
MOM12x3											
Consumer Svs	-0.1	0.7	0.7	1.0**	1.3***	1.3***	1.4***	1.5***	1.5***	1.9***	2.0***
	(-0.27)	(1.49)	(1.45)	(2.09)	(2.75)	(2.76)	(2.93)	(3.06)	(2.92)	(3.29)	(2.82)
MOM3x3											
Brazil	0.9	0.9	0.3	-0.2	-0.3	-0.1	0.4	0.8*	1.2**	1.4**	0.5**
	(1.29)	(1.46)	(0.66)	(-0.38)	(-0.86)	(-0.33)	(0.97)	(1.66)	(2.04)	(2.34)	(2.00)

Table 5.23: Carhart 4 factors model

	Losers	2	3	4	5	6	7	8	9	Winners	WML
MOM9x3											
BRIC	0.8*	0.6	0.6	0.8**	1.1***	1.5***	1.7***	1.6***	1.6***	1.6***	0.8**
	(1.81)	(1.56)	(1.63)	(2.41)	(3.25)	(3.72)	(3.97)	(3.74)	(3.49)	(3.69)	(2.27)
Consumer Gds	0.5	0.4	0.5	0.7**	1.1***	1.4***	1.8***	1.6***	1.7***	1.4***	0.9**
	(1.01)	(0.88)	(1.38)	(2.09)	(3.06)	(3.71)	(4.21)	(3.23)	(3.48)	(2.95)	(2.17)
Financials	0.8	0.5	0.5	0.8**	0.9**	1.3***	1.3***	1.6***	1.4***	1.9***	1.1**
	(1.60)	(1.27)	(1.44)	(2.07)	(2.43)	(3.13)	(3.20)	(3.86)	(3.11)	(4.12)	(2.20)
India	0.5	0.4	0.5	0.7**	1.1***	1.4***	1.8***	1.6***	1.7***	1.4***	0.9**
	(1.01)	(0.88)	(1.38)	(2.09)	(3.06)	(3.71)	(4.21)	(3.23)	(3.48)	(2.95)	(2.17)
MOM12x3											
Consumer Svs	0.03	0.9**	0.8*	1.0**	1.4***	1.4***	1.4***	1.4***	1.4***	1.7***	1.7***
	(0.07)	(2.23)	(1.92)	(2.37)	(2.88)	(2.82)	(2.89)	(3.00)	(2.89)	(3.41)	(4.07)
MOM3x3											
Brazil	0.9	0.9	0.3	-0.1	-0.3	-0.1	0.4	0.8*	1.2**	1.4**	0.5*
	(1.34)	(1.52)	(0.70)	(-0.34)	(-0.81)	(-0.30)	(1.00)	(1.69)	(2.07)	(2.36)	(1.96)

Table 5.24: Carhart 4 factors plus liquidity factor

	Losers	2	3	4	5	6	7	8	9	Winners	WML
MOM9x3											
BRIC	0.9**	0.7*	0.6*	0.8**	1.2***	1.5***	1.6***	1.6***	1.5***	1.5***	0,6
	(2.16)	(1.79)	(1.7)	(2.57)	(3.32)	(3.66)	(3.87)	(3.58)	(3.32)	(3.42)	(1.64)
Consumer Gds	0.6	0.4	0.6	0.7**	1.1***	1.5***	1.8***	1.6***	1.7***	1.3***	0.7
	(1.33)	(1.07)	(1.51)	(2.20)	(3.11)	(3.71)	(4.12)	(3.14)	(3.35)	(2.74)	(1.64)
Financials	1.0*	0.6	0.6	0.8**	0.9**	1.3***	1.2***	1.5***	1.3***	1.8***	0.8*
	(1.90)	(1.53)	(1.62)	(2.22)	(2.43)	(3.02)	(3.02)	(3.59)	(2.84)	(3.81)	(1.65)
India	0.6	0.4	0.6	0.7**	1.1***	1.5***	1.8***	1.6***	1.7***	1.3***	0.7
	(1.33)	(1.07)	(1.51)	(2.20)	(3.11)	(3.71)	(4.12)	(3.14)	(3.35)	(2.74)	(1.64)
MOM12x3											
Consumer Svs	0.6	1.4***	1.4***	1.6***	1.9***	1.9***	1.8***	1.9***	1.9***	2.3***	1.7***
	(1.35)	(3.46)	(3.21)	(3.49)	(3.75)	(3.72)	(3.73)	(3.90)	(3.85)	(4.46)	(4.02)
MOM3x3											
Brazil	0.7	0.7	0.2	-0.2	-0.3	-0.1	0.4	0.8	1.1*	1.4**	0.7**
	(0.99)	(1.24)	(0.46)	(-0.49)	(-0.94)	(-0.38)	(0.96)	(1.54)	(1.91)	(2.20)	(2.60)

5.8 5x5 cross-sectional portfolios and asset pricing model

In the following three table 5.25 - 5.27, the results of the three regressions of the 5X5 cross-sectional portfolios for all the BRIC countries as a whole are presented. We run asset pricing model regressions using Fama French three factors model, Carhart 4 factors and Carhart 4 factors plus the liquidity factor model from July 2002 until June 2019 for the 25 cross-sectional portfolios.

The following tables show that 18 out of the 25 cross-sectional portfolios generate positive and statistically significant alphas using all the three asset pricing models. We expect the High X4 portfolio to generate the highest and most significant alpha because this is the best performing cross-sectional portfolio. However, we observe that the highest alphas are

not yielded by portfolios comprised of stocks with the highest book-to-market value and the highest past cumulative returns, but rather the portfolios consisting of stocks in the second value decile and the second and third momentum quantile along with the portfolio in the third value decile and the second momentum quantile. Furthermore, we observe that most of the cross-sectional portfolios generate higher alphas than the alphas obtained by zero-cost portfolios with the fair value and pure momentum strategies, indicating that the cross-sectional combination of value and momentum strategy portfolios generate risk-adjusted returns higher than the market return and they outperform both value and momentum strategy alone. We observe that the alphas generated and statistical significance become either bigger or smaller with additional factors and statistical significance increase.

Table 5.25: Fama French 3 factors model

Table 5.25 shows alphas issued from Fama French 3 factors model regression on the excess returns of the 25 double sorted portfolios on value and momentum for BRIC during the period from July 2002 to June 2019. Table 5.26 shows alphas issued from Carhart 4 factors model regression on the excess returns of the 25 double sorted portfolios on value and momentum for BRIC during the period July 2002 to June 2019. Table 5.27 shows alphas issued from Carhart 4 factors plus liquidity factor model regression on the excess returns of the 25 double sorted portfolios on value and momentum for BRIC during the period July 2002 to June 2019. At the end of June year t, stocks are firstly sorted into five quintile portfolios based on their book-to-market ratio at December year t-1 and stocks within each of the formed quintile portfolio are sorted again based on their past cumulative returns from June year t-1 to May year t into five quintile portfolios. One month is skipped between the formation and holding period. In this way, we create 5X5, 25 double sorted portfolios and they are held for one year. T-statistics are presented in the bracket under the value of the alphas. * means that the return is statistically significant at the 10% level; ** means that the return is statistically significant at 5% level, *** means that the return is statistically significant at 1% level.

Value		Momentum quantile			
quantile	Losers	2	3	4	Winners
Low	0.5	1.3**	0.9**	1.2**	1.0**
	(0.86)	(2.42)	(2.21)	(2.47)	(2.03)
2	1.4**	1.7***	1.7***	1.6***	0.9
	(2.30)	(3.04)	(3.09)	(2.76)	(1.42)
3	1.0*	1.7***	1.5***	1.6***	1.1**
	(1.80)	(3.02)	(2.87)	(2.96)	(2.19)
4	0.4	1.1**	0.8*	0,5	0.7
	(0.78)	(2.26)	(1.78)	(1.27)	(1.58)
High	0.7	0.6	0.8**	1.1***	0.9***
	(1.58)	(1.60)	(2.59)	(3.37)	(2.66)

Table 5.26: Carhart 4 factors model

Value		Momentum quantile			
quantile	Losers	2	3	4	Winners
Low	0.5	1.3**	0.9**	1.2**	1.0**
	(0.96)	(2.56)	(2.25)	(2.48)	(2.03)
2	1.4**	1.7***	1.7***	1.6***	0.9
	(2.46)	(3.15)	(3.13)	(2.76)	(1.42)
3	1.0*	1.7***	1.6***	1.6***	1.1**
	(1.96)	(3.16)	(2.93)	(2.97)	(2.18)
4	0.4	1.1**	0.8*	0.6	0.7
	(0.86)	(2.41)	(1.84)	(1.29)	(1.57)
High	0.7	0.6	0.8**	1.1***	0.9***
	(1.63)	(1.64)	(2.59)	(3.36)	(2.65)

Table 5.27: Carhart 4 factors plus liquidity factor model

Value		Momentum quantile			
quantile	Losers	2	3	4	Winners
Low	0.5	1.3***	1.0**	1.3**	1.0**
	(1.04)	(2.61)	(2.24)	(2.53)	(2.15)
2	1.5**	1.8***	1.8***	1.6***	0.9
	(2.55)	(3.17)	(3.18)	(2.75)	(1.46)
3	1.1**	1.8***	1.6***	1.6***	1.1**
	(2.00)	(3.22)	(2.95)	(2.85)	(2.16)
4	0.4	1.1**	0.8*	0.5	0.7
	(0.83)	(2.36)	(1.80)	(1.17)	(1.58)
High	0.7	0.6	0.7**	1.1***	0.9***
	(1.64)	(1.55)	(2.44)	(3.20)	(2.72)

5.9 Weighted combination portfolios and asset pricing model

In the following three tables, results of the three regressions on the weighted combination portfolios of value and momentum (50/50, 75/25 and 25/75) for BRIC as a whole, India, consumer services sector and financial sector are presented. We run asset pricing model regressions using Fama French 3 factors model, Carhart 4 factors model and Carhart 4 factors plus the liquidity factor model from July 2002 until June 2019.

The following table 5.28 shows that among the four 50/50 weighted combinations of value and momentum portfolios, only India generates positive and significant alphas using all the 3 asset pricing models, meaning that the weighted combination portfolios for

India generate abnormal returns after controlling for the risk factors. Among the four 25/75 weighted combinations of value and momentum portfolios, India and consumer services sector generate positive and statistically significant alphas. Among the four 75/25 weighted combinations of value and momentum portfolios, only India generates positive and significant alphas. Furthermore, alphas and t-statistics are reduced when using carhart 4 factors plus liquidity model. We observe further that for India, alphas obtained by the weighted combination of value and momentum portfolios are higher than alphas obtained with pure momentum strategy portfolio. However, for consumer services, alphas obtained by the weighted combination of value and momentum portfolios are lower than the pure momentum strategy portfolio and alphas obtained by the weighted combination of value and momentum portfolios are lower than the pure value strategy portfolio. Therefore, we can not say with certainty that the weighted combination of value and momentum strategies are better than either value or momentum strategy alone.

Table 5.28: Alphas of the weighted combination portfolios

Table 5.28 shows alphas issued from Fama French 3 factors model, Carhart 4 factors model and Carhart 4 factors plus liquidity factor model regressions on the weighted combination portfolios for BRIC as a whole, India, consumer services sector and financial sector, during the period from July 2002 to June 2019. Panel A shows alphas for the 50/50 weighted combination portfolios of value and momentum. Panel B shows alphas of the 25/75 weighted combination portfolios of value and momentum. Panel C shows alphas of the 75/25 weighted combination portfolios of value and momentum. * means that alpha is statistically significant at 10% level; ** means that alpha is statistically significant at 5% level, *** means that alpha is statistically significant at 1% level.

	BRIC	India	Consumer svs	Financials
Panel A: 50/50				
Fama French 3 factors model	0.4	1.3***	0.6	0.8*
	(1.07)	(3.44)	(1.34)	(1.77)
Carhart 4 factors model	0.2	1.3***	0.5	0.7*
	(1.13)	(3.51)	(1.43)	(1.91)
Carhart 4 factors plus	0.1	1.2***	0.3	0.5
liquidity factor model	(0.46)	(3.25)	(1.03)	(1.43)
Panel B: 25/75				
Fama French 3 factors model	0.5	1.2***	1.0***	0.9
	(1.14)	(2.63)	(3.54)	(1.62)
Carhart 4 factors model	0.4	1.1***	1.0***	0.7*
	(1.28)	(2.67)	(3.50)	(1.78)
Carhart 4 factors plus	0.2	0.9**	1.1***	0.5
liquidity factor model	(0.58)	(2.28)	(3.60)	(1.22)
Panel C: 75/25				
Fama French 3 factors model	0.2	1.9***	0.1	0.7*
	(0.80)	(4.71)	(0.24)	(1.73)
Carhart 4 factors model	0.1	1.9***	0.0	0.6*
	(1.28)	(4.73)	(0.01)	(1.72)
Carhart 4 factors plus	0.04	1.9***	-0.1	0.5
liquidity factor model	(0.20)	(4.66)	(-0.27)	(1.40)

5.10 Fama MacBeth and momentum premiums

Some of the explanations related to value and momentum premium are behavioural. Moskowitz (2010) wrote that the under or overreaction to firm's announcement causes the prices to be driven away from the fundamentals. As a consequence, the momentum premium is short-lived, because, in the long run, prices are corrected to the levels implicated by their fundamentals. Some studies have other risk-based explanations. Asness (1997) found that the momentum premium is larger for firms with risky cash flows and growth firms. Asness, Moskowitz and Pedersen (2013) found that liquidity risk is one explanation for the momentum premium. The asset pricing theory uses risk factors in order to explain the returns of financial assets. These risk factors can be macroeconomic factors (for example, inflation rate or unemployment rate) and financial factors (for example, the size of an enterprise, etc.). The method of Fama Macbeth two stages' regression is a practical method to test how these factors explain the returns of these assets. It enables us to calculate the risk premiums related to each of these factors.

Table 5.29 below shows the results of the second step of Fama MacBeth regression. Forty momentum premiums are regressed on the seven betas obtained from the first step of Fama MacBeth regressions. Results of the first step of Fama MacBeth shows that the size factor has a positive relationship with the momentum premium and liquidity risk and recession factor has a negative relationship with the risk premium, but these results will not be presented here since the size of the results is very large. The following table shows that we obtain significant coefficients only using the model including all the factors. We observe that all the risk premiums obtained are significant except for the risk premiums related to High minus Low and GDP growth factor. For example, the risk premium related to Small minus Big factor is positive, meaning that if the sensibility to the SMB factor increases by 1%, the momentum premium will be increased by 0.029% and he risk premium related to the funding liquidity risk factor (IRSTB) is negative, meaning that if the sensibility to the funding liquidity risk factor increases by 1%, the momentum premium should be decreased by 0,029%.

Table 5.29: Fama-MacBeth Cross-Sectional Regressions

Table 5.29 shows the cross-sectional regression coefficient estimates from the second step of the Fama MacBeth regression. The average returns of 40 momentum portfolios are regressed on the 7 beta estimates obtained from the first step regression using a rolling window over the past 3 years of returns. β_{SMB} is the beta estimate of the Small minus Big factor; β_{HML} is the beta estimate of the High minus Low factor; β_{ILLIQ} is the beta estimate of the liquidity factor; β_{IRSTB} is the beta estimate of the Interest rate swaps minus T-Bills factor; β_{TS} is the beta estimate of the 10 year government bonds minus 3 months Treasury bills factor; β_{GDP} is the beta estimate of the GDP growth factor; β_{REC} is the beta estimate of the recession factor. T-statistics are presented in the bracket under the value of the alphas. * means that the return is statistically significant at the 10% level; ** means that the return is statistically significant at 5% level, *** means that the return is statistically significant at 1% level.

	(1)	(2)	(3)	(4)
Intercept	0.001	0.001	0.0002	-0.036**
	(0.674)	(0.574)	(0.070)	(-2.282)
β_{SMB}	0.103	0.089	0.087	2.938**
	(0.91)	(0.679)	(0.668)	(2.244)
β_{HML}	-0.194	-0.204	-0.218	-0.698
	(-1.356)	(-1.344)	(-1.428)	(-0.880)
β_{ILLIQ}		0.003	0.006	-0.308**
		(0.208)	(0.371)	(-2.232)
β_{IRSTB}			-0.085	-2.893***
			(-1.103)	(-3.072)
β_{TS}				2.299***
				(3.923)
β_{GDP}				0.010
				(0.212)
β_{REC}				-0.917***
				(-4.788)

5.11 Residual returns and momentum

Blitz, Huij and Marten (2011) found that they obtain the same momentum premium using residual returns compared with total returns, but the risk is halved with residual momentum, meaning that the residual momentum generates risk-adjusted profits which are about twice larger than the total momentum. Table 5.30 shows that residual momentum strategy generates higher momentum premium both for BRIC countries as a whole and for China. For China, the total return momentum strategy using overlapping holding period generates no momentum premium which is positive and statistically significant. However,

three momentum strategies (MOM9X12, MOM12X9 and MOM12X12) yield negative and statistically significant excess return. The residual return momentum strategy MOM12X3 for China generates a positive and statistically significant momentum premium of 0.49%. Almost all the other momentum premiums are positive as well but statistically insignificant, this is due to the tiny difference between returns generated from the losers portfolio and the winners portfolio. For BRIC countries as a whole, only one of the 16 winners minus losers portfolio with the total return momentum strategy using overlapping holding period generates positive and significant momentum premium of 0.65%. Two residual momentum strategy for BRIC as a whole generate positive and statistically significant momentum premiums: MOM 9X3 yields momentum premiums of 0.81%, which is 0.16% higher than the excess returns yielded with total return momentum strategy, MOM12X3 yields momentum premiums of 0.60%. More of the winners minus losers portfolios generate positive excess returns using residual return momentum strategy compared with total return momentum strategy, the level of the excess returns is also higher with residual return momentum strategy. Furthermore, just as with the total momentum strategy, it is strategies with long formation period and short holding period which have better performance.

We have further compared sharp ratios of residual return momentum strategy with that of total return momentum strategy. The result shows that the residual return momentum strategy have Sharpe ratios higher than total return momentum strategy, this is due to the low volatility of the residual momentum. In fact, we find that the volatility of the residual return momentum strategy is about 40% less than that of the total return momentum strategy. Thus, using volatility adjusted residual returns for momentum strategy tackles the problem that higher return stocks also have higher risk. By using volatility adjusted residual returns for the formation of the decile portfolios, we take both risk and return into consideration. We could draw the conclusion that volatility adjusted residual return momentum strategy yields higher risk-adjusted returns than total return momentum strategy.

Table 5.30: Residual returns and momentum strategy - Overlapping holding period

Table 5.30 shows the equal weighted average monthly returns (in percentage) of the 16 momentum strategies, formed on volatility adjusted residual returns during the period from January 2002 to June 2019, for BRIC as a whole and China. These 16 portfolios are constructed with different formation periods(F= 3,6,9,12) and holding periods (H=3,6,9,12). At the end of month M, stocks are divided into deciles based on their past F months' volatility adjusted residual returns, we skip one month between the formation and the holding period. With the overlapping holding periods, we rebalance each month 1/H of the total portfolios and hold the rest of stocks formed in the previous months. The formed portfolios are held for H months and equal weighted returns are calculated at the end of the holding period. Losers represent portfolios consisting of stocks with the lowest past cumulative returns and winners represent portfolios consisting of stocks with the highest past cumulative returns. WML portfolio (winners minus losers) is constructed by buying stocks in the winners portfolio and short selling stocks in the losers portfolio. T-statistics are presented in the bracket under the value of the returns. * means that the return is statistically significant at 10% level; ** means that the return is statistically significant at 5% level, *** means that the return is statistically significant at 1% level.

		BRIC				China			
F	H=	3	6	9	12	3	6	9	12
3 Sell (Losers)		2.51	1.17	0.82	0.67	1,7	1,71	1,82	1,87
		(6.76)	(4,08)	(3,33)	(2.46)	(3.79)	(3,66)	(3,96)	(4,1)
3 Buy (Winners)		2.11	1,05	0.90	0.78	1,72	1,74	1,85	1,89
		(5.89)	(3.69)	(3.99)	(3.05)	(3,83)	(3,89)	(4,13)	(4,22)
3 Buy-sell (WML)		-0,39	-0.12	0.08	0.11	0,02	0,03	-0,03	0,02
		(-1.21)	(-1.33)	(1.02)	(1.22)	(0,17)	(0,92)	(0,31)	(0,24)
6 Sell (Losers)		2.15	0.86	0.89	0.63	1,65	1,73	1,86	1,94
		(6.07)	(3.51)	(3.69)	(2.98)	(5,17)	(5,24)	(5,74)	(5,9)
6 Buy (Winners)		2.20	0.87	0.95	0.69	1,73	1,82	1,9	1,94
		(6,38)	(3,45)	(4.06)	(3.86)	(5,41)	(5,57)	(5,97)	(6,01)
6 Buy-sell (WML)		0.05	0.01	0.06	0.06	0,08	0,09	0,03	0
		(0.89)	(0.23)	(0.94)	(0.94)	(1,13)	(1,38)	(0,51)	(0,03)
9 Sell (Losers)		1.78	1.03	0.77	0.69	1,75	1,85	1,96	2,05
		(4.79)	(3.75)	(2.99)	(2.74)	(6,51)	(6,79)	(7,12)	(7,35)
9 Buy (Winners)		2.59	1.21	0.96	0.70	1,83	1,92	1,98	2,04
		(6.89)	(4.33)	(3.85)	(2.98)	(6,84)	(7,17)	(7,31)	(7,44)
9 Buy-sell (WML)		0.81**	0.18	0.19	0.01	0,08	0,08	0,01	-0,01
		(2.03)	(1.31)	(1.39)	(0.24)	(1,36)	(1,32)	(0,28)	-(0,24)
12 Sell (Losers)		1.59	1.02	0.56	0.64	1,86	1,95	2,07	2,12
		(4.58)	(3.70)	(2.73)	(2.42)	(7,82)	(8,08)	(8,45)	(8,51)
12 Buy (Winners)		2.19	0.92	0.62	0.69	2.35	1,99	2,05	2,05
		(6.23)	(3.55)	(4.09)	(2.44)	(8,16)	(9,86)	(8,57)	(8,45)
12 Buy-sell (WML)		0.60*	-0.1	0.06	0.05	0,49*	0,05	-0,02	-0,06
		(1.87)	(-2,59)	(1.10)	(0.95)	(0.88)	(0.09)	-(0,45)	-(1,52)

6 Limitations and further improvements of our study

We have not considered the effects of taxes and transaction costs. We assume that all stocks are liquid, and short selling is possible for all stocks. We have kept all stocks in our study, including the stocks belonging to the sectors financials and utilities since we want to have a more realistic view of all the stocks, this might bias our regression results. We have downloaded daily price and daily trading volume from Datastream in local currencies instead of the common currency dollar due to the problem of lack of data in US dollar, this might have a slight bias in the calculation of the liquidity, liquidity factor and the residual returns and the regressions involved the liquidity factor.

We have used the MSCI BRIC Index as the market index. However, this index is value-weighted; this might cause some biases in our analysis result since all the returns in our formed portfolios are equal-weighted.

We have only constructed a dollar neutral portfolio. However, in the real world, it is more common to construct an ex-ante beta neutral portfolio as well in addition to the dollar neutral portfolio.

We could have conducted our study in another currency, for example, Norwegian kroner or the currency used in one of the BRIC countries in order to do the robust check. Furthermore, the NBER recession indicators are ex-post indicators, we only know them after the recession has occurred, we could have done the robust check by using an ex-ante indicator which could predicts the changes in the business cycles.

We could also have examined the correlations between value and momentum strategies of different countries in order to combine value and momentum strategy for the countries where the two strategies are most less correlated.

We could have used the term structure factor, so the spread between 10Y government bond and three months government bonds as an indicator of recession and use this as a variable in the Fama MacBeth regression. However, since we have run the regression for BRIC as a whole, we did not find data for BRIC. We could have run the regression for each country in BRIC instead of BRIC as a whole.

We could have used the most recent market value instead of lagged market value when we calculate the book-to-market ratio to conduct robust checks since Asness and Frazzini (2012) found that using the most recent market value is essential when examining value strategy in the combination of value and momentum strategy.

We could have used other firm characteristics in studying value and momentum strategies, for example, profitability and asset growth and so on, incorporating these characteristics could eventually improve the results. We could have conducted the residual return momentum strategy for other countries and cross-country sectors if we have more time.

We have rebalanced portfolios monthly despite the expected gain per amount traded. Further research could optimize the portfolio rebalancing frequencies, extending or reducing the holding period of portfolios in a sense to minimize trading costs and maximizing gains.

7 Conclusion

In our master thesis, we have studied the performance of value, momentum and the combination of value and momentum strategy in each BRIC countries, BRIC countries as a whole and the ten cross-country sectors for the period between January 2002 to June 2019. We further study the relationship between momentum strategies and business cycles and the combination of value and momentum strategy. Furthermore, we have used different asset pricing models to check whether the premium we have obtained are excess returns or just returns which comprise for risk. In the end, we use residual returns instead of total returns to check whether we could get better results and we studied the risk premiums related to the factors which explain the momentum premium.

For the value strategy, we observe that all the fifteen High minus Low portfolios generate positive returns, twelve out of them are statistically significant. India has the highest return among all the BRIC countries, and the oil and gas sector has the highest return among all sectors, and it has the highest return among all the countries and all the sectors as well. For example, we could make a monthly return of up to 1.91% if we invest in the HML portfolio in India and up to 2.10% in the cross-sectional Oil and Gas sector. Some of the alphas generated are statistically significant, thus, we could say that the value strategy is profitable before deducting transaction costs and commissions into account.

For the momentum strategy, Jegadeesh and Titman (1993) found the MOM 12x3 strategy to be the best performer in the US market; our results show that we do not have one strategy that is dominant across all the countries and all the sectors, rather each country and each sector has its own most profitable strategy. However, the MOM12X3 strategy for the consumer services sector is the one which has the highest momentum premium among all the countries and all the sectors, with 1.56% monthly returns. Jegadeesh and Titman (1993)'s findings mean implicitly that the strategy with the most extended formation period and the shortest holding period is the most profitable one for the zero-cost portfolio. In our data, using overlapping holding periods, we observe that the momentum premium decreases with the length of the holding period and increases with the length of the formation periods, the momentum strategies that lead to relatively better results are the ones with relatively short holding periods and long formation periods. We are able to

generate excess returns after controlling for the risk factors using different asset pricing models. For example, alpha generated is 2% for the consumer services MOM12X3 strategy, using Fama French 3 factors model with a t-statistic of 2.83 and 1.7% using Carhart 4 factors model with a t-statistics of 4.07 and 1.7% using Carhart 4 factors model plus liquidity factor model with a t-statistics of 4.02.

Using non-overlapping periods, We find that the momentum strategies have a higher performance during periods of expansions, all the countries and sectors except the utility sector generate positive and significant momentum premiums in one or another or two of the expansion periods. We see that there is no one strategy which is the best performer in all of the three sub-periods for all the country and sector indices and there is no one strategy which dominates in one of the three sub-period across all the country and sector indices. We observe further that the sector indices have higher momentum premium compared with the country indices, indicating that momentum strategy works better for sectors than countries. The best sub-period of the momentum strategy for sector indices is the expansion period from July 2002 to April 2007. For example, the MOM 3x6 for the technology sector yields 4.36%, which is the highest momentum premium across all the country and sector indices in this sub-period.

Using cross-sectional value and momentum double sorted portfolios, we observe the general trend that returns increase from losers portfolios to winners portfolios within the same value quantile and returns increase from portfolios with low book-to-market ratio to portfolios with high book-to-market ratio within the same momentum quantile. Using different weighted combination portfolios, all the selected portfolios of weighted combination of value and momentum strategy outperform the pure momentum portfolio, meaning that the weighted combination of the value and momentum strategy can be used as a hedge in periods of momentum crashes. For example, the sharpe ratio is increased by more than 57% if we switch from the pure momentum portfolio to the 25/75 portfolio during the recession period for BRIC. Our findings are in line with the findings of Asness, Moskowitz and Pedersen (1992).

We find that residual momentum strategy generates higher excess returns both for BRIC countries as a whole and for China. The residual return momentum strategy MOM12X3 for China generates a positive and statistically significant excess return of 0.49%. Two

residual momentum strategy for BRIC as a whole generate positive and statistically significant excess returns: MOM 9X3 yields excess returns of 0.81%, which is 0.16% higher than the excess returns yielded with total return momentum strategy, MOM12X3 yields excess returns of 0.60%.

We find that the residual return momentum strategy have higher Sharpe ratios than total return momentum strategy, this is due to the low volatility of the residual momentum, which is about 40% less than that of the total return momentum strategy. By using volatility adjusted residual returns for the formation of the decile portfolios, we take both risk and return into consideration. We could draw the conclusion that volatility adjusted residual return momentum strategy yields higher risk-adjusted returns than total return momentum strategy.

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