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Full Length Research Paper

Momentum strategy and board size: Evidence from Taiwan Stock Exchange (TWSE)

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This paper establishes a link between momentum profitability and board size. We use stocks listed on the Taiwan Stock Exchange (TWSE) to show that momentum profits are derived mainly from firms with small and medium board size, but it is nonexistent among large board size firms. The momentum profitability across small and medium board size firms does not represent for system risk based on the Fama-French three-factor model. After controlling by firm size, book-to-market value, our findings are still robust. This board size effect on momentum profits may be due to group decision process and an incentive to engage in risk-reduction activities for more powerful chief executive officers (CEOs).

Key words: Momentum strategy, board size, corporate governance.

INTRODUCTION

Jegadeesh and Titman (1993) document that past winners on average, continue to outperform past losers, so that based on the price momentum strategy, buying winners and selling losers, investors earn statistically and economically significant payoffs. Moreover, Fama and French (1996) show that the CAPM three-factor model fails to explain momentum profitability. The successes of momentum strategy not only violate weak-form market efficiency but provide a serious challenge to asset pricing theory. Abundant studies generate various explanations of the financial market anomaly.

Several factors have been documented to have impacts on momentum profits. For example, Conrad and Kaul (1998) document that the cross-sectional variation in the mean returns of individual stocks can potentially account for momentum profitability. Moskowitz and Grinblatt (1999) show that industry component of stock returns can explain individual stock momentum anomaly. Lee and Swaminathan (2000) report that low (high) trading volume stocks among winners (losers) exhibit greater persistence in price momentum. Grundy and Martin (2001) suggest that momentum profits are in part due to momentum in the stock-specific component of returns. Avramov et al. (2007) establish a link between momentum and credit rating and find that momentum profitability is significant among low-grade firms, but it is nonexistent in high-grade firms. Asem (2009) finds that momentum profits are lower among dividend-paying firms than their non-paying counterparts.

Another strand of research tries to solve the momentum puzzle based on investor's behavior. Barberis et al. (1998) propose a parsimonious model of investor sentiment and successfully predict that stock prices overreact consistent patterns of good or bad news. Daneil et al. (1998) develop a model based on psychological biases to explain momentum profitability. Moreover, Chan et al. (1999) report that the source of momentum profits comes from the sluggish response of market participants. Hong and Stein (1999) build a unified model to account for investors' under- and overreactions. Hong et al. (2000) test the model proposed by Hong et al. (1999), and found that negative information diffuses slowly across the investing public.

There is a family of research developing risk-based frameworks to explain momentum profitability. Chordia and Shivakuma (2002) claim that profits to momentum strategies can be explained by a set of lagged macro-economic variables. Avramov and Chordia (2006) add a momentum factor into Fama-French's three-factor model and find that the modified model fail to capture the momentum impact on the individual stocks returns.

Momentum profits have been documented to be related

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to various factors and both behavioral and risk-based models succeed to explain momentum profitability. However, the consistent explanation of momentum anomaly is far from conclusive. There might be unexplored factors affecting momentum profit.

The board of directors of a corporation performs the important functions of monitoring and advising top management. The relationship between board size and firm performance has been documented by several studies. Yermack (1996) provides evidence that companies with small boards exhibit higher firm value. Eisenberg et al. (1998) also find a significant negative correlation between board size and profitability for small and midsize firms (Coles et al., 2008; Cheng, 2008). Adams et al. (2005) and Cheng (2008) suggest that firm performance can be measured by stock returns. Since board size has impacts on stock price, it is natural to ask whether the price momentum payoffs are related to board size. Nevertheless, there are no studies exploring the relationship between momentum profits and board size. In this paper, we provide a new and unexplored dimension in understanding the profitability of momentum strategy.

Cheng (2008) finds the evidence that firms with larger boards have lower variability of returns. Since board size is negatively associated with the variability of stock returns, it is reasonable to conjecture that the momentum profits among small board stocks will be more prominent than large board stocks. In this study, we investigate the relationship between board size and momentum profits in Taiwan's stock market. We first implement the momentum strategy by various strategy formation intervals to test whether the strategy succeeds to generate profits. Then we divide our sample into subgroups by board size to investigate the relationship between board size and momentum profits. Our experimental result shows that momentum profits exhibit among small and medium board size only which indicates a nonlinear and negative association between board size and the firm performance variability.

DATA AND INITIAL EVIDENCE

Our sample includes all stocks listed on the Taiwan Stock Exchange (TWSE) during January, 1996 through March, 2008 period. Several stock selection criteria are employed to construct the portfolio. First, we exclude all stocks priced below five NT. dollars at the beginning of the holding period to avoid extremely liquid stocks (Gutierrez and Kelley, 2008). In addition, stocks must have at least six consecutive monthly returns before the portfolio construction. We use stock price and board size data from the Taiwan Economic Journal (TEJ) database. The filtering procedure leaves us 682 stocks.

For each month t, filtered TWSE stocks in the monthly TEJ database with returns for month t-6 through t-1 are ranked into decile portfolio according to their cumulative return during that period. We then form a portfolio comprising of a long position of winners (P10) and a short position of losers (P1). The positions are held for the following 6 months. Monthly returns represent the equally weighted average return from the current month's momentum strategy in addition to the previous five months.

Panel A of Table 1 shows that the average monthly return during the entire period is a significant 0.82% with a large portion of the profit from winner stocks. In addition, the momentum profit in January is negative. The empirical results are consistent with US market (Jegadeesh et al., 1993; Chordia et al., 2002). The average monthly momentum return for non-January months is positive and statistically significant, indicating that the January effect does not accelerate the momentum.

This study also examines whether the profitability of momentum strategies identified earlier is related to business cycle conditions. The table shows that the momentum profits are positive and significant during expansion periods but insignificant during recession. These estimates contradict the findings in the Germany, UK and France markets proposed by Antoniou et al. (2007) that momentum strategies generate significant positive profits during both expansion and recession periods. However, the insignificant profits during recession periods in the Taiwan market are similar to the findings of Chordia et al. (2002) for the US market. In short, the momentum anomaly is not only limited to the US and European markets but also in the emerging Taiwan market.

We also calculate the differences between the second extreme winners (P9) and losers (P2) to examine whether the momentum profits exist in this strategy. For the overall period, the momentum profits of P9 to P2 is an insignificant 0.2% per month which is about quarter of 0.84% obtained from P10-P1 strategy. The momentum profits of P9 to P2 for the other subsamples in panel A of Table 1 are all insignificant. The results indicate that the momentum effect mainly comes from extreme winners and losers.

Panel B of Table 1 shows the descriptive statistics of board size for each decile portfolio and all firms. Board size is defined as the number of directors on the board. For each month t, the board size of each firm is recorded. We then compute the descriptive statistics of board size for each decile portfolio and for the whole sample during the entire period. The mean values of board size for the extreme winner (P10) and loser (P1) portfolio are 7.17 and 7.2 respectively which are lower than the average 7.63 of all firms. Compared with the other non-extreme loser or winner portfolios, the values are also lower than their averages. In addition, the variances of board size for extreme winner and loser portfolios show a similar manner to that of the mean value statistics. Furthermore, the skewness of board size for winner and loser portfolio is higher than that of all firms. In the mean time, they are also higher than the other non-extreme portfolios. In

Table 1. Momentum profits and board size descriptive statistics.

Board size	Panel A: Monthly momentum returns				
	Overall	**Non-January**	**January**	**Expansion**	**Recession**
P1	0.0038 (0.96)	0.0026 (0.63)	0.0168 (2.69)*	0.0059 (0.9)	0.0015 (0.37)
P2	0.0072 (2.07)*	0.0063 (1.71)	0.0171 (2.77)*	0.008 (1.44)	0.0063 (1.54)
P3	0.0063 (2.0)*	0.0057 (1.66)	0.0137 (2.71)*	0.0072 (1.39)	0.0054 (1.45)
P4	0.0086 (2.89)*	0.0079 (2.45)*	0.0164 (3.24)*	0.0105 (2.2)*	0.0066 (1.78)
P5	0.0081 (2.76)*	0.0075 (2.36)*	0.0147 (2.61)*	0.0086 (1.87)	0.0075 (1.99)*
P6	0.0084 (2.95)*	0.0078 (2.51)*	0.015 (2.85)*	0.0093 (2.03)*	0.0076 (2.06)*
P7	0.0094 (3.2)*	0.0088 (2.76)*	0.0162 (2.59)*	0.011 (2.37)*	0.0077 (2.04)*
P8	0.01 (3.27)*	0.0096 (2.9)*	0.0145 (2.57)*	0.0117 (2.45)*	0.0082 (2.07)*
P9	0.0091 (2.97)*	0.0088 (2.61)*	0.0131 (2.21)*	0.0108 (2.2)*	0.0074 (1.86)
P10	0.012 (3.27)*	0.0117 (2.97)*	0.0153 (1.64)	0.0185 (3.16)*	0.0052 (1.17)
P10-P1	0.0082 (3.36)*	0.009 (3.57)*	-0.0015 (-0.2)	0.0125 (3.17)*	0.0036 (1.35)
P9-P2	0.002 (1.45)	0.0025 (1.78)	-0.0041 (-0.86)	0.0028 (1.32)	0.0012 (0.66)

	Panel B: Descriptive statistics of board size		
	Mean	**Variance**	**Skewness**
P1	7.20	9.51	1.91
P2	7.57	11.94	1.85
P3	7.66	12.62	1.81
P4	7.74	13.23	1.75
P5	7.82	13.78	1.76
P6	7.86	13.72	1.67
P7	7.73	12.60	1.75
P8	7.70	12.56	1.81
P9	7.57	11.57	1.86
P10	7.17	10.03	2.18
All firms	7.63	12.17	1.84

The table shows momentum profits for TWSE stocks from January 1996 through March 2008. Panel A shows the average monthly returns during the holding period of the winner and loser portfolios and momentum returns. t-statistics are in parentheses, with * denoting significant at 5% level. Panel B presents the descriptive statistics of board size.

summary, the statistical results indicate that the board size distribution for extreme winners or losers is less diversified and center away from large board size firms. The coarse results show that momentum profits seem to stem mainly from firms with small and medium board size rather than from large board size firms.

MOMENTUM PROFITS AND BOARD SIZE

To understand the relation between momentum profits and board size, we implement momentum strategies by conditioning on both board size and cumulative six-month formation period returns. Board size is defined as the number of directors on the board. We start to sort on board size then on past returns to construct board size-past return groups. First, we construct three board size groups and ten previous six-month formation period return portfolios. We then consider seven board size groups and three past six-month formation period returns portfolios. For each month t, the three board size groups are formed based on the number of board directors (small: board size range from 3 through 7, medium: range from 8 through 11, and large: range 12 through 27). Each of the board size groups is then divided into decile based on their returns over months t-1 to t-6. The seven board size groups are also formed each month by the number of board directors. The stocks in each group are divided into three momentum portfolios containing the bottom 30% (P1), middle 40% (P2) and top 30% (P3) stocks by their past six-month returns.

Panel A of Table 2 presents the results for three board size and ten momentum portfolios. The evidence shows that the statistically significant momentum profits exist only in the small and medium board size groups. For the large board size group, the monthly payoff is an insignificant 0.27%. The momentum profits for small and medium board size groups are economically and statistically significant at 1.02 (t-stat = 3.93) and 0.81% (t-stat = 2.94) respectively. These findings support our previous conjecture that momentum profits stem mainly from small and medium board size firms.

During expansions, the momentum strategy profit for large board size group increases slightly to 0.37% but it remains insignificant. The payoffs for small and medium board size group rise significantly to 1.63 and 1.18% respectively. During recessions, momentum profits decrease for all groups and turn to insignificant. Momentum strategy payoffs pattern in the non-January months are similar with the overall period. It is worth noticing that the payoffs in January for medium and large board size groups are negative albeit insignificant.

Panel B of Table 2 shows the momentum monthly returns of the seven board size and three momentum groups. Again, the evidence shows that momentum profits mainly stem from small and medium board size firms. Among large board size firms, the highest momentum payoff (P3 to P1) per month is an insignificant 0.21% exhibited in board size 14~15 group. The negative momentum profit is recorded in the board size 12~13 group. The momentum payoff for the board size 8~9 group is higher than those of large board size groups albeit insignificant. Except for the board size 8~9 group, the profits for any other small and medium board size groups are statistically and economically significant. The highest monthly payoff, 1.08% (t-stat = 5.98), appears in the board size 10~11 group. During expansions, the momentum strategy payoff for board size 14~15 group increases to 0.55% and turns to be statistically significant. The profits for the other two large board size groups remain insignificant. The highest momentum profits 1.14% (t-stat = 3.69) are in the board size 10~11 group. During recessions, the statistically significant momentum profits appear only in the board size 8~9, 10~11, and 12~13 groups and the highest payoffs remain in the board size 10~11 group. The momentum payoffs in January are all insignificant. The payoffs in the non-January months are all positive but insignificant for large board size groups. For the medium and small board size groups, the payoff patterns are similar with the overall period.

So far, the relationship between momentum profits and board size has been examined by using portfolio strategies based on sorting board size using the previous six-month returns. Now we construct different subsamples to implement momentum strategy based on previous six-month return. We start with firms with larger board size then progressively extend to firms with smaller board size. Through this analysis, the subsample driving momentum profits can be revealed.

Table 3 shows the average monthly momentum returns for each subsample as we sequentially add firms with smaller board size. We also report the percentage of market capitalization represented by each subsample and the percentage of total number of firms included in each subsample. We calculate these two measures each month and then average the overall period time series to obtain the estimates. Consistent with prior evidence, the momentum profits (P10-P1) are insignificant at the 5% level when the subsample contains firms with board size within the range 12~27. Meanwhile, this sample includes 27.5% of market capitalization of all firms and it contains 12.99% of the total number of the firms. In other words, the momentum profits are derived from a sample of firms that account for less than 72.5% of the total market capitalization or less than 87.01% of all firms. Recalling that boar size 10~11 subsample exhibits the highest payoff 1.08% in panel B of table 2. As board size 10~11 firms are added in the sample, the payoff soars to 0.99% (t-stat = 3.99) from 0.27% (t-stat = 1.31) and turns to be statistically and economically significant. As smaller board size firms are sequentially added in the sample, the momentum payoffs remain positive and are statistically and economically significant. Again, the evidence shows that momentum profits are driven from firms with

Table 2. Momentum profits for various board size sub samples.

		Panel A: Momentum profits and 3 board size groups		
	Board size	**Small**	**Medium**	**Large**
		3~7	**8~11**	**12~27**
All	P1	0.0037 (0.92)	0.0028 (0.71)	0.0029 (0.87)
	P2	0.0092 (2.49)*	0.0049 (1.44)	0.0043 (1.43)
	P3	0.008 (2.35)*	0.0069 (2.27)*	0.0032 (1.11)
	P4	0.009 (2.7)*	0.0063 (2.36)*	0.0074 (2.72)*
	P5	0.0086 (2.67)*	0.0075 (2.99)*	0.0065 (2.42)*
	P6	0.0095 (3.02)*	0.0089 (3.33)*	0.0066 (2.5)*
	P7	0.011 (3.3)*	0.0103 (3.66)*	0.0059 (2.27)*
	P8	0.0117 (3.54)*	0.0088 (3.09)*	0.0035 (1.29)
	P9	0.0095 (2.86)*	0.0113 (3.86)*	0.0071 (2.55)*
	P10	0.0139 (3.56)*	0.0109 (2.75)*	0.0056 (1.8)
	P10-P1	0.0102 (3.91)*	0.0081 (2.87)*	0.0027 (1.31)
	P9-P2	0.0003 (0.19)	0.0063 (3.39)*	0.0028 (2.07)*
Expansion	P1	0.0047 (0.7)	0.0081 (1.22)	0.007 (1.21)
	P2	0.0101 (1.72)*	0.009 (1.6)	0.0077 (1.64)
	P3	0.0082 (1.51)	0.0123 (2.41)*	0.006 (1.28)
	P4	0.0085 (1.65)	0.0097 (2.21)*	0.0125 (2.79)*
	P5	0.0084	0.0108	0.0104

Table 2. Contd.

		(1.65)	(2.66)*	(2.48)*
	P6	0.0091 (1.85)*	0.0133 (3.16)*	0.0101 (2.39)*
	P7	0.0118 (2.22)*	0.0126 (2.82)*	0.009 (2.21)*
	P8	0.0136 (2.68)*	0.0115 (2.52)*	0.0054 (1.24)
	P9	0.0109 (2.12)*	0.0146 (3.07)*	0.0093 (2.11)*
	P10	0.0209 (3.37)*	0.0199 (3.06)*	0.0107 (2.13)*
	P10-P1	0.0163 (3.89)*	0.0118 (2.47)*	0.0037 (1.09)
	P9-P2	0.0008 (0.37)	0.0056 (1.85)*	0.0016 (0.81)
Depression	P1	0.0027 (0.6)	-0.0027 (-0.73)	-0.0013 (-0.43)
	P2	0.0083 (1.81)*	0.0006 (0.17)	0.0007 (0.2)
	P3	0.0077 (1.89)*	0.0013 (0.43)	0.0003 (0.11)
	P4	0.0095 (2.21)*	0.0028 (0.91)	0.0021 (0.77)
	P5	0.0088 (2.19)*	0.0041 (1.35)	0.0024 (0.76)
	P6	0.01 (2.47)*	0.0044 (1.26)	0.003 (0.94)
	P7	0.0101 (2.48)*	0.0079 (2.17)*	0.0026 (0.82)
	P8	0.0096 (2.26)*	0.0059 (1.59)	0.0016 (0.46)
	P9	0.0079 (1.87)*	0.0078 (2.17)*	0.0047 (1.34)
	P10	0.0065 (1.41)	0.0015 (0.36)	0.0004 (0.1)

Table 2. Contd.

	P10-P1	0.0038 (1.34)	0.0042 (1.62)	0.0017 (0.76)
	P9-P2	-0.0003 (-0.17)	0.0072 (3.28)*	0.004 (1.82)*
January	P1	0.0164 (2.56)*	0.0138 (1.86)*	0.0127 (2.09)*
	P2	0.0175 (2.21)*	0.0155 (3.03)*	0.0116 (1.84)*
	P3	0.0165 (2.59)*	0.0149 (3.19)*	0.0093 (1.66)*
	P4	0.018 (2.78)*	0.0124 (2.35)*	0.0152 (2.43)*
	P5	0.0159 (2.53)*	0.0109 (2.26)*	0.008 (1.67)*
	P6	0.0186 (2.98)*	0.0129 (1.97)*	0.0088 (1.22)
	P7	0.019 (2.58)*	0.0181 (2.05)*	0.0113 (1.86)*
	P8	0.0163 (2.71)*	0.015 (2.09)*	0.0054 (1.1)
	P9	0.0139 (2.05)*	0.0157 (2.34)*	0.0092 (1.88)*
	P10	0.0203 (1.72)*	0.0115 (0.93)	0.0074 (1.33)
	P10-P1	0.0039 (0.37)	-0.0023 (-0.24)	-0.0053 (-0.79)
	P9-P2	-0.0036 (-0.62)	0.0002 (0.02)	-0.0024 (-0.66)
Non January	P1	0.0026 (0.6)	0.0018 (0.44)	0.0021 (0.58)
	P2	0.0084 (2.14)*	0.004 (1.1)	0.0036 (1.17)
	P3	0.0072 (1.98)*	0.0062 (1.91)*	0.0027 (0.89)

Table 2. Contd.

	P4	0.0082 (2.3)*	0.0058 (2.01)*	0.0067 (2.37)*
	P5	0.008 (2.3)*	0.0072 (2.65)*	0.0063 (2.25)*
	P6	0.0087 (2.58)*	0.0086 (2.94)*	0.0064 (2.28)*
	P7	0.0103 (2.88)*	0.0096 (3.17)*	0.0054 (1.95)*
	P8	0.0112 (3.18)*	0.0082 (2.62)*	0.0034 (1.13)
	P9	0.0091 (2.56)*	0.0109 (3.41)*	0.0069 (2.27)*
	P10	0.0133 (3.22)*	0.0108 (2.61)*	0.0055 (1.64)
	P10-P1	0.0108 (3.98)*	0.009 (3.13)*	0.0034 (1.61)
	P9-P2	0.0006 (0.41)	0.0069 (3.58)*	0.0033 (2.08)*

Panel B: Momentum profits and 7 board size groups

	Number of directors	**3~5**	**6~7**	**8~9**	**10~11**	**12~13**	**14~15**	**16~27**
All	P3-P1	0.0038 (2.51)*	0.0047 (2.57)*	0.0025 (1.30)	0.0108 (5.98)*	-0.0011 (-0.49)	0.0021 (1.31)	0.0008 (0.55)
	P1	0.0056 (1.76)*	0.0065 (2.05)*	0.0064 (2.08)*	-0.0012 (-0.44)	0.0017 (0.56)	0.0033 (1.31)	0.0046 (1.78)*
	P3	0.0093 (3.29)*	0.0112 (3.61)*	0.009 (3.31)*	0.0096 (3.44)*	0.0005 (0.21)	0.0054 (2.18)*	0.0055 (2.2)*
Expansion	P3-P1	0.0054 (2.51)*	0.0072 (2.42)*	0.0017 (0.41)	0.0114 (3.69)*	-0.0066 (-1.77)	0.0055 (2.1)*	-0.0008 (-0.39)
	P1	0.0058 (1.16)	0.0080 (1.51)	0.0107 (2.03)*	0.0045 (1.0)	0.0068 (1.35)	0.0053 (1.23)	0.009 (2.12)*
	P3	0.0112 (2.56)*	0.0152 (3.16)*	0.0121 (2.78)*	0.0159 (3.53)*	0.002 (0.06)	0.0108 (2.75)*	0.0082 (2.11)*
Depression	P3-P1	0.0029 (1.60)	0.0029 (1.41)	0.0043 (2.25)*	0.011 (5.78)*	0.0049 (1.97)*	-0.0014 (-0.78)	0.0024 (1.12)
	P1	0.0065 (1.63)*	0.0063 (1.82)*	0.0029 (0.92)	-0.0063 (-2.28)	-0.0035 (-1.17)	0.0015 (0.52)	0.0006 (0.19)

Table 2. Contd.

	P3	0.0094 (2.70)*	0.0092 (2.43)*	0.0073 (2.27)*	0.0046 (1.47)	0.0014 (0.38)	0.00004 (0.013)	0.003 (0.93)
	P3-P1	-0.0009 (-0.17)	0.003 (0.49)	-0.0046 (-0.67)	0.0113 (1.51)	-0.014 (-1.5)	0.0017 (0.51)	-0.0059 (-1.32)
January	P1	0.0147 (2.62)	0.0129 (2.15)*	0.0156 (3.73)*	0.0034 (0.56)	0.014 (1.89)*	0.0093 (2.5)*	0.0089 (1.35)
	P3	0.0138 (2.20)*	0.016 (2.34)*	0.011 (1.52)	0.0147 (1.86)*	0.0034 (0.64)	0.011 (2.04)*	0.0029 (0.85)
	P3-P1	0.0042 (2.67)*	0.0048 (2.51)*	0.0031 (1.56)	0.0108 (5.74)*	0.00002 (0.01)	0.0021 (1.23)	0.0014 (0.92)
Non January	P1	0.0047 (1.40)	0.0059 (1.73)*	0.0057 (1.68)*	-0.0016 (-0.56)	0.005 (1.17)	0.0028 (1.01)	0.0043 (1.53)
	P3	0.0089 (2.94)*	0.0108 (3.23)*	0.0088 (3.04)*	0.0092 (3.08)*	0.0006 (0.2)	0.0019 (1.84)*	0.0057 (2.11)*

Panel A of the table shows three board size subsample momentum profits for TWSE stocks from January 1996 through March 2008. Panel B shows the momentum profits for seven board size subsamples. The stocks in each group are divided into three momentum portfolios containing the bottom 30% (P1), middle 40% (P2) and top 30% (P3) stocks by their past six-month returns. t-statistics are in parentheses, with * denoting significant at 5% level.

small and medium board size firms.

The relationship between significant momentum profit and board size across small to medium firms is not linear. This result indicates that the linkage between board size and firm performance may not be linear either. Prior board size and firm performance studies such as Eisenberg et al. (1998), and Coles et al. (2008) employ log linear model to develop their arguments which imply the nonlinear relationship between board size and firm performance. Since nonlinear effects may result in unpredictable outcomes which cannot be explained by linear model. Our findings shed new light on future studies of board size and firm performance.

ROBUSTNESS

Adjusting for size and book-to-market factors

Fama et al. (1996) concede that their model does not explain the momentum profit and is, therefore, unlikely to impact the results. However, the Fama-French three-factor model coefficients are computed for completeness. Here, we employ the Fama-French (1993) three-factor model to investigate whether the momentum profits in this study can be explained by factors related to size and book-to-market. Since momentum portfolio returns are formed in equal-weighted manner, we use equal-weight return as market return instead of using value-weighted market index return in the analysis. The regression model is given by:

$$r_{pt} - r_{ft} = \alpha_p + b_p(r_{mt} - r_{ft}) + s_p SMB_t + h_p HML_t + \varepsilon_{pt} \quad (1)$$

Where r_{pt} is portfolio return in month t; z and r_{mt} are the Treasury bill rate and the return on the equal-weight return respectively; SMB_t is the return on the mimicking portfolio for size; and HML_t is the return on the mimicking portfolio for book-to-market.

Panel A of Table 4 reports summary statistics of the time series regressions for winners (P10), losers (P1), and buying winners and selling losers (P10- P1) portfolios respectively in panel A of Table 1. Consistent with Chan et al. (1996), the winner portfolio concentrates more heavily on glamour stocks, so the coefficient of book-to-market factor is -0.39. The intercept for the loser portfolio is -0.99% per month which indicates that the loser portfolio has persistently low returns. The intercept for the buying winners and selling losers portfolio is 0.77% with a t-statistic of 3.36.

Panel B of Table 4 shows the regression results for small and medium board size groups momentum portfolios listed in panel A of Table 2. Focusing on the

Table 3. Momentum profits for progressively extending sub samples.

Board size	Momentum profit	Percent of total market cap	Number of firm	Percentage of firm
14~27	0.0006 (0.29)	21.49	44.61	10.31
12~27	0.0027 (1.31)	27.52	56.87	12.99
10~27	0.0099 (3.99)*	41.72	87.46	19.68
8~27	0.0065 (2.65)*	60.53	168.74	36.72
6~27	0.0077 (3.11)*	83.37	318.98	66.34
4~27	0.0076 (3.06)*	98.54	464.05	95.53
All firms	0.0082 (3.35)*	100.00	482.5	100.00

The table shows various board size subsamples momentum profits for TWSE stocks from January 1996 through March 2008. We start with firms with larger board size then progressively extend firms with smaller board size. The market capitalization of each subsample is shown as a percentage of overall sample of TWSE stocks. The average number (percentage) of firms per month for each subsample during the sample period are also reported. t-statistics are in parentheses, with * denoting significant at 5% level.

Table 4. Fama-French three factors model regression results.

Board size	Portfolio	Intercept	Market	Size	Book-to market	R^2
		α_p	b_p	S_p	h_p	
Panel A:						
	P10:Winner	0.04 (0.26)	1.03 (22.17)*	-0.13 (-1.63)	-0.39 (-7.19)*	0.80
	P1:Losers	-0.99 (-8.31)*	1.09 (33.47)*	0.11 (1.96)*	-0.15 (-3.87)*	0.95
	P10-P1	0.77 (3.36)*	-0.05 (-0.85)	-0.26 (-2.29)*	-0.23 (-3.12)*	0.40
Panel B:						
8~11	P10-P1	0.75 (2.78)*	-0.03 (-0.45)	-0.31 (-2.37)*	-0.19 (-2.18)*	0.34
3~7	P10-P1	0.98 (4.04)*	-0.02 (-0.37)	-0.32 (-2.69)*	-0.29 (-3.65)*	0.44

This table reports the Fama-French three factor model regression results. Portfolio return is the momentum profit described in Table 1 and the regression results are shown in panel A. Panel B of this table reports the regression results for the small and medium board size momentum returns shown in panel A of table 2. Adjusted R^2 is reported in the last column. t-statistics are in parentheses, with * denoting significant at 5% level.

monthly intercepts, we find that they are 0.75 (t-stat=2.78) and 0.98% (t-stat=4.04) for medium and small board size groups, respectively. From the regression results, we conclude that adjusting for size and book to

Table 5. Independent sorts by board size and firm size.

Board size	Small	Medium	Large
	3~7	8~11	12~27
Panel A: Large firm size			
P3-P1	0.0073	0.0058	0.0024
	(3.75)*	(3.46)*	(1.73)*
P1	0.0034	0.0039	0.0027
	(1.22)	(1.39)	(1.072)
P3	0.0107	0.0098	0.0051
	(3.42)*	(3.53)*	(2.07)*
Panel B: Small firm size			
P3-P1	0.0032	0.0035	0.0003
	(2.15)*	(1.92)*	(0.20)
P1	0.0073	0.0053	0.0038
	(2.09)*	(1.69)*	(1.26)
P3	0.0104	0.0088	0.0041
	(3.49)*	(3.11)	(1.62)

The table reports the monthly momentum profits for sorts by board size and firm size. Panel A and B of the table reports the mean monthly returns for portfolio P1 (bottom 30%), P3 (top 30%) and momentum portfolio (P3-P1) for large and small stocks respectively. t-statistics are in parentheses, with * denoting significant at 5% level.

market does not change the observed pattern in returns.

Size effect

Chan et al. (1996) suggest that small size stocks may have survivor bias problems. Therefore, they test momentum strategy for large size firms only to alleviate the potential problem. Lesmond et al. (2004) report that the short position of loser portfolios in small firms contributes more to momentum profits than in large firms. On the other hand, the strong relationship between firm size and board has been documented in corporate governance literature. Booth and Deli (1996) suggest that larger firms have more external contracting relationships than smaller firms and, thus, require larger boards to deal with complicated environment (Pfeffer, 1972). Consistent with the corporate governance literature, the board size 12~27 subsample in Table 3 accounts for only 12.99% of the total number of all firms but contain 27.5% of the market capitalization. An essential question that arises is whether the impact of board size on momentum profits is subsumed by firm size. To alleviate the possibility, we assess the robustness of momentum profitability across the board size dimension based on 3×2 subsamples sorted independently on board size and firm size.

Table 5 presents the monthly momentum profits for sorts by board size and firm size. Large firms comprise stocks whose market capitalization as of the portfolio formation date exceeds the median market value of TWSE stocks and the other stocks that belong to small firms. Consistent with prior results, the statistically significant returns are evident only in small and medium board size subsamples. For large board size subsample, the return is still insignificant although it should be noted that the momentum returns are all statistically significant for three board size subsamples. The return of small board size subsample is significantly higher than that of large board size by 0.49% (t-statistic = 2.68). Moreover, the difference of momentum profit between medium board size and large board size subsample is 0.34% (t- statistic = 2.41) which is also statistically significant at 5% level. Another salient feature is that the momentum profit of each subsample in large firms is higher than that of the corresponding subsample in small firms. To sum up, the evidence shows that the momentum profits are driven mainly by small and medium board size firms is robust after controlling firm size.

Book to market effect

Daniel and Titman (1999) suggest that overconfidence affects difficult-to-value companies' more than stable companies. They also argue that lower book-to-market companies have more growth options, therefore the price of their stocks should exhibit stronger overconfidence

Table 6. Independent sorts by board size and book-to-market value.

Board size	Small	Medium	Large
	3~7	8~11	12~27
Panel A: Low book-to-market value firms			
P3-P1	0.0039 (2.52)*	0.0066 (3.66)*	0.0007 (0.45)
P1	0.0064 (2.23)*	0.0028 (0.99)	0.0028 (1.14)
P3	0.0103 (3.41)*	0.0094 (3.14)*	0.0035 (1.46)
Panel B: High book-to-market value firms			
P3-P1	0.0031 (1.98)*	0.0037 (2.39)*	0.0019 (1.54)
P1	0.0075 (2.03)*	0.0048 (1.59)	0.0055 (1.84)*
P3	0.0106 (3.34)*	0.0086 (3.30)*	0.0074 (2.78)*

The table reports the monthly momentum profits for sorts by board size and book-to-market value. A and B of the table reports the mean monthly returns for portfolio P1 (bottom 30%), P3 (top 30%) and momentum portfolio (P3-P1) for low and high book-to-market value firms respectively. t-statistics are in parentheses, with * denoting significant at 5% level.

effects, and momentum effects should be stronger for hard-to-value stocks than for stable stocks. Their empirical results show that the highest momentum profit exhibits in the lowest book-to-market quintile and the lowest and insignificant momentum payoff is in the highest book-to-market quintile. To control the book-to-market effect, we construct 3×2 subsamples sorted independently on board size and book-to-market value to test robustness.

Table 6 reports the monthly momentum returns for sorts by board size and book-to-market value. For each month t, stocks whose book-to-market values exceed the median of book-to-market value of TWSE stocks belong to the high book-to-market value group and the others are included in the low book-to-market value group. The empirical results are consistent with Daniel et al. (1999). The momentum profits for small and medium board size groups are higher among the low book-to-market value firms than those in the high book-to-market firms. Meanwhile the returns for small and medium board size groups in each book-to-market value group are statistically significant. However, the payoffs for large board size subsamples in both high and low book-to-market value groups are insignificant. These results rule out the concern that the low momentum profits for large board size firms comes from book-to-market effect.

Conclusion

This paper establishes a link between momentum profitability and board size. We show that momentum profits are derived mainly from firms with small and medium board size. Strategies based on sorting past six-month returns yield significant return over the subsequent six months among small and medium board size firms, but it does not exist among large board size firms. The momentum profitability across small and medium board size firms does not represent for system risk based on the Fama-French three-factor model. Moreover, the results are robust and cannot be explained by size or by book-to-market effect.

Another contribution of this paper is to provide evidence of larger boards having lower variability of returns. Cheng (2008) argues that firm performance may become more variable or less variable as board size increases. His findings show that the returns of companies with larger boards will be less diversified. Our results are consistent with the findings of Cheng (2008). This phenomenon may be attributable to the fact that the decisions of a large board reflect more compromise and tend to be less extreme and that more powerful chief executive officers (CEOs) have less variable performance owing to an incentive to engage in risk-reduction activities. This

study not only contributes to the momentum anomaly literature but also to the relationship between board size and corporate performance variability literature.

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