BOFIT Discussion Papers
20 • 2009

Martin T. Bohl, Michael Schuppli
and Pierre L. Siklos

Stock return seasonalities and investor structure: Evidence from China's B-share markets

EUROJÄRJESTELMÄ
EUROSYSTEMET

Bank of Finland, BOFIT
Institute for Economies in Transition

BOFIT Discussion Papers
Editor-in-Chief Iikka Korhonen

BOFIT Discussion Papers 20/2009
28.10.2009

Martin T. Bohl, Michael Schuppli, and Pierre L. Siklos: Stock return seasonalities and investor structure: Evidence from China's B-share markets

ISBN 978-952- 462- 995- 9
ISSN 1456-5889
(online)

Suomen Pankki
Helsinki 2009

Contents

Martin T. Bohl, Michael Schuppli, and Pierre L. Siklos

Stock return seasonalities and investor structure: Evidence from China's B-share markets

Tiivistelmä

Tässä työssä tutkitaan, liittyvätkö osakemarkkinoiden päivittäisten tuottojen kausivaihtelut yksityisten ja institutionaalisten sijoittajien toimintaan markkinoilla. B-osakkeiden omistusta koskeneet rajoitukset Shanghain ja Shenzhenin osakemarkkinoilla purettiin vuonna 2001, ja tämän jälkeen nähty omistusrakenteiden muutos antaa hyvän mahdollisuuden tutkia aihetta. Uudistuksen jälkeen kiinalaiset yksityiset sijoittajat ovat saaneet toimia näillä markkinoilla, mikä on vähentänyt viikonpäiviin liittyvää säännöllistä kausivaihtelua. Tuloksien mukaan instituutionalisten sijoittajien toiminta on aiheuttanut anomalioita osakemarkkinoiden hinnoittelussa. Markkinoiden liberalisoinnin jälkeen myös osakeindeksin autokorrelaatio ja Yhdysvaltain markkinoiden vaikutus Kiinan osakemarkkinoihin ovat vähentyneet.

Asiasanat: institutionaaliset sijoittajat, yksityiset sijoittajat, osakkeiden tuottojen kausivaihtelu, kiinalaiset osakemarkkinat, GARCH-malli

Stock Return Seasonalities and Investor Structure: Evidence from China's B-Share Markets*

Martin T. Bohl**

Westfälische Wilhelms-University Münster, Germany

Michael Schuppli

Westfälische Wilhelms-University Münster, Germany

Pierre L. Siklos

Wilfrid Laurier University and Viessmann European Research Centre, Waterloo, Canada

Abstract

This paper investigates whether seasonalities in daily stock returns are related to the trading behavior of individual and institutional investors. The change in the investor structure of B-share markets in Shanghai and Shenzhen after the abolition of ownership restrictions in 2001 provides a unique testing environment. We show that day-of-the-week effects are attenuated after the market entrance of Chinese individual investors, who had previously not been allowed to trade in B-shares. Our empirical results suggest that institutional rather than individual investors are a main driving force behind such anomalies. In addition, we find evidence of reduced index return autocorrelation and US spillover effects in the post-liberalization period.

JEL Classification: G12; G14; G18

Keywords: Institutional Investors, Individual Investors, Stock Return Seasonalities, Chinese Stock Markets, GARCH Model

---

* The authors would like to thank Jeffrey Callen, Roland Füss, Mathieu Gex, Eric Girardin, Iikka Korhonen, Tse-Chun Lin, Christian Salm, André Uhde, Zhishu Yang, Enzo Weber, an anonymous referee as well as participants at Campus for Finance 2009 and the Workshop "Chinese Financial Markets and the World Economy" at the Bank of Finland for useful comments and suggestions. Bohl and Siklos gratefully acknowledge financial support from the Alexander von Humboldt Foundation.

** Corresponding author: Westfälische Wilhelms-University Münster, Department of Economics, Am Stadtgraben 9, D-48143 Münster, Germany, email: martin.bohl@wiwi.uni-muenster.de, phone: ++49-251-83-25005, fax: ++49-251-83-22846.

Stock Return Seasonalities and Investor Structure: Evidence from China's B-Share Markets

Abstract

This paper investigates whether seasonalities in daily stock returns are related to the trading behavior of individual and institutional investors. The change in the investor structure of B-share markets in Shanghai and Shenzhen after the abolition of ownership restrictions in 2001 provides a unique testing environment. We show that day-of-the-week effects are attenuated after the market entrance of Chinese individual investors, who had previously not been allowed to trade in B-shares. Our empirical results suggest that institutional rather than individual investors are a main driving force behind such anomalies. In addition, we find evidence of reduced index return autocorrelation and US spillover effects in the post-liberalization period.

JEL Classification: G12; G14; G18

Keywords: Institutional Investors, Individual Investors, Stock Return Seasonalities, Chinese Stock Markets, GARCH Model

1 Introduction

One of the most prominent anomalies challenging the hypothesis of stock market efficiency in its weak form is the day-of-the-week effect in daily stock returns. Following seminal articles by Cross (1973) and French (1980) documenting significantly negative Monday returns, a large body of literature has evolved to document abnormal daily returns for many stock markets around the globe. In particular, a number of studies (Barone, 1990; Solnik and Bousquet, 1990; Agrawal and Tandon, 1994) find average Tuesday returns in major stock markets outside the US to be significantly negative. The vast body of evidence concerning daily stock return seasonalities has led to a debate on possible origins of the observed phenomenon. Proposed explanations include the settlement procedure hypothesis (Lakonishok and Levi, 1982), measurement errors (Rogalski, 1984), the timing of earnings announcements (Peterson, 1990), and the influence of institutional versus individual investor trading.

This paper adds to the debate about the role of institutional and individual investors in explaining stock return seasonalities. We study Chinese B-share markets before and after the abolition of ownership restrictions. Originally, only foreign, predominantly institutional, investors were allowed to trade in B-shares, while mostly private Chinese investors could only purchase and sell A-shares. In a move to foster market capitalization and liquidity of the B-share segment, Chinese authorities announced in February 2001 that domestic investors would be allowed to enter the B-share market. This institutional setting provides a unique environment for studying the impact of individual versus institutional trading on day-of-the-week effects in stock returns.

The individual investor hypothesis argues that the behavior of this investor group is the primary cause of daily seasonalities in stock returns. Following the line of argumentation of its proponents, private investors generally use the weekend to process information and revise their portfolio allocation or determine liquidity needs. Therefore, their propensity to trade on the following Monday is high compared to other days of the week. Moreover, Lakonishok and Maberly (1990) argue that the influence of analysts' recommendations, which are typically biased towards buys (Groth et al., 1979), is less strong on weekends than on trading days. In contrast, institutional investors avoid Monday trading because they are busy deciding on portfolio rebalancing and fear informed trading by private agents. Sias and Starks (1995) challenge the individual investor hypothesis, arguing that institutional investors also follow analysts' recommendations and that the high return autocorrelation typically observed in institutional portfolios may contribute to abnormal Monday returns. They find that the Monday seasonal in conditional returns is stronger in portfolios of stocks with high as opposed to low institutional ownership. While such arguments may explain part of the Monday effect found for Western stock markets, they do not seem to apply to Asian markets, where significantly negative returns are typically observed on Tuesdays. However, this finding may be attributed to the time zone hypothesis of Jaffe and Westerfield (1985), i.e. the lagged effect of negative Monday returns in Western stock markets.

While US studies typically rely on institutional ownership data, the market entrance of private investors in China's B-share markets provides a unique testing ground for studying the relationship between stock return seasonalities and different investor groups. We analyze the marginal effect of ownership liberalization on day-of-the-week effects in daily Shanghai and Shenzhen B-Share Index returns. There is evidence of the negative Tuesday effect commonly observed in Asian stock markets. More importantly, we find a substantial reduction in daily seasonalities in the post-liberalization period. This result holds for both the Shanghai and Shenzhen Stock Exchange and is robust to various modifications of our empirical approach. Moreover, the market entrance of domestic private investors seems to reduce return autocorrelation and spillover effects from the US. At the same time, the effect of local spillovers from A-share markets appears stronger during the post-liberalization period.

Our results are also related to research providing evidence regarding the sophistication of Chinese investors. A recent study by Fifield and Jetty (2008) compares results from variance ratio tests before and after the deregulation of B-share markets in Shanghai and Shenzhen. The authors conclude that these market segments have become more efficient following the market entrance of domestic investors. Recent evidence on shareholder activism during the split-share structure reform suggests that domestic institutional investors have actively promoted shareholder rights. Empirical results reported by Liao et al. (2008) show that compensation of tradable share owners and post-reform performance are positively related to domestic institutional ownership. Ng and Wu (2006) examine individual brokerage accounts in order to deduce investor preferences. Their results imply that Chinese investors base their investment decisions on information about stock characteristics and thus exhibit rational behavior. Papers challenging this view include Chen et al. (2007), who document behavioral biases such as overconfidence, a representativeness bias, and a disposition effect. Another strand of literature dealing with price differentials between A- and B-share markets finds evidence that domestic investors have better information regarding fundamental asset values than do foreigners (Chakravarty et al. (1998), Chan et al. (2008)). Karolyi and Li (2003) document how domestic investors used this informational advantage to arbitrage away the B-share discount after the 2001 liberalization. By studying the influence of domestic private investor trading on day-of-the-week effects in stock returns, our paper provides indirect evidence of private investor sophistication in China.

A number of other papers study seasonalities in Chinese stock returns. For example, a recent paper by Girardin and Liu (2005) examines monthly and quarterly stock returns between 1993 and 2003. They find positive June and second quarter as well as negative December and fourth quarter effects in both the Shanghai and Shenzhen markets. A comprehensive study by Mitchell and Ong (2006) finds evidence of holiday effects and higher returns during the 6 months after Chinese Lunar New Year (from February to June). The evidence regarding day-of-the-week effects is rather mixed, as conclusions from various studies seem to depend heavily on the particular choice of sample period and estimation approach. Even so, a number of studies (e.g. Mookerjee and Yu (1999), Cai et al. (2006), Mitchell and Ong (2006)) find some evidence of negative Tuesday returns in B-share markets, which is consistent with results for other Asian markets.

Most closely related to our paper is the work of Chen et al. (2001), who estimate standard dummy regressions as well as Integrated GARCH(1,1) models on Shanghai and Shenzhen A-share and B-share index returns. They consider two subsamples, 1992-1995 and 1995-1997, motivated by economic events such as the commencement of the company law and economic austerity programs implemented in 1994. The only abnormal daily return is found for Tuesday in the second sample period. However, the effect disappears once conditional heteroskedasticity, non-normal errors and spillover effects from the US are accounted for. While estimating various models for both A-share and B-share indices, none of the cited papers explicitly addresses the question to what extend the abolition of ownership restrictions has affected anomalies in stock returns in more recent years.

The remainder of the paper is structured as follows. Section 2 characterizes stock markets in Mainland China, focusing on regulatory peculiarities. Our dataset and empirical approach are described in Sections 3 and 4, respectively. Estimation results are discussed in Section 5, and Section 6 concludes.

2 Chinese Stock Market Regulation and Investor Structure

Since their reopenings on November 26, 1990 and April 11, 1991, respectively, Chinese stock markets in Shanghai and Shenzhen have expanded rapidly. This development is manifest in both total market capitalization and in the number of firms listed. After about 17 years of operations, the number of listed companies has risen to 904 in Shanghai and to 736 in Shenzhen. At the end of 2007, the total market capitalization had reached about 5,700 billion Renminbi (RMB) in Shenzhen and about 27,000 billion RMB for the Shanghai Stock Exchange. The development of the two exchanges has been asymmetric, not only in terms of total market capitalization but also in that larger companies generally tend to list in Shanghai (Girardin and Liu, 2005; Walter and Howie, 2006).

China has been and in some respects still is a planned economy. Hence the transition to liberalized financial markets has been subject to strict regulation (see Walter and Howie (2006) for an overview). In particular, there are various regulatory details that impede arbitrage. First, there is an official ban on short-selling. Forcing investors to keep their trading accounts with the stock exchange allows authorities to effectively enforce anti-short-sale legislation. If there is a negative day-of-the-week effect and if short selling was allowed, rational arbitrageurs could sell stocks short in the morning of that day and buy them back the next day. Such trading activity would eventually result in the disappearance of the effect. In the absence of short-sales, however, such arbitrage is not possible. Second, the fact that the People's Bank of China (PBC) prohibits bank loans to be invested in stocks effectively prevents leveraged trading strategies and thus arbitrage. Third, derivatives markets have only recently begun to develop. Many studies highlight the importance of derivatives markets for exploiting arbitrage opportunities (e.g. Kamara (1997), Faff and McKenzie (2002)). For example, in the absence of futures contracts, investors face considerably higher transaction costs when trading against seasonalities in stock returns. Summing up, these institutional details imply that both foreign institutional and domestic private investors will find it difficult to arbitrage away day-of-the-week effects in Chinese stock returns.

Ownership segmentation, however, has probably been the most noticeable peculiarity of stock markets in Mainland China. During the first decade after the reopening of stock exchanges, companies have typically issued different categories of shares. There are two classes of shares traded on stock exchanges in Shanghai and Shenzhen. In addition to A-shares, with ownership initially restricted to Chinese citizens (denominated in RMB), there are B-shares, which until February 2001 only foreign (mostly institutional) investors were allowed to purchase (denominated in USD or HKD). Furthermore, some companies have issued H-shares listed in Hong Kong (denominated in HKD) or N-shares listed in other overseas markets. In principle, all categories of shares are identical other than for who can own them.

Due to foreign investors' reluctance to invest in B-shares, and because firms planning to raise foreign capital could alternatively list in overseas markets, the market capitalization and liquidity of stocks listed in the B-share segment was rather low. In a move to foster its growth, the Chinese Securities Regulatory Commission (CSRC) announced on February 19, 2001 that ownership restrictions on B-shares would be lifted so that Chinese investors would be able to legally trade in B-shares. As authorities were afraid of a massive influx of domestic capital leading to a dramatic increase in B-share prices, trading was suspended until February 28, 2001.

In fact, the abolition of ownership restrictions has led to an inflow of domestic capital into the B-share market. This is reflected in a steep increase in annual B-share trading volume. In case of Shanghai, for instance, the value of traded shares rose by more than 800% between 2000 and 2001 (Shanghai Stock Exchange, 2001). Correspondingly, more than 80% of new B-share trading accounts opened between 2001 and 2006 are owned by Chinese domestic investors. At the end of 2006, domestic investors accounted for about 88% of all B-share trading accounts (Shanghai Stock Exchange, 2006).

It is important to notice that the domestic investor structure in the Shanghai and Shenzhen stock exchanges differs greatly from mature markets. Domestic institutional investments constitute only a small fraction of total domestic equity investment (Kling and Gao, 2008). According to account ownership data from the Chinese Securities Depository and Clearing Company, about 99% of A-share trading accounts are owned by individual investors (compare Ng and Wu (2006) and Walter and Howie (2006)). Moreover, despite the large number of trading accounts, active stock market participation by low-income households is limited. Instead, as Walter and Howie (2006) highlight, a small number of privately managed (gray-market) investment funds sponsored by wealthy individuals account for most of the domestic investable capital in China's equity markets. Data from individual trading accounts analyzed by Ng and Wu (2006) confirm this conjecture. In addition, wealthier Chinese are more likely to have US Dollar accounts necessary to engage in B-share trading. Thus the liberalization of China's B-share markets allows us to study the marginal effect of wealthy private investors' trading on day-of-the-week effects in stock returns.

Most papers on Chinese equity markets implicitly assume that foreign institutions such as mutual funds accounted for most of B-share trading prior to liberalization (e.g. Fernald and Rogers (2002)). High information costs and fees make direct investment in an emerging stock market unattractive for a foreign individual investor. Nonetheless, such a private investor may be willing to indirectly invest in the same assets via dedicated emerging market equity funds, which offer economies of scale in terms of transaction costs and hedging. Therefore, the assumption that foreign investors are mostly institutions appears quite plausible.

3 Data

We obtain daily data on the B-share indices of the Shanghai and Shenzhen Stock Exchanges from Thomson Financial Datastream. Our sample covers the period between January 3, 1994 and December 28, 2007. Observations before this period are excluded because of infrequent trading in the early days of both stock exchanges. Daily index returns are computed as the difference in logs between the closing value of the index on day t closing minus the closing value the previous day, $r_t = \ln(P_t) - \ln(P_{t-1})$.

We split our sample into the periods before and after ownership liberalization. The first subsample covers all trading days before liberalization (January 3, 1994 - February 18, 2001). The day trading resumed after the announcement (February 28, 2001) marks the beginning of the post-liberalization subsample. A dummy variable that takes on the value of unity beginning at this date identifies observations from the later period.

In order to model the influence of other stock markets outside Mainland China, we also need data on foreign stock indices. For our baseline model of returns, we use the US S&P 500 Composite Index and the Taiwan Capitalization Weighted Stock Index to proxy for sources of global and regional spillover effects. Alternatively, we also consider other regional stock market indices that may have an influence on B-share index returns such as the Nikkei 225, the Korea Composite Stock Price Index (KOSPI), and the Hang Seng index. In addition, we take into account the possibility of local spillovers, using data on daily A-share index closing values. For all indices, we obtain data from Datastream and compute log returns.

[Insert Table 1 about here]

Table 1 presents summary statistics for Shanghai and Shenzhen B-share index returns, distinguishing between the total sample period as well as the pre-liberalization and post-liberalization subsamples. Most parameters, such as the standard deviation of daily returns, minima and maxima, are similar for all three periods considered. Only mean returns increase considerably after the abolition of ownership restrictions. Moreover, as can be seen from the Table, Shanghai and Shenzhen B-share index returns exhibit excess kurtosis and are skewed to the right. As expected, they are unlikely to be normally distributed. The last row of Table 1 reports results for the sign bias test of Engle and Ng (1993). Results for both Shanghai and Shenzhen B-share index returns indicate asymmetric reactions of conditional volatility to negative past return innovations, whereas coefficient estimates for size bias and combined tests (not reported) are generally statistically insignificant.

Additional diagnostics are provided in Figure 1, which compares mean returns across days of the week and subsamples. Evidently, the largest mean return in absolute value occurs on Tuesdays during the pre-liberalization period. This is true for Shanghai (-0.26%) and Shenzhen (-0.37%) as well. Interestingly, the negative Tuesday return is reversed for the post-liberalization sample.

[Insert Figure 1 about here]

4 Methodology

We employ a mean equation and GARCH framework for modeling daily B-share log index returns. There is a vast body of literature, beginning with Connolly (1989), that highlights the importance of taking conditional heteroskedasticity into account when studying day-of-the-week effects in stock returns. Our general approach is to include interaction terms with a dummy variable for the post-liberalization period in order to draw conclusions about the marginal effect of the regime change on various parameters of our model. More specifically, we assume daily log returns to follow:

$$\begin{aligned} r_t \;=\; & \sum_{j=1}^{5} \alpha_j W_{j,t} + \sum_{j=1}^{5} \alpha'_j W_{j,t} D_t + \beta_1 r_{t-1} + \beta'_1 r_{t-1} D_t \\ & + \beta_2 r_{t-1}^{US} + \beta'_2 r_{t-1}^{US} D_t + \beta_3 r_t^{TW} + \beta'_3 r_t^{TW} D_t + \beta_4 r_t^{A} + \beta'_4 r_t^{A} D_t + \varepsilon_t \end{aligned} \tag{1}$$

where r_t denotes the daily log return on the Shanghai or Shenzhen B-share composite index, $W_{j,t}$ dummy variables for Monday through Friday, and D_t a dummy variable that takes on the value of 1 during the post-liberalization period and zero otherwise. Short-term return dynamics may be governed by price adjustment delays, trend effects and noise trading. It is therefore necessary to include lagged returns in the mean equation since coefficient estimates for day-of-the-week effects may otherwise be biased. Additionally, including an interaction term of lagged returns and the post-liberalization dummy enables us to detect changes in the autocorrelation of returns, which can be inferred from the parameter estimate of β'_1.

Furthermore, in order to account for global, regional and local spillover effects, we include the log returns on the lagged US S&P 500 Composite Index (r_{t-1}^{US}), the Taiwan Capitalization Weighted Stock Index (r_t^{TW}), and the corresponding Shanghai or Shenzhen A-share index (r_t^{A}). Because of different time zones, we lag US stock index returns by one period. Again, we allow for a change in these effects by including multiplicative dummy terms. This enables us to distinguish changes in day-of-the-week effects due to a changing investor structure from potentially time-varying influences of US, Taiwanese and local A-share markets.

It is important to bear in mind that all coefficients on terms without dummies (α_1,..., α_5, β_1,..., β_4) model day-of-the-week, autoregressive, and spillover effects for the whole sample period, whereas coefficients on interaction terms (α'_1,..., α'_5, β'_1,..., β'_4) can be interpreted as marginal changes in these effects in the post-liberalization period.

Following Glosten et al. (1993), we assume conditional volatility (denoted h_t) to react asymmetrically to positive and negative past innovations in returns. This modeling approach is motivated by results from sign bias tests discussed in Section 3. In addition, we want to test the hypothesis of a shift in the level of conditional volatility in the post-liberalization period. The variance equation of the GJR-GARCH(1,1) model can be written as

$$h_t = \gamma_0 + \gamma'_0 D_t + \gamma_1 h_{t-1} + \gamma_2 \varepsilon^2_{t-1} + \gamma_3 \varepsilon^2_{t-1} I_t \tag{2}$$

where the usual stationarity condition ($\gamma_1 + \gamma_2 + 1/2\ \gamma_3 < 1$) applies and I_t denotes an indicator variable that is equal to one if the lagged disturbance in returns is negative ($\varepsilon_{t-1} < 0$) and zero otherwise. Hence, the coefficient γ_3 measures the degree to which negative past return innovations have a stronger effect on conditional volatility than positive return shocks. A positive asymmetric response of conditional volatility is consistent with the well-known leverage effect of Black (1976).

Notice that we use an additional dummy term to model changes in the intercept of the variance equation due to the change in investor structure. A significantly positive (negative) parameter estimate for γ'_0 implies that the conditional variance of returns is higher (lower) for the post-liberalization period than for the total sample period. However, this model specification may seem rather restrictive, as it implies that the regime change will only affect a single parameter of the variance equation. Hence we also estimate an alternative GJR-GARCH(1,1) model, which allows us to test the hypothesis of a parallel shift in all parameters of the proposed conditional volatility model. This modified model is given by

$$h_t = (1 + \gamma_D D_t)(\gamma_0 + \gamma_1 h_{t-1} + \gamma_2 \varepsilon^2_{t-1} + \gamma_3 \varepsilon^2_{t-1} I_t). \tag{3}$$

The multiplicative dummy term enables us to determine the magnitude and significance of a potential shift in all parameters of our variance equation due to ownership liberalization. A significantly positive (negative) parameter estimate for γ_D implies that the relevant coefficients are higher (lower) for the post-liberalization period than for the total sample period.

Sample statistics discussed in Section 3 show that Chinese B-share index returns exhibit skewness and excess kurtosis with respect to the standard normal distribution. Thus the usual assumption of normally distributed errors may be violated. We therefore estimate the above model by quasi-maximum likelihood, relying on the robust variance-covariance estimator of Bollerslev and Wooldridge (1992). More precisely, we maximize the normal log likelihood using the Broyden-Fletcher-Goldfarb-Shanno (BFGS) method implemented under RATS 6.2 and suitable starting values. We emphasize that this procedure delivers correct inference even if the true error distribution may have fat tails. Alternatively, one can derive maximum likelihood estimates based on a specific fat-tailed error distribution, such as Student's t-distribution, and estimate the degrees of freedom parameter ν along the way.

In order to reduce the complexity of the model and as an additional robustness check, we also employ a general-to-specific approach. First, we estimate the proposed general GJR-GARCH(1,1) model. We then exclude the coefficient with the highest p-value (lowest significance) and re-estimate the model. This procedure is iterated until all coefficients in the remaining specification are statistically different from zero at the 10% level of significance.

5 Empirical Results

Parameter estimates for the proposed general and specific baseline models of stock returns are summarized in Table 2. As pointed out above, the GARCH framework allows us to draw conclusions about the time series behavior of conditional volatility and possible structural changes. Coefficient estimates for γ_1 show that index return volatility is highly persistent. Moreover, a significantly positive parameter estimate of γ_2 suggests that unexpected stock returns (ε_{t-1}^2) increase volatility. The evidence regarding asymmetric responses of stock return volatility to negative past return innovations is mixed. The parameter γ_3 is significantly positive at the 5% level in the general model for Shanghai, implying that negative surprises in returns have a stronger impact on volatility than positive ones. At the same time, the point estimate for γ_3 is statistically indistinguishable from zero in the three other cases.

[Insert Table 2 about here]

The coefficient measuring a shift in the intercept (γ_0') is negative and significant for all return time series and models. This result indicates a decrease in stock return volatility in Chinese B-share markets after the abolition of ownership restrictions, due to the trading activity of domestic private investors. This finding is in contrast to evidence of speculative behavior of Chinese investors entering the B-share market documented by Mei et al. (2005).

Turning to estimation results for the mean equation, we find a strong positive autocorrelation of index returns as measured by highly significant β_1 coefficients. Yet significant point estimates for β_1' imply that this phenomenon is less pronounced during the period after the liberalization of stock ownership. This finding can be related to the changing investor structure of China's B-share markets during the post-liberalization period.

Previous US evidence presented by Sias and Starks (1997) shows that autocorrelation in daily returns of portfolios and individual stocks traded on NYSE increases with institutional ownership. Possible explanations include short-term positive feedback trading by institutional investors (Nofsinger and Sias, 1999; Griffin et al., 2003) and institutional agents breaking up trades to reduce execution costs or camouflage informed trading (Barclay and Warner, 1993). Our empirical evidence for Chinese B-share markets provides indirect support for this view.

Furthermore, parameter estimates for β_2 suggest that US market returns have a strong effect on stock returns in China's B-share segment, which is consistent with evidence in Chen et al. (2001). This finding is not surprising as we expect the B-share market, which is China's foreign share market, to be integrated with overseas stock markets to a certain extent. The influence of Taiwanese markets is less pronounced with point estimates of β_3 being generally significant but comparably small in magnitude. The linkage with domestic A-share markets appears stronger as mirrored by β_4 coefficients that are significant at the 1% level. Moreover, the change in ownership regimes has a significant effect on the integration of China's B-share markets with other markets. Negative β_2' coefficients suggest that spillover effects from the US appear to be less strong after February 2001. The influence of A-share markets, by contrast, seems to increase after liberalization, as reflected by large and highly significant β_4' coefficients.

Significant linkages between A-share and B-share markets can be interpreted in terms of information flows between the two market segments as, for example, in Chui and Kwok (1998). Along these lines, the growing influence of A-share market movements may be due to market integration after liberalization. Moreover, our results are consistent with the notion of a changing investor structure affecting daily return dynamics. Foreign institutional investors, who account for all trading in B-shares during the pre-liberalization period, are inclined to react to news from overseas markets, thus causing significant US spillover effects in daily returns. The post-liberalization period, by contrast, witnesses the growing influence of domestic private investors, who are probably more concerned about local short-term market developments.

Most importantly, results for both the Shanghai and Shenzhen B-share markets imply that there are day-of-the-week effects and that these are most pronounced for Tuesday. In all four cases, the coefficient estimates of α_2 are significant at the 1% level. In addition, there is some but weaker evidence of a negative Wednesday effect in both markets and a Thursday effect in the Shenzhen B-share market. The finding of a negative Tuesday effect is consistent with long-standing evidence for Asian markets (Jaffe and Westerfield, 1985; Agrawal and Tandon, 1994). In contrast to previous evidence for China (Chen et al., 2001), the effect is robust to the inclusion of spillover terms. In fact, lagged returns on Western stock markets as proxied by the S&P 500 Composite Index cannot explain negative Tuesday returns. This implies that we can reject the time zone hypothesis (Jaffe and Westerfield, 1985).

At the same time, significant estimates of α_2' and α_3' suggest that the observed day-of-the-week effects are reduced during the post-liberalization period. This is also true for the Thursday effect in Shenzhen (α_4'). Thus trading activities of Chinese private investors entering the B-share markets of Shanghai and Shenzhen appear to have reduced abnormal daily returns. This empirical result leads to the conclusion that day-of-the-week effects in Shanghai and Shenzhen B-share markets are instead explained by foreign institutional investor trading. Such reasoning is in accordance with previous US evidence showing that stocks with higher institutional ownership exhibit stronger daily seasonalities (Sias and Starks, 1995).

It is important to notice that this result is not due to time variation in spillovers from US markets. As pointed out above, our empirical specification permits the separate estimation of the marginal effects of seasonalities and global market integration. Even though we find a simultaneous reduction in both daily return seasonals and US influence, the two phenomena are in fact distinct. Along the same lines, one may argue that the entrance of domestic investors in B-share markets has led to an integration of A-share and B-share markets in the post-liberalization period and thus to a reduction in day-of-the-week effects. We emphasize that our results on seasonalities in B-share returns are robust to including A-share spillovers in our baseline model.

Moreover, it is conceivable that our empirical results on the post-liberalization reduction in day-of-the-week effects may be due to factors other than ownership structure, which affect both A-share and B-share returns. Examples include other regulatory regime shifts, changing government privatization policies, general economic conditions, and the like. We therefore test the proposed model of returns on A-share index data for the same sample period, including the B-share liberalization dummy. If our results are due to common factors affecting both markets, the coefficients on dummy interaction terms (α_1',...,α_5', β_1',..., β_4') should be statistically different from zero. As can be seen from Table 3, this is not the case. We find no evidence of reversed seasonalities in daily A-share returns after February 19, 2001, except for a Wednesday effect in the case of Shenzhen. Furthermore, neither US nor B-share returns appear to significantly influence A-share returns. In sum, estimation results for A-share markets lend further support to our conclusion that the market entrance of domestic investors has had a significant effect on day-of-the-week effects in B-share markets.

[Insert Table 3 about here]

To further investigate the robustness of our empirical results, we conduct additional tests, with the empirical approach to modeling B-share returns modified with respect to the number of coefficients in GJR-GARCH(1,1) model, the assumed structural change in conditional volatility, the sample period, alternative regional spillover effects, and the assumed error distribution.

Applying the general-to-specific procedure outlined above provides a robustness check for our empirical results. As can be seen from the above discussion of estimation results in Table 2, our main findings also hold for the more parsimonious specifications obtained from iteratively dropping terms from the general model. Day-of-the-week (especially Tuesday) effects, autocorrelation, the level of conditional volatility, as well as the influence of US spillover effects, are reduced for the post-liberalization period whereas the impact of A-share spillovers appears to increase.

As pointed out in Section 4, the assumption that the change in investor structure affects only the level of conditional volatility may seem restrictive. Therefore, as an additional robustness check, we complement our analysis by estimating the alternative GJR-GARCH(1,1) model given by Equations 1 and 3. Coefficient estimates for γ_D (not reported) are negative and significantly different from zero for both Shanghai and Shenzhen markets. Thus, in addition to finding evidence for a decrease in the level of conditional volatility, we cannot reject the hypothesis of a simultaneous structural change in all coefficients of the variance equation. At the same time, our empirical findings on day-of-the-week effects in index returns are robust to both models of conditional volatility.

We also investigate a shorter sample period for two reasons. First, we want to make sure that our main results are not specific to the 1994 - 2007 period. More specifically, we drop 3 years of observations at either end of the sample to maintain its symmetry around the liberalization date. The shorter sample thus covers trading days between January 2, 1997 and December 31, 2004. Second, by setting the starting point after November 16, 1996, we address the issue of varying price change limits prior to this date and their potential effects on seasonalities in returns (Mookerjee and Yu, 1999). Parameter estimates are presented in Table 4. Some of the significant coefficients in our baseline model are not robust to our general-to-specific procedure. More importantly, estimation results for the shorter sample period generally confirm the robustness of our previous results. We find a significant reduction in negative Tuesday effects in the post-liberalization period as well as reduced autocorrelation of returns and a diminished (increased) role of spillovers from US

(A-share) markets.

[Insert Table 4 about here]

Next, we analyze the effect of alternative regional spillover hypotheses on our estimation results. We replace the Taiwan Capitalization Weighted Stock Index as a proxy for regional influences with the Nikkei 225, the Korea Composite Stock Price Index (KOSPI), or the Hang Seng index from Hong Kong. Table 5 summarizes the estimation results. Interestingly, the effect of Japanese stock market index returns on China's B-share markets is not significant, suggesting a low degree of bilateral market integration. Spillover effects from South Korea are significant only for Shenzhen. On the contrary, there is strong evidence of regional spillovers from Hong Kong, which are however attenuated after the market entrance of domestic investors. In addition, the coefficient measuring the influence of US stock markets turns insignificant when we include the Hang Seng index in our model of Shanghai B-share returns. This finding may be due to strong linkages between stock markets in Hong Kong and the United States. For example, Hu et al. (1997) find a particularly strong feedback relationship in volatility between the Hang Seng index and the Dow Jones index when performing causality-in-variance tests for different stock markets in the South China Growth Triangular.

Most importantly, our main conclusions are not affected by the choice of proxy for regional spillovers. For all specifications considered, we find mitigated day-of-the-week effects, intensified A-share spillovers, a significant reduction of autocorrelation and, in most cases, a significant decrease in conditional volatility during the post-liberalization period.

[Insert Table 5 about here]

Finally, we investigate whether our main results are sensitive to alternative assumptions about the distribution of error terms. In additional estimations, we explore the effect of assuming t-distributed errors on our empirical findings. Maximum likelihood parameter estimates (not reported) suggest that our key results, i.e. the reduction in negative

Tuesday effects, autocorrelation, conditional volatility, and US spillover effects in the post-liberalization period, also hold under this alternative estimation approach.

6 Conclusions

This paper contributes to the debate on institutional and individual investors' behavior as a driver of day-of-the-week effects in stock returns by exploiting a unique institutional feature of Chinese B-share markets, i.e. the abolition of ownership restrictions in February 2001. We investigate whether the change in investor structure in form of the market entrance of domestic individual investors has an effect on daily return seasonalities in these markets.

Studying daily B-share index returns for the 1994-2007 sample period, we find evidence of negative Tuesday and to a lesser extent negative Wednesday and Thursday effects. These effects are significantly mitigated in the post-liberalization period, which witnesses the rising influence of domestic individual investor trading. This empirical result is in line with previous evidence of institutional investors being the primary cause of daily return seasonalities in the US (Sias and Starks, 1995). Two other results bear mention. First, we find evidence of positive autocorrelation of daily Shanghai and Shenzhen B-share index returns. This serial correlation has diminished considerably since the market entrance of domestic private investors. This finding is reminiscent of previous literature relating return autocorrelation to institutional ownership (Sias and Starks, 1997). Second, we detect a strong influence of the US stock market on the B-share segment of both stock exchanges. Again, this effect is weaker during the post-liberalization period. Our main findings are robust across exchanges, models, sample periods, and various other modifications of our empirical setup.

Summing up, our empirical results suggest that day-of-the-week effects in stock returns are related to the trading activity of different groups of investors. The market entrance of individual investors seems to improve the efficiency of China's B-share markets in terms of reduced day-of-the-week effects. This finding is in contrast to previous evidence attributing such return seasonalities to this presumably less sophisticated investor group (Lakonishok and Maberly, 1990; Abraham and Ikkenberry, 1994; Chan et al., 2004). A possible explanation is that private investors have actively traded against day-of-the-week effects, despite a number of institutional aspects hindering arbitrage. This view is consistent with the notion of wealthy domestic private investors being rather sophisticated and well-informed about fundamental asset values. Such reasoning is in line with literature documenting informational advantages of domestic investors (Hau, 2001; Chan et al., 2008) and wealthy investors acting as well-informed smart money traders (Kelly, 1997).

An alternative interpretation is that day-of-the-week effects may have died out in the post-liberalization period as the institutional share in daily trading volume diminished, while the increasing fraction of private investor trading has reduced seasonalities in aggregate indices. As Sias and Starks (1995) argue, the observed relationship between institutional ownership and day-of-the-week effects may be due to strong autocorrelation in institutional portfolios. At the same time, typical explanations involving buy or sell recommendations and information processing over the weekend clearly do not apply to negative Tuesday or Wednesday effects. Another possible conjecture is that such effects are due to other details of institutional trading patterns which have to date escaped discovery.

References

Abraham, Abraham, and David L. Ikkenberry, 1994, The individual investor and the weekend effect, *Journal of Financial and Quantitative Analysis* 29, 263 – 277.

Agrawal, Anup, and Kishore Tandon, 1994, Anomalies or illusions? Evidence from stock markets in eighteen countries, *Journal of International Money and Finance* 13, 83 – 106.

Barclay, Michael J., and Jerold B. Warner, 1993, Stealth trading and volatility: Which trades move prices?, *Journal of Financial Economics* 34, 281 – 305.

Barone, Emilio, 1990, The italian stock market - efficiency and calendar anomalies, *Journal of Banking and Finance* 14, 483 – 510.

Black, Fisher, 1976, Studies of stock price volatility changes, in *Proceedings of the Business and Economics Statistics Section, American Statistical Association* (American Statistical Association, Washington, DC).

Bollerslev, Tim, and Jeffrey M. Wooldridge, 1992, Quasi-maximum likelihood estimation of dynamic models with time-varying covariances, *Econometric Reviews* 11, 143–172.

Cai, Jinghan, Yuming Li, and Yuehua Qi, 2006, The day-of-the-week effect - new evidence from the Chinese stock market, *The Chinese Economy* 39, 71 – 88.

Chakravarty, Sugato, Asani Sarkar, and Lifan Wu, 1998, Information asymmetry, market segmentation and the pricing of cross-listed shares: Theory and evidence from Chinese A and B shares, *Journal of International Financial Markets, Institutions, and Money* 8, 325 – 356.

Chan, Kalok, Albert J. Menkveld, and Zhishu Yang, 2008, Information asymmetry and asset prices: Evidence from the China foreign share discount, *Journal of Finance* 63, 159–196.

Chan, Su Han, Wai-Kin Leung, and Ko Wang, 2004, The impact of institutional investors on the Monday seasonal, *Journal of Business* 77, 967 – 986.

Chen, Gongmeng, Kenneth A. Kim, John R. Nofsinger, and Oliver M. Rui, 2007, Trading performance, disposition effect, overconfidence, representativeness bias, and experience of emerging market investors, *Journal of Behavioral Decision Making* 20, 425 – 451.

Chen, Gongmeng, Chuck C. Y. Kwok, and Oliver M. Rui, 2001, The day-of-the-week regularity in the stock markets of China, *Journal of Multinational Financial Management* 11, 139 – 163.

Chui, Andy C.W., and Chuck C. Y. Kwok, 1998, Cross-autocorrelation between A shares and B shares in the chinese stock market, *Journal of Financial Research* 21, 333 – 353.

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

Cross, Frank, 1973, The behavior of stock prices on Fridays and Mondays, *Financial Analysts Journal* 29, 67–69.

Engle, Robert F., and Victor K. Ng, 1993, Measuring and testing the impact of news on volatility, *Journal of Finance* 48, 1749 – 1778.

Faff, Robert W., and Michael D. McKenzie, 2002, The impact of stock index futures trading on daily returns seasonality: A multicountry study, *Journal of Business* 75, 95–125.

Fernald, John, and John H. Rogers, 2002, Puzzles in the Chinese stock market, *Review of Economics and Statistics* 84, 416–432.

Fifield, Suzanne G.M., and Juliana Jetty, 2008, Further evidence on the efficiency of the Chinese stock market: A note, *Research in International Business and Finance* 22, 351 – 361.

French, Kenneth R., 1980, Stock returns and the weekend effect, *Journal of Financial Economics* 8, 55–69.

Girardin, Eric, and Zhenya Liu, 2005, Bank credit and seasonal anomalies in China's stock markets, *China Economic Review* 16, 465 – 483.

Glosten, Lawrence R., Ravi Jagannathan, and David E. Runkle, 1993, On the relation between the expected value and the volatility of the nominal excess return on stocks, *Journal of Finance* 48, 1779 – 1801.

Griffin, John M., Jeffrey H. Harris, and Selim Topaloglu, 2003, The dynamics of institutional and individual trading, *Journal of Finance* 58, 2285 – 2320.

Groth, John C., Wilbur G. Lewellen, Gary G. Schlarbaum, and Ronald C. Lease, 1979, An analysis of brokerage house securities recommendations, *Financial Analysts Journal* 35, 32–40.

Hau, Harald, 2001, Location matters: An examination of trading profits, *Journal of Finance* 56, 1959 – 1983.

Hu, John Wei-Shan, Mei-Yuan Chen, Robert C.W. Fok, and Bwo-Nung Huang, 1997, Causality in volatility and volatility spillover effects between US, Japan and four equity markets in the South China Growth Triangular, *Journal of International Financial Markets, Institutions and Money* 7, 351–367.

Jaffe, Jeffrey, and Randolph Westerfield, 1985, The week-end effect in common stock returns: The international evidence, *Journal of Finance* 40, 433–454.

Kamara, Avraham, 1997, New evidence on the Monday seasonal in stock returns, *Journal of Business* 70, 63–84.

Karolyi, G. Andrew, and Lianfa Li, 2003, A resolution of the Chinese discount puzzle, Working paper, Ohio State University.

Kelly, Morgan, 1997, Do noise traders influence stock prices?, *Journal of Money, Credit, and Banking* 29, 351 – 363.

Kling, Gerhard, and Lei Gao, 2008, Chinese institutional investors' sentiment, *Journal of International Financial Markets, Institutions and Money* 18, 374 – 387.

Lakonishok, Josef, and Maurice Levi, 1982, Weekend effect on stock returns: A note, *Journal of Finance* 37, 883–889.

Lakonishok, Josef, and Edwin Maberly, 1990, The weekend effect: Trading patterns of individual and institutional investors, *Journal of Finance* 45, 231 – 243.

Liao, Li, Meijuan Shi, and Hao Wang, 2008, The value of shareholder activism: New evidence from the split-share structure reform in China, Working Paper, Tsinghua University.

Mei, Jianping, Jose Scheinkman, and Wei Xiong, 2005, Speculative trading and stock prices: Evidence from Chinese A-B share premia, NBER Working Paper No. 11362, National Bureau of Economic Research, Cambridge, MA.

Mitchell, Jason D., and Li Lian Ong, 2006, Seasonalities in China's stock markets: Cultural or structural?, IMF Working Paper 06/4, International Monetary Fund, Washington, DC.

Mookerjee, Rajen, and Qiao Yu, 1999, Seasonality in returns on the Chinese stock markets: the case of Shanghai and Shenzhen, *Global Finance Journal* 10, 93 – 105.

Ng, Lilian, and Fei Wu, 2006, Revealed stock preferences of individual investors: Evidence from Chinese equity markets, *Pacific-Basin Finance Journal* 14, 175–192.

Nofsinger, John R., and Richard W. Sias, 1999, Herding and feedback trading by institutional and individual investors, *Journal of Finance* 54, 2263 – 2295.

Peterson, David R., 1990, Stock return seasonalities and earnings information, *Journal of Financial and Quantitative Analysis* 25, 187 – 201.

Rogalski, Richard J., 1984, New findings regarding day-of-the-week returns over trading and non-trading periods: A note, *Journal of Finance* 39, 1603–1614.

Shanghai Stock Exchange, 2001, Factbook.

Shanghai Stock Exchange, 2006, Factbook.

Sias, Richard W., and Laura T. Starks, 1995, The day-of-the-week anomaly: The role of institutional investors, *Financial Analysts Journal* 51, 58 – 67.

Sias, Richard W., and Laura T. Starks, 1997, Return autocorrelation and institutional investors, *Journal of Financial Economics* 46, 103 – 131.

Solnik, Bruno, and Laurence Bousquet, 1990, Day-of-the-week effect on the Paris Bourse, *Journal of Banking and Finance* 14, 461 – 468.

Walter, Carl E., and Fraser J. T. Howie, 2006, *Privatizing China - Inside China's Stock Markets* (John Wiley & Sons, Singapore), 2nd edition.

Table 1: Shanghai and Shenzhen B-Share Index Returns: Summary Statistics

	Shanghai			Shenzhen		
	pre	post	total	pre	post	total
mean	−0.0001	0.0009	0.0004	0.0000	0.0010	0.0005
min	−0.1308	−0.1029	−0.1308	−0.1670	−0.0958	−0.1670
max	0.1218	0.0945	0.1218	0.1245	0.0940	0.1245
std dev	0.0230	0.0219	0.0225	0.0239	0.0214	0.0227
skewness	0.4019	0.2899	0.3480	0.2517	0.1521	0.2036
kurtosis	7.6541	7.6171	7.6446	10.4463	7.0717	9.2230
ϕ_1			−0.1498			−0.1556
			(0.0664)			(0.0966)

Note: The table reports sample statistics for log returns on the Shanghai and Shenzhen B-share indices as well as results from Engle and Ng (1993) sign bias tests. The coefficient ϕ_1 is obtained by regressing squared past (standardized) return innovations from a GARCH(1,1) model on an indicator variable, which takes on the value of one if the previous residual is negative. P-values are in parentheses. Pre and post refer to the pre-liberalization and post-liberalization subsamples. The total sample period is January 3, 1994 - December 28, 2007.

Table 2: Shanghai and Shenzhen B-Share Index Returns, 1994 - 2007

	Shanghai				Shenzhen			
	General		Specific		General		Specific	
α_1	−0.071	(0.058)*			−0.017	(0.668)		
α'_1	−0.162	(0.000)***	−0.232	(0.000)***	−0.030	(0.580)		
α_2	−0.265	(0.000)***	−0.252	(0.000)***	−0.243	(0.003)***	−0.243	(0.000)***
α'_2	0.239	(0.001)***	0.234	(0.000)***	0.214	(0.022)**	0.208	(0.023)**
α_3	−0.116	(0.085)*			−0.146	(0.010)***		
α'_3	0.189	(0.023)**	0.079	(0.088)*	0.129	(0.061)*		
α_4	−0.053	(0.242)			−0.217	(0.003)***	−0.223	(0.003)***
α'_4	0.081	(0.135)			0.287	(0.002)***	0.296	(0.002)***
α_5	−0.047	(0.299)			−0.001	(0.983)		
α'_5	0.077	(0.150)			0.068	(0.325)		
β_1	0.172	(0.000)***	0.176	(0.000)***	0.181	(0.000)***	0.191	(0.000)***
β'_1	−0.119	(0.000)***	−0.122	(0.000)***	−0.157	(0.000)***	−0.169	(0.000)***
β_2	0.188	(0.000)***	0.180	(0.000)***	0.202	(0.000)***	0.199	(0.001)***
β'_2	−0.165	(0.000)***	−0.156	(0.000)***	−0.175	(0.000)***	−0.162	(0.017)**
β_3	0.031	(0.072)*	0.037	(0.011)**	0.056	(0.002)***	0.078	(0.000)***
β'_3	0.009	(0.637)			0.044	(0.053)*		
β_4	0.121	(0.000)***	0.123	(0.000)***	0.091	(0.000)***	0.091	(0.000)***
β'_4	0.805	(0.000)***	0.803	(0.000)***	0.801	(0.000)***	0.801	(0.000)***
γ_0	0.001	(0.000)***	0.001	(0.001)***	0.003	(0.001)***	0.003	(0.001)***
γ'_0	−0.001	(0.005)***	−0.001	(0.084)*	−0.001	(0.037)**	−0.001	(0.053)*
γ_1	0.764	(0.000)***	0.766	(0.000)***	0.653	(0.000)***	0.653	(0.000)***
γ_2	0.231	(0.000)***	0.234	(0.000)***	0.347	(0.000)***	0.335	(0.000)***
γ_3	0.026	(0.026)**			−0.044	(0.125)		

Note: The table reports coefficient estimates and p-values (in parentheses) for a GJR-GARCH(1,1) model, which in its general specification is given by

$$\begin{aligned} r_t &= \sum_{j=1}^{5} \alpha_j W_{j,t} + \sum_{j=1}^{5} \alpha'_j W_{j,t} D_t + \beta_1 r_{t-1} + \beta'_1 r_{t-1} D_t + \beta_2 r_{t-1}^{US} + \beta'_2 r_{t-1}^{US} D_t \\ &\quad + \beta_3 r_t^{TW} + \beta'_3 r_t^{TW} D_t + \beta_4 r_t^{A} + \beta'_4 r_t^{A} D_t + \varepsilon_t \\ h_t &= \gamma_0 + \gamma'_0 D_t + \gamma_1 h_{t-1} + \gamma_2 \varepsilon_{t-1}^2 + \gamma_3 \varepsilon_{t-1}^2 I_t \end{aligned}$$

where r_t denotes the log return on the Shanghai and Shenzhen B-Share Index, and $W_{j,t}$ dummy variables for Monday through Friday. r_{t-1}^{US}, r_t^{TW} and r_t^{A} are the log return on the US S&P 500 Composite Index, the Taiwan Capitalization Weighted Stock Index, and the Shanghai and Shenzhen A-Share Index, respectively. The dummy variable D_t is one for all observations after February 19, 2001 and zero otherwise. The indicator variable I_t takes on the value of one if the preceding innovation in returns was negative ($\varepsilon_{t-1} < 0$) and is zero otherwise. Following a general-to-specific approach, we iteratively eliminate coefficients that are insignificant at the 10% level, which results in the specific model. P-values are based on robust Bollerslev and Wooldridge (1992) standard errors. *, ** ,*** denote statistical significance at the 10%, 5% and 1% level, respectively. Point estimates for coefficients α_j and α'_j as well as γ_0 and γ'_0 are multiplied by 100. The sample period is January 3, 1994 - December 28, 2007.

Table 3: Shanghai and Shenzhen A-Share Index Returns, 1994 - 2007

	Shanghai				Shenzhen			
	General		Specific		General		Specific	
α_1	−0.040	(0.704)			−0.039	(0.694)		
α'_1	0.100	(0.387)			0.051	(0.669)		
α_2	−0.053	(0.238)			−0.026	(0.766)		
α'_2	0.116	(0.025)**			0.117	(0.248)		
α_3	0.150	(0.085)*			0.194	(0.012)**	0.206	(0.000)***
α'_3	−0.149	(0.128)			−0.219	(0.010)***	−0.250	(0.000)***
α_4	0.004	(0.885)			0.055	(0.112)		
α'_4	−0.141	(0.003)***	−0.140	(0.001)***	−0.198	(0.000)***	−0.154	(0.000)***
α_5	0.050	(0.533)			0.024	(0.569)		
α'_5	−0.102	(0.255)			−0.136	(0.031)**	−0.125	(0.003)***
β_1	−0.017	(0.503)			−0.005	(0.805)		
β'_1	0.017	(0.568)			0.039	(0.068)*	0.034	(0.053)*
β_2	−0.023	(0.436)			−0.043	(0.144)	−0.029	(0.070)*
β'_2	0.026	(0.408)			0.019	(0.573)		
β_3	0.239	(0.000)***	0.239	(0.000)***	0.285	(0.000)***	0.276	(0.000)***
β'_3	0.323	(0.000)***	0.322	(0.000)***	0.322	(0.000)***	0.328	(0.000)***
β_4	0.012	(0.629)			0.003	(0.892)		
β'_4	−0.014	(0.630)			−0.032	(0.214)	−0.027	(0.084)*
γ_0	0.005	(0.274)	0.005	(0.000)***	0.005	(0.273)	0.001	(0.000)***
γ'_0	−0.004	(0.316)	−0.004	(0.000)***	−0.004	(0.300)		
γ_1	0.886	(0.000)***	0.886	(0.000)***	0.891	(0.000)***	0.907	(0.000)***
γ_2	0.092	(0.011)**	0.091	(0.000)***	0.084	(0.001)***	0.072	(0.000)***
γ_3	0.057	(0.000)***	0.060	(0.000)***	0.061	(0.018)**	0.067	(0.000)***

Note: The table reports coefficient estimates and p-values (in parentheses) for a GJR-GARCH(1,1) model, which in its general specification is given by

$$\begin{aligned} r_t &= \sum_{j=1}^{5} \alpha_j W_{j,t} + \sum_{j=1}^{5} \alpha'_j W_{j,t} D_t + \beta_1 r_{t-1} + \beta'_1 r_{t-1} D_t + \beta_2 r^{US}_{t-1} + \beta'_2 r^{US}_{t-1} D_t \\ &\quad + \beta_3 r^{TW}_t + \beta'_3 r^{TW}_t D_t + \beta_4 r^B_t + \beta'_4 r^B_t D_t + \varepsilon_t \\ h_t &= \gamma_0 + \gamma'_0 D_t + \gamma_1 h_{t-1} + \gamma_2 \varepsilon^2_{t-1} + \gamma_3 \varepsilon^2_{t-1} I_t \end{aligned}$$

where r_t denotes the log return on the Shanghai and Shenzhen A-Share Index, and $W_{j,t}$ dummy variables for Monday through Friday. r^{US}_{t-1}, r^{TW}_t and r^B_t are the log return on the US S&P 500 Composite Index, the Taiwan Capitalization Weighted Stock Index, and the Shanghai and Shenzhen B-Share Index, respectively. The dummy variable D_t is one for all observations after February 19, 2001 and zero otherwise. The indicator variable I_t takes on the value of one if the preceding innovation in returns is negative ($\varepsilon_{t-1} < 0$) and is zero otherwise. Following a general-to-specific approach, we iteratively eliminate coefficients that are insignificant at the 10% level, which results in the specific model. P-values are based on robust Bollerslev and Wooldridge (1992) standard errors. *, ** ,*** denote statistical significance at the 10%, 5% and 1% level, respectively. Point estimates for coefficients α_j and α'_j (γ_0 and γ'_0) are multiplied by 100 (1000). The sample period is January 3, 1994 - December 28, 2007.

Table 4: Shanghai and Shenzhen B-Share Index Returns, 1997 - 2004

	Shanghai				Shenzhen			
	General		Specific		General		Specific	
α_1	−0.048	(0.261)			−0.109	(0.463)		
α'_1	−0.135	(0.003)***	−0.182	(0.000)***	0.086	(0.627)***		
α_2	−0.405	(0.000)***	−0.389	(0.003)***	−0.349	(0.000)***	−0.356	(0.000)***
α'_2	0.367	(0.000)***	0.359	(0.011)**	0.289	(0.009)***	0.291	(0.000)***
α_3	−0.082	(0.115)			−0.184	(0.084)*		
α'_3	0.144	(0.014)**			0.252	(0.050)**		
α_4	0.092	(0.050)**			−0.081	(0.391)		
α'_4	−0.077	(0.130)			0.118	(0.274)		
α_5	−0.109	(0.001)***			0.017	(0.838)		
α'_5	0.087	(0.014)**			0.048	(0.576)		
β_1	0.120	(0.000)***	0.123	(0.000)***	0.100	(0.000)***	0.105	(0.000)***
β'_1	−0.082	(0.000)***	−0.082	(0.029)**	−0.082	(0.014)**	−0.085	(0.000)***
β_2	0.171	(0.000)***	0.180	(0.000)***	0.190	(0.000)***	0.203	(0.000)***
β'_2	−0.148	(0.000)***	−0.164	(0.001)***	−0.149	(0.004)***	−0.171	(0.000)***
β_3	0.092	(0.000)***	0.043	(0.010)**	0.131	(0.000)***	0.085	(0.000)***
β'_3	−0.064	(0.000)***			−0.064	(0.076)*		
β_4	0.657	(0.000)***	0.657	(0.000)***	0.644	(0.000)***	0.650	(0.000)***
β'_4	0.277	(0.000)***	0.281	(0.000)***	0.348	(0.000)***	0.340	(0.000)***
γ_0	0.004	(0.000)***	0.004	(0.001)***	0.005	(0.000)***	0.005	(0.000)***
γ'_0	−0.003	(0.000)***	−0.003	(0.002)***	−0.004	(0.000)***	−0.004	(0.000)***
γ_1	0.720	(0.000)***	0.721	(0.000)***	0.683	(0.000)***	0.687	(0.000)***
γ_2	0.235	(0.000)***	0.252	(0.000)***	0.275	(0.000)***	0.255	(0.000)***
γ_3	0.042	(0.000)***			−0.030	(0.461)		

Note: The table reports coefficient estimates and p-values (in parentheses) for a GJR-GARCH(1,1) model, which in its general specification is given by

$$\begin{aligned} r_t &= \sum_{j=1}^{5} \alpha_j W_{j,t} + \sum_{j=1}^{5} \alpha'_j W_{j,t} D_t + \beta_1 r_{t-1} + \beta'_1 r_{t-1} D_t + \beta_2 r_{t-1}^{US} + \beta'_2 r_{t-1}^{US} D_t \\ &\quad + \beta_3 r_t^{TW} + \beta'_3 r_t^{TW} D_t + \beta_4 r_t^{A} + \beta'_4 r_t^{A} D_t + \varepsilon_t \\ h_t &= \gamma_0 + \gamma'_0 D_t + \gamma_1 h_{t-1} + \gamma_2 \varepsilon_{t-1}^2 + \gamma_3 \varepsilon_{t-1}^2 I_t \end{aligned}$$

where r_t denotes the log return on the Shanghai and Shenzhen B-Share Index, and $W_{j,t}$ dummy variables for Monday through Friday. r_{t-1}^{US}, r_t^{TW} and r_t^{A} are the log return on the US S&P 500 Composite Index, the Taiwan Capitalization Weighted Stock Index, and the Shanghai and Shenzhen A-Share Index, respectively. The dummy variable D_t is one for all observations after February 19, 2001 and zero otherwise. The indicator variable I_t takes on the value of one if the preceding innovation in returns is negative ($\varepsilon_{t-1} < 0$) and is zero otherwise. Following a general-to-specific approach, we iteratively eliminate coefficients that are insignificant at the 10% level, which results in the specific model. P-values are based on robust Bollerslev and Wooldridge (1992) standard errors. *, ** ,*** denote statistical significance at the 10%, 5% and 1% level, respectively. Point estimates for coefficients α_j and α'_j as well as γ_0 and γ'_0 are multiplied by 100. The sample period is January 2, 1997 - December 31, 2004.

Table 5: Shanghai and Shenzhen B-Share Index Returns with Alternative Regional Spillover Effects, 1994 - 2007

	Shanghai						Shenzhen					
	Japan		Korea		Hong Kong		Japan		Korea		Hong Kong	
α_1	−0.070	(0.328)	0.020	(0.353)	−0.058	(0.363)	−0.014	(0.729)	−0.022	(0.749)	−0.027	(0.479)
α'_1	−0.166	(0.080)*	−0.162	(0.083)*	−0.179	(0.029)**	−0.032	(0.570)	−0.017	(0.859)	−0.018	(0.726)
α'_2	−0.274	(0.000)***	−0.290	(0.000)***	−0.278	(0.000)***	−0.267	(0.000)***	−0.259	(0.000)***	−0.268	(0.000)***
α'_2	0.249	(0.000)***	0.279	(0.000)***	0.242	(0.000)***	0.247	(0.000)***	0.228	(0.000)***	0.239	(0.000)***
α_3	−0.118	(0.021)**	−0.060	(0.035)**	−0.126	(0.086)*	−0.126	(0.038)**	−0.117	(0.119)	−0.151	(0.023)**
α'_3	0.195	(0.001)***	0.182	(0.004)***	0.206	(0.019)**	0.133	(0.081)*	0.115	(0.236)	0.157	(0.050)**
α_4	−0.052	(0.198)	0.006	(0.473)	−0.014	(0.843)	−0.211	(0.001)***	−0.211	(0.004)***	−0.171	(0.009)***
α'_4	0.083	(0.109)	0.048	(0.380)	0.050	(0.553)	0.279	(0.000)***	0.287	(0.002)***	0.252	(0.002)***
α_5	−0.041	(0.564)	0.011	(0.000)***	−0.077	(0.238)	0.006	(0.891)	0.000	(0.994)	−0.011	(0.801)
α'_5	0.071	(0.476)	0.060	(0.464)	0.105	(0.243)	0.051	(0.345)	0.067	(0.421)	0.086	(0.118)
β_1	0.172	(0.000)***	0.188	(0.000)***	0.168	(0.000)***	0.183	(0.000)***	0.188	(0.000)***	0.182	(0.000)***
β'_1	−0.118	(0.000)***	−0.079	(0.000)***	−0.115	(0.000)***	−0.160	(0.000)***	−0.171	(0.000)***	−0.158	(0.000)***
β_2	0.193	(0.000)***	0.252	(0.000)***	0.039	(0.223)	0.213	(0.000)***	0.189	(0.000)***	0.086	(0.296)
β'_2	−0.149	(0.001)***	−0.208	(0.000)***	−0.016	(0.643)	−0.183	(0.003)***	−0.159	(0.000)***	−0.060	(0.514)
β_3	0.008	(0.771)	0.009	(0.435)	0.222	(0.000)***	0.020	(0.321)	0.048	(0.009)***	0.129	(0.031)**
β'_3	−0.008	(0.822)	−0.007	(0.720)	−0.167	(0.000)***	0.068	(0.009)***	0.034	(0.152)	−0.016	(0.811)
β_4	0.121	(0.000)***	0.243	(0.000)***	0.116	(0.000)***	0.091	(0.000)***	0.092	(0.000)***	0.094	(0.000)***
β'_4	0.805	(0.000)***	0.724	(0.000)***	0.803	(0.000)***	0.795	(0.000)***	0.791	(0.000)***	0.787	(0.000)***
γ_0	0.001	(0.003)***	0.090	(0.000)***	0.001	(0.004)***	0.003	(0.000)***	0.003	(0.000)***	0.003	(0.000)***
γ'_0	−0.001	(0.135)	−0.036	(0.000)***	0.000	(0.182)	−0.001	(0.014)**	−0.001	(0.039)**	−0.001	(0.032)**
γ_1	0.762	(0.000)***	−1.001	(0.000)***	0.759	(0.000)***	0.659	(0.000)***	0.650	(0.000)***	0.655	(0.000)***
γ_2	0.235	(0.000)***	0.008	(0.000)***	0.238	(0.000)***	0.341	(0.000)***	0.350	(0.000)***	0.345	(0.000)***
γ_3	0.027	(0.369)	−0.006	(0.000)***	0.031	(0.386)	−0.038	(0.167)	−0.041	(0.205)	−0.065	(0.049)**

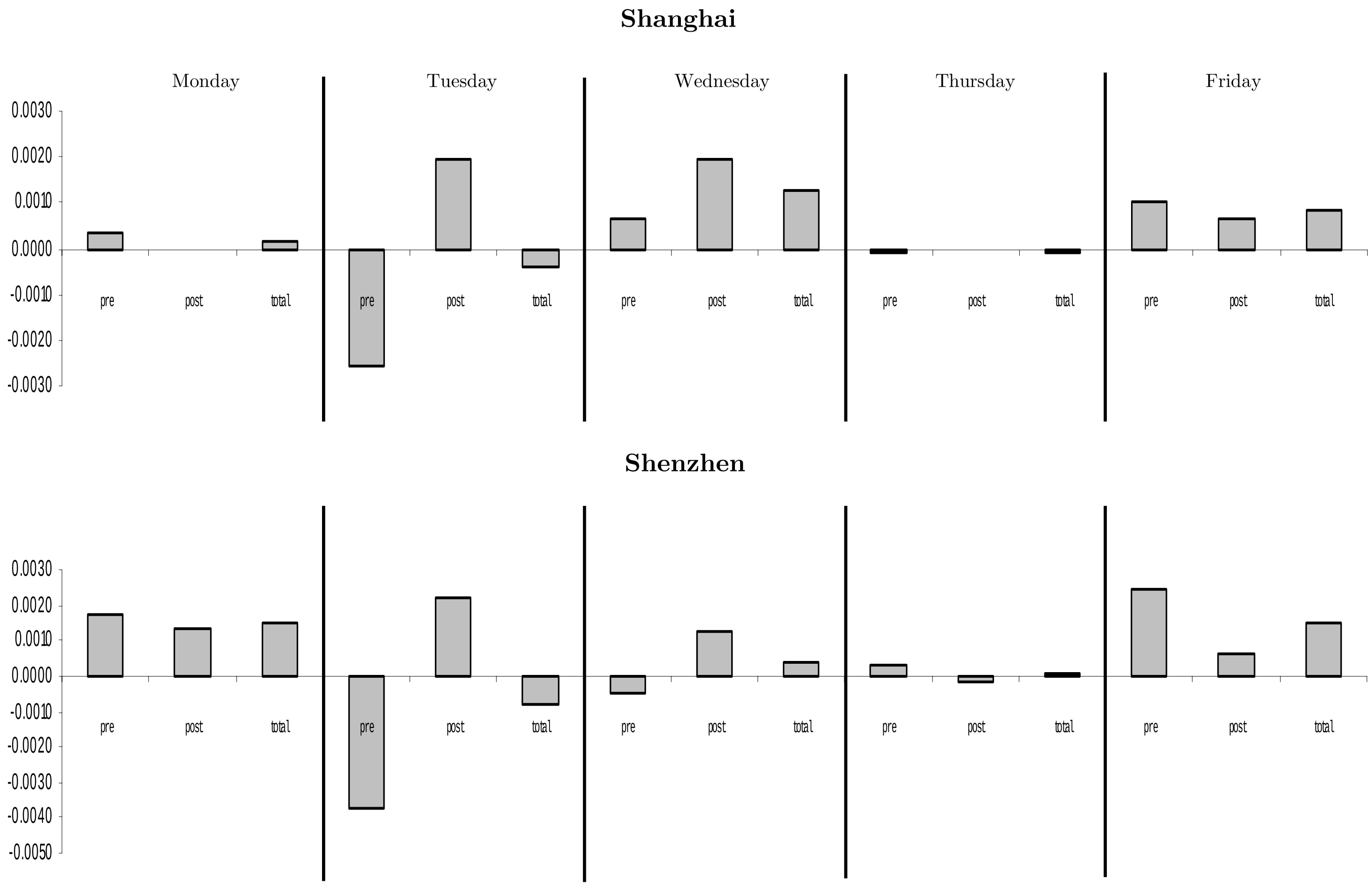
Note: The table reports coefficient estimates and p-values (in parentheses) for a GJR-GARCH(1,1) model, which in its general specification is given by

$$r_t = \sum_{j=1}^{5} \alpha_j W_{j,t} + \sum_{j=1}^{5} \alpha'_j W_{j,t} D_t + \beta_1 r_{t-1} + \beta'_1 r_{t-1} D_t + \beta_2 r_{t-1}^{US} + \beta'_2 r_{t-1}^{US} D_t + \beta_3 r_t^{REG} + \beta'_3 r_t^{REG} D_t + \beta_4 r_t^A + \beta'_4 r_t^A D_t + \varepsilon_t$$

$$h_t = \gamma_0 + \gamma'_0 D_t + \gamma_1 h_{t-1} + \gamma_2 \varepsilon_{t-1}^2 + \gamma_3 \varepsilon_{t-1}^2 I_t$$

where r_t denotes the log return on the Shanghai and Shenzhen B-Share Index, and $W_{j,t}$ dummy variables for Monday through Friday. r_t^{US} is the log return on the US S&P 500 Composite Index. r_t^{REG} denotes different regional index returns from Japan (Nikkei 225), South Korea (Korea Composite Stock Price Index, KOSPI), and Hong Kong (Hang Seng). r_t^A denotes the log return on the Shanghai and Shenzhen A-Share Index. The dummy variable D_t is one for all observations after February 19, 2001 and zero otherwise. The indicator variable I_t takes on the value of one if the preceding innovation in returns is negative ($\varepsilon_{t-1} < 0$) and is zero otherwise. Following a general-to-specific approach, we iteratively eliminate coefficients that are insignificant at the 10% level, which results in the specific model. P-values are based on robust Bollerslev and Wooldridge (1992) standard errors. *, ** ,*** denote statistical significance at the 10%, 5% and 1% level, respectively. Point estimates for coefficients α_j and α'_j as well as γ_0 and γ'_0 are multiplied by 100. The sample period is January 3, 1994 - December 28, 2007.

Figure 1: Average B-Share Index Returns by Day of the Week



Note: The figure compares daily average log close-to-close returns on the Shanghai and Shenzhen B-Share Index across days of the week. Pre and post refer to mean log returns before and after the abolition of ownership restrictions on February 19, 2001. The sample period is January 3, 1994 - December 28, 2007.

Earlier BOFIT Discussion Papers

For a complete list of Discussion Papers published by BOFIT, see www.bof.fi/bofit

2009 No 1 Jenni Pääkkönen: Economic freedom as a driver for growth in transition
No 2 Jin Feng, Lixin He and Hiroshi Sato: Public pension and household saving: Evidence from China
No 3 Laurent Weill: Does corruption hamper bank lending? Macro and micro evidence
No 4 Balázs Égert: Dutch disease in former Soviet Union: Witch-hunting?
No 5 Rajeev K. Goel and Iikka Korhonen: Composition of exports and cross-country corruption
No 6 Iikka Korhonen and Aaron Mehrotra: Real exchange rate, output and oil: Case of four large energy producers
No 7 Zuzana Fungáčová, Christophe J. Godlewski and Laurent Weill: Asymmetric information and loan spreads in Russia: Evidence from syndicated loans
No 8 Tuuli Juurikkala, Alexei Karas, Laura Solanko: The role of banks in monetary policy transmission: Empirical evidence from Russia
No 9 Ying Fang and Yang Zhao: Do institutions matter? Estimating the effect of institutions on economic performance in China
No 10 Michael Funke and Hao Yu: Economic growth across Chinese provinces: in search of innovation-driven gains
No 11 Jarko Fidrmuc and Iikka Korhonen : The impact of the global financial crisis on business cycles in Asian emerging economies
No 12 Zuzana Fungáčová and Laurent Weill: How market power influences bank failures: Evidence from Russia
No 13 Iikka Korhonen and Maria Ritola: Renminbi misaligned - Results from meta-regressions
No 14 Michael Funke, Michael Paetz and Ernest Pytlarczyk: Stock market wealth effects in an estimated DSGE model for Hong Kong
No 15 Jenni Pääkkönen: Are there industrial and agricultural convergence clubs in China?
No 16 Simo Leppänen, Mikael Linden and Laura Solanko: Firm behavior under production uncertainty: Evidence from Russia
No 17 Julan Du, Yi Lu and Zhigang Tao: China as a retulatory state
No 18 Aaron Mehrotra and Tomáš Slačík: Evaluating inflation determinants with a money supply rule in four Central and Eastern European EU member states
No 19 Chun-Yu Ho: Market structure, welfare, and banking reform in China
No 20 Martin T. Bohl, Michael Schuppli, and Pierre L. Siklos: Stock return seasonalities and investor structure: Evidence from China's B-share markets

Bank of Finland
BOFIT – Institute for Economies in Transition
PO Box 160
FIN-00101 Helsinki

☎ + 358 10 831 2268
bofit@bof.fi
http://www.bof.fi/bofit