MARKET STATES AND THE PROFITABILITY OF MOMENTUM STRATEGIES: EVIDENCE FROM THE TAIWAN STOCK EXCHANGE

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ABSTRACT

This paper examines the impact of market states on the profitability of momentum strategies using weekly data from the Taiwan Stock exchange over the 10-year period 1997-2006. Market states refer to the states of market such as up or down markets. In this paper, the formation period is defined as in an up (down) state if the market return over the six-month period prior to the holding period is nonnegative (negative). The results indicate that market states in the formation period are positively associated with the profitability of the momentum strategies. The results are consistent with the overreaction theory developed in Daniel et al. (2004). Moreover, the empirical results indicate that market states in the holding period are negatively associated with the profitability of the momentum strategies. The holding period is defined as in an up (down) state if the market return in the six-month period following the formation period is nonnegative (negative). The momentum profits appear to be higher in a bearish holding period and lower for a bullish holding period. Thus, the market states in the holding period also provide information regarding the profitability of the momentum strategies.

JEL: G11, G14

INTRODUCTION

Previous research has documented the short-term cross-sectional momentum in stock returns (i.e., Jagadeesh and Titman, 1993) and long-term cross-sectional reversals in stock returns (i.e., De Bondt and Thaler, 1985, 1987). Several behavioral theories have been developed to explain the anomalous price behavior. Daniel, Hisrhleifer and Subrahmanyam (1998), for example, propose a theoretic model in that investors' overconfidence about their private information leads to the short-term price momentum and the long-term price reversal. Specifically, investors tend to react differently to new information due to a self-attribution bias. If the upcoming information is consistent with these investors' prior belief, they tend to attribute the confirming news to their own skill. In contrast, if the upcoming information is inconsistent with their prior belief, they tend to attribute such disconfirming information to external noise. The self-attribution bias reinforces the overconfidence following the arrival of the confirming news, which generates the pattern of short-term price momentum. In the long-run, however, the arrival of information regarding the fair firm value leads to a price correction and thus long-term price reversals.

Cooper, Gutierrez and Hameed (2004) examine the overreaction theories by examining the impact of market states on momentum profits. In their research, the stock market is defined as in an up (down) market if the market return in the portfolio formation period is nonnegative (negative). Specifically, they test the theory of Daniel et al. (1998) which predicts greater aggregate overconfidence following market gains. Since investors in aggregate hold a long position in equity securities, their overconfidence tend to be greater following market gains due to the reinforcement of the self-attribution bias. If so, short-term price momentum should be greater following up markets. Using CRSP monthly data from 1929-1995, Cooper et al. (2004) examine the profitability of momentum strategies that take a long position in the prior winner portfolio and a short position in the prior loser portfolio. Moreover, they examine whether the state of markets affects the profitability of momentum strategies. The state of markets is divided into up and down markets based on market returns in the portfolio formation period. They find that the average monthly momentum profit following up markets is significantly positive at 0.93%. In contrast, the average monthly

momentum profit following down markets is negative at -0.37%. Moreover, the up-market momentum profit reverses in the long-run. The results of asymmetrical momentum profits in the up and down markets are consistent with the prediction of the overreaction model in Daniel et al. (1998). While the empirical analysis in Cooper et al. (2004) examines the impact of formation-period market states on momentum profits, the overreaction theory in Daniel et al. (1998) can extended to examine the impact of market states in both the formation and the holding period.

Following Cooper et al. (2004), we examine the impact of formation-period market states on the profitability of momentum strategies using data from the Taiwan Stock Exchange over the 10-year period 1997-2006. The formation period is defined as in an up (down) state if the market return over the six-month period *prior to* the holding period is nonnegative (negative). The market return is based on the value-weighted market index compiled by the Taiwan Stock Exchange. Aside from the formation-period market states, we also examine the impact of holding-period market states on the profitability of the momentum strategies. The holding period is defined as in an up (down) state if the market return in the six-month period *following* the formation period is nonnegative (negative).

Consistent with the finding in Cooper et al. (2004), our results indicate that the formation-period market states affect the momentum profits. Momentum strategies generate significantly positive returns following market gains in the formation periods. Moreover, our empirical result indicates that the holding-period market states also affect momentum. Momentum strategies perform better for holding periods in down markets as opposed to up markets. The plan of this paper is as follow. Section 2 provides a brief literature review. Section 3 introduces the institutional background of the Taiwan Stock Exchange. Section 4 describes the data and methodology employed in this paper. Section 5 presents empirical results and Section 6 concludes.

LITERATURE REVIEW

De Bondt and Thaler (1985) note that, based on research in experimental psychology (i.e., Kahneman and Tversky, 1982), most people tend to overreact to unexpected and dramatic news events. If investors overreact to unexpected good news and bad news in the prior period and correct their overreaction in the subsequent period, we would expect price reversals in the successive periods. De Bondt and Thaler (1985) test the overreaction hypothesis by examining the stock price behavior for stocks contained in the CRSP monthly data file over the period 1926 through 1982. Their results indicate that the return data are consistent with the prediction of the overreaction hypothesis. For stocks ranked in the past 3-year formation period, losers outperform winners in the subsequent 3-year holding period. The average cumulative abnormal return in the holding period is significantly positive at 19.6% for the losers, but only -5% for the winners. Thus, the contrarian strategies of buying prior losers and selling prior winners would yield abnormal returns over a 3-year holding period.

Similarly, other research provides evidence of shorter-term price reversals (i.e., Jagadeesh, 1990; Lehmann, 1990). These papers indicate that contrarian strategies based on returns in prior weeks as well as prior months generate significant abnormal returns. However, since shorter-term strategies involve intensive transactions, abnormal returns generated from these strategies may be sensitive microstructure issues such as bid-ask spreads. Lo and MacKinlay (1990) point out that a large part of the short-term contrarian profits can be attributed to a delayed price reaction to common factors rather than to overreaction.

Although the profitability of contrarian strategies has attracted much attention in academic literature, early literature on trading strategies focused on momentum strategies that buy prior winners and sell prior losers. Levy (1967), for example, documents empirical evidence that momentum strategies based on the relative strength of stocks in the past 27 weeks produce significant abnormal returns. Similarly, Jegadeesh and Titman (1993) report significant abnormal returns in the holding period of 3-12 months for momentum strategies that buy prior winners and sell prior losers for stocks ranked in the formation period of 3-12 months. They note that the momentum profits cannot be attributed to systematic risk or to delayed stock price reactions to common factors.

Several explanations have been offered regarding the abnormal returns of the momentum strategies. Jegadeesh and Titman (1995) suggest that investors' underreaction to firm-specific information is a major cause of momentum abnormal returns. Conrad and Kaul (1998) indicate that momentum profits result from cross-sectional differences in expected returns. Jegadeesh and Titman (2001) suggest that momentum profits are due to delayed overreactions that eventually reverse. Bhojraj and Swaminathan (2006) propose that investors initially under-react to information which results in undervalued stock prices. Then, stock prices move to their fundamental values gradually so that price continuation exists in the short run. The stock prices may rise even above and far from their fundamental values. Finally, the stock prices may revert to their fundamental values eventually in the long-run.

Moreover, recent literature provides empirical evidence that the state of market is an important factor that may affect momentum profits (see, for example, Griffin, Ji and Martin, 2003; Cooper et al., 2004; Antonios and Patricia, 2006; Huang, 2006). Griffin et al. (2003) indicate that momentum profits are pronounced in both good and bad economic states, and this phenomenon reverses in the holding periods of 1- to 5- years. Cooper et al. (2004) classify market returns into up and down states based on lagged three-year market returns. Their empirical results indicate that short-run momentum profits exist following up markets and that the mean monthly profit in the up markets is higher than that in the down markets. This phenomenon is robust when one- or two-year market returns are used to classified market states. Finally, they find significant prices reversals following both up and down markets in the long run. They consider that the short-term momentum and long-term price reversals are consistent with the overreaction hypothesis.

Antonios and Patricia (2006) examine the profitability of momentum strategies following bull and bear markets utilizing data from the London Stock Exchange. They define bull and bear markets based on market returns over different periods. Their empirical findings indicate that momentum profits are more pronounced following bear markets. In addition, the longer the bear market periods, the more pronounced the momentum returns. Moreover, they find that momentum profits become negative following stronger bull markets. One possible explanation for the momentum profits is that investors who realize their losses (gains) in the past tend to underreact (overreact) to present information. Their findings are consistent with the behavioral model proposed by Daniel et al. (1998) and Hong and Stein (1999).

Institutional Background

Established in 1962, the Taiwan Stock Exchange is the major stock market in Taiwan. The number of listed stocks varies in the sample period 1997 through 2006 ranging from 404 in 1997 to 688 in 2006. Individual investors contribute a large share in trading volume although institutional investors play an increasing important role in recent years. In particular, trading volume contributed by individual investors declines from 90.7% in 1997 to 72.8% in 2006 with the remaining trading volume coming from institutional investors. Moreover, trading activity is heavy with turnover ratios ranging from 407.32% in 1997 to 142.2% in 2006. As such, investors appear to hold their stocks in relatively shorter periods than investors in other more mature markets (i.e., Securities and Futures Bureau, Taiwan, R.O.C., 2008).

The Taiwan Stock Exchange is an order-driven market without the aid of market makers. Investors submit buy and sell orders to their brokers; these orders are then matched by the computer system in the stock exchange. The matching process is based on the price and time priority. Thus, all buy orders with bidding prices above the transaction prices are filled with priority. Similarly, all sell orders with asking prices below the transaction prices are filled with priority.

The Taiwan Stock Exchange opens from 9:00 a.m. to 1:30 p.m. Mondays through Fridays. During the pre-trade period 8:30-9:00 a.m., investors submit their orders which are accumulated to determine the opening price at 9:00 a.m. through a call auction method. Following opening, the transaction prices are determined through the same call method every 30 to 45 seconds. Finally, the closing price is determined by the same call method for orders accumulated over the last 5-minute interval 1:25 to 1:30 p.m. preceding the closing of the trading session

Daily price limits and a sliding schedule of tick sizes are utilized in the Taiwan Stock Exchange. In an attempt to control excessive price volatility, the Taiwan Stock Exchange imposes a daily price limit of 7%. The prevailing tick sizes or minimum price variations are NT$0.01, 0.05, 0.10, 0.50, 1.00, 5.00 respectively for trading prices in the range of NT$0-10, 10-50, 50-100, 100-500, 500-1000, and 1000-above respectively.

The major transaction costs involve commission fees and transaction taxes. For a buy transaction, investors pay a commission fee of 0.1425% to brokers and a transaction tax of 0.3% to the government. For a sell transaction, investors pay only the brokerage fee of 0.1425% although brokers may provide discounts to investors in order to promote business. For a typical round-trip transaction without discounts, the transaction cost involve a 0.585% ((0.1425%)×(2)+0.3%=0.585%) of the trading value.

SAMPLE AND METHODOLOGY

The sample involves all stocks listed on the Taiwan Stock Exchange over the 10-year period 1997 to 2006. Weekly return data are obtained from the Taiwan Economic Journal Database. Sample firms suffering from financial distress are excluded. The screening process yields a total of 294 to 597 sample firms in the sample period.

To examine the profitability of momentum strategies, sample firms are first sorted into quintiles based on market-adjusted abnormal returns in the *formation period*. The quintile with the highest average abnormal return is the *winner* portfolio while the quintile with the lowest average abnormal return is the *loser* portfolio. The stocks in the winner or loser portfolio are equally weighted to yield the portfolio returns. The momentum strategies involve a long position in the winner portfolio and a short position in the loser portfolio. The profitability of the momentum strategies is assessed by the abnormal return of the momentum strategies in the subsequent *holding period.*

The formation periods involve five time intervals ranging from 1, 2, 4, 12 to 26 weeks while the subsequent holding periods involve six time intervals ranging from 1, 2, 4, 12, 26 to 52 weeks. Thus, the profitability for a total of $5 \times 6 = 30$ momentum strategies is examined. The time windows for the formation and the holding periods roll over the whole sample period. The momentum strategy with the formation periods of 1 week and the holding period of 1 week, or strategy (1, 1), starts from the formation period of January 4, 1997 to January 11, 1997 and the corresponding holding period from January 11, 1997 to January 18, 1997. This process continues until the end of the sample period.

The overreaction theory in Daniel et al. (1998) predicts greater short-term momentum profits following market gains. To examine this theory, we follow Cooper et al. (2004) by identifying the market states in the holding period into either in an up or down market. The formation period is considered in an up (down) state if the market return over the six-month period *prior to* the holding period is nonnegative (negative). The value-weighted market index compiled by the Taiwan Stock Exchange is used to derive the market return. To examine the impact of market states on the profitability of momentum strategies, momentum profits following an up-market formation period are compared to those following a down-market formation period. According to the overreaction theory, we would expect the momentum profits following an up market to perform better than those following a down market.

For each momentum strategy (J, K) with a formation period J and a holding period K, the momentum profit in an up or down market is estimated by averaging abnormal returns over holding periods across securities and market states. First, market-adjusted abnormal returns for each stock i in the holding period is estimated. The market-adjusted abnormal returns for firm i in holding period t following a market state c, $AR_{i,t,c}$, is estimated as the return on stock i minus the corresponding market return as follow (the subscripts (j, k) for the associated strategy (J, K) are omitted in $AR_{i,t,c}$ for brevity):

$$AR_{i,t,c} = (R_{i,t,c} - R_{m,t,c}) \tag{1}$$

The stock returns, $R_{i,t,c}$, and market returns, $R_{m,t,c}$, are evaluated as the price relatives: $R_{i,t,c} = (P_{i,t,c} - P_{i,t-1,c})/P_{i,t-1,c}$, $R_{m,t,c} = (P_{m,t,c} - P_{m,t-1,c})/P_{m,t-1,c}$, where $R_{i,t,c}$ denotes the return on stock i in either an up or down state, $R_{m,t,c}$ denotes the market return derived from the Taiwan Weighted Stock Index, and [t-1, t] is the holding period over which returns are estimated. The average abnormal returns (AARs) for each strategy (J, K) in the up or down states are evaluated by averaging the abnormal returns $AR_{i,t,c}$ across the total sample observations for the winner and the loser portfolios respectively as follows:

$$AAR_{j,k,c}^{L} = \sum_{s=1}^{OBS} AR_{j,k,c,s}^{L} / OBS_{j,k,c}^{L} \tag{2a}$$

$$AAR_{j,k,c}^{W} = \sum_{s=1}^{OBS} AR_{j,k,c,s}^{W} / OBS_{j,k,c}^{W} \tag{2b}$$

where $OBS_{j,k,c}^{L}$ and $OBS_{j,k,c}^{W}$ are the total numbers of return observations for the momentum strategy (J, K) following market state c, whereas the superscripts L and W denote the loser portfolio and the winner portfolio respectively and c denotes the market state as either an up or a down state in the formation periods.

Since the momentum strategy consist of taking a long position in the winner portfolio and a short position in the loser portfolio. The average abnormal returns of the strategy (J, K) in a market state c are evaluated as the differences between the average abnormal returns on the winner quintiles and those on loser quintiles in each state of the market, or $AAR_{j,k,c} = (AAR_{j,k,c}^{W} - AAR_{j,k,c}^{L})$.

Aside from the consideration of market states in the formation periods, we also examine how momentum strategies perform when the holding periods turn out to be in either an up or down market. The state of the market for the holding period is determined similar to that for the formation periods. Specifically, a holding period is in an up (down) state if the market return in the six-month period *following* the formation period is nonnegative (negative). While previous research documents the impact of formation-period market states on momentum profits, a further analysis on how market states in holding periods affect momentum profits should enhance our understanding of stock price behavior.

EMPIRICAL RESULTS

Market States in the Formation Periods and Momentum Profits

Table 1 reports momentum profits following up-market formation periods. The results indicate that momentum strategies generate significantly positive abnormal returns for 24 out of the 30 momentum strategies. The average abnormal return across the 30 momentum strategies is 2.17% with winner and loser portfolios earning average abnormal returns at 3.05% and 0.88% respectively. Thus, the results indicate price continuation for the winner portfolios and slight price reversals for the loser portfolios.

Moreover, Table 1 indicates that the momentum profits become larger as formation periods increase up to 12 weeks. For example, with holding periods of one year (K = 52 weeks), momentum profits (W-L) with long positions in winners and short positions in losers increase from 3.81% for the formation period of one week (J = 1 week) to 9.80% for formation period of 3 months (J = 12 weeks). Similarly, the momentum profits become larger as holding periods become longer. For formation period of 4 weeks (J = 4 weeks), for example, the momentum profits increase from 0.38% for holding period of one week (K = 1 week) to 6.49% for holding period of 52 weeks (K = 52 weeks).

Table 1: Average Abnormal Returns for Strategies (J, K) Following Up-Market Formation Periods

Formation Period (J)	Holding Period (K)	Following Up-market Formation Periods					
		Winner	t $_W$	Loser	t $_L$	W-L	t $_{W-L}$
1	1	0.0023	4.93 *	0.0022	5.52 *	0.0002	0.25
	2	0.0056	8.53 *	0.0021	3.90 *	0.0035	4.07 *
	4	0.0093	9.95 *	0.0020	2.58 *	0.0073	5.93 *
	12	0.0168	10.65 *	0.0093	6.43 *	0.0076	3.54 *
	26	0.0377	15.95 *	0.0180	8.35 *	0.0197	6.15 *
	52	0.0698	18.19 *	0.0317	8.80 *	0.0381	7.25 *
2	1	0.0028	4.29 *	0.0012	2.10 *	0.0017	1.94
	2	0.0076	8.44 *	0.0007	0.91	0.0069	5.93 *
	4	0.0102	8.01 *	-0.0013	-1.24	0.0115	7.00 *
	12	0.0211	9.52 *	0.0062	3.27 *	0.0149	5.12 *
	26	0.0406	12.43 *	0.0073	2.50	0.0333	7.60 *
	52	0.0734	13.86 *	0.0199	4.08 *	0.0535	7.43 *
4	1	0.0035	3.54 *	-0.0003	-0.38	0.0038	3.05 *
	2	0.0092	6.89 *	0.0013	1.32	0.0079	4.71 *
	4	0.0126	6.59 *	0.0024	1.66	0.0102	4.20 *
	12	0.0262	8.10 *	0.0072	2.68 *	0.0191	4.54 *
	26	0.0498	10.45 *	0.0100	2.37 *	0.0398	6.25 *
	52	0.0853	11.32 *	0.0204	2.96 *	0.0649	6.35 *
12	1	0.0049	2.80 *	-0.0024	-1.75	0.0073	3.28 *
	2	0.0100	4.63 *	0.0028	1.50	0.0072	2.54 *
	4	0.0146	4.56 *	-0.0040	-1.50	0.0185	4.47 *
	12	0.0313	5.33 *	0.0004	0.09	0.0309	4.14 *
	26	0.0520	6.66 *	0.0058	0.73	0.0461	4.12 *
	52	0.0779	5.86 *	-0.0201	-1.65	0.0980	5.42 *
26	1	0.0052	2.56 *	0.0110	5.07 *	-0.0058	-1.93
	2	0.0014	0.48	0.0157	5.53 *	-0.0143	-3.50 *
	4	-0.0034	-0.82	0.0082	2.15 *	-0.0116	-2.06
	12	0.0370	5.09 *	0.0087	1.43	0.0284	3.00 *
	26	0.0746	6.72 *	0.0090	0.77	0.0656	4.08 *
	52	0.1253	6.56 *	0.0883	4.11 *	0.0370	1.29
Mean		0.0305		0.0088		0.0217	

*An asterisk, *, indicates significance at 5% of one-tail test.*

Table 2 reports momentum profits following down-market formation periods. The results indicate that momentum strategies generate significantly negative abnormal returns for 17 out of the 30 momentum strategies. In contrast, only 4 strategies generate significantly positive abnormal returns. The average abnormal return across the 30 momentum strategies is -1.18% with the winner portfolios earning average abnormal returns of 0.29% and the loser portfolios 1.47%. Thus, the results indicate stronger price reversals

for the loser portfolios but only minor price continuation for the winner portfolios following down-market formation periods.

Moreover, Table 2 indicates that the momentum profits become more negative as formation periods increase up to 4 weeks. For example, with the formation periods of 4 weeks (J = 4 weeks), momentum profits are all significantly negative ranging from -0.34% with the holding period of one week (K = 1 week) to -5.52% for the holding period of 26 weeks (K = 26 weeks).

Thus, the results in Tables 1 and 2 are consistent with the prediction of the overreaction theory in Daniel et al. (1998) in that the state of markets provides additional information regarding the profitability of momentum strategies. Following market gains in the formation period, investors tend to be overconfident. Moreover, investors may attribute trading gains to their own selection skill more than they should. Thus, the overconfidence appears to be stronger for the winner portfolio than for the loser portfolio. The short-run price continuation for the winner portfolio may reflect this self-attribution bias. In contrast, following market losses in the formation period, investors tend to attribute trading losses to external noise more than they should. Price reversals are more evident especially for the loser portfolio.

Market States in the Holding Periods and Momentum Profits

Tables 3 and 4 report momentum profits classified by market states in the holding periods. Table 3 report momentum profits following market gains in the formation period. As expected, Table 3 indicates that the momentum profits are generally positive following market gains. However, momentum profits are higher for holding periods in a down market as opposed to holding periods in an up market. The average abnormal return for the 30 momentum strategies is 2.81% for the down-market holding period as opposed to the 1.33% for the up-market holding market. Moreover, for the holding periods in down markets, 25 momentum strategies experience significantly positive abnormal returns. In contrast, for the holding periods in a down market, only 14 momentum strategies earn significantly positive abnormal returns.

The higher momentum profits for holding periods in down markets appear to be driven by the different reaction between the winner and the loser portfolio in the holding period. Specifically, loser portfolios appear to be more sensitive to market states in the holding period than do winner portfolios. That is, the loser portfolio performs better than the market in the up-market holding period, but worse than the market in the down-market holding period. For the loser portfolio, the average abnormal return across the 30 strategies is 2.16% in an up-market holding period but only -0.03% in a down-market holding period. The higher sensitivity of the loser portfolio to holding-period market states is more evident for longer holding periods. In contrast, winner portfolios are less sensitive to market states in the holding period. For the winner portfolio, the average abnormal return across the 30 strategies is 3.49% in an up-market holding period and still 2.78% in a down-market holding period. The higher market sensitivity of the loser portfolio results in higher momentum profits in the down state of the holding period.

Table 2: Average Abnormal Returns for Strategies (J, K) Following Down-Market Formation Periods

Formation Period (J)	Holding Period (K)	Following Down-market Formation Periods					
		Winner	t $_W$	Loser	t $_L$	W-L	t $_{W-L}$
1	1	-0.0020	-4.16 *	-0.0002	-0.43	-0.0018	-2.50 *
	2	0.0000	0.05	-0.0017	-2.42 *	0.0018	1.78
	4	0.0009	0.91	0.0001	0.13	0.0008	0.55
	12	0.0056	2.92 *	0.0139	7.02 *	-0.0083	-3.00 *
	26	0.0061	2.28 *	0.0338	11.51 *	-0.0277	-6.94 *
	52	0.0143	3.67 *	0.0364	8.69 *	-0.0221	-3.87 *
2	1	-0.0011	-1.51	-0.0015	-2.01 *	0.0004	0.42
	2	0.0003	0.25	-0.0024	-2.23 *	0.0026	1.78
	4	0.0024	1.57	0.0011	0.75	0.0013	0.62
	12	0.0080	2.77 *	0.0119	4.05 *	-0.0039	-0.95
	26	0.0059	1.46	0.0407	9.20 *	-0.0347	-5.77 *
	52	0.0085	1.50	0.0355	5.59 *	-0.0269	-3.16 *
4	1	-0.0045	-4.26 *	-0.0011	-0.99	-0.0034	-2.19 *
	2	-0.0064	-4.40 *	0.0001	0.04	-0.0065	-3.13 *
	4	-0.0057	-2.61 *	0.0117	5.35 *	-0.0173	-5.63 *
	12	0.0017	0.41	0.0217	5.28 *	-0.0200	-3.43 *
	26	-0.0137	-2.57 *	0.0415	6.45 *	-0.0552	-6.61 *
	52	-0.0058	-0.74	0.0395	4.51 *	-0.0453	-3.86 *
12	1	0.0005	0.30	-0.0056	-2.73 *	0.0061	2.28 *
	2	0.0021	0.96	-0.0004	-0.14	0.0025	0.74
	4	-0.0165	-5.09 *	0.0139	3.69 *	-0.0304	-6.11 *
	12	-0.0213	-3.90 *	0.0240	3.68 *	-0.0453	-5.32 *
	26	-0.0135	-1.54	0.0370	3.87 *	-0.0505	-3.89 *
	52	0.0292	2.07 *	0.0111	0.85	0.0181	0.95
26	1	0.0103	3.76 *	-0.0068	-2.58 *	0.0170	4.50 *
	2	0.0146	3.94 *	-0.0070	-1.86	0.0217	4.08 *
	4	0.0011	0.21	0.0252	4.63 *	-0.0241	-3.14 *
	12	0.0066	0.80	0.0892	7.56 *	-0.0826	-5.74 *
	26	0.0150	1.04	-0.0055	-0.40	0.0205	1.03
	52	0.0441	2.14 *	-0.0152	-0.72	0.0592	2.02 *
		0.0029		0.0147		-0.0118	

*An asterisk, *, indicates significance at 5% of one-tail test.*

Table 3: Average Abnormal Returns for Strategies (J, K) Following Up-Market Formation Periods

Formation Period (J)	Holding Period (K)	Holding Periods in Up Markets				Holding Periods in Down Markets			
		Winner	Loser	W-L	t_{W-L}	Winner	Loser	W-L	t_{W-L}
1	1	0.0004	0.0016	-0.0012	-1.55	0.0043	0.0027	0.0016	1.72
	2	0.0014	0.0000	0.0014	1.22	0.0101	0.0044	0.0057	4.35 *
	4	0.0049	-0.0022	0.0071	4.42 *	0.0139	0.0065	0.0074	3.99 *
	12	0.0055	0.0016	0.0039	1.34	0.0292	0.0176	0.0116	3.67 *
	26	0.0417	0.0253	0.0164	3.33 *	0.0335	0.0103	0.0232	5.77 *
	52	0.0788	0.0535	0.0254	3.07 *	0.0602	0.0085	0.0517	8.11 *
2	1	0.0022	0.0001	0.0021	1.88	0.0035	0.0022	0.0012	0.94
	2	0.0030	-0.0024	0.0054	3.57 *	0.0126	0.0039	0.0086	4.77 *
	4	0.0054	-0.0052	0.0107	4.87 *	0.0153	0.0030	0.0124	5.04 *
	12	0.0107	-0.0003	0.0109	2.81 *	0.0324	0.0131	0.0192	1.74
	26	0.0482	0.0077	0.0405	6.15 *	0.0327	0.0069	0.0258	4.50 *
	52	0.0920	0.0443	0.0477	4.22 *	0.0536	-0.0060	0.0596	6.85 *
4	1	-0.0003	-0.0013	0.0011	0.65	0.0068	0.0006	0.0061	3.38 *
	2	0.0020	-0.0002	0.0022	0.96	0.0157	0.0027	0.0130	5.35 *
	4	0.0068	-0.0006	0.0073	2.18 *	0.0176	0.0050	0.0126	3.67 *
	12	0.0125	0.0037	0.0088	1.53	0.0385	0.0103	0.0282	4.67 *
	26	0.0569	0.0093	0.0476	4.73 *	0.0436	0.0106	0.0329	4.09 *
	52	0.0950	0.0377	0.0573	3.41 *	0.0774	0.0064	0.0710	5.69 *
12	1	-0.0088	-0.0075	-0.0013	-0.34	0.0114	0.0000	0.0114	4.16 *
	2	-0.0026	-0.0037	0.0012	0.25	0.0160	0.0059	0.0101	2.83 *
	4	0.0037	-0.0045	0.0082	1.17	0.0198	-0.0037	0.0234	4.57 *
	12	0.0278	-0.0003	0.0281	2.27 *	0.0330	0.0008	0.0323	3.46 *
	26	0.0910	0.0309	0.0601	2.86 *	0.0334	-0.0061	0.0395	3.01 *
	52	0.1252	0.0939	0.0313	0.76	0.0562	-0.0723	0.1285	7.04 *
26	1	0.0024	0.0212	-0.0188	-4.33 *	0.0081	0.0006	0.0075	1.87
	2	-0.0055	0.0253	-0.0308	-4.93 *	0.0084	0.0058	0.0026	0.50
	4	-0.0080	0.0293	-0.0373	-4.39 *	0.0013	-0.0132	0.0145	2.02 *
	12	0.0290	0.0207	0.0083	0.71	0.0453	-0.0036	0.0488	3.26 *
	26	0.1014	0.0131	0.0883	4.02 *	0.0474	0.0048	0.0426	1.99 *
	52	0.2232	0.2574	-0.0342	-0.67	0.0529	-0.0369	0.0897	2.88 *
		0.0349	0.0216	0.0133		0.0278	-0.0003	0.0281	

*An asterisk, *, indicates significance at 5% of one-tail test.*

Table 4 reports momentum profits following market losses in the formation period. Table 4 indicates that most momentum strategies yield negative abnormal returns following market losses. Moreover, the momentum profits appear to be higher in a down-market holding period as opposed to those in an up-market holding period. Of the 30 momentum strategies, 25 strategies perform better in down markets as opposed to in up markets. The average abnormal return for the 30 momentum strategies is 0.42% in the down-market holding period as opposed to the -1.79% in the up-market holding market. Moreover, only 9 momentum strategies experience significantly negative abnormal returns in a down market. In contrast, 23 momentum strategies experience significantly negative abnormal returns in an up market.

Again, the poor performance of the momentum strategies following market losses appears to be driven by different market sensitivity between winner and loser portfolios. That is, the loser portfolios are more

sensitive to market states than the winner portfolios. The average abnormal returns across the 30 strategies indicate that the loser portfolio perform better than the winner portfolio in the up market, but worse than the winner portfolio in the down market. For up markets in the holding period, the average abnormal return across the 30 strategies is 1.18% for the loser portfolio, which is higher than the -0.61% for the winner portfolio. In contrast, for down markets in the holding period, the average abnormal return across the 30 strategies is 1.61% for the loser portfolio, which is lower than the 2.03% for the winner portfolio.

Table 4: Average Abnormal Returns for Strategies (J, K) Following Down-Market Formation Periods

Formation Period (J)	Holding Period (K)	Holding Periods in Up Markets				Holding Periods in Down Markets			
		Winner	Loser	W-L	t_{W-L}	Winner	Loser	W-L	t_{W-L}
1	1	-0.0050	-0.0022	-0.0028	-3.25 *	0.0030	0.0032	-0.0001	-0.09
	2	-0.0052	-0.0021	-0.0031	-2.55 *	0.0090	-0.0011	0.0101	5.87 *
	4	-0.0068	-0.0030	-0.0038	-2.21 *	0.0143	0.0055	0.0088	3.56 *
	12	-0.0033	0.0125	-0.0159	-4.32 *	0.0205	0.0163	0.0042	1.03
	26	-0.0032	0.0305	-0.0337	-6.03 *	0.0221	0.0395	-0.0173	-3.44 *
	52	0.0190	0.0495	-0.0306	-3.88 *	0.0061	0.0135	-0.0073	-0.97
2	1	-0.0055	0.0000	-0.0055	-4.27 *	0.0066	-0.0042	0.0108	5.92 *
	2	-0.0072	-0.0017	-0.0055	-3.00 *	0.0134	-0.0036	0.0170	6.74 *
	4	-0.0069	-0.0011	-0.0057	-2.24 *	0.0190	0.0050	0.0140	3.86 *
	12	-0.0010	0.0141	-0.0151	-2.72 *	0.0232	0.0082	0.0150	2.55 *
	26	-0.0027	0.0392	-0.0420	-4.94 *	0.0210	0.0431	-0.0221	-3.03 *
	52	0.0105	0.0504	-0.0399	-3.37 *	0.0051	0.0095	-0.0044	-0.40
4	1	-0.0089	0.0003	-0.0091	-4.86 *	0.0022	-0.0032	0.0054	2.07 *
	2	-0.0126	-0.0038	-0.0088	-3.54 *	0.0038	0.0065	-0.0027	-0.73
	4	-0.0148	0.0034	-0.0182	-4.82 *	0.0105	0.0263	-0.0158	-3.02 *
	12	-0.0093	0.0124	-0.0217	-2.76 *	0.0180	0.0354	-0.0174	-2.05 *
	26	-0.0214	0.0288	-0.0502	-4.18 *	-0.0016	0.0616	-0.0632	-6.22 *
	52	-0.0125	0.0314	-0.0438	-2.74 *	0.0046	0.0522	-0.0476	-2.51 *
12	1	0.0012	0.0037	-0.0025	-0.71	-0.0002	-0.0161	0.0159	3.92 *
	2	-0.0046	0.0009	-0.0055	-1.28	0.0097	-0.0018	0.0115	2.27 *
	4	-0.0342	0.0122	-0.0464	-7.17 *	0.0100	0.0166	-0.0066	-0.86
	12	-0.0429	-0.0029	-0.0399	-3.37 *	0.0033	0.0548	-0.0516	-4.27 *
	26	-0.0364	0.0072	-0.0436	-2.19 *	0.0125	0.0710	-0.0585	-3.68 *
	52	0.0522	-0.0271	0.0793	2.61 *	0.0026	0.0553	-0.0527	-2.28 *
26	1	-0.0026	-0.0115	0.0090	2.15 *	0.0349	0.0023	0.0326	4.48 *
	2	-0.0023	-0.0069	0.0046	0.81	0.0526	-0.0075	0.0600	5.37 *
	4	-0.0122	0.0409	-0.0531	-6.89 *	0.0626	-0.0472	0.1098	5.02 *
	12	-0.0187	0.1152	-0.1339	-7.07 *	0.0632	0.0312	0.0320	1.77 *
	26	-0.0087	-0.0038	-0.0049	-0.19	0.0681	-0.0093	0.0774	2.88 *
	52	0.0241	-0.0314	0.0555	1.49	0.0885	0.0210	0.0675	1.46
		-0.0061	0.0118	-0.0179		0.0203	0.0161	0.0042	

An asterisk, *, indicates significance at 5% of one-tail test.

Regression of Momentum Profits Against Market States

To further examine the relationship between the profitability of momentum strategies and the market states in both the formation period and the holding period, the following regression analysis is performed:

$$R = \alpha + \beta_1 \times Market_f + \varepsilon, \tag{3a}$$

$$R = \alpha + \beta_1 \times \text{Market}_f + \beta_2 \times \text{Market}_h + \varepsilon, \tag{3b}$$

where R denotes the momentum profits for winner, loser, and winner less loser, respectively. For simplicity, the average abnormal returns across the 30 strategies for winner, loser, and winner less loser, are selected to indicate the momentum profits.

Market $_f$ is a dummy variable for the formation-period market state that assumes a value 1 if the market is in an up state, and zero otherwise, and

Market $_h$ is a dummy variable for the holding-period market state that assumes a value 1 if the market is in an up state, and zero otherwise.

Table 5 reports the regression results between the momentum profits and the market states. Panel A of Table 5 indicates a positive association between the momentum profits and the formation-period market states. The estimated coefficients for the holding-period market states, β_1, are significantly positive in both regressions. The estimated coefficient is 2.83 with a t-value of 23.96 for the first regression. This positive association suggests that the momentum profits tend to be positive following market gains and negative following market losses. The results are consistent with those documented in Cooper et al. (2004)

However, the second regression in Panel A of Table 5 indicates that the momentum profits are negatively related to market states in the holding period. The estimated coefficient for the holding-period market state, $\beta2$, is significantly negative. The estimated coefficient for the holding-period market state is -1.04% with a t-value of -8.78. The results are consistent with the finding in Tables 3 and 4 that momentum strategies perform better in the down state of the holding period.

Panel B of Table 5 reports the sensitivity of the winner portfolios to market states. The results indicate that the average abnormal returns for the winner portfolio are positively related to the formation-period market states. The estimated coefficients for the formation-period market states, β_1, are significantly positive in both regressions. However, the second regression indicates that the sensitivity of the winners' abnormal returns to market states in the holding period is negative. The estimated coefficient for the holding-period market state is -0.77% with a t-value of -8.88.

Panel C of Table 5 indicates that the average abnormal returns for the loser portfolio are negatively related to formation-period market states. However, the abnormal returns for the loser portfolios are positively related to the market states in the holding period. The estimated coefficients for the holding-period market states, β_2, is significantly positive. The estimated coefficient is 0.28 with a t-value of 3.25. This positive association suggests that the loser portfolios are more sensitive to market states than the winner portfolios in the holding period. That is, the loser portfolio tends to perform better in an up-state holding period, but worse in a down-state holding period.

Table 5: Regression of Momentum Profits against Market State in Formation and Holding Periods.
$$R = A + \beta_1 \times \text{Market}_f + \varepsilon \text{ and } R = \alpha + \beta_1 \times \text{Market}_f + \beta_2 \times \text{Market}_h + \varepsilon$$

	α	β₁	β₂	F-value	Pr > F	R²	adj-R²
Panel A: Panel A: Momentum Profits (W-L) Against Market States							
Equation1	- 0.0166	0.0283		573.96	<.0001	0.0014	0.0014
Equation2	-0.0114	0.0270	-0.0104	325.60	<.0001	0.0016	0.0015
Panel B: Winner Profits Against Market States							
Equation1	-0.0248	0.0221		659.24	<.0001	0.0016	0.0016
Equation2	-0.0209	0.0211	-0.0077	369.14	<.0001	0.0018	0.0018
Panel C: Loser Profits Against Market States							
Equation1	-0.0082	-0.0063		54.92	<.0001	0.0001	0.0001
Equation2	-0.0096	-0.0059	0.0028	32.75	<.0001	0.0002	0.0002

In Panel A, the equation 1 is: W-L = α + β 1 × Market f + ε where W-L denotes the profits of the momentum strategies. The equation 2 is: W-L = α +β 1 × Market f + β 2 × Market f, h + ε.   In Panel B and C, the equation 1 is: R = α + β 1 × Market f + ε, where R denotes the profits of the winners and losers respectively, Market f denotes the market state of the formation periods. The numbers in the parentheses are t-values. An asterisk, *, indicates significance at 5% of one-tail test. The equation 2 is: R = α +β 1 × Market f + β 2 × Market h + ε, where Market h denotes the market state of the holding periods while following up or down markets.

Discussion

Two interpretations are possible regarding the higher market sensitivity of the loser portfolio in the holding period. First, since the loser portfolio is more sensitive to market returns in the holding period, the higher sensitivity risk for the loser portfolio may be undervalued in estimating the momentum profits. If so, the positive momentum profits in a down-state holding period can be due to the underestimated risk premium for the loser portfolio. While we cannot rule out this possibility, the fact that the loser portfolio performs worse in the formation period suggests that the systematic risk for the loser portfolio probably is not high at least in the up-state formation period.

Alternatively, the higher market sensitivity for the loser portfolio in the holding period may reflect the asymmetrical reaction of investors regarding prior winner and the loser portfolios. If the market turns out to be bullish in the holding period, price reversals may be more likely for the loser portfolio. Investors may adjust their belief and consider these stocks undervalued so that price adjustment is warranted. This is especially true if the up state in the holding period becomes longer. However, if the market turns out to be bearish in the holding period, price decline may continue for the loser portfolio. Investors may reinforce their belief regarding the poor performance of the loser portfolio in the prior period. As a result, we would observe higher market sensitivity for the loser portfolio in the holding period. Such higher market sensitivity could be less likely for the winner portfolio. If the market is bullish in the holding period, certain investors may worry if the winner stocks are overpriced. In contrast, if the market is bearish in the holding period, some investors may be reluctant to adjust their positive assessment of the winner stocks. Thus, winner stocks could be less sensitive to market states in the holding period.

CONCLUSION

This paper examines the impact of market states on the profitability of momentum strategies using weekly data from the Taiwan Stock exchange over the 10-year period 1997-2006. The results indicate that market states in the formation period are positively associated with the profitability of the momentum strategies. The momentum profits are significantly positive following market gains in the formation period. In contrast, momentum profits appear to be negative following market losses in the formation period. The results are consistent with the overreaction theory developed in Daniel et al. (2004). Thus, market states in the formation period provide useful information regarding the profitability of momentum strategies in the subsequent holding period.

In addition, the empirical results indicate that market states in the holding period are negatively associated with the profitability of the momentum strategies. The momentum profits appear to be higher in a bearish holding period and lower for a bullish holding period. Moreover, the negative association between market states and momentum profits in the holding period appears to be driven by the higher market sensitivity of the loser portfolio than the winner portfolio. When compared to the winner portfolio, the loser portfolio appears to perform better in the bullish holding period. In contrast, the loser portfolio appears to perform worse in the bearish holding period. Thus, the market states in the holding period also provide information regarding the profitability of the momentum strategies.

It should be noted, however, that the empirical results documented in this paper reflect the behavior of traders in the Taiwan Stock market. The composition of traders in the Taiwan stock market indicates that individual traders account for a major part of around 70-90% of the trading volume in the sample period 1997-2006. Since these individual traders may have less access to information than institutional investors, the behavior of individual traders and institutional investors needs not be the same. Thus, any generalization of the empirical results obtained from the Taiwan Stock Exchange to other stock markets should be taken with care if the composition of traders differs drastically from that in the Taiwan stock market. Future research on how institutional investors and individual investors react in up and down markets is useful in enhancing our knowledge regarding this issue.

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