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VOLATILITY AND MOMENTUM STRATEGIES AT STOCK
MARKETS: AN EMPIRICAL STUDY*

Drawing on price momentum strategies proposed by Jegadeesh and Titman (1993) and momentum strategies by Chan, Jegadeesh and Lakonshok (1996), this study examines the phenomenon of momentum at Taiwan market and investigates the relations between momentum strategies and volatility. The empirical result shows that there exists the phenomenon of price momentum at Taiwan market, and it has the best effect during a three-month holding period. Volatility has evident influence on price momentum strategy returns. There exists the phenomenon of the continuity of the price momentum in Taiwan market, i.e. the information of momentum could be reflected in stock price. Investors can use price momentum as an index to construct their portfolios, and a three-month holding period or more could achieve the best performance. Price momentum returns are in inverse proportion to holding period. Investors who intend to hold long-term portfolios can adopt conditional momentum strategies. However, after the strike of the global financial crisis at open markets, investors cast doubt on stock-market investment, and thus this situation shows the contrast that should be further studied.

Keywords: volatility; price momentum; momentum strategy; stock exchange; Taiwan.

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ВОЛАТИЛЬНІСТЬ ТА ІМПУЛЬСНІ СТРАТЕГІЇ НА ФОНДОВИХ
РИНКАХ: ЕМПІРИЧНЕ ДОСЛІДЖЕННЯ

У статті, з урахуванням цінових імпульсних стратегій, запропонованих Джегадіш і Титман (1993), та імпульсних стратегій (Чєн, Джегадіш, Лєконшєк, 1996), досліджено явище імпульсу на Тайванській фондовій біржі, а також взаємозв'язок між імпульсними стратегіями та волатильністю. Емпіричні результати підтверджують існування явища імпульсу на Тайванській біржі. При цьому суттєвим є вплив волатильності на цінові імпульсні стратегії. Також підтверджено існування на біржі Тайваню явища пролонгації цінового імпульсу, оскільки інформація про імпульс має здатність відображатись на вартості акцій. Інвестори можуть використовувати інформацію про імпульс при формуванні портфелів. Інвесторам, які орієнтуються на довготермінові портфелі, краще обирати стратегії умовного імпульсу. Однак після глобальної фінансової кризи чимало інвесторів з набагато більшими сумнівами працюють на біржах, тому явище імпульсу у сучасному, посткризовому контексті потребує подальших досліджень.

Ключові слова: волатильність; ціновий імпульс; імпульсна стратегія; Тайвань; фондова біржа. Табл. 4. Літ. 23.

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ВОЛАТИЛЬНОСТЬ И ИМПУЛЬСНЫЕ СТРАТЕГИИ
НА ФОНДОВЫХ РЫНКАХ: ЭМПИРИЧЕСКОЕ ИССЛЕДОВАНИЕ

В статье, с учётом ценовых импульсных стратегий, предложенных Джегадиш и Титманом (1993) и импульсных стратегий (Чєн, Джегадиш, Лєконшєк, 1996), исследовано явление импульса на Тайваньской фондовой бирже, а также взаимосвязь между импульсными стратегиями и волатильностью. Эмпирические результаты подтверждают существование явления импульса на Тайваньской бирже. При этом

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значимое влияние на ценовые импульсные стратегии имеет явление волатильности. Также подтверждено существование на бирже Тайваня явления пролонгации ценового импульса, так как информация о импульсе имеет свойство отображаться на цене акций. Инвесторы могут использовать информацию об импульсе при формировании портфелей. Инвесторам, ориентирующимся на долгосрочные портфели, лучше следовать стратегии условного импульса. Однако после глобального финансового кризиса многие инвесторы с большой опаской работают на биржах, поэтому явление импульса в современном, посткризисном контексте требует дальнейших исследований.

Ключевые слова: волатильность; ценовой импульс; импульсная стратегия; Тайвань; фондовая биржа.

1. Introduction

Jegadeesh and Lehmann (1990) discovered that the empirical results of short-term price regression trend at weekly interval varied, continuity was present in mid-term receipts of portfolios constructed at the interval between 3 to 12 months, i.e. the mid-term price had an effect of momentum to continuously vary toward a certain direction. Jegadeesh and Titman (1993) first advanced price momentum strategies, discovering that the portfolios formed on the basis of previous stock returns, that is, buying in past winners and selling out past losers, could earn excess returns. The studies of momentum trading strategies have been officially unfolded ever since. Chan, Jegadeesh and Lakonishok (1996) use 3 indices of earnings – standardized unexpected earnings (SUE), cumulative abnormal return (CAR) before and after the earnings announcement, and analyst's revision of management earnings forecast – as the criteria demarcating winners and losers, and argue that the momentum trading strategies based on earnings can nonetheless earn surplus returns. Rouvenhorst (1998) found similar mid-term price momentum effect in 12 other countries, showing that such effect does not derive from data sampling deviation. In fact, momentum trading strategies, or relative strength trading strategies, had already been widely applied prior to these studies, e.g. the application of the value line rankings in the US by Liu and Lu (2011), by using investment model, to calculate momentum returns and study the mutual influence between trading volumes and stock returns.

Whaley (1993) proposed to create a market volatility index (MVI) as a means to estimate the degree of price volatility of future stock market, and initiates the discussion of the relations between stock market volatility and stock returns. Whaley (2000) and Giot (2003, 2005) examine the relations between volatility index and market share price index returns. Volatility index is considered one of the sentiment indicators of investors. The research indicates there is an inverse relationship between volatility index variation and the synchronous large-cap index returns, and a positive relationship with future returns. Besides, volatility index is continually applied in the issues related to the portfolios returns.

The stock market would be influenced by the external macroeconomic variables. Taiwanese industries are mostly export-oriented and are apt to be influenced by external macroeconomic variables and then influence stock volatility. Hence, researches vary in their explanations for the reverse momentum strategies occur. Cooper, Gutierrez and Hameed (2004) imply that only when the market state is on the rise can momentum investment performance be acquired. However, this viewpoint is not applicable when the market is on its fall. There also exists the situation of positive momentum strategies.

It is widely adapted by researchers and scholars to construct portfolios through momentum strategies. Momentum investment strategies are applied to measure the tools to earn excess returns. The method of momentum strategies to choose stocks has been studied for a long time: it considers the stock price or profit-making performance in the past the indicator to judge whether the fundamental is good or bad; the performance of a stock market is indeed affected by the variables related to macroeconomics, and thus economic variables should be taken into account in the consideration of investment; the volatility index represents all the stock market participants' expectations for future market and is regarded as the indicator of panic representing investors' sentiment, and thus it could not be neglected. This research would use all the factors listed above to build a model of momentum strategies in expectation of discovering the ways to apply momentum investment strategies.

2. Literature review

Jegadeesh and Titman (1993) studied the listed stocks of New York Stock Exchange and American Stock Exchange from 1965 to 1989, classifying them in accordance with the cumulative return of share over the past, and found that price momentum strategies of buying past winners and selling past losers could earn excess returns in the first year. Chan, Jegadeesh and Lakonishok (1996) later explored the listed stocks of New York Stock Exchange, American Stock Exchange and NASDAQ from 1977 to 1993, and revealed that executing price momentum strategies could earn excess returns; furthermore, they used 3 earning indicators as the criterion demarcating winners and losers, and then conducted earning momentum strategies, and they discovered that excess returns could still be acquired. However, the duration of earning momentum strategies is shorter and weaker in comparison with price momentum strategies. Jegadeesh and Titman (2001) took listed stocks in the US from 1965 to 1998 as their sample, and reaffirmed that empirically momentum indeed existed, which also applies to the countries other than the US (Rouwenhorst, 1998; Hong, Lee, Swaminathan, 2003). Chan, Jegadeesh and Lakonishok (1996) point out that price momentum and earning momentum contain different information. Hong, Lee and Swaminathan (2003) analyzed 11 markets and found that only when earning momentum occurred price momentum had the possibility to occur as well, and thus stated that price momentum should be included in earning momentum. From Swedish stock market reports and the control of trading cost, Herberger and Tim (2011) found that investors who employ momentum strategies could indeed produce high return in a specific time. Clifford (2011) shows that the result of Japanese stock market corresponds with momentum strategies, and the result is within statistical deviation, illustrating that momentum strategies in fact corresponds with Japan's stock market.

The phenomenon of momentum is undoubtedly a huge strike for the efficient market hypothesis, since the Fama-French three-factor model is unable to explain momentum returns. Although Fama (1998) admits there is something abnormal in price and earning momentum, he still champions the efficient market hypothesis. Up to the present, there is still no consensus on the origin of momentum strategy returns; the rational expectation school holds that momentum returns bear some risks, the factors of which, however are yet to be determined. Drawing on the behavior approach, Hong and Stein (1999) regard the surplus returns as a consequence of the psychological biases of investors, whose slow reaction to messages results in the con-

tinuation of momentum. On the other hand, Chordia and Shivakumar (2002) discovered that momentum strategies were influenced by business cycle, where surplus returns could be earned during the period of expansion, while average returns are negative during the recession. Besides, they establish a regression model based on 4 macroeconomic variables – default spread, term spread, PE ratio, and treasury yield of 3 months. The empirical result shows that macroeconomic variables can predict momentum returns, thus implying that the unconfirmed risk factors can be steered in the direction of macroeconomic variables. Chordia and Shivakumar (2006) further point out to a significant correlation between earning momentum returns and future economic activities; the variables used in this study include GDP growth rate, the industrial production index, and the inflation rate etc. Some kind of relationship between stock returns and macroeconomic variables indeed exists, but the relationship is yet to be determined. Rapach, Ohar and Rangvid (2004) propose that macroeconomic variables can be used to predict stock returns, and the variables they use in their study include the inflation rate, the export value, the unemployment rate, the industrial production index, the interest rate etc. However, they also point out that the common problem lies in the fact that the predictability of macroeconomic variables is unstable during the calculated period, to the extent that even the contradictory empirical results appear. Proponents of the efficient market hypothesis such as Fama (1990) believe that what the current share price reflects is an expectation of future economy. It is noted, through an empirical study, that at the US market, most stock returns can be explained by future real economic activities. However, in using the industrial growth rate and the real GDP to represent the variables of real economic activities, Binswanger (2000) repeatedly verifies that at the US stock market from the late 1940s to the mid-1960s, future real economic activities are unable to explain past stock returns. Young and Simon (2002) further indicate that such macroeconomic variables as default spread and the interest rate are capable of predicting momentum strategy returns. However, the correlations between earning momentum returns and macroeconomic variables are mostly negative, which means that future economic activities can't explain momentum returns. Thus they conclude that neither the Rational School, nor the Behavior School can provide a reasonable explanation.

The scholars mentioned above investigate the phenomenon of excess returns from the perspective of economy-related variables. On the other hand, there are some researches that investigate the relationship between the volatility index and the stock market index returns. The Chicago Board Option Exchange (CBOE) advanced the volatility index original (VXO) in 1993 and, subsequently, the volatility index (VIX) in 2003. The volatility index represents the prediction of S&P 100 stock market index volatility at the market: while VXO descends, the fluctuation of the stock index is flat; while VXO ascends, it demonstrates that traders are uneasy about market states. Thus, VXO is also termed as "investors' indicator of panic." Referring to this innovation of CBOE, Taiwan Futures Exchange simultaneously adopts VXO and VIX, officially providing instant display of the Volatility of Taiwan Index Options since Dec 18, 2006, and of the Volatility of Taiwan Index Options since Dec 17, 2007. Whaley (2000) and Giot (2003) indicate there is a negative correlation between the volatility index, the synchronic S&P 100 index returns and NASDAQ 100 index returns. Giot (2005) also discovers that the volatility index has negative correlation to future returns at low level

and notable positive correlation to future returns at high level. Lo, Lan and Chang (2007) note that the volatility index is in negative correlation with the returns of Taiwan Capitalization Weighted Stock Index (TAIEX) over the same period, but in positive correlation with the TAIEX in future. The result, as that of Giot (2005), demonstrates that the future market return rate can be predicted by the volatility index, and the regression coefficient of low volatility level is significantly negative, while that of the high volatility level – significantly positive. The volatility index, besides being capable to predict the market index returns, is noted by scholars to be correlated with the returns of portfolios. Copeland and Copeland (1999) discover that VIX can function as the leading indicator of stock returns, and thus trading strategies could be sketched according to VIX trend. Banerjee, Doran and Peterson (2006) investigate the relations between VIX and the returns of various portfolios. Using the β value, the B/M value, and the scale in the Fama-French three-factor model as indicators to classify portfolios, they establish, respectively, the portfolio-to-VIX regression models. The results show that VIX has considerable predicting ability in different portfolios, and VIX is positively correlated to β , while negatively correlated to B/M and the scale.

This study intends to examine whether there is the phenomenon of price momentum at Taiwan market, to establish conditional momentum strategies, and to investigate the relations between momentum returns and the volatility index, so as to find out more optimized momentum investment strategies. By establishing the regression model of momentum returns, it investigates whether momentum strategy returns are predictable, and the relations between momentum returns and various economic variables.

3. Study design

This study, spanning from Jan., 2002 to Dec., 2011, takes the listed companies in Taiwan as the object of the study, excluding preferred stock, convertible bonds, beneficiary certificates and full-cash delivery stock. The sources of the rate of stock price monthly returns and the data per share come from the Taiwan Economic Journal (TEJ) Database. The number of samples in this study is illustrated in Table 1.

Table 1. Research data statistics

Momentum strategies	Market	Concentrated market	
		Number of Companies	Observation
Price momentum strategies		753	55,372

The construction of portfolios is ranked in accordance with the performance of each share during the period of formation, and is categorized into 10 groups, the top 10% of which is called winner (P10), while the bottom 10% – loser (P1). Then, at the beginning of each month, one executes momentum strategies through buying in winners and selling out losers with the equal-weight technique, and observes the average monthly returns during the holding period. This paper executes momentum strategies with overlapping technique, with the holding periods categorized into 1, 3, 6, 12, 24 and 36 months. For momentum strategies and price momentum strategies, drawing on Jegadeesh and Titman (1993), the monthly returns over the past 6 months of each share are adopted as the classification index.

Besides establishing momentum strategies on the basis of the previous studies (hereafter as original momentum strategies), this paper also sets up conditional momentum strategies, as follows:

Table 2. Conditional momentum strategies

Condition		Strategies
$R_W * R_L < 0$	Where $R_W > R_L$	Buying in winners and selling out losers (i.e. original momentum strategy)
$R_W * R_L > 0$	If $R_W > 0, R_L > 0$	Buying in winners only
	If $R_W < 0, R_L < 0$	Selling out losers only

Note: R_W and R_L represent, respectively, the average returns of winners and losers over the past 6 months.

In terms of the investigation of the relations between volatility and momentum strategies returns, since this study executes momentum strategies at the beginning of every month, it also calculates the corresponding volatility index at the same time, so as to observe the influence of volatility on momentum strategy returns. This paper calculates the volatility of stock exchange market by using volatility. The sources come from the TEJ.

4. Empirical results and analysis

Focusing on the period between Jan., 2002 and Dec., 2011, this study takes the listed stocks in Taiwan as its sample to execute price momentum investment strategies. The holding periods of the portfolios are 1, 2, 3, 6, 12, 24, and 36 months.

Price momentum strategies construct the portfolios by using the average returns over the past 6 months as the index. From Table 3, it can be observed that among the listed stocks, almost all returns are negative in the short term when adopting original price momentum strategies or conditional price momentum strategies. When the holding periods of listed stocks are over 3 to 6 months, the positive returns appear in the long term, but all the parts wherein positive returns are not evident. It shows that the continuity of price momentum at Taiwan market is not evident.

Table 3. Price momentum strategy returns (stock exchange market)

	P10	P1	P10- P1	Conditional strategy returns
One-month holding period (N = 62)	0.372(0.541) [0.127]	0.723(1.231) [0.081]	-0.351(-1.119) [0.226]	-0.351(-1.119) [0.226]
Two-month holding period (N = 71)	0.671(0.173) [0.323]	0.714(1.242) [0.065]	-0.043(-0.535) [0.625]	-0.043(-0.535) [0.625]
Three-month holding period (N = 75)	0.823(1.249) [0.013]	0.697(1.256) [0.023]	0.126(0.532) [0.521]	0.126(0.532) [0.521]
Six-month holding period (N = 67)	1.211(2.634) [0.028]	0.837(1.225) [0.053]	0.374(0.281) [0.345]	0.374(0.281) [0.345]
One-year holding period (N = 61)	1.532(2.302) [0.008]	1.197(2.128) [0.000]	0.335(0.420) [0.202]	0.335(0.420) [0.202]
Two-year holding period (N = 53)	1.705(4.249) [0.000]	1.265(3.331) [0.000]	0.440(1.323) [0.028]	0.440(1.323) [0.028]
Three-year holding period (N = 40)	1.248(9.352) [0.000]	0.972(8.634) [0.000]	0.276(0.361) [0.211]	0.276(0.361) [0.211]

Note: (1) P1 and P10 represent respectively the combination of the highest and the lowest accumulated returns over the past 6 months.

(2) Rate of return is the average rate of return; () stands for the t-statistic; [] stands for the p-value.

The following investigates whether price momentum strategy returns are affected by market volatility. It is known from the literature review above that VIX is correlative to future returns. Giot (2005) indicates that when VIX is at the relatively high point, it means that the market is in the state of panic, where positive returns can be gained if entering the market at this point. On the contrary, when VIX is at the relatively low point, it means that the market is currently too optimistic, and the returns would be negative if entering the market at this point.

The results of the analysis are shown in Table 4. It could be seen that at the stock market, whether using price momentum strategies or the conditional one, if the holding period is within 1 year (R12), returns can even be all positive whether the volatility level is high or low. And if the holding period is within 2 years, the returns that momentum strategies earn are all higher at relatively high volatility level than it does at relatively low volatility level. However, in 2008, when the global financial crisis affected the stock market in Taiwan, although the volatility reached record height, investors were not willing to invest, resulting in enormous discrepancy. Therefore, the short-term R1, R2, and R3 momentum strategies were affected, demonstrating different circumstances, influencing original price momentum strategies.

Table 4. The volatility levels and regression coefficients of different holding periods

Price momentum strategies	R1	R2	R3	R6	R12	R24	R36
Relatively low level	2.171 (0.001)	1.210 (0.002)	1.191 (0.001)	2.781 (0.000)	1.248 (0.000)	0.362 (0.008)	0.323 (0.015)
Relatively high level	3.249 (0.000)	3.307 (0.000)	2.228 (0.000)	2.358 (0.000)	1.832 (0.000)	0.616 (0.002)	-0.061 (0.257)
Conditional momentum strategies	R1	R2	R3	R6	R12	R24	R36
Relatively low level	1.217 (0.020)	1.246 (0.032)	1.091 (0.152)	0.812 (0.311)	0.521 (0.051)	0.279 (0.300)	0.514 (0.000)
Relatively high level	-1.270 (0.013)	-1.203 (0.045)	-1.073 (0.022)	1.320 (0.028)	2.242 (0.002)	0.452 (0.231)	0.902 (0.352)

Note: the numerical is the regression coefficient; p-values are in parenthesis.

5. Conclusions and further suggestions

This paper takes as an object for analysis the listed companies in Taiwan from Jan., 2002 to Dec., 2011, investigating the momentum of Taiwan market. Then, by price momentum strategies and adding volatility variables, it intends to find out the more optimized momentum strategies. Finally, it selects the volatility index to establish the regression model, in order to observe the relations between momentum returns and volatility.

Firstly, the phenomenon of the continuity of price momentum is found existing at Taiwan market; that is, the stock information could be reflected in the performance of the stock price. Conditional momentum strategies, on the other hand, are a relatively conservative but a steady way to invest. If investors intend to hold the portfolios in a long term, they could adopt conditional momentum strategies. Volatility is an extremely important market index. This research uses volatility as an analytic tool, and volatility index is one of the indexes most suitable to predict future returns at stock markets; the other indicators of indexes could also be compared with each other

for investment guidance. The duration of this study is 9 years, which is relatively short and requires further observations for a longer time.

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