How do momentum strategies 'score' against individual investors in Taiwan, Hong Kong and Korea?

Anurag N. Banerjee[1], Chi-Hsiou D. Hung[2,*]
[1]*Durham Business School, Durham University, U.K.*
[2]*Adam Smith Business School, University of Glasgow, U.K.*

This version: June 2, 2014

Abstract

We compare the momentum returns to the return distribution of the zero-net-worth strategies of uninformed "naive" individual investors in Taiwan, Hong Kong, and Korea. The high stock ownership and high proportion of trading volume from individual investors in these economies make it an ideal setting to use the score function proposed by Banerjee and Hung (BH, 2011). As in BH we find that the average scores of the momentum profits in these emerging markets are close to zero and statistically insignificant. In contrast to BH's finding that in the U.S. market the winner stocks get significantly positive scores, we find that in all the three markets the scores of the winner portfolio are statistically insignificant.
JEL classification: G11; G12; G14
Keywords: Emerging stock markets; Momentum; Naive strategies; Return percentiles; Price information; Score function

*The authors thank the anonymous referee and Jonathan Batten for suggestions to impove the paper. Corresponding author. *E-mail address:* Chi-Hsiou.Hung@glasgow.ac.uk

1. Introduction

In this paper we conduct a close scrutiny on the relative performance of momentum strategies and individual investors' strategies in the stock markets in Taiwan, Hong Kong and South Korea.[1] These economies are particularly interesting because individual investors play a significant role in these stock markets. First, domestic individual investors' stock ownership in Taiwan is very high compared to the ownership of domestic financial institutions (40.37% versus 4.99% in 2011 according to the Taiwan Stock Exchange). In Hong Kong the stock ownership number (2,035,000 individuals) and percentage (33.8%) of the adult population reached their highest level in 2011, having been increasing since 1989 when the survey started (see, Retail Investor Survey 2011 published by the Hong Kong Stock Exchange).

Second, in Taiwan the trading conducted by individual investors as a proportion of the total trading volume was 84.41% in 2001. Although it gradually decreases to 62.7% in 2011 (see, the Taiwan Stock Exchange), this figure is still significantly higher than the 14.4% of volume traded by individuals in the U.S. as of 2001 reported by Griffin et al. (2003). In Hong Kong retail stock investors represent 35.7% of the adult population in 2011. Retail investors contributed 22% to total market turnover in 2012-2013, with retail online trading accounted for 39% of total retail investor trading (see, Cash Market Transaction Survey 2012/13). Likewise, in Korea individual investors' trading activity accounts for 79.5% of total share trading volume (see, the Korea Stock Exchange) .

Most notably, the overwhelmingly important role of individual investors in these markets

[1] Jegadeesh and Titman (1993 and 2001) show the profitability of the momentum strategies that are long in the winners and short in the losers stocks. Many papers have examined the profitability of momentum strategies in countries other than the U.S. (e.g., Rouwenhorst, 1998; Chordia and Shivakumar, 2002; and Griffin, Ji and Martin, 2003).

has led to investigations and controversies over individuals' trading performance relative to professional asset managers. This is because the financial literature often thinks of individual investors as uninformed traders, while views institutional asset managers as informed traders. One of the most prominent debates is on the profitability of momentum strategies in these Asian countries (see, e.g., Hameed and Kusnadi, 2002; Fu and Wood, 2010; Wang, Huang and Lin, 2010; Chui, Titman, and Wei, 2010; Cheng and Wu, 2010, among others). Chui, Titman, and Wei (2010) argue that individualism reflects overconfidence and document that momentum profits are positively related to individualism. For example, in Taiwan where individualism is low (Hofstede's individualism index (HII) score of 17) momentum profits are insignificant, whereas in the U.S. (HII score of 91) where individualism is high momentum profits are significant. In contrast, Barber, Lee, Liu and Odean (2009) argue that the majority of individual investors in Taiwan place aggressive orders, and report that '... all individual trading losses can be traced to their aggressive orders'.

Our aim is to investigate the relative performance of the momentum investors (MI, hereafter), a particular type of professional or institutional asset managers, and the "naive" individual investors (NI, hereafter) in the stock markets in these three economies. Individual investors are diverse in their own investing instincts or decision rules, resulting in a wide spectrum of their portfolio returns. The large proportion of individual traders in these markets gives us an ideal experimental environment for our setting of the naive individual investors.

We adopt the score function approach developed by Banerjee and Hung (2011) (BH, hereafter) who demonstrate that the risk-based approach requires a correctly specified asset-

pricing model. They argue that the estimated alpha inevitably has an omitted variable bias if a "true" factor is omitted in a model. BH (2011) demonstrate that the scores of the risk-adjusted return and the raw return are the same. This is very important because the use of the score function does not require the identification of the source of risk and the estimation of factor loadings.[2]

A researcher or an asset management company can directly use the score function to reward or penalize a strategy for performance evaluation. In addition, the score function is robust against return outliers, which is useful when there are extreme return values. Further, an overall increase or decrease in asset returns or a jump in volatility does not affect the score of a strategy. Thus, the momentum strategies do not receive rewards when everyone else in the market does as well; likewise, they are not punished during a period of an overall market crash.

We perform a t-test of the average of the sample scores to examine whether the average scores of the momentum strategies and momentum decile portfolios are significantly positive. We find that in all the three stock markets the momentum profits from buying the winners and selling short the losers receive an average score close to zero. These results are similar to BH's finding that the momentum strategies in the U.S. do not generate better performance than the NI's strategies because the average scores of momentum profits are close to zero. Note that as the scores are not linearly additive, one cannot obtain the score

[2]Many financial economists take the risk-based approach to analyze momentum and show that momentum profits remain significant in a risk-adjusted sense (e.g., Grundy and Martin, 2001; Johnson, 2002; Avramov and Chordia, 2006; Sagi and Seasholes, 2007). Other studies investigate momentum profits after transaction costs (Lesmond, Schill and Zhou, 2004; Korajczyk and Sadka, 2004) or consider liquidity (Sadka, 2006). The theory and empirical evidence from behavioral approach advocate that the deviations from rational behavior can result in momentum (e.g., Chan, Jegadeesh and Lakonishok, 1996; Hong and Stein, 1999; Grinblatta and Han, 2005; Hvidkjaer, 2006).

of the momentum profit by subtracting the losers' score from the winners' score.

We show (in Figures 4 and 6) that the profits of momentum strategies in all the three markets have large dispersions, and either go higher than the 80th percentile or drop below the 20th percentile of the naïve strategies profits. Thus, the momentum profits have either the highest or the lowest scores at different points in time which offset each other over time.

In a sharp contrast to BH's finding for the U.S. markets where the winner stocks get positive and significant average scores, we find that, in Taiwan, Hong Kong and Korea, none of the momentum decile portfolios outperforms the naive strategies. In other words, although aggressively chasing winners in the U.S. outperforms the NI's strategies, this is certainly not the case in the three emerging markets. The average scores of all the decile portfolios are statistically insignificant. This is because the return differences between the decile portfolios and the NIs' have high variability and are negative, on average. Thus, taking a long position in each of the momentum decile portfolios (including the winner portfolio) financed at the risk-free rate receives a negative (insignificant) reward, on average.

For Taiwan we further consider a sub-sample period between January 1992 and December 2008. This choice of sub-sample analysis is not only motivated by the result of Lo and Ju (2011) who document significant momentum profits, but also because the Taiwan stock market did not allow investment from foreign institutional investors until 1991 (see, Lin and Chen, 2006). We find that once foreign institutional investors enter into the market, the economic and statistical significance of the profitability of the momentum strategies increase. In term of the score of momentum relative to the distribution of naive investors, however, it is zero and statistically insignificant, showing the same overall pattern of results with the

whole sample period.

Overall, we find that the momentum strategist is no better than a simple "naive" randomizer because the rewards and penalties cancel out over the long-run. Our findings suggest that the chance of the momentum long-short trading in these emerging stock markets for beating the portfolios of the naïve investors is only 50%. In other words, asset managers who pursue the momentum strategies and charge fees on their investors do not outperform the simple strategies of naive individual investors.

The rest of the paper is structured as follows. Section 2 defines the strategies of the naive investors, and the score function. In Section 3 we detail our empirical methodology, and in Section 4 we describe our sample and discuss the empirical tests. Section 5 presents the results, and Section 6 concludes. The Appendix contains the necessary theorems for the score function. The details of proofs are presented in BH (2011).

2. The strategies of naive individual investors and the score function

We use the construction of NI's and the score function to evaluate the momentum strategies with the strategies of the naive individual investors**.** BH's (2011) approach rewards and penalizes the momentum strategist who uses the past return information in the strategy formation by comparing momentum returns to those of the "NIs" who use no information and give weight to stocks randomly. An investor's portfolio strategy $\mathbf{F}$ is defined over the feasible asset set A comprised of N stocks. The vector of returns in excess of the risk-free rate on the feasible asset set is $\mathbf{r}$, and the excess portfolio returns on strategy $\mathbf{F}$ is $\mathbf{r}'\mathbf{F}$.

The sophisticated momentum traders first observe and analyze the information of past

returns on the set of N stocks feasible for trading. The MI then forms the winner portfolio $\mathbf{F}_W$ (top 10% past returns), the loser portfolio $\mathbf{F}_L$ (bottom 10% past returns), and constructs the momentum strategies $\mathbf{F}_P = (\mathbf{F}_W - \mathbf{F}_L)$ at period t, deriving a profit $\mathbf{r}'\mathbf{F}_P$.

The naive individual investor (NI) in our construction adopts any possible long-only strategies without using any information, and deploys a random vector of N dimensional weight over the $N-1$ simplex. Notice that the winner and loser portfolios are also in this $N-1$ simplex, i.e. that, $\mathbf{F}_W$ and $\mathbf{F}_L$ are two of the possible strategies of the NIs. *Such random allocations are random drawings from an uniform distribution over a simplex, and do not necessarily give equal weights.* Since the NI randomly chooses weights, the chance of investing in only one asset is the same as the chance of splitting the investment to different assets equally with weights.

Defining $\mathbf{\Phi}$ as the random portfolio weight vector, in what follows the cumulative distribution of the NIs' strategy profits is $G(q|\,\mathbf{r}) = \Pr(\mathbf{r}'\mathbf{\Phi} \leq q|\,\mathbf{r})$. We then generate the percentiles q_k of the profit distribution as $G(q_k\,|\,\mathbf{r}) = \frac{k}{K},\ k = 0, 1, .., K$. We simulate the weights of the naive strategies using Theorem A1 (see, in Appendix reproduced from BH (2011) who derive analytical expressions for the weights and give a method for generating the random weight vector).

The NI liquidates the portfolio at the end of period t when stock returns $\mathbf{r}$ are realized, and obtains portfolio return $\mathbf{r}'\mathbf{\Phi}$. Notice that the portfolio returns are random variables because the portfolio weights are random variables. In the next period $t+1$ the NI uses the same method to reform and hold a portfolio.

We use the score function to evaluate the excess portfolio returns $\mathbf{r}'\mathbf{F}$ on a strategy $\mathbf{F}$

relative to the percentiles of the profit distribution of the NIs' strategies. Specifically, as shown in Figure1, we assign a reward of 2 units for the MI if the momentum profit is above the 80th percentile of the return distribution of the NI; a reward of 1 unit if it is above the 60th percentile but below the 80th percentile. Likewise, we penalize the MI by awarding negative rewards of -1 and -2, respectively, if the momentum profit falls below the 40th percentile and the 20th percentile of the NI return distribution. We give a reward of zero to the MI if the momentum profit falls between the 40th percentile and the 60th percentile. The reward thus decreases with the quintiles. In general, the reward function does not have to be a five point function or even symmetric. Users can change the parameters of this function. For illustration purpose, we display the score function below:

[Insert Figure 1 here]

The score function thus constructed is invariant under any common risk factors (see Theorem A3 in the Appendix). In other words, the scores are the same for both the risk-adjusted returns and raw returns. The score function thus allows us to avoid the identification of risk factors, and base on raw returns for comparison.

3. Empirical methodology

We consider the long-only momentum decile portfolios (including the winner and the loser portfolios) in addition to the long-short momentum strategies. In our context the NIs are unsophisticated and do not fully understand the processes, costs and risks involving in short-sales of stocks. Our construction of not involving the NI to sell short is consistent with the widely documented finding that short-sales is very difficult because of the risks, costs, legal

and institutional restrictions, and the need of sufficient stock supply from investors who are willing to lend (see, Jones and Lamont, 2002).[3] In contrast to the MI, the NIs do not use past price information to construct their portfolios. The NI forms a long position randomly using the same feasible stock set as is available for the MI for forming the momentum strategies.

At the beginning of each month t the NI forms a random portfolio by choosing with equal chances any positive or zero weight for each of the feasible stocks. The weights of this portfolio, summing to unity, are thus a non-negative vector of random drawings from an uniform distribution. The NI finances the investment in the stock portfolios through borrowing at the risk-free rate (which we proxy using the Taiwan money market rate). The initial position of the NI's strategy has zero net-worth with a long leg in the risky assets and a short leg in the risk-free asset. Thus, the portfolio return of the NI in excess of the risk-free rate is the profit of the naive individual investor's strategy.

We generate the portfolio weights using Monte Carlo method, and construct 1,000 portfolios for the NIs in each month of our sample period, and hence obtain a cross-section of the returns of the NIs at the end of period t. Therefore we get a probability distribution of the returns of the NIs in each month, and thus get the return distributions of the NI throughout our sample period.

In order to examine whether momentum traders outperform the "naive" individual investors, we compare the profits of momentum strategies that buy the winners and sell short the losers to the quintiles of the return distribution of the simple strategies of the NIs. We

[3]Empirical finance research shows that the level of shares sold short in the stock market is generally very low. In the U.S. stock market, for example, Dechow, Hutton, Meulbroek, and Sloan (2001) report that those stocks having short interest greater than 5% of shares outstanding account for less than 2% of all stocks for the 1976–1993 period. Similarly the median of the ratio of short interest over shares outstanding is 0.03 for the period over 2006-2009 according to the Taiwan Economic Journal.

use the BH's (2011) score function to assign rewards to the MI. In each period the MI gets a reward from the set of {2, 1, 0, -1 or -2}. Over a period of T years the MI receives a time-series of rewards.

We test whether the scores of momentum profits and the momentum decile portfolios are significantly higher than those of the NIs' strategies. By construction, the expected reward of the NI is zero because of the fact that the score of the median of the NI's profits is always zero, and that the rewards/penalties of the NI are uniformly distributed with a probability of 1/5. Our hypothesis is that if the MI's strategy is better than the NI's strategy, then he/she should, on average, get a positive reward for the efforts over this $T-$year period.

4. Sample and empirical tests

We use the data of all stocks listed on the Taiwan Stock Exchange collected from the Taiwan Economic Journal (TEJ) for the period between January 1986 and December 2011. We also use the monthly equity data of all stocks listed on the Hong Kong Stock Exchange and on the Korea Stock Exchange for the period between January 1986 and December 201, collected from Datastream. The interest rate data are collected from the IMF data base. The interest rate data for Hong Kong goes back to 1993, for South Korea the earliest we obtain is from 1991. We exclude all stocks with prices below NTD 5 at portfolio formation as in Lo and Ju (2011). In order to enter the analysis, a stock must have at least six consecutive monthly returns. Our final sample consists of 803 stocks. We use all the stocks in case of Hong Kong and Korea.

The sample stocks in these three markets define our feasible asset set A. For each

market, at the end of each month, the stocks within the top 10% of past returns comprise the winner portfolio and stocks within the bottom 10% of past returns comprise the loser portfolio. Our tests focus on the representative momentum strategies that form equally weighted portfolios by sorting stocks on their past 6-month compounded returns and hold portfolios for 6 months (6×6 momentum, hereafter) (see also, Chordia and Shivakumar, 2002; and Griffin, Ji and Martin, 2003). We also analyse the 3-month by-3-month portfolio formation (3×3 momentum, hereafter)[4]. We form equally weighted portfolios at the time of formation and hold them without rebalancing during the holding period.[5] For example, the overlapping momentum strategies are comprised of six strategies with each starting one month apart, as in Jegadeesh and Titman (1993). The portfolio returns on the overlapping strategies are the averages of the portfolio returns on the six strategies.

The scores in our empirical tests is increasing with the percentiles of profits. Specifically, we give scores from -2 to 2 in ascending order to the quintile intervals as in BH (2011). In order to assign scores as in definition (Figure 1) to the momentum strategies, we generate the cross-sectional distribution of excess portfolio returns of the NIs. Specifically, in each month, we construct a cross-section of excess returns of 5,000 portfolios for the NIs using the result in Theorem (A1), and then obtain the quintile points of the excess return distribution.

For the purpose of illustration for the NIs' strategies, we use the stocks in our Taiwan sample to plot Figure 2 which shows in box charts the profit distribution, each month, of the

[4]We thank the referee for the suggestion.

[5]We compute monthly excess portfolio returns and the profits to momentum strategies using single-period returns. In the case when a stock is delisted during the holding period, the liquidating proceeds are reinvested in the remaining stocks in the portfolio.

NIs' strategies for the period 1992–2008 examined by Lo and Ju (2011). The top, middle and bottom boxes display, respectively, the 60th to the 80th percentiles,the 40th to the 60th percentiles, and the 20th to the 40th percentiles of the excess returns of the NIs strategies.

[Insert Figure 2 here]

We also use the stocks in our Taiwan sample to plot Figure 3 which displays the centered box charts using the centered excess returns $\mathbf{r}_c = \mathbf{r} - \overline{r}\mathbf{1}$. We see immediately that, once the excess returns are centered, the distribution of the centered returns is stable. This pattern is important because the score function is also stable according to Corollary A4 that *the score of affine transformations of the excess returns remains the same*, i.e., $S(\mathbf{F} : \mathbf{r}) = S(\mathbf{F} : \mathbf{r}_c)$.

[Insert Figure 3 here]

We evaluate the momentum strategies and the momentum decile portfolios using the score function (A3) in our empirical tests. In one month a strategy or a portfolio receives a score of 2, 1, or 0, respectively, if the profit or excess return goes higher than the 80th percentile, falls within the 60th and the 80th percentiles, or falls within the 40th and the 60th percentiles of the excess return distribution of the NIs strategies. The negative scores are given vice versa. We evaluate the score of the momentum strategies every month and then calculate the average score, $\widehat{\mu}(\{\mathbf{F}_{P_t} : \mathbf{r}_t\})$ during the T evaluation periods.[6]

We test whether the scores of momentum profits and the momentum decile portfolios are significantly higher than those of the NIs' strategies. Notice that the average score of the strategy $\mathbf{F}_t$ is $\widehat{\mu}(\{\mathbf{F}_t : \mathbf{r}_t\}) = \frac{1}{T}\sum_{t=1}^{T} S_t(\{\mathbf{F}_t : \mathbf{r}_t\})$, and that the mean of the average scores

[6]Banerjee and Hung (2011) give details for the statistical tests of the scores (their Appendix C).

$\widehat{\mu}(\{\mathbf{\Phi}_t : \mathbf{r}_t\})$ is zero ($E[\widehat{\mu}(\{\mathbf{\Phi}_t : \mathbf{r}_t\})] = 0$). The null hypothesis is $H_0 : E[S(\mathbf{F}_P\colon \mathbf{r})] = 0$ against the alternative $H_A : E[S(\mathbf{F}_P\colon \mathbf{r})] > 0$. We also run the test for each of the decile portfolios.

5. Results

5.1. Taiwan

As discussed earlier, there are debates over the profitability of the momentum strategies in Taiwan. Hameed and Kusnadi (2002) use an early sample over 1979–1994 and find that the momentum profit is statistically insignificant. Table 1 reports the average excess returns and scores of the momentum decile portfolios. Panel A shows for the 6 × 6 momentum that, over the whole sample period 1986–2011, the winner (P10) portfolio has the highest average excess return of 1.24% per month, while the loser portfolio (P1) gives the lowest monthly average excess return of 0.53%, and the average momentum profit is 0.71%, albeit statistically insignificant.

[Insert Table 1 here]

Lo and Ju (2011) document significant momentum profit over 1992–2008. As presented in Panel B, we find similar results for the 6 × 6 momentum for the sub-sample period that winner stocks have the highest average excess return of 1.09% per month; loser stocks lose, on average, -0.27% per month in excess of the risk free rate. The momentum profit is, on average, 1.04%, with a t-ratio of 1.86.

Importantly, the average score of the momentum profits is close to zero and statistically insignificant over the whole sample period and the sub-sample period. The results of the

scores show that the momentum strategies are not performing any better than the zero net-worth strategies of the NIs. We also find a striking pattern of the average scores of all the decile portfolios – they are all negative albeit statistically insignificant, regardless of examining the whole sample period or the sub-sample period. Put it differently, investing in any of the stock decile portfolios formed based on past return information only delivers excess returns lower than the 40th percentile of the profit distribution of the naive investors' strategies, on average.

Panels C and D of Table 1, for the whole sample period and the sub-sample period, respectively, reports the results of the 3×3 momentum in Taiwan. Both panels show that the excess returns of the winner and the loser portfolios are not significantly different from each other. Thus, the momentum profit is statistically insignificant, either over the whole sample or the sub-sample period. The overall pattern of the results is consistent with the findings on the momentum effect in the Taiwan stock market.

Figure 4 gives more insights into the results presented in Table 1 by displaying the relative frequencies of the scores for both the 6×6 and the 3×3 momentum strategies. As displayed in Figure 4 the scores of the winner portfolio (in the first column) and the loser portfolio (in the second column) frequently locate at the extreme ends of either positive 2 or negative 2. The winner portfolio, in particular, receives relatively more scores of negative 2 than scores of positive 2. In other words, the winner portfolio has more than 50% chances of delivering excess returns lower than the 20th percentile of the profit distribution of the naive investors' strategies. This is slightly offset by the chances of delivering excess returns higher than the 80th percentile of the naive profits. The net outcome of the winner portfolio is thus negative.

Recall that a negative score is an outcome of the excess portfolio return lower than the 40th percentile of the profit distribution of the naive investors' strategies.

The scores of the profits (in the third column) of both the $6\times$ 6 and the $3\times$ 3 momentum strategies tend to be at the extreme ends of either positive or negative 2, with close chances, thereby offsetting each other. Thus, the momentum profits receive an average score close to zero, and statistically insignificant.

[Insert Figure 4 here]

In order to clearly illustrate the risky nature of the momentum profits we plot Figure 5 which displays the box charts for the centered $6 \times$ 6 momentum profits r_c $(= r - \overline{r})$.[7] This figure demonstrates that there are large profits and loses occurring at different points in time, thereby receiving extreme ends of scores of either positive 2 or negative 2.

[Insert Figure 5 here]

The overall evidence in this section suggests that individual investors in Taiwan are not better off by pursuing either a long / a short position on momentum investing or the combined long-short momentum strategies. For example, selling short the loser portfolio does not ensure a positive and statistically significant average excess return, nor does it get a positive and statistically significant average score.

[7] $$\mathbf{r}_c'\mathbf{F}_P = (\mathbf{r}-\overline{r}\mathbf{1})'(\mathbf{F}_W - \mathbf{F}_L) = \mathbf{r}(\mathbf{F}_W - \mathbf{F}_L) \text{ since } \mathbf{1}'\mathbf{F}_W = \mathbf{1}'\mathbf{F}_L = 1.$$

5.2. Hong Kong

Table 2 reports the average excess returns and scores of the momentum decile portfolios in Hong Kong. Panels A and B present results of the 6×6 momentum and the 3×3 momentum, respectively. The results from both strategies show that although the average excess return on winner stocks is higher than that of the loser stocks, neither of them are statistically significant. The average profit from the 6×6 momentum is 0.95% per month and statistically significant at the 10% level. The average profit from the 3×3 momentum is high at 1.28% per month ($t = 2.75$). The overall pattern of the results is consistent with the findings on the momentum effect in the Hong Kong stock market (e.g., Cheng and Wu, 2010; Chui, Titman, and Wei, 2010).

[Insert Table 2 here]

In terms of scores, however, we find a consistent pattern with our findings for Taiwan – the average score of the momentum profits is essentially zero and statistically insignificant, in either case of the 6×6 momentum or the 3×3 momentum. These result indicate that the zero net-worth strategies of the NIs perform as well as the momentum strategies.

Panel A of Figure 6 for Hong Kong presents the relative frequencies of the scores. Similar to what we reported for Taiwan, the momentum profits (in the third column) are more likely to score either a positive 2 or a negative 2. Consequently, the momentum profits receive an average score of zero. On the other hand, the winner portfolio and the loser portfolio often score either a positive 2 or a negative 2. The loser portfolio, for example, receives relatively more scores of negative 2 than scores of positive 2. As a result, the average score of the loser

portfolio is negative.

[Insert Figure 6 here]

5.3. Korea

Panels C and D of Table 2 present, respectively, the average excess returns and scores of the 6×6 momentum and the 3×3 momentum in Korea. Consistent with the literature on the Korea stock market (e.g., Hameed and Kusnadi, 2002; Chui, Titman, and Wei, 2010), our results show that the average excess return on the winner stocks are higher than that on the loser stocks. The average momentum profit for both the 6×6 momentum and the 3×3 momentum are relatively low and statistically insignificant.

Similar to our findings for Taiwan and Hong Kong, the average score of the momentum profits as shown in Table 2 is virtually zero and statistically insignificant. For example, the momentum profit from the 6×6 momentum has an average score of 0.0024 ($t = 0.19$). Once again, these results indicate that the zero net-worth strategies of the NIs perform as well as the momentum strategies.

Panel B of Figure 2 for Korea presents the relative frequencies of the scores for both the 6×6 momentum and the 3×3 momentum. Similar to what we reported for Taiwan and Hong Kong, although the momentum profits are slightly more likely to score a positive 2 than a negative 2, the extreme scores offest each other, on average. Thus, the momentum profits receive an average score of zero.

Table 2 also presents that the average excess returns of all the decile portfolios are statistically insignificant. Interestingly, almost all of the momentum decile portfolios receive

negative average scores, albeit statistically insignificant. These patterns show that investing in any of the momentum decile portfolios does not only generate statistically insignificant excess returns, but also does not outperform the naive investors' strategies.

6. Conclusions

The stock markets in Taiwan, Hong Kong and Korea share similar characteristic that there are high stock ownership and high proportion of trading volume from individual investors. The large proportion of individual traders in these emerging markets gives us an ideal experimental environment for our setting of the naive individual investors. The diversity of individual investors' investing instincts and decision rules results in a wide spectrum of their portfolio returns. These features make it an ideal setting to use the score function proposed by Banerjee and Hung (2011) for evaluating momentum portfolio returns and the profitability of the momentum strategies. The score function is invariant under risk factor models and thus does not require the specification for the risk factors underlying the momentum effect. As in Banerjee and Hung (2011), we give scores to the momentum strategies that use past return information relative to the cross-section of the profit distribution of the zero net-worth strategies of "naive individual investors" who do not use any information.

We consider the long-only momentum decile portfolios (including the winner and the loser portfolios) in addition to the long-short momentum strategies. In a sharp contrast to BH's finding that in the U.S. markets the winner stocks get positive and significant average scores, we find that none of the momentum decile portfolios outperforms the naive strategies in Taiwan, Hong Kong and Korea.

Similar to BH's finding for the long-short momentum strategies in the U.S., we find that in all these three markets average scores of the momentum strategies are close to zero and statistically insignificant. Our evidence suggests that, on average, the long-short momentum strategies do not outperform the naive strategies. Furthermore, chasing the winners in any of the three stock markets does not get positive average scores, either. Our findings provide important evidence on the profitability of momentum strategies in these three economies, and contribute to the prominent debate in this area of the literature.

From a practical point of view, the momentum trading requires costs of intensive transactions to form overlapping positions, and of acquiring and analyzing return information. Further, establishing the long-short strategy position involves taking additional risks and costs as well as facing regulation restrictions on short sales of stocks. These necessary costs and trading difficulties do not help the momentum traders.

7. Appendix:

For illustration purpose, we re-iterate the necessary theorems and definitions in Banerjee and Hung (2011) below. Further details are presented in BH (2011).

Theorem A1 *The joint distribution of the portfolio weights of the NI is uniform and is given by* $\mathbf{\Phi} = (\phi_1, ..., \phi_i, ..., \phi_N)$ *where the marginal distribution of the weight on stock* i *is* $\phi_i = \frac{E_i}{\sum E_i}$, *and* $E_i \sim iid$ ExponentialDist(1) *such that the density of* $\mathbf{\Phi}$ *is*

$$h(\mathbf{w}) = N!, \ \textit{if } \mathbf{w} \in W_+(A);$$

$$= 0, \ \textit{otherwise}$$

Corollary A1 *The cross-sectional mean and the projection median,* PM, *of* $\mathbf{\Phi}$ *are given by*

$$E[\mathbf{\Phi}] = PM(\mathbf{\Phi}) = \frac{1}{N}\mathbf{1} \tag{A1}$$

where $\mathbf{1}$ *is a vector of ones with length* N.

Corollary A2 *The variance-covariance matrix of* $\mathbf{\Phi}$ *is*

$$E[\mathbf{\Phi}\mathbf{\Phi}'] = \Sigma_{\mathbf{\Phi}} = \frac{1}{N(N+1)}\left(\mathbf{I} - \frac{1}{N}\mathbf{1}\mathbf{1}'\right). \tag{A2}$$

Corollary A3 *The excess portfolio return from a naive strategy* $\mathbf{\Phi}$ *is given by* $\mathbf{r}'\mathbf{\Phi}$. *Following from (A1), the cross-sectional mean and the median of the excess portfolio returns of the NI*

strategies are

$$E[\mathbf{r}'\mathbf{\Phi}] = M(\mathbf{r}'\mathbf{\Phi}) = \frac{1}{N}\sum_{i=1}^{N} r_i = \overline{r}$$

Hence, $\overline{r}$ is effectively the equally weighted excess return of the feasible asset set. From (A2) the variance of the excess portfolio returns of the NI strategies is

$$Var(\mathbf{r}'\mathbf{\Phi}) = \frac{1}{N+1}\sum_{i=1}^{N}(r_i - \overline{r})^2 .$$

Theorem A2 *Let g be the density of the profits of the NIs' strategies such that $G(q|\,\mathbf{r}) = \int_{-\infty}^{q} g(q|\,\mathbf{r})\,dz$, where $\mathbf{r}$ is a vector of excess returns. We have:*

$$g(q|\,\mathbf{r}) = \sum_{k=1}^{N} \frac{(r_k - q)^{N-1}}{\prod_{l=1, l\neq k}^{N}(r_l - r_k)}$$

Corollary A4 *The score function is invariant under common affine transformation i.e., for any $\sigma \in R^+$ and $\mu \in R$, the score of affine transformations of the excess returns remains the same.*

$$S(\mathbf{F} : \sigma\mathbf{r} + \mu\mathbf{1}) = S(\mathbf{F} : \mathbf{r}).$$

Definition 1 *We give a strategy $\mathbf{F}$ a score of s_k or zero in the following way:*

$$S(\mathbf{F} : \mathbf{r}) = \sum_{k=1}^{K} s_k I[q_{k-1} \leq \mathbf{r}'\mathbf{F} < q_k] \tag{A3}$$

where I has a value of 1 if $\mathbf{r}'\mathbf{F}$ is between the percentiles q_{k-1} and q_k such that $G(q_k\,|\,\mathbf{r}) =$

$\frac{k}{K}$, *and* 0 *otherwise.*

Theorem A3 *Let the excess return generating process be given by the factor model*

$$\mathbf{r}_t = \alpha_t + \mathbf{B}_t \mathbf{x}_t + \varepsilon_t,\ \varepsilon_t \sim \left(0,\ \sigma_t^2 \mathbf{I}_{N_t}\right),\ t = 1, ..., T \tag{A4}$$

where α_t *is the vector of intercepts,* $\mathbf{B}_t$ *is the vector of factor loadings,* $\mathbf{x}_t's$ *are common risk factors,* σ_t^2 *is the cross-sectional variance at time* t *and* N_t *is the total number of assets at time* t*. Then for any strategy* $\mathbf{F}_t \in W(A)$ *the score of the risk-adjusted return is the same as that of the excess return,*

$$S\left(\mathbf{F}_t : \frac{\mathbf{r}_t - \mathbf{B}_t \mathbf{x}}{\sigma}\right) = S\left(\mathbf{F}_t : \mathbf{r}_t\right),\ t = 1, ..., T.$$

References

Avramov, D., Chordia, T. 2006. Asset pricing models and financial market anomalies. *Review of Financial Studies* 19, 1001-1040.

Banerjee, A., Hung, C.-H. 2011. Informed momentum trading versus uninformed "naive" investors strategies. *Journal of Banking and Finance* 35, 3077–3089.

Barber, B., Lee, Y.-T., Liu, Y.-J., and Odean, T. 2009. Just how much do individual investors lose by trading? *Review of Financial Studies 22,* 609-632.

Chan, L., Jegadeesh, N., Lakonishok, J. 1996. Momentum strategies. *Journal of Finance* 51, 1681-1713.

Cheng, J., Wu, H.-F. 2010. The profitability of momentum trading strategies: Empirical evidence from Hong Kong. *International Review of Economics and Finance* 19, 527-538.

Chordia T., Shivakumarand, L. 2002. Momentum, business cycle and time-varying expected returns. *Journal of Finance* 57, 985-1019.

Chui, A., Titman, S., Wei, K. 2010. Individualism and momentum around the world. *Journal of Finance* 65, 361-392.

Fama, E., French, K., 1993. Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics* 33, 3-56.

Fu, H.-P., Wood, A. 2010. Momentum in Taiwan: seasonality matters!. *Applied Economics Letters* 17, 1247-1253.

Griffin, J. Harris, J. and Topaloglu, S. 2003. The Dynamics of Institutional and Individual Trading, *Journal of Finance* 58, 2285–2320.

Griffin, J., Ji, X., Martin, J. 2003. Momentum investing and business cycle risk: evidence from pole to pole. *Journal of Finance* 58, 2515-2547.

Grinblatta, M., Han, B., 2005. Prospect theory, mental accounting, and momentum. *Journal of Financial Economics* 78, 311–339.

Grundy, B., Martin, S. 2001. Understanding the nature of the risks and the sources of the rewards to momentum investing. *Review of Financial Studies* 14, 29-78.

Hameed, A., Kusnadi, Y. 2002. Momentum strategies: evidence from pacific basin stock markets. *Journal of Financial Research* 25, 383-397.

Harvey, C., Siddique, A. 2000. Conditional skewness in asset pricing tests. *Journal of Finance* 55, 1263-1295.

Hong, H., Stein, J. 1999. A unified theory of underreaction, momentum trading and overreaction in asset markets. *Journal of Finance* 54, 2143–2184.

Hvidkjaer, S. 2006. A trade-based analysis of momentum. *Review of Financial Studies* 19, 457-491.

Jegadeesh, N., Titman, S. 1993. Returns to buying winners and selling losers: Implications for stock market efficiency. *Journal of Finance* 48, 65-91.

Jegadeesh, N., Titman, S. 2001. Profitability of momentum strategies: An evaluation of alternative explanations. *Journal of Finance* 56, 699-720.

Johnson, T. 2002. Rational momentum effects. *Journal of Finance* 58, 585-608.

Jones, C., Lamont, O. 2002. Short-sale constraints and stock returns. *Journal of Financial Economics* 66, 207-239.

Korajczyk, R., Sadka, R. 2004. Are momentum profits robust to trading costs? *Journal of Finance* 59, 1039-1082.

Lesmond, D., Schill, M., Zhou, C. 2004. The illusory nature of momentum profits. *Journal of Financial Economics* 71, 349–380.

Lin, A., Chen, C.-Y. 2006, The Impact of qualified foreign institutional investors on Taiwan's stock market. *Web Journal of Chinese Management Review* 9, 1-27.

Lo, K.-H., Ju, S.-E. 2011. Momentum strategy and board size: Evidence from Taiwan Stock Exchange. *African Journal of Business Management* 5, 8150-8162.

Pastor, L., Stambaugh, R. 2003. Liquidity risk and expected stock returns. *Journal of Political Economy* 111, 642-685.

Rouwenhorst, K. G. 1998, 'International Momentum Strategies', *Journal of Finance* 53, 267-284.

Sadka, R. 2006. Momentum and post-earnings-announcement drift anomalies: The role of liquidity risk. *Journal of Financial Economics* 80, 309–349.

Sagi, J., Seasholes, M. 2007. Firm-specific attributes and the cross section of momentum. *Journal of Financial Economics* 84, 389–434.

Wang, C.-P., Huang, H.-H., Lin, W.-L. 2010. Momentum strategy and institutional investing in Taiwan stock market. *Applied Financial Economics* 20:21, 1651-1658

Table 1:

Table 2:

Table 3:

Table 4:

Table 5:

Table 6:

Table 7:

Table 8:

Table 1
Excess returns and scores of the momentum strategies in Taiwan

This table presents excess portfolio returns and scores on the overlapping momentum strategies with ranking and holding periods of 6 months (in Panel A for the whole sample and Panel B for the sub-sample) and 3 months (in Panel C and Panel D). The momentum portfolios are equally weighted. Winner is the top past-return decile, and Loser is the lowest past-return decile. "Profit" denotes the momentum profit from the zero net-worth strategy that is long Winner and short Loser. The asterisk of *, ** and *** denotes the significance at the 10%, 5% and 1% levels, respectively.

Panel A Taiwan: 6×6 momentum, whole sample 01-1986 to 12-2011											
	Loser	2	3	4	5	6	7	8	9	Winner	Profit
Return	0.53%	0.87%	0.94%	0.95%	0.75%	0.91%	0.93%	0.81%	0.94%	1.24%	0.71%
t-stat	(0.68)	(1.17)	(1.31)	(1.41)	(1.15)	(1.43)	(1.44)	(1.21)	(1.29)	(1.56)	(1.48)
Score	-0.106	-0.039	-0.049	-0.056	-0.060	-0.034	-0.034	-0.044	-0.039	-0.029	0.037
t-stat	(-1.01)	(-0.36)	(-0.46)	(-0.53)	(-0.55)	(-0.31)	(-0.31)	(-0.41)	(-0.36)	(-0.26)	(0.32)
Panel B Taiwan: 6×6 momentum, sub-sample 01-1992 to 03-2008											
Return	-0.18%	0.22%	0.23%	0.29%	0.11%	0.30%	0.36%	0.31%	0.44%	0.86%	1.04%
t-stat	(-0.27)	(0.36)	(0.40)	(0.50)	(0.20)	(0.55)	(0.63)	(0.53)	(0.66)	(1.09)	(1.86)
Score	-0.109	-0.053	-0.045	-0.062	-0.057	-0.023	-0.013	-0.019	-0.034	-0.019	0.071
t-stat	(-0.85)	(-0.41)	(-0.34)	(-0.47)	(-0.42)	(-0.16)	(-0.10)	(-0.14)	(-0.25)	(-0.13)	(0.50)
Panel C Taiwan: 3×3 momentum, whole sample 01-1986 to 12-2011											
Return	1.07%	0.78%	0.87%	0.85%	0.81%	0.96%	1.07%	0.96%	0.97%	0.93%	-0.14%
t-stat	(1.32)	(1.06)	(1.30)	(1.29)	(1.26)	(1.56)	(1.67*)	(1.45)	(1.43)	(1.32)	(-0.28)
Score	-0.063	-0.072	-0.046	-0.063	-0.056	-0.028	-0.012	-0.028	-0.020	-0.053	0.016
t-stat	(-0.58)	(-0.67)	(-0.43)	(-0.59)	(-0.53)	(-0.26)	(-0.11)	(-0.26)	(-0.18)	(-0.48)	(0.14)
Panel D Taiwan: 3×3 momentum, sub-sample 01-1992 to 03-2008											
Return	0.50%	0.42%	0.37%	0.29%	0.22%	0.37%	0.40%	0.35%	0.27%	0.57%	0.07%
t-stat	(0.65)	(0.64)	(0.62)	(0.49)	(0.39)	(0.66)	(0.71)	(0.57)	(0.45)	(0.79)	(0.12)
Score	0.005	0.004	0.004	0.003	0.002	0.004	0.004	0.004	0.003	0.006	0.001
t-stat	(0.65)	(0.64)	(0.62)	(0.49)	(0.39)	(0.66)	(0.71)	(0.57)	(0.45)	(0.79)	(0.12)

Table 2

Excess momentum returns and scores in Hong Kong and Korea

This table presents excess portfolio returns and scores on the overlapping momentum strategies with ranking and holding periods of 6 months and 3 months. Panels A and B for Hong Kong show results of the 6×6 momentum and the 3×3 momentum, respectively. Panels C and Panel D for Korea show results of the 6×6 momentum and the 3×3 momentum, respectively. The momentum portfolios are equally weighted. Winner is the top past-return decile, and Loser is the lowest past-return decile. "Profit" denotes the momentum profit from the zero net-worth strategy that is long Winner and short Loser. The asterisk of *, ** and *** denotes the significance at the 10%, 5% and 1% levels, respectively.

Panel A Hong Kong: 6×6 momentum 01-1993 to 12-2011											
	Loser	2	3	4	5	6	7	8	9	Winner	Profit
Return	-0.07%	0.37%	0.60%	0.80%	0.72%	0.90%	1.04%	0.88%	0.92%	0.88%	0.95%
t-stat	(-0.09)	(0.55)	(0.95)	(1.30)	(1.24)	(1.59)	(1.85*)	(1.56)	(1.57)	(1.27)	(1.73*)
Score	-0.152	-0.101	-0.037	0.008	0.016	0.046	0.049	0.049	0.048	0.007	0.056
t-stat	(-1.29)	(-0.83)	(-0.29)	(0.07)	(0.13)	(0.37)	(0.40)	(0.39)	(0.38)	(0.06)	(0.42)
Panel B Hong Kong: 3×3 momentum 01-1993 to 12-2011											
Return	-0.27%	0.27%	0.48%	0.75%	0.68%	0.71%	0.78%	0.71%	0.80%	1.01%	1.28%
t-stat	(-0.37)	(0.42)	(0.78)	(1.26)	(1.18)	(1.28)	(1.35)	(1.22)	(1.33)	(1.43)	(2.75***)
Score	-0.141	-0.083	-0.050	-0.022	0.006	0.035	0.026	0.015	0.010	0.001	0.036
t-stat	(-1.20)	(-0.67)	(-0.41)	(-0.18)	(0.05)	(0.28)	(0.21)	(0.12)	(0.08)	(0.01)	(0.28)
Panel C Korea: 6×6 momentum 01-1991 to 12-2011											
Return	0.51%	1.11%	0.96%	0.85%	0.88%	1.10%	1.23%	1.38%	0.82%	0.80%	0.29%
t-stat	(0.66)	(1.52)	(1.37)	(1.29)	(1.36)	(1.70)	(1.83)	(1.99)	(1.24)	(1.17)	(0.54)
Score	-0.083	-0.040	-0.050	-0.045	-0.057	-0.029	-0.012	0.002	-0.035	-0.006	0.024
t-stat	(-0.70)	(-0.33)	(-0.44)	(-0.39)	(-0.48)	(-0.25)	(-0.10)	(0.01)	(-0.29)	(-0.05)	(0.19)
Panel D Korea: 3×3 momentum 01-1991 to 12-2011											
Return	0.14%	0.64%	0.57%	0.58%	0.49%	1.06%	0.95%	1.25%	1.04%	0.71%	0.57%
t-stat	(0.19)	(1.01)	(0.92)	(0.91)	(0.79)	(1.67*)	(1.46)	(1.87*)	(1.55)	(1.00)	(1.01)
Score	-0.081	-0.011	-0.034	-0.029	-0.065	-0.011	-0.022	-0.025	-0.012	-0.039	0.005
t-stat	(-0.70)	(-0.10)	(-0.29)	(-0.25)	(-0.57)	(-0.10)	(-0.18)	(-0.21)	(-0.10)	(-0.33)	(0.04)

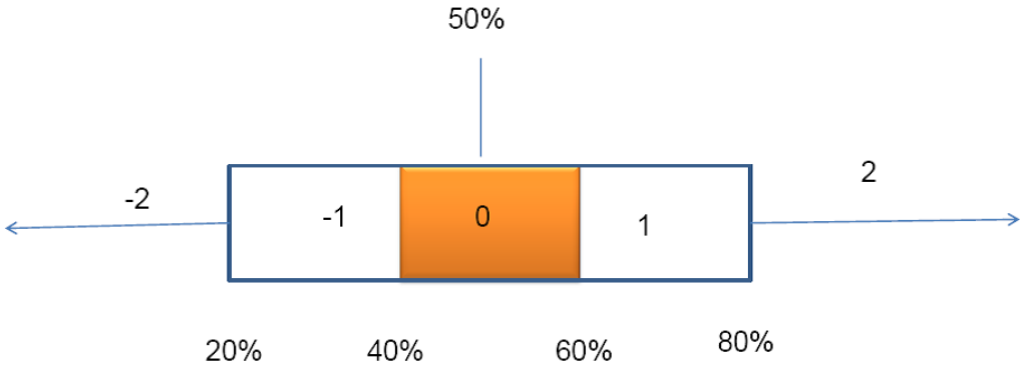


Figure 1: The five-point score function

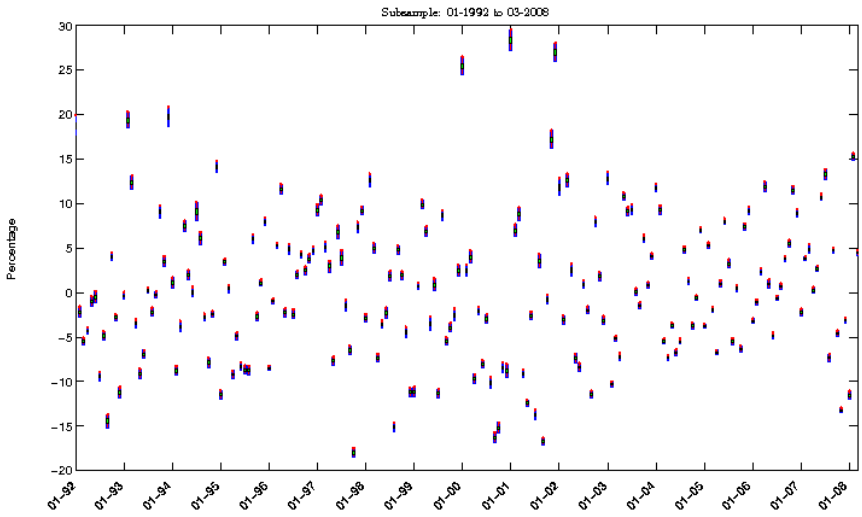


Figure 2: The monthly profit (in %) distributions of the naive strategies from January 1992 to March-2008. The distributions are displayed in box charts. The bottom box shows the 20th to the 40th percentiles of the profits of the naive investors strategies; the green box in the middle displays the 40th to the 60th percentiles; and the top box displays the 60th to the 80th percentiles.

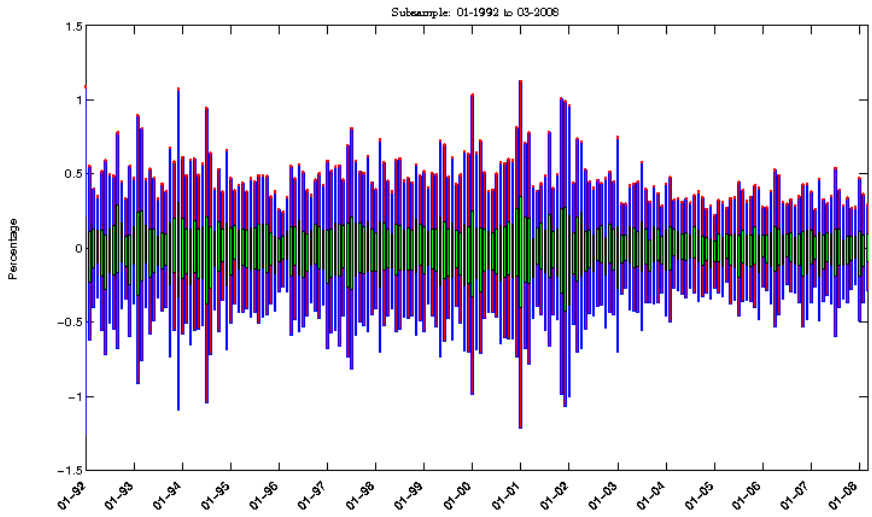
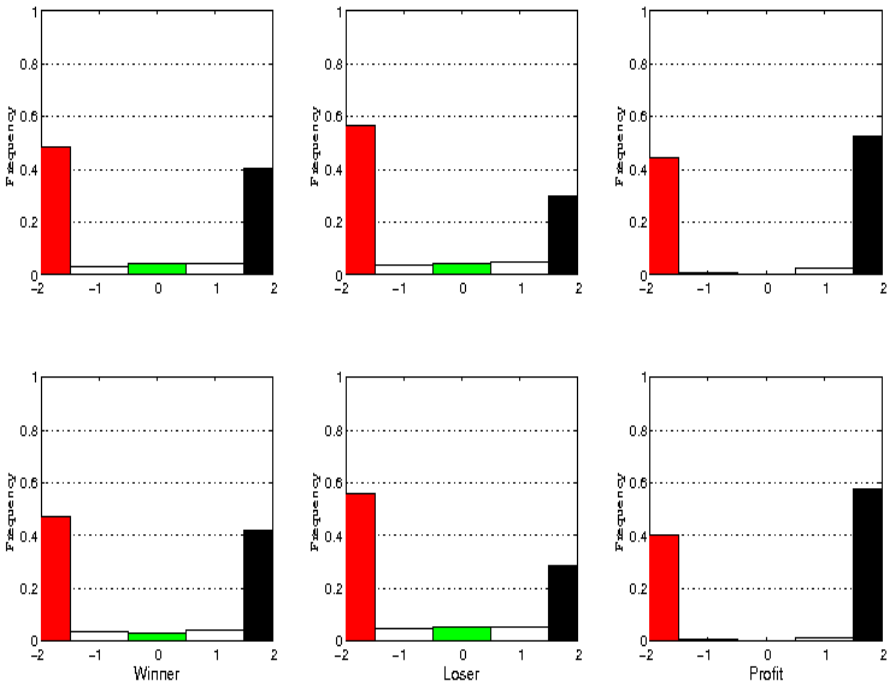


Figure 3: **The centered monthly profit (in %) distributions of the naive investors strategies from January 1992 to March 2008.** The distributions are centered by their medians and displayed in box charts. The bottom box shows the 20th to the 40th percentiles of the profits of the naive investors strategies; the green box in the middle displays the 40th to the 60th percentiles; and the top box displays the 60th to the 80th percentiles.

Panel A six month-by-six month momentum



Panel B three month-by-three month momentum

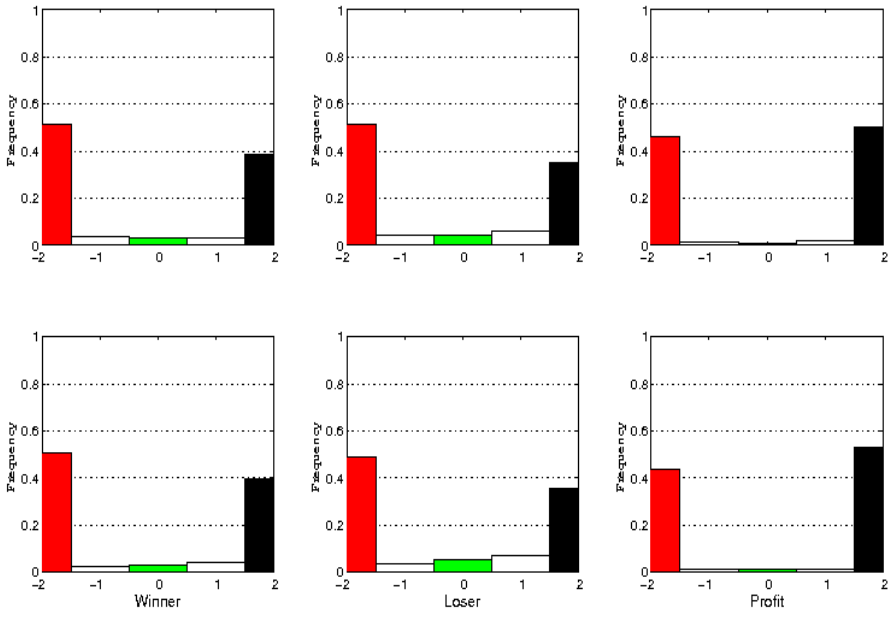


Figure 4: Frequencies of momentum scores in Taiwan. The distributions of 5 scores of the winner (1st column), the loser (2nd column) portfolios and the momentum profits (3rd column). The first and second rows in each panel display the results, respectively, for the whole sample period and the sub-sample period 01-1992 to 03-2008.

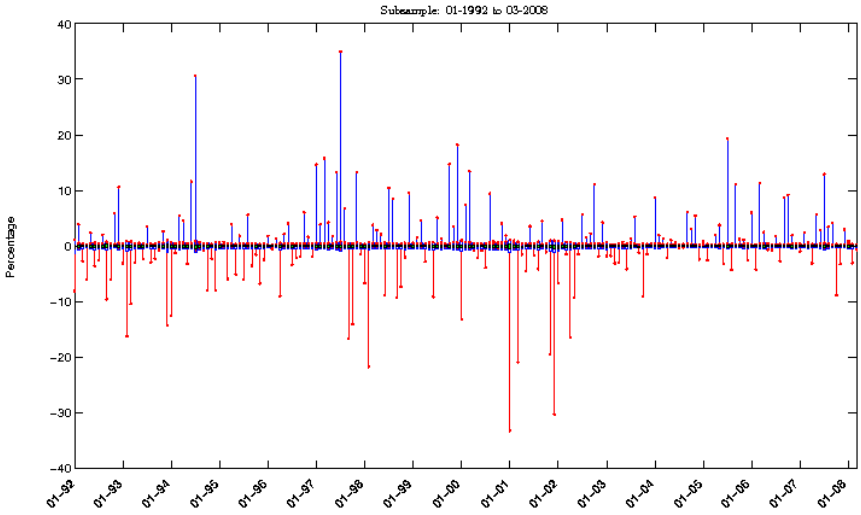
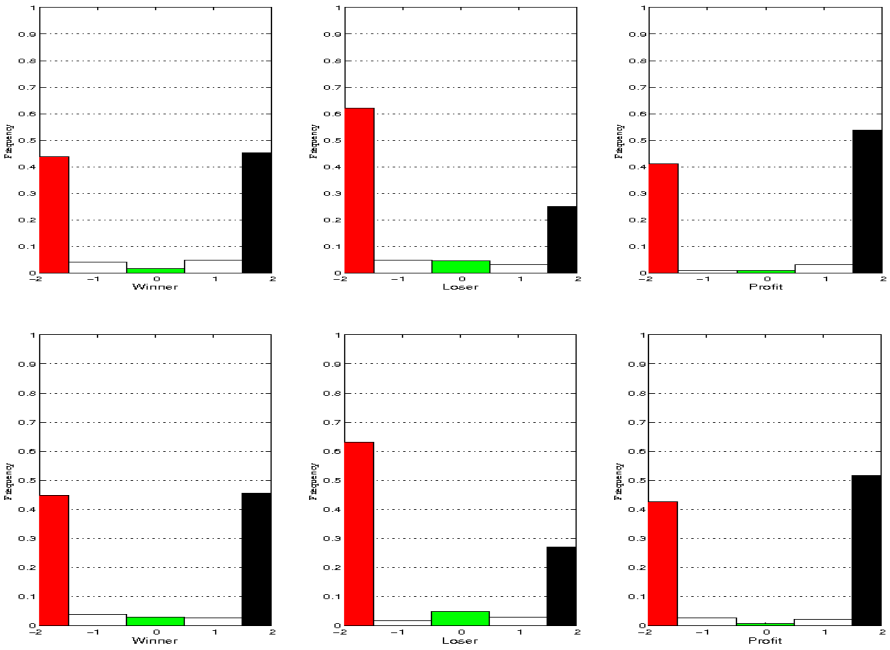


Figure 5: Six month-by-six month momentum in Taiwan. The centered monthly return (in %) distributions of the momentum profits: January 1992 to March 2008 The distributions are centered by the median profits of the naive investors strategies and displayed in box charts. The bottom box shows the 20th to the 40th percentiles of the profits of the naive investors strategies; the green box in the middle displays the 40th to the 60th percentiles; and the top box displays the 60th to the 80th percentiles. The deviations of the momentum profits above the top 80th percentile of the profits of the naive investors strategies are in blue; and the deviations of the momentum profits below the bottom 20th percentile of the profits of the naive investors' strategies are in red.

Panel A Hong Kong



Panel B Korea

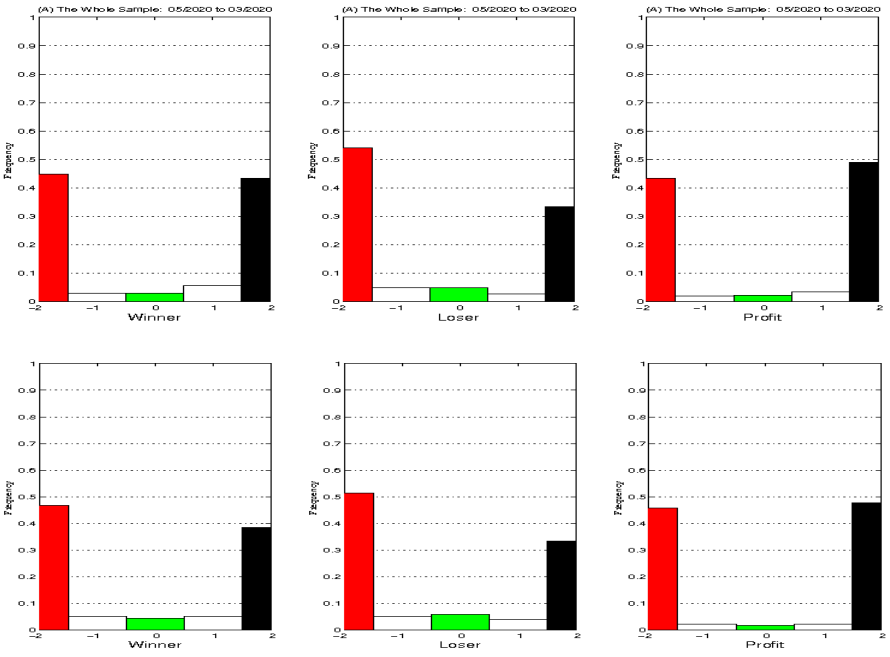


Figure 6: Frequencies of momentum scores in Hong Kong and Korea. The distributions of 5 scores of the winner (1st column), the loser (2nd column) portfolios and the momentum profits (3rd column). The first and second rows in Panel A display the results for the 6 by 6 momentum and the 3 by 3 momentum in Hong Kong, respectively. The first and second rows in Panel B display the results for the 6 by 6 momentum and the 3 by 3 momentum in Korea, respectively.