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Momentum Trading, Mean Reversal and Overreaction in Chinese Stock Market

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Abstract

While the vast majority of the literature reports momentum profitability to be overwhelming in the U.S. market and widespread in other countries, this paper finds that the pure momentum strategy in general does not yield excess profitability in the Chinese stock markets. We find instead strong mean reversion with an average half-life slightly shorter than one year. A pure contrarian investment strategy produces positive excess returns and in general outperforms the pure momentum strategy. Furthermore, momentum may interact with mean reversion. A strategy based on the rolling-regression parameter estimates of the model combining mean reversion and momentum generates both statistically and economically significant excess returns. The combined strategy outperforms both pure momentum and pure contrarian strategies. We conduct a number of robustness tests and confirm the basic findings. Collectively, our results seem to support the overreaction hypothesis.

Keywords: Chinese Stocks, Mean Reversal, Momentum, Overreaction

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1. Introduction

Financial economists have documented a number of anomalies in the stock market. Among these anomalies, two of them have received particular attention over the past decade, that is, long-term mean reversal and short-term momentum in equity returns. Jegadeesh and Titman (1993) first report that equity returns exhibit short-term price continuation. They demonstrate that a momentum strategy of sorting firms by their previous returns over the past 6-9 months and holding those with the best prior performance and short selling those with the worst prior performance generates an excess return of about one percent per month for U.S. stocks. This finding has motivated numerous researchers to study momentum in other markets and/or other sample periods, including Jegadeesh and Titman (2001), Rouwenhorst (1998), Chan, Hameed and Tong (2000), Grundy and Martin (2001), Griffin, Ji and Martin ((2003)), and Patro and Wu (2004), among many others. On the other hand, another strand of literature documents that equity returns are negatively serially correlated and stock prices have a tendency to revert to their trend lines over the long horizons. See Fama and French (1988), Poterba and Summers (1988), and Cutler, Poterba and Summers (1991). DeBondt and Thaler (1985) show that a contrarian investment strategy that buys the worst-performing stocks and short sells the best-performing stocks over the previous 3-5 years can generate excess profitability over the next 3-5 years. These results have stimulated other researchers to test for mean reversion and to investigate the profitability of contrarian-based strategies in other contexts. See, for example, Chopra, Lakonishok, and Ritter (1992), Richards (1997), and Balvers, Wu and Gilliland (2000).

The purpose of this paper is to study momentum and mean reversal in the Chinese stock markets. This research is interesting for several reasons. Firstly, while numerous previous researchers document the profitability of momentum-based trading strategies, most of them focus on developed (matured) markets.[1] The Chinese stock markets were first established in the early 1990s and have since been growing rapidly in terms of the number of traded companies, trading volume and market capitalization. Over the past decade, the performance of the Chinese stocks may be characterized as high returns and excessive volatility, as compared to stocks traded in more mature markets, such as the United States. It is of particular interest to investigate whether these two anomalies, momentum and mean reversal, which are first documented for the U.S., also exist in this young and emerging market. Secondly, most previous researchers study momentum and mean reversion in isolation. In a recent paper, Balvers and Wu (2004) demonstrate that mean reversion and momentum can simultaneously occur to the same set of assets and that it is important to consider the interaction between the two. Using data for equity market indexes for 18 developed countries, Balvers and Wu (2004) show that mean reversion and momentum are in fact negatively related. Furthermore, controlling for mean reversion extends the duration of momentum and combining momentum increases the speed of reversion. Following Balvers and Wu (2004), this paper adapts a simple time-series model to capture both the short-term and long-term dynamics of Chinese stock prices in a unified framework. Pure mean reversion and pure momentum can be treated as special cases that are nicely nested in the general specification. We use the model to study the relative importance of momentum and mean reversion and the profitability of the associated investment strategies in Chinese stock markets.

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[1] Exceptions are Griffin, Ji and Martin (2003), and Chan, Hameed and Tong (2000), who include some emerging markets in their samples.

To summarize the results at the outset, using daily data for all "A" share stocks traded at the Shanghai Stock Exchange (SHSE) from its inception (December 12, 1990) to December 31, 2001, we find that the pure momentum strategy of Jegadeesh and Titman (1993) in general does not produce significant excess returns for the arbitrage portfolio of buying the top decile portfolio and short selling the bottom decile portfolio, for the cases of sorting the stocks based on prior 3-12 months returns and holding the stocks for the subsequent 3-12 months. On the other hand, we find strong mean reversion, with the average half-life of 232 days for all stocks traded at the SHSE, which is substantially shorter than the average half-life estimated for stocks in developed markets. A pure contrarian strategy yields positive excess returns for the arbitrage portfolio for all relevant holding periods, and it beats the pure momentum strategy for 40 out of 42 cases considered. The excess returns are statistically significant at the 5% level for holding periods of 6-12 months. Adding momentum to mean reversion substantially improves the performance of the arbitrage portfolio. In particular, the combined strategy outperforms the pure momentum strategy for all relevant cases (3-12 months ranking and 3-12 months holding periods) originally studied by Jegadeesh and Titman (1993). Our baseline case (12-month ranking and 12-month holding) produces an annualized excess return of 22.2%, which is statistically significant at the 5% level. The arbitrage portfolio has a positive loading on the market risk factor, but the beta risk in general explains less than half of the excess returns. The findings for the "A" share stocks traded at the Shenzhen Stock Exchange (SZSE) are even stronger.

Our results of strong mean reversion seem to support the overreaction hypothesis of DeBondt and Thaler (1985), as formalized in the positive-feedback trading framework by DeLong *et al.* (1990). DeLong *et al.* (1990) argue that the existence of positive-feedback traders can push stock prices away from fundamentals. When good (bad) news is released, rational speculators, who expect future buying (selling) by positive-feedback traders, may actually jump on the bandwagon and purchase (sell) ahead of noise traders. Rational speculators' early buying (selling) triggers positive-feedback trading, causing short-term momentum. Therefore the market tends to overreact to news. Over the long term, stock prices converge to their fundamentals and full mean reversion is expected. Our results of long-term mean reversion interacting with short-term momentum may also be consistent with recent behavioral theories of Daniel *et al.* (1998), Barberis *et al.* (1998) and Hong and Stein (1999). While based on different assumptions on the behavioral biases of investors, these papers all imply that the same securities can have both long-term reversal and short-term momentum.

The remainder of the paper proceeds as follows. Section 2 spells out the time-series model and discusses estimation issues. Section 3 describes the data and presents some summary statistics of the data. Results on pure momentum strategies are displayed in Section 4. Section 5 reports the results from the pure contrarian strategy and the combined strategy of momentum with mean reversion. Section 6 conducts a number of robustness checks and the final section summarizes the results and concludes the paper.

2. A Parametric Model Combining Momentum with Mean Reversion

Following Fama and French (1988) and Summers (1986), we decompose the price of a stock into two components: one permanent and one transitory. The permanent component can be interpreted as the fundamental value of the stock while the transitory component can be viewed as a temporary deviation of actual stock price from its market fundamentals. This temporary deviation from fundamentals is firm specific and can be interpreted as noises or fads. Because in the long run, the price of an asset is ultimately determined by its fundamentals, a deviation from fundamentals should be self-correcting, i.e. it should be mean reverting. However, over the short horizons, temporary deviations can have positive feedbacks so that returns may exhibit momentum.

Specifically, let p_t^i denote the logarithm of stock price with dividends reinvested for company i, so that its first difference $\Delta p_t^i = p_t^i - p_{t-1}^i$ represents the continuously compounded return. We decompose p_t^i as follows:

$$p_t^i = y_t^i + x_t^i \tag{1}$$

where y_t^i represents the permanent component and x_t^i represents the temporary component.

It is apparent that neither x_t^i nor y_t^i is directly observed. By imposing some restrictions, it is possible to put the above model in a state-space format and to estimate the two unobservable components through the Kalman filter. However, this will significantly increase the computational burden. We instead use the value-weighted market index as a proxy for the permanent component. With this assumption, the temporary component is simply the difference between the log of stock i's price and the log of the value-weighted market index price, and the model can be easily estimated using simple linear regressions. We have also assumed the permanent component for each stock to be the product of the value-weighted market index and the stock's market risk factor loading following Balvers and Wu (2004), and find the results qualitatively the same.

The temporary component x_t^i is assumed to possess short-term momentum and long-term mean reversion as follows:

$$x_t^i = (1-\delta^i)\,\mu^i + \delta^i x_{t-1}^i + \sum_{j=1}^{J} \phi_j^i \Delta x_{t-j}^i + \eta_t^i. \tag{2}$$

In equation (2), if $\delta^i < 1$, then the temporary component x_t^i has mean reversion. This component converges to its unconditional mean μ^i with the speed of $(1-\delta^i)$. The *J* lagged terms Δx_{t-j}^i are included to capture the short-term feedback effects and represent return momentum if $\phi_j^i > 0$. The error term η_t^i is assumed to be a white noise and to be uncorrelated with the regressors. Since we use the market index to proxy the fundamental/permanent component, it is easy to see that the pure mean reversion model and the pure momentum model can be nicely nested into this general model. In particular, by setting all $\phi_j^i = 0$, equation (2) becomes the pure mean reversion model. On the other hand, by constraining $\delta^i = 1$ and $\phi_j^i = 1$ for all j, we obtain the pure momentum case of Jegadeesh and Titman (1993).

3. Data and Summary Statistics

All stock and market index prices are obtained from the *China Stock Markets and Accounting Research Database*, published by Guotaian Information Technology, Ltd. We collect daily individual stock prices (with dividends reinvested) for all 637 "A" share stocks traded at the SHSE.[2] The sample started on December 12, 1990 and ended on December 31, 2001, with 2732 daily return observations. We do not use any subjective criteria to screen the stocks for the sample of study because we believe that the most objective approach is to include all stocks in the investment universe. Any screening criterion employed to select stocks for the sample of study is necessarily based on *ex post* information. Such practice is data-snooping and can cause serious biases in results. Daily returns on the value-weighted and equally-weighted market portfolios for the SHSE are also obtained from the same source. The data for SZSE started on July 3, 1991 and ended on December 31, 2001 with 2615 returns observations for 503 "A" share stocks. The value-weighted and equally-weighted market indexes for the SZSE are also collected. We proxy the risk-free rate by the short-term bank interest rate obtained from the IMF's *International Financial Statistics* (line 92460ZF). The interest rate data is monthly at source and is interpolated into the daily frequency.

Table 1 presents some summary statistics of daily stock returns of the two data sets. They include cross-sectional distributions for the mean return, standard deviation, Sharpe ratio, sample size and market beta for the individual stocks traded in both markets. The corresponding statistics for the value-weighted and equally-weighted market indexes are also reported. There are in general large cross-sectional variations in these statistics. Among the 637 stocks traded on the SHSE, the mean daily return rate ranges from -0.91% to 0.34%, with the median of 0.08%. Over the full sample period, the mean daily return for the value-weighted average of the Shanghai market is 0.15%, and the mean daily return for the equally-weighted average is 0.23%. The cross-sectional dispersion for the standard deviation for these stocks is even bigger, ranging from 1.45% to 10.46% with a median of 2.67%, while the value-weighted and equally-weighted market indexes have standard deviations of 3.43% and 3.90%, respectively. Over the same sample period, the mean daily return on the value-weighted New York Stock Exchange (NYSE) index is 0.056%, and its daily standard deviation is 0.85%, while the corresponding numbers for the equally-weighted NYSE Index are 0.064% and 0.62% (not reported in the table). These numbers indicate that the daily mean returns of the SHSE market indexes are about three times as large as the NYSE, but the standard deviations are around four-six times as large as the NYSE. Results reported in the lower panel of Table 2 for stocks traded on the SZSE tell a similar story. Overall, Chinese stocks over the past decade can be characterized as high return and excessive volatility.

[2] There are two types of shares traded on the Chinese stock markets: "A" shares and "B" shares. "A" shares are quoted in the domestic currency unit (RMB) and are traded only by domestic Chinese citizens, while "B" shares are quoted in U.S. dollar terms and can be traded only by foreigners.

4. Profitability of Pure Momentum Strategies

In this section, we report evidence on the profitability of pure momentum trading strategies. As demonstrated in Section 2, the pure momentum model can be treated as a special case of our flexible parametric model (2) by setting $\delta^i = 1$ and $\phi_j^i = 1$ for all j. We consider various combinations of ranking periods (J) and holding periods (K). In addition to those combinations (J, K=3, 6, 9, 12 months) originally investigated by Jegadeesh and Titman (1993), we add the cases of one-week ranking period and one-day and one-week holding periods. Our experiment follows Jegadeesh and Titman (1993). At the beginning of each period t, all stocks are ranked in ascending order on the basis of their returns in the past J periods. We then form ten decile portfolios, each of which is an equal weighted average of all stocks contained in that decile. The top portfolio is denoted by "Max" and the bottom portfolio is denoted by "Min." We follow Jegadeesh and Titman (1993) to examine portfolios with overlapping holding periods. In order to make the results from pure momentum strategies comparable to those from the combined momentum and mean reversion strategies to be presented in the next section, we start forming our momentum portfolio at 1/3 of the sample (on July 15, 1994). The first 1/3 of the sample is needed to obtain reasonably accurate estimates of the model parameters for our combined strategies.

Table 2 presents the results on the performance of pure momentum trading strategies for all "A" share stocks traded on the SHSE. We report the mean return of the top decile portfolio ("Max"), the excess return of the top decile portfolio over the bottom decile portfolio ("Max-Min"), the excess return of "Max" over the value-weighted market portfolio ("Max-vw mkt"), and the excess return of "Max" over the equally-weighted market portfolio ("Max-ew mkt"). All return measures are annualized. The corresponding *t*-ratio for each trading strategy is also presented. For the "Max-Min" strategies, *t*-ratios in bold face and italicized denote statistical significance at the 10% level or better using a two-sided test.

Overall, these results show little evidence on the profitability of pure momentum strategies. There are altogether 42 different combinations of (J,K), among which 15 cases have negative excess returns on the momentum strategy ("Max-Min"). Furthermore, using a two-sided test, we find that three of these 15 cases are significantly negative at the 5% level (J=1 week, K=1 day; J=1 week, K=1 week; and J=3 months, K=1 day), and two of them are significantly negative at the 10% level (J=9 months, K=1 day; and J=12 months, K=1 day). Of those cases that have positive excess returns, only two are significant at the 5% level (J=1 week, K=12 months; and J=3 months, K= 12 months), and three are significant at the 10% level (J=1 week, K=9 months; J=3 month, K=9 months; and J=1 months, K=12 months). Interestingly, for the cases that Jegadeesh and Titman (1993) and others find momentum to be the strongest (namely J, k=6 months; and J, K=9 months), we do not find the excess returns to be significant, albeit the point estimates of returns are both positive. While the momentum portfolio in general does not produce significant excess returns in the vast majority of cases, the top decile portfolio does yield a higher return than the value-weighted market portfolio in many cases when the ranking period is shorter than six months, and the top decile portfolio significantly beats the value-weighted market portfolio at the 10% or better in five out of seven cases when J=1 week. These results suggest that the momentum strategy seems to pick the winning stocks more accurately than to pick the losing stocks.

The evidence against a pure momentum strategy from stocks traded on the SZSE is stronger, as can been seen from Table 3. First of all, of the 42 cases investigated, 30 have negative excess returns for the momentum portfolio. Six of these excess returns are significantly negative at the 5% level (J=1 week, K=1 week; J=3 months, K=1 day; J=3 months, K=1 week; J=9 months, K=1 day; J=9 months, K=1 week; and J=12 months, K=1 day), and two of them are significantly negative at the 10% level (J=3 months, K=1 months; and J=6 months, K=1 day). For the 12 cases that produce positive excess returns, none of them are significant at the 10% level. Furthermore, we find the excess returns to be negative for the two cases (J, K = 6 months and J, K = 9 months) where previous researchers find momentum to be the strongest in other markets. Similar to the Shanghai market, the winning decile portfolio yields a higher return than the value-weighted market portfolio in a number of cases when the ranking periods are relatively short.

In summary, while the extensive literature reports that momentum is pervasive and widespread across equity markets and time periods, the results reported in this section do not by themselves make a strong case for the profitability of pure momentum investment strategies in the Chinese equity markets. These results are consistent with Griffin, Ji and Martin ((2003)) who use a smaller sample of Chinese stocks (253 stocks from July 1994 to December 2000) and report that the excess return for the momentum strategy of J, K = 6 months is close to zero.

5. Profitability of Combined Strategies

If equity prices display long-term mean reversion, then the reversal effect can also interfere with short-term momentum. In this case, estimation of momentum without controlling for mean reversion will be distorted, rendering the pure momentum strategy unprofitable, even if momentum does indeed exist. We suspect this may be the case for Chinese stocks. While it is possible to examine the long-term mean reversion effect within the nonparametric framework of DeBondt and Thaler (1985, 1987), who use the three-five years ranking period and the three-five years holding period to investigate the profitability of a contrarian strategy for U.S. equities, Balvers, Wu and Grilliland (2000) demonstrate that a parsimonious parametric model can be used to better characterize long-term mean reversion and that a trading strategy based on forecasts obtained from a rolling regression yields better portfolio returns than the nonparametric approach. It is this parametric rolling-regression approach that we adapt here to examine the profitability of contrarian and combined strategies.

Starting at 1/3 of the sample, we use rolling regression parameter estimates of equation (2) to forecast the expected return for the upcoming period for each stock. This choice of starting point is a compromise so that we have a good number of observations to estimate the model parameters at the early part of forecasting while having a long enough period for out-of-sample forecasting. We then rank all stocks in ascending order according to their expected returns for the upcoming period. Following Jegadeesh and Titman (1993) and others, we buy 10% of the stocks with the highest expected returns and short sell 10% of the stocks with the lowest expected returns, based on equation (2) and using parameters estimated from prior data only. We will also form other portfolios to check for robustness in the next section.

We first examine the case of pure mean reversion. This is done by constraining all momentum parameters $\phi_j^i = 0$ in equation (2), leaving μ^i and δ^i the only parameters to estimate. The top panel of Table 4 reports the performance of the pure contrarian strategy for SHSE stocks, from which several observations can be made. Firstly, the pure mean reversion strategy produces a positive excess return for all holding periods. Furthermore, the excess returns are statistically significant at the 5% level for holding periods K=6, 9, and 12 months, and at the 10% level for K=3 months. Secondly, these return measures are economically important ranging from 3.1% to 22.8% per year, with the average of 11.6% per year. Thirdly, the top decile portfolio "Max" beats the value-weighted market portfolio at the 5% significance level for all holding horizons. The return of the top decile portfolio is also higher than the equally-weighted market return for all holding periods except K=1 month. Fourthly, compared to the results of the pure momentum strategy reported in Table 2, for each holding period K, the pure contrarian strategy in general produces higher excess profits than the corresponding pure momentum strategy regardless of the number of momentum lags used. The only exceptions are the cases of J=1 week and 1 month, and K=1 month, where the pure momentum strategy yields slightly higher returns than the pure mean reversion strategy. Fifthly, to examine the speed of mean reversion, we employ the estimate of δ^i to calculate the implied half-life using $\ln(0.5)/\ln(\delta^i)$ for each stock. The average half-life of all 637 stocks traded on the SHSE amounts to 232 days. It is interesting to compare this result with those obtained from developed markets. Using data from 13 OECD countries, Cutler, Poterba and Summers (1991) find the half-life of reversion to be between 4.0 and 4.6 years. More recently, Balvers, Wu and Gilliland (2000) report the implied half-life of between 3.1 and 3.5 years for 18 developed markets. Our result shows a much stronger mean reversion effect for Chinese stocks than for stocks in more mature markets.

The top panel of Table 5 displays the performance of pure mean reversion strategy for the SZSE stocks. While the excess return of the contrarian strategy is statistically significant at the 10% level in only one case (K=3 months), these excess return numbers are in general economically large with the average annual excess return of 8.69% across the seven holding periods. Furthermore, the top decile portfolio beats the value-weighted market portfolio at the 5% significance level, and the equally-weighted average market index (albeit not statistically significant) for all holding periods. More remarkably, at each holding horizon, the pure mean reversion strategy outperforms all pure momentum strategies. Similar to the Shanghai market, we find fast speed of reversion for the SZSE stocks, with the average half-life of 212 days.

The aforementioned results suggest that mean reversion exists and may indeed be stronger than momentum in Chinese stocks. We next investigate whether accounting for mean reversion and momentum simultaneously can further improve the performance of the trading strategies. To this end, we estimate model (2) with momentum terms added. To increase estimation efficiency, we constrain the momentum parameters to be the same, i.e. we set $\phi_j^i = \phi^i$ for all lags j. Similar to the previous experiment, we start the forecast period at 1/3 of the sample on July 15, 1994 and update parameter estimates as we roll the sample forward.

Panels 2 to 7 of Table 4 show the results from the combined mean reversion with momentum strategy for the SHSE stocks. The momentum lags selected are the same as those in the pure momentum cases discussed in Section 4 above. Several comments are noteworthy. Firstly, the excess returns of the trading strategy ("Max-Min") are positive in all 42 cases, regardless of the number of momentum lags

selected and the length of holding periods used. Furthermore, 13 cases are statistically significant at the 5% level or better and 10 additional cases are significant at the 10% level (all in bold face and italicized). Secondly, these figures are in sharp contrast with those from pure momentum trading strategies reported in Table 2. A comparison case by case reveals that the excess profitability from our combined strategy with mean reversion is higher than the pure momentum strategy in all but three cases (J=1 week, K=1 month; and J=1 month, K=1 week; and J=1 month, K=1 month). These results indicate the important role played by the mean reversion factor. Thirdly, the top decile portfolio generates higher returns than the value-weighted market index in all 42 cases, and than the equally-weighted average index in 26 out of 42 cases. Furthermore, in 35 out of 42 cases, the top decile portfolio beats the value-weighted market portfolio at the 5% significance level. Fourthly, compared with the pure mean reversion case, we find that the excess returns of the combined strategy are higher in numerous cases especially when the momentum lag is long. For each holding period (K), we average the excess returns of the combined strategy across six different momentum lags. This yields average returns of 11.61%, 5.36%, 6.57%, 9.76%, 14.50%, 18.86% and 21.76%, for K=1 week up to 12 months, respectively, for the combined strategy. Five out of seven are higher than the corresponding figures from the pure mean reversion strategy. This simple comparison justifies the benefits of adding momentum to the mean reversion model.

Panels 2 to 7 of Table 5 report the results of portfolio performance for the combined trading strategy for the SZSE stocks. Overall, these results are stronger than those from the SHSE stocks. Firstly, the combined strategy yields positive excess returns ("Max-Min") for all ranking and holding periods. Of the 42 cases examined, the excess return is statistically significant at the 5% level for 19 cases, and at the 10% level for an additional nine cases. Secondly, compared to the pure momentum case displayed in Table 3, the strategy combining momentum with mean reversion produces higher excess returns for all ranking and holding periods. Thirdly, to make a comparison with the pure mean reversion strategy, for each holding period (K) we compute the average excess return of the combined strategy over all ranking periods (J). This yields average excess return figures of 20.85%, 14.87%, 13.68%, 15.43%, 13.00%, 14.07%, and 14.55% for the holding periods K=1 day up to 12 months, respectively. Quite strikingly, each of these numbers is higher by a substantial margin than the corresponding one for the pure mean reversion case. Fourthly, most impressively, the top decile portfolio generates a higher return than both the value-weighted and equally-weighted market portfolios regardless of ranking and holding periods. Furthermore, the top decile portfolio beats the value-weighted market index at the 5% significance level in all 42 cases.

In sum, the evidence presented in this section suggests that Chinese stocks exhibit strong mean reversion, and mean reversion can indeed be more important than momentum. The existence of long-term mean reversion may interfere with short-term momentum and it is necessary to control for mean reversion when estimating the duration and impact of momentum. A strategy combining momentum and mean reversion in a unified framework produces higher returns than the pure mean reversion strategy which in turn outperforms the pure momentum strategy.

6. Robustness of Results

The previous section documents the success of the simple two-component time series model of stock prices, which combines short-term momentum with long-term mean reversion in equity returns. In this section, we conduct a number of robustness checks for the model. We take as the baseline case the combination strategy with mean reversion and 12-month momentum and 12-month holding period, and do a number of experiments on this baseline model.

Firstly, Jegadeesh (1990) and Lehmann (1990) report that for very short ranking and holding period, reversal rather than momentum is observed in U.S. equity prices. These authors argue that this phenomenon could be caused by bid-ask bounce and/or infrequent trading. Other authors (e.g. Berk, Green and Naik 1999) suggest extreme returns signaling changes in systematic risks as a possible explanation. Accordingly, researchers suggest skipping one period between the portfolio ranking and holding periods. Therefore, we form the strategy portfolio one day after the stocks are ranked.

Secondly, the results reported so far are all based on sorting stocks into 10 decile portfolios. While this is common practice for studies using U.S. data, we acknowledge that the total number of stocks in the Chinese markets is far smaller than that in the U.S. markets, and each decile may contain too few stocks especially in the early part of the sample. We therefore consider sorting stocks into three and five equal-sized portfolios and study the excess return of buying the top portfolio and shorting the bottom portfolio. We also sort the stocks into 20 equal-sized portfolios and document the excess return of the top-bottom portfolio to see whether certain outliers in the extreme portfolios may significantly affect our results.

Thirdly, we check how systematic market risk and transactions costs affect our strategy returns.

Table 6 reports these results for the SHSE stocks where the baseline case is replicated here for ease of comparison. Our baseline case produces a 22.2% annualized excess return which is significant at the 5% level. This portfolio does load positively on the market risk factor (with beta = 0.497). Correcting the risk premium due to the positive factor loading, we find the risk-adjusted excess return (the alpha) to be 11.2%. Therefore, market risk accounts for nearly 50% of the excess return. This is in stark contrast with previous studies using data from other markets, such as Jegadeesh and Titman (1993), Grundy and Martin (2001), Chordia and Shivakumar (2002), Chan, Jegadeesh and Lakonishok (1996), Balvers, Wu and Grilliland (2000), and Rouwenhorst (1998). These authors report that the simple market beta risk explains virtually nothing of the excess return, and in many cases the excess return has a negative market factor loading. Our top decile portfolio produces a higher Sharpe ratio than the value-weighted market portfolio but a lower Sharpe ratio than the equally-weighted market index. Our strategy involves an average portfolio turnover rate of 88% per year, a relatively low number. Apparently, a reasonable transactions cost per trade, say 1-2%, will only reduce a small portion of the total excess return. Therefore, transactions cost itself does not provide an obvious explanation of the excess profitability.

Skipping one day between the ranking and holding periods slightly reduces the excess return to 20.8%, which is statistically significant at the 10% level. The risk-adjusted return also decreases by the same amount (to 9.8% per year). Therefore, the bid-ask bounce or other micro-structure biases are unlikely to be important factors affecting our results.

Sorting stocks into three portfolios does significantly reduce the excess return. The 11.8% annualized return is now statistically insignificant. Furthermore, the risk-adjusted return becomes a much smaller 4.9%. However, sorting stocks into five portfolios produces an excess return of 17.4%, which is significant at the 10% level, and a risk-adjusted return of 9.0%, similar to the baseline case. Finally, a much finer sorting of stocks into 20 portfolios dramatically increases the excess return to 35.2%, which is statistically significant at the 1% level, with a large risk-adjusted return of 20.0%. These results accord well with intuition and demonstrate that our simple two-component model combining momentum with mean reversion characterizes the dynamics of Chinese stock returns reasonably well.

Table 7 reports the results on robustness checks for the SZSE stocks. These results are qualitatively similar to those for the SHSE stocks and in general stronger quantitatively. In particular, we find that the beta risk in general explains a smaller proportion of excess returns than for the SHSE stocks.

7. Summary and Conclusions

The purpose of this paper has been to investigate whether short-term momentum and/or long-term reversal exists in the Chinese stock markets. While the vast majority of the literature reports momentum profitability to be overwhelming in U.S. equity market, and widespread in other countries, we find that the pure momentum strategies produce weak and in some cases even negative excess profitability in the Chinese stock markets. This is especially the case for the intermediate-term sorting and holding periods (six-nine months), which many researchers find momentum to be the strongest.

On the other hand, we find strong mean reversion in the Chinese stock markets. The implied half-life computed from parameter estimates is under one year on average for all Chinese stocks. This speed of reversion is much faster than those estimated for developed markets (with half-life of between three and five years). The pure parametric contrarian investment strategy produces positive excess returns for all holding periods and in general outperforms the pure momentum strategy. The existence of mean reversion does not by itself preclude short-term momentum. Instead, we find short-term momentum in fact interacts with long-term mean reversion. A two-component model for stock price provides a parsimonious characterization of these two effects and their interactions. A strategy based on the rolling-regression parameter estimates from the model generates positive excess returns in all cases, most of which are statistically significant. This combined strategy in general outperforms both the pure momentum strategy and the pure contrarian strategy. The strategy loads positively on the market risk factor, but the beta risk explains only part of the excess return. Nor is transactions cost a dominant factor explaining the excess profitability.

Our results of strong mean reversion seem to support the overreaction hypothesis of DeBondt and Thaler (1985), as formalized in a noise trader model by DeLong *et al.* (1990). DeLong *et al.* (1990) argue that the existence of positive-feedback traders in the financial market can push asset prices away from fundamentals and cause overreaction to news. When good (bad) news about market fundamentals comes out, rational speculators, who expect future buying (selling) by positive-feedback traders, may actually jump on the bandwagon and purchase (sell) ahead of noise traders. Rational speculators' early buying (selling) triggers positive-feedback trading, causing short-term momentum. Therefore the market tends to overreact to news. Over the long term, stock prices converge to their fundamentals and full mean reversion is expected. On the other hand, our results of mean reversion interacting with momentum may also be consistent with recent behavioral theories of Daniel *et al.* (1998), Barberis *et al.* (1998) and Hong and Stein (1999). These behavioral models, while derived from different assumptions about investors' behavioral biases, all imply that the same securities can have both long-term reversal and short-term momentum. Of course, our explanations are only preliminary and suggestive. More direct and rigorous tests of these alternative hypotheses in the context of the Chinese stock markets are certainly more involved and can be potentially fruitful. These are beyond the scope of this paper and are left for future research.

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Table 1. Summary Statistics of Chinese Daily Stock Returns

This table reports summary statistics for daily stock returns for Chinese "A" shares traded on the Shanghai and Shenzhen Stock Exchanges. The sample covers the period from December 12, 1990 to December 31, 2001 for 637 stocks traded on the Shanghai Stock Exchange; and the period from July 3, 1991 to December 31, 2001 for 503 stocks traded on the Shenzhen Stock Exchange.

	cross-section average	cross-section std. dev.	Minimum	25 percentile	50 percentile	75 percentile	Maximum	value-weighted market index	equally-weighted mkt index
				Shanghai Market					
Mean return (%)	0.0524	0.1104	-0.9056	0.0178	0.0779	0.1105	0.3397	0.1524	0.2282
std. dev (%)	2.8258	0.8095	1.4460	2.2990	2.6730	3.3000	10.4600	3.4280	3.9030
Sharpe ratiox100	0.8305	4.2936	-35.9800	0.0869	1.9290	2.8120	12.8700	3.6400	5.1390
No. of obs	1130	699	13	454	1116	1873	2732	2732	2732
Beta	1.026	0.156	0.518	0.938	1.019	1.105	2.167		
				Shenzhen Market					
mean return (%)	0.0685	0.0649	-0.1777	0.0327	0.0785	0.1108	0.2439	0.1164	0.1395
Std dev (%)	2.8707	0.5879	1.5910	2.4570	2.7670	3.2650	5.5240	2.8990	2.9890
Sharpe ratiox100	1.5266	2.3615	-9.1650	0.6277	1.8490	2.8400	8.7990	3.0640	3.7470
No. of obs	1216	553	231	853	1171	1466	2615	2615	2615
Beta	1.013	0.115	0.487	0.941	1.019	1.093	1.413		

Table 2. Performance of Pure Momentum Portfolio Switching Strategies: Shanghai "A" Shares

This table reports the mean returns (annualized) and t-ratios of Max, Min, Max-Min, Max-vw Market, and Max-ew market portfolios, where Max is the top decile portfolio, Min is the bottom decile portfolio, and vw Market and ew Market are the value-weighted and equally-weighted averages of all "A" shares traded on the Shanghai Stock Exchange. The strategies considered are pure momentum strategies described in Jegadeesh and Titiman (1993). J denotes the number of momentum lags, and K denotes the holding period. The sample covers the period from December 12, 1990 to December 31, 2001 with 2732 daily returns observations and 637 stocks. Forecasting starts on July 15, 1994 and ends on December 12, 2001 with 1823 trading days. Numbers italicized and in bold face denote statistical significance at the 10% level or better using a 2-sided test.

	K=1 day		K=1 week		K=1 month		K=3 month		K=6 months		K=9 months		K=12 months	
	Mean	t-ratio	mean	t-ratio	mean	t-ratio	mean	t-ratio	mean	t-ratio	mean	t-ratio	mean	t-ratio
						J=1 week								
Max	0.332	1.888	0.214	1.268	0.359	2.211	0.337	2.094	0.337	2.108	0.339	2.124	0.346	2.161
Max-min	-0.264	***-2.594***	-0.239	***-3.179***	0.048	1.044	0.031	0.633	0.081	1.271	0.126	***1.714***	0.161	***1.985***
Max-vw mkt	0.044	0.671	-0.074	-1.483	0.071	1.971	0.049	1.718	0.049	1.910	0.051	2.059	0.058	2.341
Max-ew mkt	-0.037	-0.572	-0.156	-3.083	-0.011	-0.308	-0.033	-1.266	-0.032	-1.598	-0.030	-1.570	-0.024	-1.293
						J=1 month								
Max	0.383	2.224	0.376	2.253	0.373	2.266	0.306	1.906	0.314	1.980	0.308	1.947	0.318	2.008
Max-min	-0.085	-0.858	0.028	0.320	0.054	0.755	0.007	0.120	0.080	1.204	0.101	1.336	0.139	***1.717***
Max-vw mkt	0.095	1.508	0.088	1.520	0.085	1.738	0.018	0.487	0.026	0.857	0.020	0.712	0.030	1.080
Max-ew mkt	0.014	0.210	0.007	0.120	0.004	0.070	-0.063	-1.742	-0.055	-1.967	-0.061	-2.347	-0.051	-2.100
						J=3 months								
Max	0.367	2.202	0.340	2.070	0.311	1.920	0.294	1.855	0.292	1.868	0.293	1.874	0.293	1.876
Max-min	-0.215	***-2.212***	-0.083	-0.915	0.011	0.128	0.057	0.668	0.118	1.356	0.157	***1.694***	0.197	***2.024***
Max-vw mkt	0.079	1.298	0.052	0.890	0.022	0.428	0.006	0.132	0.004	0.122	0.005	0.150	0.005	0.153
Max-ew mkt	-0.003	-0.042	-0.029	-0.481	-0.059	-1.062	-0.076	-1.724	-0.077	-2.197	-0.077	-2.374	-0.077	-2.539
						J=6 months								
Max	0.329	1.981	0.315	1.936	0.307	1.920	0.279	1.774	0.265	1.686	0.261	1.661	0.254	1.613
Max-min	-0.137	-1.409	-0.080	-0.868	-0.011	-0.124	-0.014	-0.155	0.028	0.289	0.082	0.783	0.088	0.821
Max-vw mkt	0.041	0.704	0.027	0.487	0.019	0.363	-0.009	-0.197	-0.023	-0.590	-0.027	-0.763	-0.034	-1.027
Max-ew mkt	0.040	-0.652	-0.054	-0.917	-0.063	-1.153	-0.090	-1.926	-0.104	-2.576	-0.108	-2.935	-0.116	-3.401
						J=9 months								
Max	0.265	1.629	0.265	1.641	0.241	1.493	0.228	1.424	0.238	1.499	0.235	1.482	0.233	1.468
Max-min	-0.184	***-1.896***	-0.068	-0.754	-0.023	-0.240	0.011	0.104	0.065	0.589	0.090	0.806	0.112	0.978
Max-vw mkt	-0.023	-0.395	-0.023	-0.396	-0.047	-0.856	-0.060	-1.253	-0.050	-1.147	-0.053	-1.303	-0.055	-1.405
Max-ew mkt	-0.104	-1.663	-0.104	-1.684	-0.128	-2.192	-0.142	-2.754	-0.131	-2.855	-0.134	-3.143	-0.136	-3.404
						J=12 months								
Max	0.238	1.391	0.236	1.387	0.232	1.371	0.234	1.395	0.235	1.411	0.239	1.432	0.229	1.366
Max-min	-0.190	***-1.755***	-0.137	-1.302	-0.047	-0.443	0.029	0.250	0.078	0.657	0.115	0.953	0.130	1.053
Max-vw mkt	-0.050	-0.812	-0.052	-0.869	-0.056	-0.969	-0.055	-1.025	-0.053	-1.083	-0.049	-1.042	-0.059	-1.298
Max-ew mkt	-0.131	-2.033	-0.133	-2.121	-0.138	-2.275	-0.136	-2.489	-0.134	-2.719	-0.130	-2.812	-0.140	-3.201

Table 3. Performance of Pure Momentum Portfolio Switching Strategies: Shenzhen "A" Shares

This table reports the mean returns (annualized) and t-ratios of Max, Min, Max-Min, Max-vw Market, and Max-ew market portfolios, where Max is the top decile portfolio, Min is the bottom decile portfolio, and vw Market and ew Market are the value-weighted and equally-weighted averages of all "A" shares traded on the Shenzhen Stock Exchange. The strategies considered are pure momentum strategies described in Jegadeesh and Titiman (1993). J denotes the number of momentum lags, and K denotes the holding period. The sample covers the period from July 3, 1991 to December 31, 2001 with 2615 daily returns observations and 503 stocks. Forecasting starts on July 15, 1994 and ends on December 12, 2001 with 1816 trading days. Numbers italicized and in bold face denote statistical significance at the 10% level or better using a 2-sided test.

	K=1 day		K=1 week		K=1 month		K=3 months		K=6 months		K=9 months		K=12 months	
	mean	t-ratio	mean	t-ratio	mean	t-ratio	mean	t-ratio	mean	t-ratio	mean	t-ratio	mean	t-ratio
						J=1 week								
Max	0.410	2.259	0.287	1.667	0.373	2.290	0.360	2.235	0.364	2.273	0.365	2.283	0.373	2.323
Max-min	-0.174	-1.501	-0.161	***-1.964***	0.057	1.112	0.077	1.267	0.039	0.568	0.036	0.483	0.072	0.946
Max-vw mkt	0.108	1.445	-0.015	-0.262	0.072	1.898	0.059	2.166	0.062	2.506	0.064	2.581	0.071	2.844
Max-ew mkt	0.021	0.286	-0.102	-1.864	-0.016	-0.451	-0.029	-1.271	-0.025	-1.382	-0.023	-1.382	-0.016	-0.986
						J=1 month								
Max	0.434	2.586	0.424	2.571	0.391	2.427	0.348	2.203	0.356	2.276	0.346	2.214	0.351	2.246
Max-min	-0.106	-0.984	0.036	0.394	0.062	0.883	0.017	0.247	-0.012	-0.161	0.007	0.092	0.039	0.488
Max-vw mkt	0.132	1.988	0.123	2.023	0.090	1.833	0.047	1.325	0.054	1.773	0.044	1.505	0.049	1.719
Max-ew mkt	0.045	0.668	0.035	0.574	0.002	0.043	-0.041	-1.133	-0.033	-1.104	-0.043	-1.530	-0.038	-1.416
						J=3 months								
Max	0.346	2.077	0.333	2.029	0.341	2.116	0.341	2.207	0.334	2.181	0.323	2.116	0.320	2.096
Max-min	-0.289	***-2.716***	-0.226	***-2.340***	-0.152	***-1.718***	-0.075	-0.921	-0.036	-0.426	-0.030	-0.340	-0.014	-0.154
Max-vw mkt	0.044	0.659	0.032	0.514	0.039	0.699	0.040	0.919	0.032	0.885	0.021	0.624	0.018	0.567
Max-ew mkt	-0.043	-0.615	-0.055	-0.863	-0.048	-0.830	-0.048	-1.017	-0.055	-1.404	-0.066	-1.814	-0.069	-2.026
						J=6 months								
Max	0.368	2.329	0.343	2.207	0.342	2.235	0.334	2.210	0.311	2.083	0.299	2.018	0.286	1.935
Max-min	-0.178	***-1.680***	-0.144	-1.515	-0.062	-0.693	-0.026	-0.276	-0.025	-0.250	0.023	0.237	0.044	0.437
Max-vw mkt	0.067	1.096	0.042	0.727	0.040	0.751	0.032	0.672	0.010	0.233	-0.003	-0.072	-0.015	-0.409
Max-ew mkt	-0.021	-0.311	-0.046	-0.732	-0.047	-0.799	-0.055	-1.028	-0.077	-1.613	-0.090	-2.016	-0.103	-2.420
						J=9 months								
Max	0.327	2.075	0.311	2.028	0.317	2.105	0.273	1.865	0.260	1.797	0.252	1.749	0.261	1.801
Max-min	-0.224	***-2.080***	-0.217	***-2.075***	-0.165	-1.544	-0.110	-1.011	-0.046	-0.424	-0.037	-0.331	-0.029	-0.251
Max-vw mkt	0.025	0.388	0.010	0.152	0.016	0.269	-0.029	-0.544	-0.042	-0.868	-0.049	-1.109	-0.041	-0.972
Max-ew mkt	-0.062	-0.865	-0.078	-1.117	-0.071	-1.082	-0.116	-1.928	-0.129	-2.324	-0.137	-2.633	-0.128	-2.604
						J=12 months								
Max	0.314	1.971	0.335	2.100	0.323	2.086	0.258	1.738	0.260	1.754	0.265	1.783	0.266	1.782
Max-min	-0.261	***-2.250***	-0.162	-1.459	-0.102	-0.953	-0.108	-0.984	-0.071	-0.619	-0.053	-0.454	-0.062	-0.515
Max-vw mkt	0.013	0.171	0.033	0.446	0.021	0.322	-0.044	-0.855	-0.042	-0.891	-0.037	-0.822	-0.036	-0.832
Max-ew mkt	-0.075	-0.925	-0.054	-0.685	-0.066	-0.930	-0.131	-2.233	-0.129	-2.385	-0.124	-2.404	-0.123	-2.505

Table 4. Performance of Parametric Portfolio Switching Strategies: Shanghai "A" Shares Mean Reversion with Momentum

This table reports the mean returns (annualized) and t-ratios of Max, Min, Max-Min, Max-vw Market, and Max-ew market portfolios, where Max is the top decile portfolio, Min is the bottom decile portfolio, and vw Market and ew Market are the value-weighted and equally-weighted averages of all "A" shares traded on the Shanghai Stock Exchange. The strategies considered are pure mean reversion and mean reversion with momentum. J denotes the number of momentum lags, and K denotes the holding period. The sample covers the period from December 12, 1990 to December 31, 2001 with 2732 daily returns observations and 637 stocks. Forecasting starts on July 15, 1994 and ends on December 12, 2001 with 1823 trading days. Numbers italicized and in bold face denote statistical significance at the 10% level or better using a 2-sided test.

	K=1 day		K=1 week		K=1 month		K=3 months		K=6 months		K=9 months		K=12 months	
	mean	t-ratio	mean	t-ratio	mean	t-ratio	mean	t-ratio	mean	t-ratio	mean	t-ratio	mean	t-ratio
J=0, pure mean reversion														
Max	0.427	2.573	0.374	2.247	0.367	2.198	0.375	2.237	0.370	2.212	0.381	2.273	0.378	2.260
Max-min	0.070	1.200	0.031	0.609	0.045	0.939	0.093	***1.766***	0.144	***2.179***	0.201	***2.687***	0.228	***2.813***
Max-vw mkt	0.139	3.393	0.086	2.242	0.079	2.130	0.087	2.543	0.082	2.494	0.093	2.866	0.090	2.889
Max-ew mkt	0.058	1.756	0.005	0.167	-0.002	-0.088	0.005	0.219	0.001	0.044	0.011	0.531	0.009	0.416
J=1 week														
Max	0.440	2.644	0.378	2.305	0.367	2.227	0.372	2.248	0.366	2.215	0.374	2.258	0.373	2.251
Max-min	0.130	***2.319***	0.060	1.299	0.035	0.850	0.069	1.419	0.117	***1.857***	0.172	***2.374***	0.204	***2.556***
max-vw mkt	0.152	3.831	0.090	2.582	0.079	2.422	0.084	2.733	0.078	2.599	0.086	2.880	0.085	2.899
max-ew mkt	0.070	2.205	0.009	0.322	-0.002	-0.077	0.003	0.137	-0.003	-0.150	0.005	0.253	0.003	0.190
J=1 month														
Max	0.430	2.598	0.372	2.248	0.376	2.277	0.374	2.261	0.366	2.223	0.375	2.280	0.377	2.291
Max-min	0.082	1.531	0.010	0.204	0.030	0.661	0.080	1.559	0.134	***2.109***	0.180	***2.460***	0.217	***2.750***
max-vw mkt	0.142	3.521	0.084	2.305	0.088	2.499	0.086	2.564	0.078	2.462	0.087	2.809	0.089	2.942
max-ew mkt	0.061	1.885	0.003	0.093	0.006	0.241	0.004	0.190	-0.003	-0.157	0.006	0.306	0.007	0.377
J=3 months														
Max	0.455	2.767	0.394	2.403	0.385	2.336	0.379	2.295	0.370	2.253	0.361	2.202	0.367	2.238
Max-min	0.113	***2.093***	0.080	1.530	0.128	***1.956***	0.166	***2.140***	0.198	***2.240***	0.231	***2.413***	0.277	***2.742***
max-vw mkt	0.167	4.183	0.106	2.824	0.097	2.752	0.091	2.781	0.082	2.591	0.073	2.319	0.079	2.579
max-ew mkt	0.086	2.665	0.025	0.856	0.016	0.615	0.009	0.415	0.001	0.045	-0.008	-0.395	-0.002	-0.116
J=6 months														
Max	0.455	2.768	0.415	2.521	0.372	2.271	0.363	2.222	0.358	2.187	0.361	2.207	0.364	2.233
Max-min	0.094	***1.654***	0.060	1.086	0.029	0.512	0.045	0.595	0.090	0.991	0.144	1.435	0.171	***1.646***
max-vw mkt	0.167	3.998	0.126	3.079	0.084	2.151	0.075	2.077	0.070	1.965	0.073	2.094	0.076	2.248
max-ew mkt	0.085	2.433	0.045	1.324	0.002	0.073	-0.006	-0.211	-0.011	-0.399	-0.009	-0.316	-0.005	-0.187
J=9 months														
Max	0.521	3.027	0.432	2.614	0.403	2.432	0.380	2.284	0.378	2.283	0.365	2.218	0.356	2.164
Max-min	0.190	***3.048***	0.105	***1.675***	0.125	***1.693***	0.125	1.282	0.154	1.469	0.182	***1.663***	0.204	***1.789***
max-vw mkt	0.233	4.276	0.144	2.961	0.115	2.430	0.092	2.083	0.090	2.192	0.077	1.913	0.068	1.704
max-ew mkt	0.152	3.220	0.063	1.487	0.034	0.830	0.011	0.284	0.008	0.238	-0.004	-0.126	-0.014	-0.404
J=12 months														
Max	0.500	2.832	0.397	2.353	0.369	2.220	0.343	2.088	0.355	2.170	0.352	2.157	0.338	2.075
Max-min	0.134	1.578	0.029	0.444	0.068	0.939	0.105	1.113	0.173	***1.684***	0.210	***1.946***	0.222	***1.978***
Max-vw mkt	0.212	2.848	0.109	2.004	0.081	1.547	0.055	1.159	0.067	1.489	0.064	1.448	0.050	1.148
Max-ew mkt	0.131	1.897	0.027	0.553	-0.001	-0.012	-0.027	-0.646	-0.015	-0.372	-0.017	-0.445	-0.031	-0.825

Table 5. Performance of Parametric Portfolio Switching Strategies: Shenzhen "A" Shares Mean Reversion with Momentum

This table reports the mean returns (annualized) and t-ratios of Max, Min, Max-Min, Max-vw Market, and Max-ew market portfolios, where Max is the top decile portfolio, Min is the bottom decile portfolio, and vw Market and ew Market are the value-weighted and equally-weighted averages of all "A" shares traded on the Shenzhen Stock Exchange. The strategies considered are pure mean reversion and mean reversion with momentum. J denotes the number of momentum lags, and K denotes the holding period. The sample covers the period from July 3, 1991 to December 31, 2001 with 2615 daily returns observations and 503 stocks. Forecasting starts on July 15, 1994 and ends on December 12, 2001 with 1816 trading days. Numbers italicized and in bold face denote statistical significance at the 10% level or better using a 2-sided test.

	K=1 day		K=1 week		K=1 month		K=3 month		K=6 months		K=9 months		K=12 months	
	mean	t-ratio	mean	t-ratio	mean	t-ratio	mean	t-ratio	mean	t-ratio	mean	t-ratio	mean	t-ratio
J=0, pure mean reversion														
Max	0.474	2.805	0.431	2.585	0.425	2.556	0.434	2.612	0.403	2.435	0.402	2.424	0.397	2.388
Max-min	0.098	1.430	0.058	0.993	0.064	1.133	0.137	***1.946***	0.087	1.168	0.074	0.957	0.090	1.136
Max-vw mkt	0.173	3.228	0.130	2.877	0.124	3.046	0.132	3.472	0.101	2.737	0.101	2.691	0.096	2.540
Max-ew mkt	0.086	1.757	0.042	1.093	0.036	1.102	0.045	1.621	0.014	0.545	0.013	0.524	0.008	0.338
J=1 week														
Max	0.511	2.963	0.451	2.677	0.428	2.576	0.425	2.580	0.400	2.433	0.399	2.414	0.393	2.370
Max-min	0.138	***2.087***	0.089	***1.655***	0.073	1.436	0.120	***1.835***	0.073	1.000	0.066	0.843	0.086	1.066
max-vw mkt	0.209	3.786	0.149	3.437	0.126	3.250	0.124	3.399	0.099	2.781	0.097	2.697	0.091	2.486
max-ew mkt	0.122	2.446	0.062	1.715	0.039	1.312	0.036	1.457	0.011	0.495	0.010	0.434	0.004	0.169
J=1 month														
Max	0.502	2.988	0.478	2.876	0.467	2.813	0.433	2.640	0.400	2.441	0.397	2.419	0.390	2.371
Max-min	0.171	***2.686***	0.124	***2.205***	0.147	***2.841***	0.115	***1.799***	0.043	0.579	0.071	0.884	0.088	1.066
max-vw mkt	0.201	4.083	0.177	4.209	0.166	4.280	0.132	3.614	0.098	2.812	0.096	2.667	0.089	2.461
max-ew mkt	0.113	2.574	0.089	2.555	0.078	2.618	0.044	1.725	0.011	0.478	0.008	0.361	0.001	0.059
J=3 months														
Max	0.507	2.938	0.457	2.698	0.423	2.510	0.417	2.511	0.394	2.389	0.396	2.396	0.389	2.352
Max-min	0.155	***2.407***	0.098	***1.769***	0.051	0.959	0.060	0.904	0.056	0.703	0.071	0.841	0.080	0.912
max-vw mkt	0.205	3.859	0.155	3.277	0.121	2.737	0.115	2.793	0.093	2.343	0.095	2.350	0.088	2.199
max-ew mkt	0.118	2.628	0.068	1.825	0.034	1.023	0.028	0.918	0.005	0.191	0.008	0.262	0.001	0.021
J=6 months														
Max	0.536	3.019	0.472	2.749	0.454	2.679	0.446	2.664	0.418	2.508	0.413	2.487	0.407	2.451
Max-min	0.198	***2.999***	0.114	***1.978***	0.110	***1.665***	0.127	1.495	0.116	1.203	0.164	***1.639***	0.183	***1.766***
Max-vw mkt	0.234	3.780	0.170	3.269	0.152	3.114	0.145	3.087	0.116	2.586	0.111	2.573	0.105	2.501
Max-ew mkt	0.147	2.761	0.083	1.965	0.065	1.682	0.057	1.562	0.029	0.825	0.024	0.728	0.018	0.567
J=9 months														
Max	0.531	3.064	0.462	2.741	0.470	2.804	0.454	2.717	0.411	2.474	0.399	2.402	0.398	2.397
Max-min	0.301	***3.817***	0.193	***2.995***	0.181	***2.486***	0.208	***2.346***	0.214	***2.213***	0.199	***1.933***	0.184	***1.710***
Max-vw mkt	0.229	3.519	0.160	3.075	0.169	3.454	0.152	3.281	0.109	2.465	0.097	2.282	0.096	2.298
Max-ew mkt	0.142	2.408	0.073	1.638	0.081	2.002	0.065	1.726	0.022	0.619	0.010	0.293	0.009	0.277
J=12 months														
Max	0.496	2.743	0.482	2.668	0.468	2.600	0.485	2.681	0.479	2.643	0.482	2.667	0.481	2.667
Max-min	0.288	***3.499***	0.274	***3.251***	0.259	***3.195***	0.296	***3.057***	0.278	***2.564***	0.273	***2.401***	0.252	***2.145***
Max-vw mkt	0.195	2.831	0.181	2.681	0.166	2.690	0.184	2.925	0.177	2.945	0.180	3.066	0.180	3.101
Max-ew mkt	0.107	1.750	0.093	1.571	0.079	1.482	0.096	1.782	0.090	1.752	0.093	1.855	0.092	1.875

Table 6. Robustness of Portfolio Performance Results: Shanghai "A" Shares

This table reports summary statistics for the trading strategy of mean reversion with 12-month momentum and 12-month holding period. Max is the top portfolio, Min is the bottom portfolio, and vw Market and ew Market are the value-weighted and equally-weighted averages of all "A" shares traded on the Shanghai Stock Exchange. The alphas and betas are obtained by estimating the traditional CAPM. The mean, standard deviation and alpha are annualized. The sample covers the period from December 12, 1990 to December 31, 2001 with 2732 daily returns observations and 637 stocks. Numbers italicized and in bold face denote statistical significance at the 10% level or better using a 2-sided test.

	Mean	Std dev	t-ratio	Sharpe Ratio	Alpha	beta	Annual portfolio turnover rate
			Baseline Case				
Max	0.338	6.962	2.075	0.049	0.060	0.958	0.840
max-min	0.222	4.798	***1.978***	0.046	0.112	0.497	0.881
max-wv mkt	0.050	1.871	1.148	0.027	0.060	-0.042	
max-ew mkt	-0.031	1.604	-0.825	-0.019	-0.019	-0.053	
			Portfolio Formed One Day after Ranking				
Max	0.345	6.951	2.119	0.050	0.061	0.957	0.840
max-min	0.208	4.786	***1.856***	0.043	0.098	0.487	0.881
max-wv mkt	0.052	1.853	1.187	0.028	0.061	-0.043	
max-ew mkt	-0.030	1.588	-0.815	-0.019	-0.018	-0.053	
			Stocks Sorted into 3 Portfolios				
Max	0.367	7.031	2.227	0.052	0.084	0.977	0.662
max-min	0.118	3.470	1.457	0.034	0.049	0.314	0.662
max-wv mkt	0.079	1.599	2.102	0.049	0.084	-0.023	
max-ew mkt	-0.003	1.250	-0.086	-0.002	0.005	-0.033	
			Stocks Sorted into 5 Portfolios				
Max	0.373	6.971	2.286	0.054	0.094	0.958	0.763
max-min	0.174	4.216	***1.759***	0.041	0.090	0.380	0.775
max-wv mkt	0.085	1.903	1.911	0.045	0.094	-0.042	
max-ew mkt	0.004	1.635	0.101	0.002	0.016	-0.053	
			Stock Sorted into 20 Portfolios				
Max	0.382	7.573	2.152	0.050	0.085	1.041	0.821
max-min	0.352	5.622	***2.671***	0.063	0.200	0.688	0.862
max-wv mkt	0.094	2.063	1.940	0.045	0.085	0.041	
max-ew mkt	0.012	1.723	0.308	0.007	0.006	0.030	

Table 7. Robustness of Portfolio Performance Results: Shenzhen "A" Shares

This table reports summary statistics for the trading strategy of mean reversion with 12-month momentum and 12-month holding period. Max is the top portfolio, Min is the bottom portfolio, and vw Market and ew Market are the value-weighted and equally-weighted averages of all "A" shares traded on the Shenzhen Stock Exchange. The alphas and betas are obtained by estimating the traditional CAPM. The mean, standard deviation and alpha are annualized. The sample covers the period from July 3, 1991 to December 31, 2001 with 2615 daily returns observations and 503 stocks. Numbers italicized and in bold face denote statistical significance at the 10% level or better using a 2-sided test.

	Mean	Std dev	t-ratio	Sharpe Ratio	Alpha	beta	Annual portfolio turnover rate
			Basic Case				
max	0.481	7.688	2.667	0.063	0.160	1.085	0.828
max-min	0.252	5.013	***2.145***	0.050	0.188	0.275	0.904
Max-wv mkt	0.180	2.469	3.101	0.073	0.160	0.085	
Max-ew mkt	0.092	2.098	1.875	0.044	0.080	0.052	
			Portfolio Formed One Day after Ranking				
max	0.497	7.675	2.757	0.065	0.168	1.084	0.828
max-min	0.249	4.897	***2.168***	0.051	0.187	0.257	0.904
max-wv mkt	0.189	2.463	3.262	0.077	0.168	0.084	
max-ew mkt	0.101	2.095	2.045	0.048	0.088	0.050	
			Stocks Sorted into 3 Portfolios				
max	0.385	7.023	2.335	0.055	0.080	1.014	0.727
max-min	0.153	3.183	***2.045***	0.048	0.119	0.143	0.724
max-wv mkt	0.083	1.661	2.138	0.050	0.080	0.014	
max-ew mkt	-0.004	1.292	-0.133	-0.003	0.001	-0.019	
			Stocks Sorted into 5 Portfolios				
max	0.409	7.118	2.449	0.057	0.102	1.024	0.802
max-min	0.178	3.909	***1.941***	0.046	0.137	0.173	0.829
max-wv mkt	0.108	1.802	2.543	0.060	0.102	0.024	
max-ew mkt	0.020	1.407	0.612	0.014	0.023	-0.010	
			Stock Sorted into 20 Portfolios				
max	0.478	7.760	2.627	0.062	0.156	1.088	0.797
max-min	0.241	5.780	***1.776***	0.042	0.159	0.348	0.863
max-wv mkt	0.177	2.646	2.846	0.067	0.156	0.088	
max-ew mkt	0.089	2.277	1.673	0.039	0.077	0.054	