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Momentum strategies and stock returns: Chinese evidence

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Abstract

This paper investigates the profitability of momentum investment strategies for equities listed in the Shanghai Stock Exchange. We also investigate the role of trading volume to examine whether there is any relationship between stock returns and past trading volume for Chinese equities. We find evidence of substantial momentum profits during the period 1995 to 2005 and that momentum is a pervasive feature of stock returns for the market investigated in this paper.

Our findings suggest that investors can generate superior returns by investing in strategies unrelated to market movements. We also investigate the potential of past volume to explain momentum profits, and find no strong link between past volume and momentum profits. Our findings also show a strong momentum effect around earnings announcements but the magnitude of these returns is small in relation to the average monthly returns earned in the early months following portfolio formation.

JEL classification: G11; G12; G15
Keywords: Momentum; Turnover ratio; Past returns; Earnings announcements; Shanghai

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I. Introduction

DeBondt and Thaler (1985) show that contrarian strategies (buying prior losers and selling prior winners) generate superior returns. They show that 3 years after the formation losers outperform the market by 19.6% whereas the winners earn 5% less than the market. They argue that their findings are consistent with the overreaction hypothesis. DeBondt and Thaler (1987) show that the winner–loser effect is not a size effect and in addition that the earnings of winners and losers demonstrate patterns consistent with the overreaction hypothesis.

In an important paper, Jegadeesh and Titman (1993) document that strategies which buy stocks that have performed well in the past and sell stocks that have performed poorly in the past generate superior returns over various monthly holding periods. For instance, they show that a strategy that picks stocks based on their past 6-month returns and holds for a period of 6 months generates an average return of 12% per year. They also report that the profitability arising from these strategies cannot be attributed to their systematic risk or delayed stock price reactions to common factors. More importantly, they document that stock returns are predictable around quarterly earnings announcements.

Lee and Swaminathan (2000) report an asymmetric relation between past returns and trading volume; that is, extreme winners have a higher trading volume than extreme losers. However, the literature on past volume and future returns presents a somewhat different picture to the past volume and past returns discussion above. Datar et al. (1998) show that low (high) volume firms earn higher (lower) future returns. Lee and Swaminathan (2000) and Connolly and Stivers (2003) show that past trading volume can provide an important link between momentum and value strategies as past trading volume can predict the magnitude and persistence of price momentum. In a similar vein, Blume et al. (1994) argue that traders can obtain valuable information about stock returns by observing past price and past trading volume.

The result from momentum strategies is not only large in magnitude — it is also robust and documented to be an international phenomenon. Rouwenhorst (1998) obtains significant momentum returns from a sample of 12 European countries over the period from 1980 to 1995: an internationally diversified relative strength portfolio that invests in past winners and sells past losers earns approximately 1% a month. He also finds that international momentum returns are correlated with those of the United States. This result suggests that exposure to a common factor may drive the profitability of momentum trading strategies globally. Rouwenhorst (1999) confirms the existence of momentum strategies in an emerging market setting. Chan et al. (2000) report significant evidence of momentum profits based on their research of 23 stock market indices. Hameed and Kusnadi (2002) find statistically significant momentum profits from six Asian stock markets. Wang and Chin (2004) investigate the effectiveness of momentum strategies in a Chinese setting and document strong evidence of predictable patterns of returns. They also document that their findings are more in line with behavioural finance models. They state that additional out-of-sample evidence is beneficial for academics to understand volume–return dynamics in asset markets (2004, p.563).

More recent evidence from Griffin et al. (2003) confirms the international pervasiveness of the phenomenon in data from the US and 39 other countries. However, momentum profits were weakest in Asia with negative, but statistically insignificant, returns reported for China using six-month formation and six-month holding periods. Kang et al. (2002) however, document statistically significant positive profits from both momentum and contrarian strategies across a range of formation and holding periods.

Since the predictability of stock returns over time is one of the most controversial issues in stock market efficiency (Fama, 1991), there have been several attempts to explain this anomaly.

Many studies have examined the return patterns and studied whether the result is driven by improper response of markets to information, microstructure biases or by accounting for risks.[3] Chan et al. (1996) suggest that underreaction to earnings information can partly explain medium-term continuation of stock returns. Lo and MacKinlay (1990) propose that momentum profit can be attributed to a lead-lag effect from delayed stock price reaction to information about a common factor, while Jegadeesh and Titman (1993) provide evidence that the result comes from delayed price reactions to firm specific information.

Conrad and Kaul (1998) conclude that momentum profits can be explained by the cross sectional difference in individual stocks' expected returns. Fama and French (1996) show that while contrarian strategies can be consistent with multifactor-models of returns, their three factor model fails to explain medium-term continuation of stock returns and therefore momentum profits cannot be explained by loading on risk factors. Researchers have also employed behavioural models to explain the source of momentum profits or the tendency to herd among fund managers.[4] Hong and Stein (1997) argue that human cognitive bias either makes investors underreact to information or to adopt positive feedback strategies that result in delayed overreaction to information. This paper extends the literature on momentum trading in China. We use more recent and extensive data than in prior studies (Wang and Chin 2004, Griffin et al., 2003, Kang et al., 2002). We also extend the literature by examining the link between past volume and momentum profits. In addition, our study is the first to investigate the magnitude of momentum profits around earnings announcements for Chinese equities. There are several reasons why it is exciting to examine the effectiveness of momentum strategies for Chinese equities.

Firstly, China is one of the fastest growing economies in the world and is one of the few countries negatively correlated with the US stock market (Kang et al., 2002). Since the inception of the stock markets in 1990, the total capitalization of the two Chinese markets (Shanghai and Shenzhen) have grown to more than 50% of the country's GDP in 2000 (MacNeil, 2002). This places China ahead of most EU members other than the UK in terms of the significance of the stock market to the economy (Maher and Andersson, 2000).

Second, the Chinese market has been reported to unique attributes that challenge traditional asset pricing models and the theory of rationality. Drew et al. (2003) suggest that the Chinese market is difficult to comprehend using conventional analysis. For example, they document that the mimic portfolio for book-to-market equity generates on average a negative monthly return.[5] They therefore suggest that this strange result may come from investors' misvaluation. Kang et al. (2002) also suggest that the lack of rigorous stock analysis and research may have led to the perception that prices are driven by sentiment as much as by other factors.[6] Third, Chinese stock markets are attracting foreign investor's attention because of enormous growth opportunities (Wang and Chin 2004). In addition, the dominance of small retail investors in China provides motivation to examine the momentum phenomenon in that market. The remainder of the paper is

[3] See, Ball and Kothari (1989), Chan, Hamao, and Lakonishok (1991), Lakonishok, Shleifer, and Vishny (1994) and Fama and French (1996).

[4] See, Grinblatt, Titman, and Wermers (1995) and Lakonishok, Shleifer, and Vishny (1994).

[5] Fama and French (1996) provide empirical evidence from the US markets that loading on HML is positive. They suggest that high book-to-market equity stocks should generate higher returns than low book-to-market equity stocks. Thus, this result from the Chinese stock market challenges the argument that value firms are distressed.

[6] Kang, Liu and Ni (2002) find that the "A" share market in China is dominated by individual investors who only possess rudimentary knowledge on investing and trade like noise traders. Mok and Hui (1998) report an average first day returns of IPOs in the stock market of China of 289%. Su and Fleisher (1999) find evidence of mean return of more than 900% suggesting that Chinese investors are very passionate in investing in the stock market.

organised as follows: Section 2 presents the data and methodology employed in this paper. Section 3 presents the findings while Section 4 concludes the paper.

2. Data and methods

2.1. Data

Monthly stock returns, trading volume and number of outstanding shares for the period 1995 to 2005 are obtained from the Great China Database maintained by the Taiwan Economic Journal. We choose Shanghai Stock Exchange as it represents a significantly larger proportion of the Chinese equity market both in terms of number of listed companies and market capitalization. We have a total of 821 stocks in our sample. We only examine the domestic A share market (shares available to domestic investors in domestic currency) as the number of firms with B share issues (shares quoted in foreign currency and open to foreign as well as domestic investors) is far fewer and the B share market is less liquid than the A market. Our sample accounts for 57% of all firms in China and 75% of the total market capitalisation.

2.2. Methodology

Return is computed as the log of the formation day price divided by the previous month's price. Trading volume is defined as the average monthly turnover ratio where the monthly turnover ratio is obtained by dividing the monthly trading volume of a stock by the number of shares of the same stock at the end of the month. Many studies have used turnover ratio as a reliable measure of trading volume because raw trading volume is not scaled and highly likely to be correlated with size.[7] In this paper we follow the approach of Lee and Swaminathan (2000) in constructing portfolios. Our portfolios are formed on a monthly basis. Thus, at the beginning of each month, we rank all eligible stocks independently on the basis of past returns and past trading volume. The stocks are assigned to one of 5 portfolios based on their returns over the past J months and one of 3 portfolios based on the trading volume over the same period ($J=1$, 3, 6, 9 and 12 months respectively). The portfolios are then held for K months ($K=1$, 3, 6, 9 and 12 months). This results in 15 momentum–volume portfolios in any combination of J and K. Returns for K-month holding period are based on equally-weighted average returns of every stock in the portfolios.

For example, the monthly return for a three-month holding portfolio is the average of the portfolio return from this month's strategy, last month's strategy and strategy from two months ago. This is equivalent to liquidating $1/K$ of the portfolio each month for a K-month holding portfolio. We focus on the extreme winner, loser and medium deciles over the next K months and next 6 years. The strategies are to buy the winner portfolio and sell the loser portfolio for different holding and formation periods.

3. Findings

This section reports the returns for different momentum and volume-based momentum strategies. We confirm that there is strong momentum behaviour in the stock returns, which generates substantial momentum profits. Interestingly, unlike what has been documented in the

[7] See, Campbell, Grossman, and Wang (1993) and Lee and Swaminathan (2000).

US, there is no explicit role of trading volume in determining the magnitude of momentum effect. In other words, we find no evidence of a relationship between stock returns and trading volume over medium-term holding periods. However, we do find evidence that trading volume can predict the timing of reversal of the momentum phenomenon.

3.1. Simple strategies

Table 1 summarises the empirical results from several momentum strategies. Mean return volume during the portfolio formation period, the average of the median size decile of the portfolio (SzRnk), and the average of the median stock price are also reported. In addition, following Lee and Swaminathan (2000) we report the mean return from a dollar neutral strategy of buying the extreme winners and selling the extreme losers, R5−R1. At the beginning of each month, stocks are ranked and grouped into quintiles on the basis of their returns over the previous 1, 3, 6, 9 and 12 months. Thus, there are 5 portfolios ranging from top winners to worst losers every month from January 1995 to December 2005. *t*-statistics are provided in parentheses.[8]

We report results for the extreme losers (R1), and the winner (R5). In each month, we also long the winner portfolio and short the loser portfolio and the returns of this zero cost portfolio is shown as R5−R1. The results in Table 1 suggest a clear and consistent momentum effect for equities listed in the Shanghai Stock Exchange. Typically, returns at the formation date for winner portfolios are fairly similar to those of stocks in the loser portfolio. When $J=6$, winner stocks on average earn 25.14% from the previous 6 months and loser stocks on average lose 27.38% from the previous 6 months. Winner portfolios also typically have higher average price and size rank compared to loser portfolios.

In Table 1, we also report the equal-weighted average monthly returns over the next K months ($K=1, 3, 6, 9, 12$) for portfolios formed based on J months. For example, when $J=1$ and $K=6$, with a six-month portfolio formation period, past losers on average lose 0.58% over the next six months while past winners on average gain 0.55% over the same period. The zero cost portfolio which shorts the loser and longs the winner in this case earns 6.78% over six months. This return translates to an annual return of 13.56%. The differences in monthly returns between winner and loser portfolios are positive and significant in every combination of K and J. On average, these differences are very high. For example, the zero cost portfolio earns 1.66% and 1.45% when $K=1$, $J=1$ or $K=1$, $J=3$ respectively.

Table 1 also reports the annual returns for each portfolio for four years following the portfolio formation ($k=12, 24, 48$). We find that the momentum effect lasts up to one year for portfolios formed based on past 1, 3 and 6 months. From Year 2 onwards, a reversal pattern is observed for these portfolios. The zero cost portfolios consistently produce lower returns after one year. Furthermore, it seems that the reversal gets larger and larger over time as R5−R1 generates lower returns for longer holding periods.

[8] Connolly (1989) points out that the large sample sizes can result in an overstatement of statistical significance in finance studies due to Lindley's paradox (Lindley, 1957). To avoid this potential bias, Leamer (1978) suggests that critical values for regression test statistics be adjusted to reduce the likelihood of Type II errors as in the equation below:

$$t = \sqrt{T - k(T^{1/T} - 1)}.$$

This equation presents the adjustment for *t*-statistics from large sample size, where T is the sample size and k is the number of degrees of freedom lost. When the absolute value of a calculated *t*-statistic is greater than the value computed by the equation, the absolute value of the calculated *t*-statistic is reduced by the adjustment.

Table 1
Price momentum portfolios and stock returns Period: 1995–2005

		Return	Volume	SzRnk	Price	$K=1$	$K=3$	$K=6$	$K=9$	$K=12$	$K=24$	$K=36$	$K=48$
J=1	R1	−11.12	38.81	4.37	7.46	−0.02	−0.42	−0.58	−0.62	−0.68	−0.50	−0.15	−0.05
						(−0.12)	(−3.16)**	(−6.97)**	(−3.04)**	(−3.79)**	(−3.49)**	(−7.18)**	(−3.86)**
	R5	11.43	41.40	4.86	8.06	1.65	0.80	0.55	0.55	0.56	0.54	0.21	0.09
						(5.34)**	(5.80)**	(6.21)**	(7.70)**	(2.95)**	(3.64)**	(3.07)**	(6.48)**
	R5−R1					1.66	1.22	1.13	1.16	1.24	1.04	0.36	0.15
						(2.73)**	(4.48)**	(6.59)**	(5.37)**	(3.37)**	(3.57)**	(5.12)**	(5.17)**
J=3	R1	−19.06	40.55	4.24	7.39	−0.28	−0.53	−0.67	−0.70	−0.72	−0.50	−0.14	−0.04
						(−2.02)*	(−4.17)**	(−2.77)**	(−3.57)**	(−4.21)**	(−3.71)**	(−6.64)**	(−2.72)**
	R5	18.74	39.41	5.19	8.34	1.17	0.60	0.42	0.44	0.51	0.57	0.23	0.12
						(3.78)**	(4.29)**	(4.70)**	(6.06)**	(8.00)**	(3.78)**	(3.44)**	(2.68)**
	R5−R1					1.45	1.13	1.09	1.14	1.24	1.07	0.37	0.15
						(2.90)**	(4.23)**	(3.73)**	(4.82)**	(6.10)**	(3.74)**	(5.04)**	(2.70)**
J=6	R1	−27.38	41.51	4.11	7.29	−0.82	−0.75	−0.75	−0.72	−0.71	−0.44	−0.10	−0.02
						(−3.05)**	(−6.22)**	(−3.25)**	(−3.91)**	(−4.34)**	(−3.50)**	(−5.29)**	(−2.65)**
	R5	25.14	36.90	5.48	8.65	0.46	0.25	0.27	0.38	0.49	0.65	0.29	0.15
						(2.98)**	(3.59)**	(2.99)**	(5.25)**	(7.59)**	(4.31)**	(4.17)**	(3.40)**
	R5−R1					1.28	1.01	1.02	1.11	1.20	1.09	0.39	0.17
						(3.02)**	(4.91)**	(3.12)**	(4.58)**	(5.97)**	(3.91)**	(4.73)**	(3.02)**
J=9	R1	−35.13	41.80	4.06	7.26	−0.89	−0.71	−0.68	−0.65	−0.61	−0.36	−0.07	0.00
						(−3.46)**	(−6.10)**	(−3.14)**	(−3.71)**	(−3.97)**	(−3.09)**	(−4.00)**	(−0.37)
	R5	30.20	35.17	5.68	8.92	0.28	0.19	0.33	0.46	0.58	0.75	0.32	0.18
						(1.77)*	(2.59)**	(3.58)**	(6.21)**	(2.92)**	(4.88)**	(4.70)**	(3.95)**
	R5−R1					1.17	0.89	1.01	1.11	1.19	1.12	0.40	0.18
						(2.62)**	(4.35)**	(3.36)**	(4.96)**	(3.44)**	(3.99)**	(4.35)**	(2.16)*
J=12	R1	−42.26	41.54	4.02	7.22	−0.92	−0.69	−0.64	−0.57	−0.54	−0.31	−0.05	0.01
						(−3.70)**	(−6.24)**	(−3.05)**	(−3.47)**	(−3.77)**	(−2.73)**	(−2.77)**	(1.51)
	R5	34.14	33.49	5.86	9.15	0.22	0.36	0.49	0.59	0.72	0.86	0.38	0.21
						(1.40)	(2.48)**	(5.23)**	(7.74)**	(3.55)**	(5.40)**	(5.33)**	(4.44)**
	R5−R1					1.14	1.05	1.13	1.17	1.26	1.16	0.42	0.20
						(2.55)**	(4.36)**	(4.14)**	(5.61)**	(3.66)**	(4.07)**	(4.05)**	(1.47)

This table presents average monthly returns for momentum portfolio strategies for the time period 1995 to 2005. R1 represents the loser portfolio with the lowest returns, and R5 represents the winner portfolio with the highest returns during the previous J months. K represents monthly holding periods where $K=1$, 3, 6, 9, 12, 24, 36 and 48 months. Returns are the average monthly returns over the portfolio formation period. The numbers in the parentheses are t-values.
** Indicates significance at 1% level, and * indicates significance at 5% level.

In relation to past returns and trading volume our findings offer only limited support for Lee and Swaminathan (2000) finding that extreme winners have a higher trading volume than extreme losers. In our sample, the same evidence is only observed for portfolio formed on $J=1$ where trading volume is positively correlated with returns so that extreme winners have higher trading volume and vice versa. For example, when the formation period is 6 months, the average turnover for the extreme loser portfolio is 41.51% while the average turnover for the extreme winner portfolio is 36.90%.

It is noticeable from Table 1 that when the holding period is extended to more than 1 month, returns for loser portfolios (R1) generally increase. In other words, for every J, the returns of R1 portfolios are at their worst when they are held for one month ($K=1$). For winner portfolios, the returns reach their best at $K=1$ and decline if the holding period is extended to 6, 9 and 12 months. The momentum returns based on our range of formation periods are shown graphically in Fig. 1. Momentum returns are calculated as the returns on the extreme winner portfolios minus the returns on the extreme loser portfolios (R5−R1). All the formation periods show the highest returns in the first month of holding followed by a steady decline.

3.2. Volume based portfolios and future returns

In this section we examine whether there is any relation between future stock returns and past trading volume for equities listed in the Shanghai Stock Exchange Table 2 reports returns for portfolios formed on the basis of a two-way sort between past returns and past trading volume. At the beginning of each month, we sort all stocks in the sample according to their returns over the past J months and divide them into 5 portfolios from R1 to R5. In each portfolio, we sort the stocks again based on their trading volume over the past J months and allocate them into three volume portfolios V1 to V3. V1 is the lowest trading volume portfolio and V3 is the highest trading volume portfolio.

Our definition of trading volume and the criteria to classify high and low trading volume stocks are based on stock turnover ratios as described above. So far, most of our findings are consistent with previous studies in price momentum. However, when we take trading volume into consideration, we find that trading volume does not help predict stock returns. In this respect our

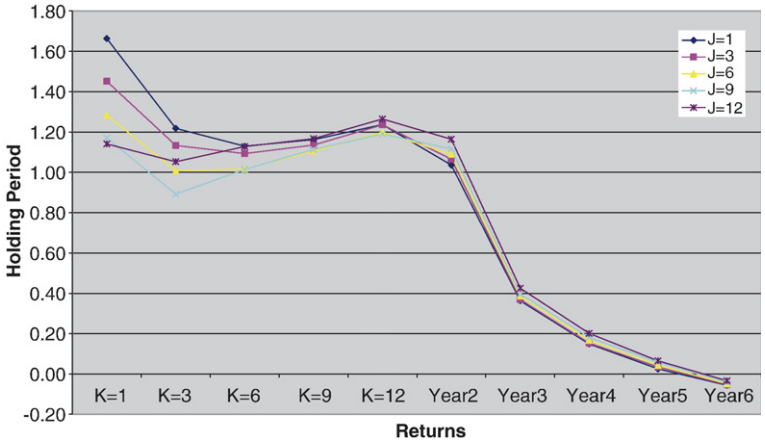

Fig. 1. Momentum returns.

Table 2
Returns for portfolios sorted on past return and volume Period: 1995–2005

		$K=1$	$K=3$	$K=6$	$K=9$	$K=12$
J	Portfolio	V3−V1	V3−V1	V3−V1	V3−V1	V3−V1
1	R1	3.30	0.86	0.20	−0.11	−0.12
		(3.39)**	(3.45)**	(1.67)*	(−0.52)	(−0.55)
	R5	−2.64	−0.63	−0.32	−0.35	−0.32
		(−2.64)**	(−1.45)	(−0.76)	(−1.09)	(−0.62)
	R5−R1	−5.95	−1.49	−0.52	−0.25	−0.20
		(−3.01)**	(−2.45)**	(−1.22)	(−0.28)	(−0.03)
3	R1	2.43	0.69	0.13	−0.20	−0.16
		(3.29)**	(1.90)*	(0.85)	(−1.84)*	(−4.18)**
	R5	−2.23	−0.67	−0.27	−0.37	−0.38
		(−3.02)**	(−0.63)	(−0.89)	(−1.66)*	(−1.46)
	R5−R1	−4.66	−1.36	−0.40	−0.17	−0.22
		(−3.15)**	(−1.26)	(−0.87)	(−0.09)	(−1.36)
6	R1	2.58	0.50	−0.09	−0.34	−0.34
		(3.04)**	(2.38)**	(−0.96)	(−2.57)**	(−2.80)**
	R5	−1.56	−0.21	−0.27	−0.39	−0.44
		(−1.73)*	(−1.53)	(−0.08)	(−2.17)*	(−2.51)**
	R5−R1	−4.14	−0.71	−0.18	−0.04	−0.10
		(−2.39)**	(−1.95)*	(−0.44)	(−0.20)	(−0.15)
9	R1	3.04	0.44	−0.14	−0.31	−0.37
		(3.91)**	(2.03)*	(−1.56)	(−2.41)**	(−1.82)*
	R5	−1.65	−0.54	−0.40	−0.50	−0.54
		(−3.06)**	(−2.16)*	(−0.50)	(−2.95)**	(−3.28)**
	R5−R1	−4.69	−0.98	−0.26	−0.20	−0.17
		(−3.49)**	(2.10)*	(−0.53)	(0.27)	(0.73)
12	R1	2.53	0.26	−0.23	−0.42	−0.49
		(3.26)**	(1.13)	(−2.27)*	(−1.02)	(−0.32)
	R5	−1.73	−0.60	−0.50	−0.54	−0.57
		(−3.15)**	(−1.94)*	(−2.66)**	(−3.21)**	(−2.03)*
	R5−R1	−4.25	−0.86	−0.28	−0.12	−0.09
		(−3.20)**	(−1.53)	(−0.19)	(−1.10)	(−0.85)

This table presents average monthly returns for portfolios sorted on past returns and past average monthly turnover for the time period 1995 to 2005. K represents monthly holding periods where $K=1$, 3, 6, 9 or 12 months. R1 represents the loser portfolio, and R5 represents the winner portfolio. V1 represents the lowest trading volume portfolio, and V3 represents the highest trading volume portfolio. The numbers in parentheses are t-values.
** Indicates significance at 1% level, and * indicates significance at 5% level.

findings challenge prior research in this area. Several interesting results can be observed in Table 2. Lee and Swaminathan (2000) find that, conditional on past returns, lower volume stocks generally perform better than high volume stocks over the next 3, 6, 9 and 12 months (Figs. 2–6). Our findings show that although most V3−V1 portfolios generate negative returns, the pattern is not dominant and consistent in our sample. Therefore, our findings for the Shanghai market do not provide a consistent picture to support prior research in this respect.

In Table 2 we also report returns of R5−R1. While, Lee and Swaminathan (2000) find that price momentum is more pronounced among high volume stocks we do not find such a pattern in our sample. For example, when $K=3$, $J=1$, the high volume zero cost portfolio R5V3−R1V3 earns 0.68% while the low volume zero cost portfolio R5V1−R1V1 earns 2.16%; however, when $K=J=6$, the low volume zero cost portfolio R5V1−R1V1 earns 1.23%.

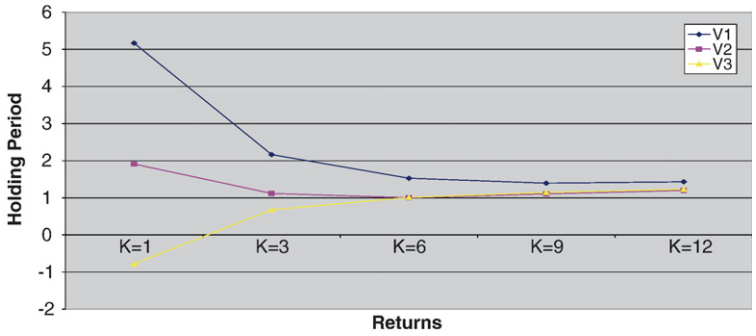

Fig. 2. Momentum returns for portfolios sorted on past returns and volume when $J=1$.

Lee and Swaminathan interpret the relationship between returns and volume as an illiquidity premium. They suggest that portfolios with lower liquidity earn higher expected returns. Our results in Table 2 show no evidence that high volume portfolios earn better momentum premium.[9] Thus, we conclude that past trading volume does not play an important role in predicting future returns for Chinese equities over the one year horizon.

3.3. Portfolios on past returns and volume

Table 3 presents sample characteristics of portfolio returns sorted on past returns and past trading volume. We choose portfolios that are formed based on past six-month performance and we hold the portfolios for another six months ($K=J=6$). We also establish different strategies from price momentum and trading volume for robustness checks. For example, Panel A reports returns for portfolios sorted into 5 price momentum and 3 trading volume (15 portfolios), Panel B reports 3 price momentum and 5 trading volume (also 15 portfolios) and Panel C reports 3 price momentum and 3 trading volume (9 portfolios).

We find that past losers (winners) tend to have lower (higher) median prices and size rank across all three panels. This result is consistent with what we present in Table 1. Regardless of how many price momentum portfolios that we sort stocks into, there still exist a clear and strong momentum effect. Again, the result reconfirms that we do not find any evidence of momentum being more pronounced for high volume stocks. For example, in Panel B, return for low volume winner portfolio R3V1 is 0.91% while the return for high volume winner portfolio R3V5 is 0.37%. Likewise, in Panel C, while low volume losers R1V1 lose 1.17%, high volume losers R1V3 lose 0.91% in the next six months. Thus, we advance the argument that trading volume does not play an important role in the Chinese equity market. We also do not find any significant difference between trading volume of winner and loser portfolios in Table 3.

3.4. Returns over the next 3 years

Table 4 presents the long-term average monthly returns for trading volume and momentum portfolios over the next 3 holding years. The results are obtained from a six-month portfolio formation period ($J=6$), five price momentum portfolios and three volume portfolios. Year 1 to

[9] We also examine the relationship between returns and volume around earnings announcements release and find no significant relation.

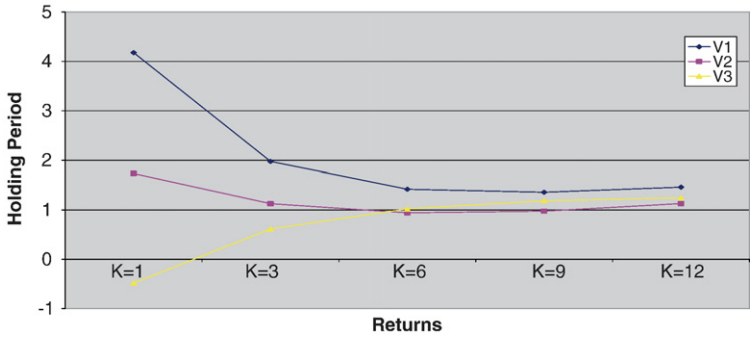

Fig. 3. Momentum returns for portfolios sorted on past returns and volume when $J=3$.

Year 3 report the yearly returns for these portfolios after 1 to 3 years respectively. Panel A presents the raw returns of these portfolios. Returns for the zero cost portfolios are also reported in the bottom row for every panel as R5 − R1. In Panel B, we report size-adjusted returns. Following, Lee and Swaminathan (2000), size adjustment is based on equal-weighted size decile portfolios. At the portfolio formation date we use all stocks available to form size benchmark portfolios. The size-adjusted return of a stock is the difference between the individual stock's monthly return and the monthly return of the appropriate size portfolio that the stock belongs to. Then, the monthly size-adjusted returns of the portfolios are the equal weighted average of the size-adjusted returns of individual stocks. First, the momentum effect on the Chinese stock market seems to last up to three year although the returns from momentum strategies that hold the portfolios for more than two years become small in magnitude. This result is consistent with what has been indicated in Table 1, that is, momentum effect lasts for more than one year and then dissipates the longer the holding period is. For example, the zero cost portfolio only earns 0.50% for low volume, 0.35% for medium volume and 0.41% for high volume when the holding period is 3 years.

Lee and Swaminathan (2000) find that low volume losers tend to outperform high volume losers in the long term once controlled for price momentum. We, however, do not find such a pattern in our sample. The results in Panel B show a similar pattern after we adjust individual

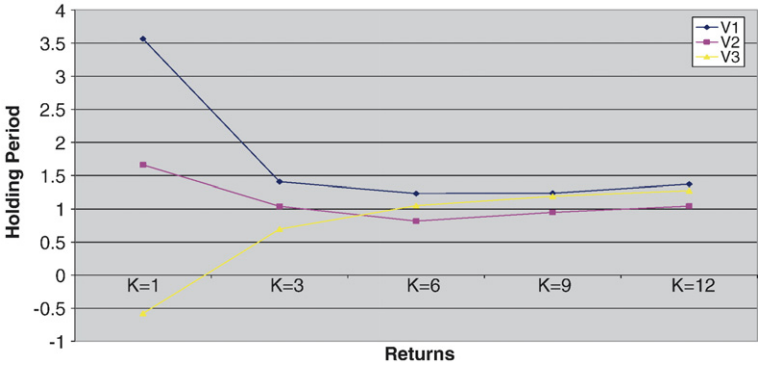

Fig. 4. Momentum returns for portfolios sorted on past returns and volume when $J=6$.

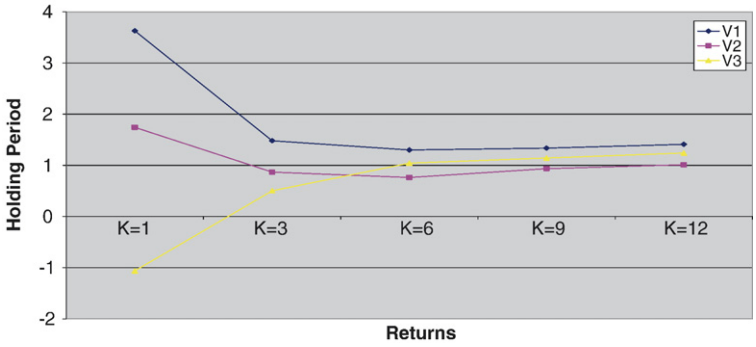

Fig. 5. Momentum returns for portfolios sorted on past returns and volume when $J=9$.

stock returns for firm size. While size adjustment does not change the results for momentum strategies, it does affect the level of significance of the results. For example, the zero cost portfolio for low volume stocks generates a raw return of 1.37% in year one with a *t*-statistic of 6.11 while the size-adjusted return is 1.38% with a *t*-statistic of 0.31.

3.5. Early and late strategies

We now replicate different volume based price momentum strategies used by Lee and Swaminathan (2000) to exploit the momentum phenomenon based on past trading volume in the long term. An early stage strategy buys low volume winners and sells high volume losers (R5V1 − R1V3) and then holds the portfolio for more than one year. Lee and Swaminathan argue that stocks in such a strategy have potential for long term price momentum. On the other hand late strategy buys high volume winners and sells low volume losers (R5V3 − R1V1) and holds the portfolio for more than one year with the expectation of a reversal of price momentum over time. In this paper we compare these two strategies with a simple strategy which is basically one that sells past losers and buys past winners without taking trading volume into account. The buy and hold returns for these three strategies are presented in Table 5 and graphically in Fig. 7. We find

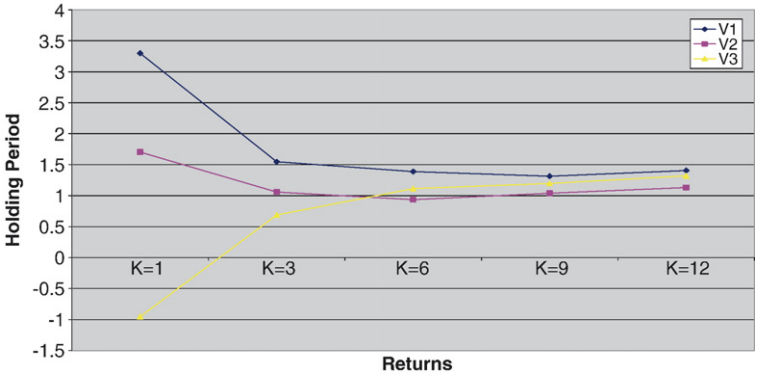

Fig. 6. Momentum returns for portfolios sorted on past returns and volume when $J=12$.

Table 3
Sample characteristics for portfolios sorted on past return and volume

Panel A: 5 price momentum, 3 trading volume portfolios

	V1				V2				V3			
Portfolio	Return	Volume	SzRnk	Price	Return	Volume	SzRnk	Price	Return	Volume	SzRnk	Price
R1	−1.09	10.52	6	6.31	−0.87	21.53	4	6.05	−1.14	44.46	4	6.58
R3	−1.23	8.98	6	5.80	−0.87	19.33	5	6.25	−0.20	43.48	5	6.78
R5	0.50	10.18	8	7.98	0.46	19.55	7	7.55	0.47	44.21	6	7.46

Panel B: 3 price momentum, 5 trading volume portfolios

	V1				V3				V5			
Portfolio	Return	Volume	SzRnk	Price	Return	Volume	SzRnk	Price	Return	Volume	SzRnk	Price
R1	−1.35	8.27	6	6.34	−0.81	20.53	4	6.03	−0.97	55.50	4	6.72
R2	−1.27	7.05	6	5.76	−0.85	19.70	5	6.22	−0.13	57.34	5	6.96
R3	0.91	7.64	7	7.16	0.69	19.33	7	7.15	0.37	56.45	6	7.27

Panel C: 3 price momentum, 3 trading volume portfolios

	V1				V2				V3			
Portfolio	Return	Volume	SzRnk	Price	Return	Volume	SzRnk	Price	Return	Volume	SzRnk	Price
R1	−1.17	10.00	6	6.18	−0.87	20.64	5	6.02	−0.91	44.05	4	6.59
R2	−1.27	8.98	6	5.84	−0.83	19.31	5	6.22	−0.25	43.76	5	6.77
R3	0.83	9.57	7	7.03	0.64	19.32	7	7.20	0.42	44.44	6	7.30

This table presents sample characteristics for portfolios sorted on past returns and volume. The sample period is from 1995 to 2005. The results are based on the six-month portfolio formation period ($J=6$) and six month holding period. Portfolio characteristics are presented for 5 price momentum and 3 trading volume portfolios, 3 price momentum and 5 trading volume portfolios, and 3 price momentum and 3 trading volume portfolios. R1 represents the loser portfolio. R3 or R5 represents the winner portfolio when we form three or five price momentum portfolios. V1 represents the lowest trading volume portfolio. V3 or V5 represents the highest trading volume portfolio when we form three or five volume portfolios. Returns are average monthly return during the last six months, and volume represents the average monthly turnover during the last six months. SzRnk represents the average median size decile of the portfolio on the portfolio formation date. Price represents the average median stock price of the portfolio in dollar term on the portfolio formation date.

that our simple strategy generates positive returns for up to five years, although the magnitude of those profits is low and lack statistical significance over time. As expected, the early strategy appears to provide the highest return of 1.71% in Year 1 and 1.80% in Year 2. However, as with the simple strategy, (which generates a return of 1.20% and 1.09% in Years 1 and 2 respectively), the magnitude of these returns is low. The late strategy does not conform to expectations as the reversal does not take place until Year 5. In sum, our comparison of a simple strategy with both the early and late strategies shows that the return differences are not statistically significant.

3.6. Momentum profits around earnings announcements

An interesting feature of earnings announcements is that anomalous returns tend to be largely realized within a short period. Jegadeesh and Titman (1993) find that about 20–25% of the annual return from a momentum and value strategy is realized in three days around earnings announcements. They argue that in this period investors observe substantial new flow of information which helps them correct the mispricing of stocks. These anomalous returns appear to

Table 4
Long term returns for portfolios sorted on past return and volume

Panel A: Raw returns

Portfolio	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3
	V1			V2		
R1	−0.57	−0.21	−0.02	−0.60	−0.34	−0.04
	(−6.10)**	(−2.95)**	(−1.14)	(−6.21)**	(−4.61)**	(−2.62)**
R5	0.80	1.06	0.48	0.45	0.63	0.31
	(6.13)**	(3.38)**	(3.49)**	(4.08)**	(7.38)**	(7.93)**
R5−R1	1.37	1.27	0.50	1.04	0.97	0.35
	(6.11)**	(3.17)**	(2.31)*	(5.15)**	(6.00)**	(5.28)**
	V3			V3−V1		
R1	−0.91	−0.73	−0.24	−0.34	−0.53	−0.22
	(−3.30)**	(−3.39)**	(−6.91)**	(−2.80)**	(−0.44)	(−5.77)**
R5	0.37	0.47	0.17	−0.44	−0.60	−0.31
	(3.62)**	(6.08)**	(4.97)**	(−2.51)**	(−2.69)**	(−1.48)
R5−R1	1.27	1.20	0.41	−0.10	−0.07	−0.09
	(3.46)**	(4.73)**	(5.94)**	(−0.15)	(−1.13)	(−2.15)*

Panel B: Size-adjusted returns

Portfolio	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3
	V1			V2		
R1	−0.59	−0.23	−0.04	−0.62	−0.37	−0.07
	(−0.74)	(−1.47)	(−1.07)	(−1.23)	(−1.14)	(−1.55)
R5	0.79	1.05	0.47	0.43	0.61	0.29
	(2.06)*	(2.49)**	(2.65)**	(0.76)	(0.86)	(1.11)
R5−R1	1.38	1.28	0.51	1.05	0.98	0.36
	(0.31)	(1.75)*	(2.04)*	(2.20)*	(2.14)*	(1.52)
	V3			V3−V1		
R1	−0.92	−0.74	−0.25	−0.35	−0.54	−0.23
	(−1.73)*	(2.31)*	(−2.79)**	(−2.65)**	(−1.52)*	(−2.49)**
R5	0.35	0.45	0.16	−0.45	−0.61	−0.32
	(1.53)	(2.14)*	(1.49)	(−2.01)*	(−2.15)*	(−2.78)**
R5−R1	1.27	1.20	0.41	−0.10	−0.08	−0.10
	(1.12)	(2.29)*	(1.71)*	(−2.32)**	(−2.95)**	(−2.17)*

This table presents monthly returns for portfolios sorted on past returns and volume using data from 1995 to 2005. The results are based on the six-month portfolio formation period (J=6). R1 represents the loser portfolio with the lowest returns, and R5 represents the winner portfolio with the highest returns during the previous 6 months. V1 represents the portfolio with the lowest trading volume, and V3 represents the portfolio with the highest trading volume. Year 1, Year 2, Year 3, Year 4 and Year 5 represent the monthly returns of portfolios in the five 12-month periods following the portfolio formation date. The numbers in parentheses are t-values.
** Indicates significance at 1% level, and * indicates significance at 5% level.

stand up to any adjustment to risk or size. In this section, we report momentum returns in a 3-day window around earnings announcements. We first collect 11,054 earnings announcements dates from the Shanghai stock exchange for the period from 1995 to 2005. An event study method is applied where we look at returns of momentum portfolios from day −2 to day 0 (day 0 is the day of earnings announcements). We then rank stocks into quintiles based on previous one, two, three,

Table 5
Early and late stage strategies

Strategy	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
R5−R1 (simple)	1.20	1.09	0.39	0.17	0.04	−0.05
	(5.97)	(3.91)	(4.73)	(3.02)	(1.60)	(−0.70)
R5V3−R1V1 (late)	0.93	0.67	0.19	0.16	−0.26	−0.27
	(4.86)	(4.51)	(3.05)	(4.36)	(−3.65)	(−2.05)
R5V1−R1V3 (early)	1.71	1.80	0.72	0.79	1.16	0.53
	(4.71)	(3.39)	(5.20)	(3.44)	(3.91)	(6.85)
(R5V3−R1V1)−(R5−R1)	−0.27	−0.42	−0.20	−0.01	−0.30	−0.22
	(−1.11)	(−0.61)	(−1.68)	(−1.34)	(−5.25)	(−1.35)
(R5V3−R1V1)−(R5−R1)	0.51	0.71	0.33	0.62	1.11	0.58
	(1.25)	(0.52)	(0.47)	(0.42)	(2.31)	(3.78)

This table summarises monthly returns from early (R5V1−R1V3) and late stage (R5V3−R1V1) strategies and compares them to the returns from a simple price momentum strategy (R5−R1) for the time period 1995 to 2005. We follow Lee and Swaminathan (2000) and define early strategy as a zero investment portfolio that is long low volume winners (R5V1) and short high volume losers (R1V3). Late is defined as a zero investment portfolio that is long high volume winners (R5V3) and short low volume losers (R1V1). R1 represents the loser portfolio with the lowest returns and R5 represents the winner portfolio with the highest returns during the previous six months. V1 represents the portfolio with the lowest trading volume, and V3 represents the portfolio with highest trading volume. Year 1, Year 2, Year 3, Year 4, Year 5 and Year 6 represent the monthly returns in each of the five 12-month periods following the portfolio formation month. The numbers within parentheses are *t*-values.

four, five and six month returns and go long on winners (R5) and short on losers (R1) from day −2 to day 0.[10] The momentum portfolio returns are presented in Table 6. On average, we see a strong momentum effect on these three days around earnings announcements across different momentum strategies. If portfolios are constructed based on the previous month performance, the momentum strategy earns 0.78% in three days around earnings announcements and this zero cost return goes up to 0.95% if the portfolios are constructed based on the previous six month performance. All *t*-statistics of momentum returns (R5−R1) are significant at the 5% level. Thus, we document that the momentum effect on Shanghai stock exchange is particularly strong in the three days around earnings announcements and the results are robust to different momentum strategies. However, the magnitude of these returns is such that they contribute just a small proportion of the monthly momentum returns reported in Table 2.

4. Conclusions

In this paper, we investigate various momentum trading strategies for equities listed on the Shanghai Stock Exchange. We also consider the role of trading volume in sorting the portfolios and use different formation and holding periods. We find evidence of substantial momentum profits during the period 1995 to 2005. An interesting finding of this paper is that past trading volume does not provide a strong link between momentum and value strategies. Specifically, we do not find any clear pattern in stock returns between high volume portfolios and low volume portfolios, controlling for momentum. Around earnings announcements, the momentum strategies earn high

[10] While momentum portfolios are based on monthly price performance, momentum profits around earnings announcements are based on daily return data obtained from Datastream.

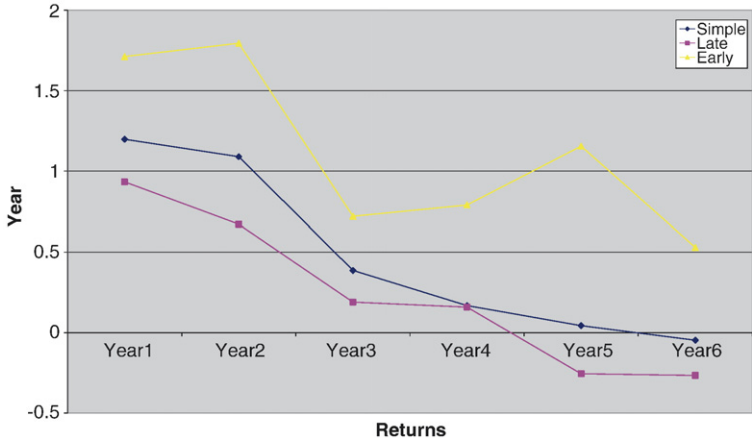

Fig. 7. Simple, late, early strategies.

short-term returns, although such returns are a relatively small component of the overall profits earned from a variety of monthly holding periods.

In longer horizons of more than one year, the strategy seems to produce positive return up to Year 4 and dissipates over time. The early and late strategies suggested by Lee and Swaminathan (2000) do not work better than the simple strategy in our sample. However, we are cautious in the interpretation of the results because of the feasibility of such long-term strategies and the low level of returns reported. Another concern is that we use raw returns in computing the profits of different momentum strategies. Jegadeesh and Titman (1993) report an average transaction cost of 0.5% per trade in the US. Thus, more investigation into this point in China may provide additional evidence on the profitability of momentum strategies. This is left for future work.

Table 6
Momentum trading around earnings announcements

	R1	R2	R5	R5−R1
J1	−0.15	−0.20	0.54	0.69
	(−0.87)	(−1.20)	(2.70)**	(2.53)**
J2	−0.17	−0.06	0.38	0.55
	(−0.99)	(−0.34)	(1.90)*	(2.06)*
J3	−0.10	−0.18	0.52	0.62
	(−0.56)	(−1.06)	(2.57)**	(2.79)**
J4	−0.09	0.11	0.37	0.47
	(−0.55)	(0.62)	(1.81)*	(2.23)*
J5	−0.35	0.20	0.56	0.91
	(−1.99)*	(1.10)	(2.72)**	(2.89)**
J6	−0.42	0.09	0.53	0.95
	(−2.30)*	(0.48)	(2.55)**	(3.53)**

This table summarises return in 3-day period from −2 to 0 around earnings announcements of momentum portfolios formed based on the previous $J=1$, 2, 3, 4, 5, and 6-month performance. Results for portfolios R1, R3 and R5 are presented. R5−R1 refers to the simple momentum strategies of going long top quintile portfolio (R5) and going short bottom quintile portfolio (R1) in 3 days around earnings announcements. Robust *t*-statistics are in parentheses.

References

Ball, R., Kothari, S.P., 1989. Nonstationary expected returns: implications for market efficiency and serial correlations in returns. Journal of Financial Economics 25, 51–74.

Blume, L., Easly, D., O'Hara, M., 1994. Market statistics and technical analysis: the role of volume. The Journal of Finance 49, 153–181.

Campbell, J.Y., Grossman, S.J., Wang, J., 1993. Trading volume and serial correlation in stock returns. Quarterly Journal of Economics 107, 905–939.

Chan, L.K.C., Jegadeesh, N., Lakonishok, J., 1996. Momentum strategies. Journal of Finance 51, 1681–1713.

Chan, L.K.C., Hamao, Y., Lakonishok, J., 1991. Fundamentals and stock returns in Japan. The Journal of Finance 46, 1739–1764.

Chan, K., Hameed, A., Tong, W., 2000. Profitability of momentum strategies in the international equity markets. Journal of Financial and Quantitative Analysis 35, 153–172.

Connolly, R., 1989. An examination of the robustness of the weekend effect. Journal of Financial and Quantitative Analysis, 24, 133–169.

Connolly, R., Stivers, C., 2003. Momentum and reversals in equity-index returns during periods of abnormal turnover and return dispersion. The Journal of Finance 58, 1521–1555.

Conrad, J.S., Kaul, G., 1998. An anatomy of trading strategies. Review of Financial Studies 11, 489–519.

Datar, V.T., Naik, N.Y., Radcliffe, R., 1998. Liquidity and stock returns: an alternative test. Journal of Financial Markets 1, 203–219.

DeBondt, Werner F.M., Thaler, R., 1985. Does the stock market overreact? Journal of Finance 40, 793–805.

DeBondt, Werner F.M., Thaler, R., 1987. Further evidence on investor overreaction and stock market seasonality. Journal of Finance 42, 557–581.

Drew, M.E., Naughton, T., Veeraraghavan, M., 2003. Firm size, book-to-market equity and security returns: evidence from the Shanghai Stock Exchange. Australian Journal of Management 28, 119–139.

Fama, E.F., 1991. Efficient capital markets: II. The Journal of Finance 46, 1575–1617.

Fama, E.F., French, K.R., 1996. Multifactor explanations of asset pricing anomalies. The Journal of Finance 50, 131–155.

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

Grinblatt, M., Titman, S., Wermers, R., 1995. Momentum investment strategies, portfolio performance and herding: a study of mutual fund behaviour. American Economic Review 85, 1088–1105.

Hameed, A., Kusnadi, K., 2002. Momentum strategies: evidence from the Pacific Basin Stock Markets. Journal of Financial Research 25, 383–397.

Hong, H., Stein, J.C.,1997. A unified theory of underreaction, momentum trading and overreaction in asset markets, NBER working paper.

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

Kang, J., Liu, M.H., Ni, S.X., 2002. Contrarian and momentum strategies in the China stock market: 1993–2000. Pacific-Basin Finance Journal 10, 243–265.

Lakonishok, J., Shleifer, A., Vishny, R., 1994. Contrarian investment, extrapolation, and risk. The Journal of Finance 49, 1541–1578.

Leamer, E.E., 1978. Specification Searches: Ad Hoc Inference with Non-experimental Data. John Wiley & Sons, New York.

Lee, Charles M.C., Swaminathan, B., 2000. Price momentum and trading volume. The Journal of Finance 55, 2017–2069.

Lindley, D.V., 1957. A statistical paradox. Biometrika 44, 187–192.

Lo, A., MacKinlay, C., 1990. When are contrarian profits due to stock market overreaction? Review of Financial Studies 3, 175–250.

MacNeil, L., 2002. Adaptation and convergence in corporate governance: the case of Chinese listed companies. Journal of Corporate Law Studies 2 (2).

Maher, M., Andersson, T., 2000. Corporate Governance: Effects on Firm Performance and Economic Growth. Oxford University Press.

Mok, H., Hui, Y.V., 1998. Underpricing and aftermarket performance of IPOs in Shanghai. Pacific Basin Finance Journal 6, 453–474.

Rouwenhorst, K.G., 1998. International momentum strategies. The Journal of Finance 53, 276–284.

Rouwenhorst, K.G., 1999. Local return factors and turnover in emerging stock markets. The Journal of Finance 54, 1439–1464.

Su, D., Fleisher, B.M., 1999. An empirical investigation of underpricing in Chinese IPOs. Pacific Basin Finance Journal 7, 173–202.

Wang, Changyung, Chin, Shengtyng, 2004. Profitability of return and volume-based strategies in China's stock market. Pacific Basin Finance Journal 12, 541–564.