A Work Project, presented as part of the requirements for the Award of a Master's degree in Finance from the Nova School of Business and Economics.

Momentum and reversals in international stock markets

Even Tarberg

Work project carried out under the supervision of: Melissa Porras Prado

04.01.2021

Abstract

This study seeks to examine the coexistence of intermediate-term momentum and long-term reversal in international stock markets. By adopting the most promising theories that supposedly isolate these two effects of momentum and reversal, this paper shows that some theories display results capturing stock returns in great magnitude. However, the well-established Jegadeesh and Titman momentum portfolio still prevails in exhibiting intermediate-term momentum followed by a subsequent long-term reversal.

Keywords: Momentum, Reversals, International stock markets, Equities

Introduction

Evidence against random walks in stock markets is today robust through a tremendous amount of research. The most compelling evidence of them all regards momentum, where construction of a zero-investment portfolio that sells bad performing stocks and buys stocks performing well in the past yields abnormal profits. This strategy revolves around continuation in stock returns over the intermediate-term; specifically, stocks experiencing superior past return exceeds stocks with inferior past return in the subsequent intermediate period. This phenomenon was first established in research by Jegadeesh and Titman (1993). Their approach ranked stocks in deciles based on past return and revealed abnormal profits by buying the top performing decile and selling short the inferior decile.

Furthermore, this strategy has been confirmed and is robust in international markets, making it the most puzzling phenomenon in equity markets. Another peculiar behavior described by Lee and Swaminathan (2000) and Jegadeesh and Titman (2001) involves long-term reversals, whereas stocks with superior past return will underperform stocks with inferior past return in the following 3 to 5 years. Leading to reversals in the zero-investment momentum portfolio, and abnormal profits made in the intermediate-term disappears. These findings have prospered many behavioral theories considering momentum and reversals as inseparable phenomena. The most famous behavioral theories are BSV (Barberis, Shleifer and Vishny 1998), DHS (Daniel, Hirshleifer and Subramanyam 1998), and HS (Hong and Stein 1999). Their models describe momentum and reversals as components of the same process, where short-run underreaction is followed by long-run overreaction. The integrated relationship between momentum and reversals is highly debated, and several theories supposedly isolate stocks showing intermediate-term momentum and long-term reversals. Moreover, there needs to be established definite empirical evidence that either separates or integrates short-term momentum and long-term reversals to fathom these anomalies.

One of the prevailing theories separating stocks exhibiting momentum and reversals is George and Hwang (2004). They relate short-term momentum with investors anchoring bias through their 52-week high strategy, showing that buying stocks near their 52-week high price and shorting stocks fare from yields profits that explains a large portion of the short-term momentum profit, and conversely no significant reversal in the long run. In a later article, George and Hwang (2007) propose a new measure, notably, The Five-Year Low strategy. Buying stocks fare from their five-year low price and simultaneously selling short stocks close to their five-year low price, thus making a zero-investment portfolio. Under extreme conditions, this measure catches maximum potential capital gains for potential investors. Therefore, it could be used to test the capital lock-in hypothesis, and the zero-investment portfolio, as previously stated, should be explanatory regarding long-term reversals of momentum portfolios.

Likewise, Conrad and Yavuz (2017) show that sorting stocks that exhibit momentum on risk metrics like size and book-to-market helps to separate momentum and reversals. They create "Max" and "Min" portfolios, where the former (latter) buys high (low) risk momentum winners and short sell low (high) risk momentum losers. By doing this, they show that Max portfolios catch intermediate-term momentum though weaker than the typical JT portfolio, but no significant reversals if the holding period exceeds one year. Contrary, the Min portfolio shows no short-run momentum but significant reversals in the long run.

Because the momentum effect is heavily researched both in the U.S and international markets, and numerous research papers suggesting different explanations of this anomaly, this research has the purpose of taking the most promising theories regarding separation of intermediate-term momentum and long-term reversals as a part of a comprehensive study seeking to see which, if any, could separate intermediate term-momentum from long-term reversals by looking at a broad set of international stock markets.

Specifically, this research will try to answer the following in international markets:

1. Could the 52-Week High and the Max strategies produce similar results or even outperform the standard JT Momentum portfolio in the intermediate-term without significant long-term reversals?

2. Will the Five Year Low and the Min strategy catch significant long-term reversal without significant intermediate-term momentum?

3. Can any of these alternative strategies for momentum fully isolate stocks exhibiting intermediate-term momentum from stocks exhibiting long-term reversals?

By looking at previous research on this topic, a broad consensus of answers to these questions appears missing and is heavily debated, especially in international markets. Therefore, this research paper seeks to close this gap in the research.

Literature review

Today, momentum portfolio returns are considered the biggest contradiction to the efficient market hypothesis, where equity markets past prices should not affect future prices. The momentum phenomenon was first discovered and described in research by Jegadeesh and Titman (1993), where they show evidence of relative strength momentum strategies that lead to abnormal trading profits. The approach is simple: constructing overlapping zero investment portfolios with long (short) positions based on the top (bottom) decile of past J months stocks return and holding these for K months before closing out the positions, with J and K ranging from three to twelve months. The same paper also documents a reversal tendency of momentum profits if K holding periods exceeds 24 months. Rouwenhorst (1998) later confirms that intermediate-term momentum alongside long-term reversals also exists among European countries. Furthermore, the momentum effect seems to hold across asset classes, supported by the findings of Asness et al.(2013).

Tremendous resources in regards to research have been devoted to establishing an understanding of these phenomena. An instinctive explanation revolves around behavioral biases. Three famous models tries to establish the behavioral approach to momentum, namely BSV (Barberis, Shleifer and Vishny 1998), DHS (Daniel, Hirshleifer and Subramanyam 1998), and HS (Hong and Stein 1999). In their models, momentum and reversals are components of the same process, where short-run underreaction is followed by long-run overreaction. Whereas HS illustrates the impact of gradual information diffusion on stock return, they describe the "news-watchers" and their inability to condition market prices when the news is distributed gradually. They also describe momentum investors and how they emphasize past prices and trade independently of news. This combination leads to an overreaction and momentum, which reverse when momentum investors close out their positions. BSV and DHS introduce cognitive biases when they describe momentum and reversals. BSV uses the conservatism of investors to explain their insufficient reaction, which leads to underreaction. They also emphasize the investors' inherent beliefs that patterns in small samples will continue, resulting in overreaction, which ends in reversal when forecasted trends fail. DHS argues that overconfidence and self-attribution is the cause of momentum, which leads to reversals. Investor confidence grows when trading signals work on a set of stocks, attributing the performance of these to their stock-picking skills and simultaneously regard the bad performing stocks on these signals as bad luck. This combination drives stock prices over their fundamental value, generating momentum, which results in reversal when stock prices revert to the mean.

These behavioral models presume a relationship between momentum and reversals, which is highly controversial. Jegadeesh and Titman (2001) stress that the coexistence of momentum and long-term reversals should be treated with caution. They find strong evidence of significant reversals for small firms but weaker evidence among large firms. Lee and Swaminathan (2000) argue for a relationship between intermediate-term momentum and long-term reversals. They show that high volume winners in momentum portfolios experience faster momentum reversals. Furthermore, stocks with higher volume also have a lower Book-to-Market ratio compared to low volume stocks. These findings strengthen the established relations the behavioral models have on momentum.

In the search for explanatory reasons for momentum and reversal, George and Hwang (2004) use the 52-week high strategy to illustrate momentum and reversals as separate phenomena in the US market. They argue that the valuation of a stock is highly dependent on the nearness of the share price to an anchor. They suggest that traders use the 52-week high price of a stock as an anchor when evaluating the news's potential impact. Moreover, traders are reluctant to bid the price up when stocks are near their 52-week high price even if the information warrants it. This reluctance leads to underreaction and initiates the momentum effect when the information eventually prevails. The same goes for stocks that are far from their 52-week high, where investors are hesitant to recognize losses and thereby an initial reluctance to sell their stocks, which leads to an underreaction. This paper's essential finding revolves around the lack of reversal in the strategy that buys stocks near their 52-week high and sells stock that is far from. They show that the 52-week high dominates the predictive power and describes most of the profits coming for intermediate-term momentum, thereby disregarding the relationship between intermediate-term momentum and long-term reversals. These findings align with Liu et al.(2011), who finds evidence of 52-week high profits in the intermediate-term with the absence of subsequent long-term reversals in some international markets.

In a later paper, George and Hwang (2007) introduce a new measure, namely the Five-Year Low Measure. This measure provides a ratio of the nearness the current stock price has to it 5-year low, which under extreme conditions could explain embedded gains of individual stocks under the assumptions that stocks are acquired all at once. They argue that this measure goes hand in hand with the capital gains lock-in hypothesis, whereas stocks identified as winners by the five-year low ranking will experience negative future returns.

Conrad and Yavuz (2017) include size and book-to-market ratio to distinguish momentum from reversals in the US market. By sorting momentum portfolios into subcomponent portfolios, specifically, Max and Min portfolios. Max portfolios buy small value winners and sell large growth losers; analogously, Min portfolios buy large growth winners and sell small value losers. Max portfolios show significant intermediate-term momentum but no reversals alongside their Min portfolios that display significant long-term reversals without any signs of intermediate-term momentum. These findings have later been confirmed in international markets by Walkshäusl et al.(2019)

Methodology

Data

Table 1

Country	No. Stocks	Mean	STD	Country	No. Stocks	Mean	STD
Australia	1054	1.91	7.51	**Italy**	200	0.67	6.57
Austria	52	0.98	6.57	**Japan**	1343	0.76	6.36
Belgium	76	1.28	5.80	**Netherlands**	108	0.94	5.48
Canada	895	1.80	6.99	**New Zealand**	108	1.23	5.85
Denmark	114	1.22	6.07	**Norway**	129	1.13	6.92
France	544	1.16	5.44	**Portugal**	38	1.39	6.83
Finland	98	0.95	7.18	**Spain**	87	0.87	6.26
Germany	443	1.29	7.82	**Sweden**	243	1.34	7.33
Hong Kong	449	2.22	9.01	**Switzerland**	155	1.41	11.13
Ireland	20	1.28	7.17	**United Kingdom**	1142	1.00	5.90

In doing this research, data from 20 developed countries around the world was retrieved from Refinitiv Datastream: Australia, Austria, Belgium, Canada, Denmark, France, Finland, Germany, Hong Kong, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, and United Kingdom. Only stocks listed on the major exchange in each country were included. Data collected were monthly returns in dollars, stock prices in dollars, market capitalization in dollars, market to book ratio, and turnover by volume. To get a sufficient amount of data, the time span for this research goes from 1990 until 2019. To make sure the dataset is reliable, filters are applied to remove stocks without return, price, market to book ratio, market capitalization, and turnover volume.

Furthermore, stocks with negative book to market (inverse of the market to book ratio) and a price below 0.1 USD are excluded from the dataset each month. Table 1 provides summary statistics, specifically, the average number of stock as of January 2005, equally-weighted mean return denoted in dollar and percentage from 1990 until 2019, and the correspondingly standard deviation.

In order to compare each strategy, measures of the holding period returns start from January 1995.

The t-statistic used to measure how significant the different results are calculated using Newey-West (1994) standard error estimates will help to account for the chance of autocorrelation and heteroskedasticity, which is highly relevant by conducting this overlapping portfolio procedure. Results will be described as significant if their correspondingly t-statistics is greater or equal to 1.65, meaning statistically significant at the 10% level.

Portfolio construction

Momentum portfolio

Following Jegadeesh and Titman (1993), all stocks are ranked in deciles based on their past 6-month cumulative return. To compare this strategy against others, stocks are bought (sold) if they are in the top (bottom) three terciles rank based on the 6-month past cumulative return measurement. The long and short portfolio returns are equally weighted, and one month is skipped between the formation period(t-6, t-1) and the holding period(0, 5) to avoid market microstructure issues. All other strategies defines momentum winners (losers) in the same manner. The portfolios is rebalanced each month, and the same goes for all strategies described below.

The 52-week high

Portfolios of stocks are created in the same style as George and Hwang (2004), where stocks are ranked based on the ratio $\frac{P_{i,t-1}}{high_{i,t-1}}$ where $P_{i,t-1}$ represents the price of a stock at time $t-1$ and $high_{i,t-1}$ is equivalent to the highest price the past 12 months. Based on this ratio, stocks are bought (sold) if they are ranked in the top (bottom) tercile of this ratio in a particular month *t*.

Five-Year Low Measure (FYL)

To measure the nearness of a stock price to its five-year low price, adopting the same model described in George and Hwang (2007). The ratio is measured as $FYL_t = \frac{P_t - P_{min}}{P_{min}}$, where P_t represents the stock price at time t and P_{min} representing the lowest price of a stock the past 5 years. Based on this ratio, winners (losers) of this strategy represents the top(bottom) terciles.

Max/Min measures

This strategy revolves around sorting momentum winners(losers) based on size and book-to-market ratio. Conrad and Yavuz (2017) classify momentum stocks with either high or low risk; specifically, they create portfolios titled "Max" and "Min," where "Max" ("Min") buys high (low) risk momentum winners and sells low (high) risk momentum losers. The high (low) risk group is defined as stocks located in the bottom (top) three deciles of the size distribution and simultaneously placed in the top (top) five deciles of the book-to-market distribution or stocks located in the bottom (top) three deciles of size distribution and simultaneously placed in the bottom(top) five deciles of book-to-market distribution.

Results

This part will present the result of the different strategies both in the short and long-term. Moreover, the first section will cover the short-term performance of different strategies. Section two will display the long-term results, and finally, section three will test the relative performance of different strategies.

Short-term performance

6-month holding period (table 2)

JT Momentum				52-WEEK HIGH				FIVE-YEAR LOW			
Winner	Loser	WML	(t-stat)	Winner	Loser	WML	(t-stat)	Winner	Loser	WML	(t-stat)
0.513	-0.132	0.645	(2.14)	0.363	-0.016	0.379	(0.93)	-0.143	-0.031	-0.112	(-0.39)

Max				Min			
Winner	Loser	WML	(t-stat)	Winner	Loser	WML	(t-stat)
0.761	-0.404	1.165	(2.45)	0.513	0.555	-0.041	(-0.10)

Table 2 displays the strategies 6-month holding period return. To get the return of different strategies the following regression adopted from George and Hwang (2004) was estimated:

$$R_{it} = b_{0_{jt}} + b_{sjt}^{Winner}\, sWinner_{i,t-j} + b_{sjt}^{Loser}\, sLoser_{i,t-j} + Country\ Dummies_{i,t} + e_{i,t},$$

Where:

- R_{it} = stock i return at time t
- j = 2,….,7
- $b_{0_{jt}}$ = return for the neutral portfolio after hedging out country effects and momentum strategies
- $sWinner_{i,t-j}$ takes value of 1 if stock i is characterized as winner in strategy s at time $t-j$
- $sLoser_{i,t-j}$ takes value of 1 if stock i is characterized as loser in strategy s at time $t-j$

By using this cross-sectional regression developed by George and Hwang (2004) the b_{sjt}^{Winner} and b_{sjt}^{Loser} will display the return in excess of the neutral portfolio $b_{0_{jt}}$ for the different strategies; furthermore, country dummies will hedge out country effects. For the holding period of 6-months, j will go from 2 until 7, thereby including the 6 portfolios formed over the past 7 months. In other words, running 6 cross-sectional regression each month. To get the pure return of both winner and loser portfolios of the different strategies, the average of the sum of the betas from the cross-sectional regressions to both the winner beta b_{sjt}^{Winner} and the loser beta b_{sjt}^{Loser} where calculated for each month, followed by a time series average of these averages. The WML measure stands for Winner minus Loser, where the Winner is the average of the sum of b_{sjt}^{Winner} from the cross-sectional regressions conducted each month minus the average of the sum of b_{sjt}^{Loser} from the cross-sectional regressions conducted each month. The return of the WML is estimated using time-series averages. The returns and t-statistics in table 2 are calculated based on the time-series averages and Newey-West (1994) standard error estimates with lags determined by the amount of overlap, which here corresponds to 6. This accounts for the chance of autocorrelation and heteroskedasticity, which is highly relevant by conducting this overlapping portfolio procedure. From this new standard error, t-stat is calculated for the time-series averages of each beta and showed in table 2 under "t-stat".

The standard JT momentum portfolio yields a significant 0.645 percent per month and aligns well with previous research. Looking at the returns for the 52-week high and the five-year low strategies, returns are somewhat in line with studies in the U.S market, however, these results are insignificant in international markets. These results support Liu et al.(2011) findings, where only half of the countries studied in international markets showed significant positive returns. Contrary to their conclusion, these results give evidence for a weak coexistence of JT momentum and 52-week High in the short-term in international markets. Moreover, the Max and Min strategies behave similar to those results found by Conrad and Yavuz (2017), where the Max strategy shows positive significant return, and correspondingly the Min strategy shows no significant returns, in the short-term.

The answer to the question if the 52-Week high and Max strategy would yield larger or similar short-term returns compared to the JT Momentum is partly true. The 52-Week high strategy yields positive returns, although weaker and insignificant compared to the JT strategy. On the other hand, the Max strategy yields 1.165 percentage per month, which is higher than the JT Momentum, which yields 0.645 percentage per month. This shows that separating momentum stocks based on risk measures will yield a more extensive and significant return than the JT Momentum strategy. It confirms that the Max strategy introduced by Conrad and Yavuz (2017) in the U.S market holds strong international. The 52-Week High, on the other hand, shows weaker and not significant returns in the short-term holding period of 6-months, thereby disregarding that it shows similar or larger returns compared to the standard JT portfolio.

Long term performance

Both George and Hwang (2004) and Conrad and Yavuz (2017) with their 52-Week high strategy and Max strategy respectively, shows no significant reversal in the U.S market and thereby concluding that these strategies somewhat separates momentum stocks from those exhibiting long-term reversals. However, in international markets, these conclusions are fare from consensus. Moreover, the Five Year Low and the Min strategy developed by George and Hwang (2007) and Conrad and Yavuz (2017) respectively, shows no signs of significant momentum in the U.S market, thereby, perchance the possibility of catching most of the long-term reversal captured by the standard JT portfolio.

To investigate the long-term performance of the different strategies, returns will be examined over a 60-month interval after the formation period. By doing this, it is possible to see how the returns of the different strategies are behaving over a longer time-period. Specifically, investigating the average monthly portfolio returns for the different strategies in different time intervals up to a holding period of 60-months.

Following the method developed by George and Hwang (2004) the following cross sectional regression is estimated each month:

$$R_{it} = b_{0_{jt}} + b_{sjt}^{Winner}\ sWinner_{i,t-k-j} + b_{sjt}^{Loser}\ sLoser_{i,t-k-j} + Country\ Dummies_{i,t} + e_{i,t},$$

Where:

- R_{it} = stock i return at time t
- j = $2, \ldots, 13$
- $k = 0, 12, 24, 36, 48$
- $b_{0_{jt}}$ = return for the neutral portfolio after hedging out country effects and momentum strategies
- $sWinner_{i,t-k-j}$ takes value of 1 if stock i is characterized as winner in strategy s at time $t-k-j$
- $sLoser_{i,t-k-j}$ takes value of 1 if stock i is characterized as loser in strategy s at time $t-k-j$

This is the same approach developed by George and Hwang (2004) and described under the short-term performance of the different strategies. The difference here lies in k, determining the time-gap and allowing to investigate different time periods in isolation. For example, to examine the time-period from month 25-36 after the portfolio formation period, k is equal to 24, where one month is skipped between the formation and holding period, by letting j go from 2 until 13. In other words conducting 12 cross sectional regressions each month. Thereby including the 12 portfolios formed over the past 13 months for period t-k-j.

Furthermore, the average from the sum of betas from both the b_{sjt}^{Winner} and b_{sjt}^{Loser} estimated in cross-sectional regression and the time-series average from these averages is displayed in table 3. The WML measure stands for Winner minus Loser, where the Winner is the average of the sum of b_{sjt}^{Winner} from the cross-sectional regressions conducted each month minus the average of the sum of b_{sjt}^{Loser} from the cross-sectional regressions conducted each month. The return of the WML is estimated using time-series averages. Newey-West (1994) standard error estimates with lags determined by the amount of overlap, which here corresponds to 12. This accounts for the chance of autocorrelation and heteroskedasticity, which is highly relevant by conducting this overlapping portfolio procedure. From this new standard error, t-stat is calculated for the time-series averages of each beta and showed in table 2 under "t-stat".

Following Hirshleifer (2001), momentum and reversals should be linked in that a stronger continuation in the short-term should be followed by a stronger reversal. Furthermore, all relative strength portfolios, including "winners" ("losers") from the formation period, will follow the path of over (under) performing in the intermediate-term and under (over) perform in the subsequent long-term.

Looking at momentum strategy in table 3, both the "Winner" and "Loser" portfolio displays significant reversal, where the "Winner" ("Loser") portfolio of the momentum strategy goes from positive(negative) to negative(positive) returns from periods 13 to 24 which aligns well with previous research, and the linkage described in Hirshleifer (2001). However, momentum profits from the WML are not significant in months 1 until 12. The persistency of significant negative average return for the WML portfolio of the momentum strategy prevails in each of the measured time intervals, which also aligns with previous research. The long-term reversal is somewhat persistent both in the "winner" and "loser" momentum portfolio, and both are uniformly contributing to the WML momentum portfolio.

Long-term performance (Table 3)

MOMENTUM	***Months 1-12***	***Months 13-24***	***Months 25-36***	***Months 37-48***	***Months 49-60***
Winner	0.338	-0.143	-0.108	0.091	-0.099
Loser	-0.069	0.322	0.346	0.254	0.266
WML	0.407	-0.465	-0.454	-0.163	-0.365
(t-stat)	(1.62)	(-1.80)	(-1.82)	(-1.05)	(-2.21)
52-WEEK HIGH					
Winner	0.230	-0.119	-0.126	-0.007	-0.168
Loser	0.149	0.486	0.423	0.403	0.378
WML	0.081	-0.605	-0.549	-0.410	-0.545
(t-stat)	(0.21)	(-1.60)	(-1.75)	(-1.71)	(-2.04)
FIVE-YEAR LOW					
Winner	-0.218	-0.281	-0.126	-0.139	-0.171
Loser	0.040	0.161	0.128	0.117	0.060
WML	-0.258	-0.442	-0.254	-0.257	-0.231
(t-stat)	(-0.83)	(-1.75)	(-0.90)	(-0.78)	(-0.84)
MIN					
Winner	0.142	-0.517	-0.405	-0.259	-0.349
Loser	0.605	0.795	0.625	0.510	0.666
WML	-0.464	-1.313	-1.030	-0.769	-1.015
(t-stat)	(-0.97)	(-2.64)	(-2.24)	(-2.18)	(-4.15)
MAX					
Winner	0.739	0.357	0.304	0.385	0.300
Loser	-0.535	-0.378	-0.263	-0.297	-0.092
WML	1.274	0.734	0.567	0.682	0.392
(t-stat)	(2.87)	(1.82)	(1.88)	(2.02)	(1.48)

Both the 52-Week High and Five Year Low strategies display contradicting returns to what is found in the U.S market. George and Hwang (2004) argue that the 52-Week High strategy is a better measure in predicting future returns than the standard JT Momentum, where the results showed similar results regarding JT momentum in the short-term with no long term reversals. However, these results seem to be weak in international markets, where returns in this research show no signs of significant positive short-term returns; moreover, this strategy shows reversal in the “winner” portfolio from month 13-24 until the last time interval, concluding that the results obtained in the U.S market do not hold looking at international markets. The same goes for the Five Year Low strategy, where George and Hwang (2007) results display no significant momentum in the WML portfolio, followed by significant long-term negative returns of the WML portfolio. They argue that the Five Year Low measure captures most of the standard JT Momentum's returns reversals. In this research, the Five Year Low measure has the same return patterns discovered in the U.S market, but not significant.

The Max and Min strategies are somewhat in line with Conrad and Yavuz (2017) studies, where the Max WML portfolio yields positive short-term return and is not followed by long-term return reversals. The “winner” and “loser” portfolios do not reverse in the long-term, showing a promising tendency of capturing short-term momentum without long-term reversal. The same goes for the Min strategy regarding no significant short-term momentum, followed by significant long-term reversals with negative returns.

These results show that the Max strategy produces significant intermediate-term momentum without long-term reversal. On the other hand, the 52-Week High strategy shows significant return reversals in the WML portfolio for the holding period from month 25 until 36 and the subsequent intervals. These findings is different to the results found by George and Hwang (2004) in the U.S market. Moreover, the Five Year Low does not display a significant negative return, as described in George and Hwang (2007). The Min strategy somewhat produces significant negative returns in the long-term period without displaying significant momentum in the short-term.

Relative performance

Since the Max and Min strategy prevails as the most promising in explaining both short-term momentum and subsequent long-term reversals, a comprehensive comparison of the Max, Min and JT Momentum will be conducted. To accomplish this, the following cross-sectional regression adopted from George and Hwang (2004) is conducted each month:

$$R_{it} = b_{0_{jt}} + b_{1jt}^{Winner}\, JTWinner_{i,t-k-j} + b_{2jt}^{Loser}\, JTLoser_{i,t-k-j} + b_{3jt}^{Winner}\, MaxWinner_{i,t-k-j} + b_{4jt}^{Loser}\, MaxLoser_{i,t-k-j} + b_{5jt}^{Winner}\, MinWinner_{i,t-k-j} + b_{6jt}^{Loser}\, MinLoser_{i,t-k-j} + Country\ Dummies_{i,t} + e_{i,t},$$

Where:

- R_{it} = stock i return at time t
- j = $2,\dots,13$
- $k = 0, 12, 24, 36, 48$
- $b_{0_{jt}}$ = return for the neutral portfolio after hedging out country effects and momentum strategies
- $JTWinner_{i,t-k-j}$ takes value of 1 if stock i is characterized as winner in JT Momentum strategy at time $t-k-j$
- $JTLoser_{i,t-k-j}$ takes value of 1 if stock i is characterized as loser in JT Momentum strategy at time $t-k-j$
- $MaxWinner_{i,t-k-j}$ takes value of 1 if stock i is characterized as winner in Max strategy at time $t-k-j$
- $MaxLoser_{i,t-k-j}$ takes value of 1 if stock i is characterized as loser in Max strategy at time $t-k-j$
- $MinWinner_{i,t-k-j}$ takes value of 1 if stock i is characterized as winner in Min strategy at time $t-k-j$
- $MinLoser_{i,t-k-j}$ takes value of 1 if stock i is characterized as loser in Min strategy at time $t-k-j$

The interpretation of the betas in this regression is similar to regressions done previously. The difference is that by including the dummies of the different strategies in this regression, the coefficient estimates capture the net of the specific strategy portfolio hedging out the other strategies and country effects. The time-series averages and the correspondingly adjusted t-statistics using Newey-West (1994) standard error estimates with lags determined by the amount of overlap, which corresponds to 12, are found in table 4. The first notable observation is that the JT Momentum shows less significant short-term momentum, measured by the 1 to 12-month range. Interestingly the negative return reversal is stronger and in greater strength. On the other hand, the Max strategy still shows significant returns in the short-term (1-12months) and shows no signs of long-term reversals. These findings support the Max strategy's research being effective in creating intermediate-term momentum, although not completely isolating the intermediate-term momentum produced by the standard JT Momentum strategy.

Relative performance of Min, Max and JT (Table 4)

	Months	***1-12***	***13-24***	***25-36***	***37-48***	***48-60***
Intercept		0.007846	0.005446	0.010937	0.011091	0.012288
	(t-stat)	(0.46)	(0.38)	(0.95)	(1.05)	(1.16)
JT Winner Dummy		0.001599	-0.002433	-0.001609	0.000108	-0.001710
	(t-stat)	(0.67)	(-1.12)	(-0.90)	(0.05)	(-1.17)
JT Loser Dummy		-0.000886	0.003573	0.003673	0.002923	0.002821
	(t-stat)	(-0.36)	(1.48)	(1.56)	(1.79)	(1.79)
MIN Winner Dummy		0.000931	-0.000059	-0.001105	-0.001044	-0.000441
	(t-stat)	(0.46)	(-0.02)	(-0.42)	(-0.45)	(-0.27)
MIN Loser Dummy		0.010264	0.008997	0.007938	0.006828	0.005126
	(t-stat)	(3.68)	(3.29)	(3.11)	(3.29)	(2.02)
MAX Winner Dummy		0.006099	0.006094	0.005048	0.004473	0.004701
	(t-stat)	(2.37)	(2.60)	(1.92)	(1.84)	(2.39)
MAX Loser Dummy		-0.004021	-0.006322	-0.004862	-0.004286	-0.002933
	(t-stat)	(-1.38)	(-1.85)	(-1.61)	(-1.71)	(-1.60)
JT Premium		0.002485	-0.006006	-0.005282	-0.002815	-0.004531
	(t-stat)	(0.90)	(-2.17)	(-2.09)	(-1.41)	(-2.64)
MIN Premium		-0.009333	-0.009056	-0.009043	-0.007871	-0.005568
	(t-stat)	(-2.15)	(-1.88)	(-2.21)	(-2.38)	(-1.55)
MAX Premium		0.010120	0.012416	0.009909	0.008759	0.007634
	(t-stat)	(1.93)	(2.31)	(1.91)	(1.90)	(2.25)

Looking at the Min strategy, there are significant negative short-term returns, which prevails through all measured time intervals except the last. Moreover, while still capturing a great deal of the long-term reversals of momentum stocks, the standard JT Momentum portfolio still shows a significant reversal in the presence of the Min strategy.

By making this comparison, the main conclusion must be drawn towards the JT momentum exhibiting short-term momentum, although not significant, with subsequent reversals. The relation of intermediate-term momentum and long-term momentum seems somewhat strong, and it is hard to draw a conclusion towards anything else.

Conclusion

Focusing on the coexistence between intermediate-term momentum and long-term reversals, this research focused on strategies that seek to separate these two phenomena. While substantial evidence in the U.S market exits, the results found in this research in international markets cannot separate intermediate-term momentum from long-term reversals by utilizing these strategies. The 52-Week High strategy seems promising by the research conducted in the U.S market; however, these results seem somewhat weaker in International markets and cannot explain the magnitude of intermediate-term momentum created by the standard JT portfolio. The same goes for the Five Year Low strategy yielding consistent negative return across all time intervals, although not significant.

The risk-based portfolios introduced by Conrad and Yavuz (2017), namely Max and Min, where sorting stocks based on book to market and size in the intersection of past momentum winners and losers are used to show that momentum stocks can be separated from stocks exhibiting long-term reversals. Both these strategies show great strength in capturing future stock returns, but in the presence of the standard JT portfolios, they cannot entirely separate and explain the full magnitude of intermediate-term momentum and long-term reversals.

The concluding remark is therefore that neither of the proposed strategies can fully separate stocks exhibiting momentum from stocks exhibiting long-term reversals, and that the coexistence still prevails in international markets.

Future research of the coexistence of momentum and reversal could conduct similar strategies but for a larger time-span in international markets if sufficient data is available.

References

Lee, Charles MC, and Bhaskaran Swaminathan. (2000). "Price momentum and trading volume." *the Journal of Finance*, *55*(5), 2017-2069.doi.org/10.1111/0022-1082.00280

Jegadeesh, Narasimhan, and Sheridan Titman. (2001). "Profitability of momentum strategies: An evaluation of alternative explanations." *The Journal of finance*, *56*(2), 699-720. doi.org/10.1111/0022-1082.00342

Barberis, Nicholas, Andrei Shleifer, and Robert hnyhny. (1998). "A model of investor sentiment." *Journal of financial economics*, *49*(3), 307-343. doi.org/10.1016/S0304-405X(98)00027-0

Daniel, Kent, David Hirshleifer, and Avanidhar Subrahmanyam. (1998)."Investor psychology and security market under-and overreactions." *the Journal of Finance*, *53*(6), 1839-1885. doi.org/10.1111/0022-1082.00077

Hong, Harrison, and Jeremy C. Stein.(1999)"A unified theory of underreaction, momentum trading, and overreaction in asset markets." *The Journal of finance*, *54*(6), 2143-2184. doi.org/10.1111/0022-1082.00184

George, Thomas J., and Chuan-Yang Hwang. (2004). "The 52-week high and momentum investing." *The Journal of Finance*, *59*(5), 2145-2176. doi.org/10.1111/j.1540-6261.2004.00695.x

George, Thomas J., and Chuan-yang Hwang. (2007). "Long-term return reversals: overreaction or taxes?." *The Journal of finance*, *62*(6), 2865-2896. doi.org/10.1111/j.1540-6261.2007.01295.x

Conrad, Jennifer, and M. Deniz Yavuz.(2017)."Momentum and reversal: Does what goes up always come down?." *Review of Finance*, *21*(2), 555-581. doi.org/10.1093/rof/rfw006

Wei, Jason Zhanshun, and Liyan Yang. (2012). "Short-term momentum and reversals in large stocks." *Available at SSRN 2029984* (2012). doi.org/10.2139/ssrn.2029984

Rouwenhorst, K. Geert. (1998)."International momentum strategies." *The journal of finance*, *53*(1), 267-284. doi.org/10.1111/0022-1082.95722

Asness, Clifford S., Tobias J. Moskowitz, and Lasse Heje Pedersen. (2013)."Value and momentum everywhere." *The Journal of Finance*, *68*(3), 929-985. doi.org/10.1111/jofi.12021

Liu, Ming, Qianqiu Liu, and Tongshu Ma.(2011). "The 52-week high momentum strategy in international stock markets." *Journal of International Money and Finance*, *30*(1), 180-204. doi.org/10.1016/j.jimonfin.2010.08.004

Walkshäusl, Christian, Florian Weißofner, and Ulrich Wessels. (2019). "Separating momentum from reversal in international stock markets." *Journal of Asset Management*, *20*(2), 111-123. doi.org/10.1057/s41260-019-00109-5

Fama, Eugene F., and James D. MacBeth.(1973)."Risk, return, and equilibrium: Empirical tests." *Journal of political economy*, *81*(3), 607-636. doi.org/10.1086/260061

Hirshleifer, David.(2001) "Investor psychology and asset pricing." *The journal of Finance 56*(4), 1533-1597. doi.org/10.1111/0022-1082.00379

Newey, Whitney K., and Kenneth D. West.(1994) "Automatic lag selection in covariance matrix estimation." *The Review of Economic Studies 61*(4), 631-653.
doi.org/10.2307/2297912