Foreign Ownership and Domestic Stock Return Volatility -- Empirical Evidence in China[1]

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Abstract

Foreign capital flows to emerging stock markets are often blamed to "come and go quickly" to cause additional volatility or even financial crises, such as the 1997 Asian financial crisis, in these markets. The segmented Chinese stock market, prohibiting capital flows between domestic and foreign investors, offers a unique opportunity for examining the effect of foreign capital on domestic stock return volatility. Precisely, we ask and address in this paper the question: Does foreign ownership have an impact on individual stock return volatility in the domestic stock market of China? We find that tradable foreign ownership drives up a firm's domestic stock return volatility while non-tradable foreign ownership, as anticipated, does not. This relationship held steady during and after, but not before, the 1997 Asian financial crisis. Our further investigation show that the higher domestic stock return volatility associated with foreign ownership is mainly due to these firms' exposure to international stock market risk. We interpret the result as follows: As China's economy becomes more and more integrated into the world economy, it is possible that domestic stock investors would also like to hedge against international stock market risk. The domestic investors could do so for firms with tradable foreign shares which provide information flows from international stock markets to the domestic stock market. Our results are robust with respect to controlling for firm and industry factors, different measures of return volatility, etc. The evidence seems to suggest that although stock market segmentation can possibly prevent stock market crises caused by international capital flows, it is still subject to international stock market risk.

1. Introduction

Foreign capital flows to emerging stock markets are often blamed to "come and go quickly" to cause additional volatility or even financial crises, such as the 1997 Asian financial crisis, in these markets. The segmented Chinese stock market, prohibiting capital flows between domestic and foreign investors, offers a unique opportunity for examining the effect of foreign capital on domestic stock return volatility. Precisely, we ask and address in this paper the question: Does foreign ownership have an impact on individual stock return volatility in the domestic stock market of China?

Following the trend of globalization, many emerging economies opened their stock markets to foreign investors. Our research is closely related to the "stock market opening" literature. Given the segmented stock markets, mainland Chinese firms could issue A-shares to domestic investors, and B-shares or H-shares to foreign investors. Bringing foreign investors into the ownership structure of a firm in such a way makes Chinese equity market open partially. Apparently there is no direct capital flow between domestic investors and foreign investors, due to the market segmentation. Therefore, the arguments made on foreign capital inflows and outflows in the literature cannot apply to Chinese stock market. This motivates why we take Chinese stock market as a separate study.

In the "stock market openings" literature, Levine and Zervos (1996 and 1998) and Rajan and Zingales (1998) find that stock market openings are positively related to long run economic growth. It appears that opening stock markets also improve market efficiency, global diversification, internationally risk-sharing and steady-state welfare gains (Obstfeld (1994), Levine and Zervos (1996 and 1998) and Boyd and Smith (1996)). Recent empirical evidence shows improved corporate governance (Doidge (2004), Kim and Singal (2003), Bae, Bailey and Mao (2005)) when stock markets open to foreign investors. This was desirable for the Chinese government when setting up her stock market in the early 1990's. In addition, Henry (2000), Bekaert and Harvey (2000) and Kim and Singal (2000) find that cost of capital is reduced upon market liberalization. Some similar evidence was offered by Foerster and Karolyi (1999),

Miller (1999) and Errunza and Miller (2000) based on cross-listing in developed stock markets. While the above findings seem to have little disagreement, whether stock market openings would stabilize or destabilize firms' returns in such markets is still controversial. In this paper, we study this particular issue for the partially-opened Chinese stock market.

Bakaer and Harvey (1997 and 2000) claim that stock market liberalizations do not drive up emerging market volatility. Kim and Singal (2000) find that volatility moves down after market liberalization. Bae, Chan and Ng (2004) document a higher firm-level stock return volatility when the investibility, the degree to which a stock can be foreign-owned, is higher. The different conclusions from these studies were actually drawn from different data sets. Lacking of the exact market opening data is one of the major disadvantages from the existing studies. In this paper, we use the exact degree of foreign ownership data for Chinese stock market. In particular we have the exact degree of foreign ownership data on each class of foreign shares for each Chinese firm.

This paper examines the relationship between foreign ownership and A-share stock return volatility for the period between January 1994 and January 2002. We find that a firm's A-share return volatility is higher if the firm has issued any one of the two tradable foreign shares: B-share or H-share. In particular, our examination shows that this relationship holds steady during and after the 1997 Asian financial crisis, but it does not hold before the financial crisis, when we further investigate the issue in different sub-sample periods. As anticipated, no systematic pattern was found between non-tradable foreign ownership and A-share return volatility in any one of our sample periods. As the maximum degree of foreign ownership is not allowed to reach 50%, interestingly we find that foreign ownership dummies and the exact proportion of foreign ownership to total shares outstanding play essentially the same role in affecting A-share return volatility. Next, we separate a firm's total volatility into a foreign volatility component and a domestic volatility component. The foreign volatility component reflects the loading (or alternatively co-movement) of a firm's A-share return on (with) foreign share market factors. In fact, this foreign volatility component

is the systematic risk from the international stock markets. Our investigation shows that foreign ownership affects only the foreign volatility component of a firm's total volatility, during and after the Asian financial crisis. Our interpretation is that foreign share market information is transmitted to the domestic stock returns through the tradable foreign shares. Our results are robust as to controlling for firm and industry factors, different measures of return volatility, etc. and they imply that the stock market segmentation initially set up by the Chinese government is still subject to the risk transferred from foreign share markets.

The remainder of the paper is organized as follows. Section 2 presents the background information of Chinese stock market. Data and a preliminary analysis are given in Section 3. We report in Section 4 the empirical results of our regression analysis on the relationship between foreign ownership and A-share return volatility. Section 5 decomposes total volatility into foreign component and domestic component. We run the regression of each of the two components on foreign ownership, so as to identify more precisely the effect of foreign ownership on A-share return volatility. The paper is concluded in Section 6.

2. Background of Chinese Stock Market

The two stock exchanges in mainland China, Shanghai Stock Exchange (SHSE) and Shenzhen Stock Exchange (SZSE), were established in November 1990 and July 1991, respectively. Almost all firms listed on the two exchanges issue A-shares which are tradable only among domestic investors, i.e., Chinese citizens. In other words, A-share market is the domestic stock market. No firm is cross-listed on the two stock exchanges. As most of the listed firms were partially privatized from state-owned enterprises, about two-thirds of all outstanding shares of the firms are actually non-tradable, owned by the Chinese government or domestic financial institutions. These

non-tradable shares are called state-owned or (domestic) legal-entity owned shares,[3] and can be transferred at substantially-discounted prices between government agencies or corporations.

To attract foreign capital through stock markets, some Chinese firms are allowed to issue foreign shares. By and large, there are three classes of foreign shares: B-shares, H-shares and non-tradable (legal-entity) foreign shares. B-shares are tradable among foreign investors on the SHSE and SZSE , denominated in Yuan but traded in foreign currency. H-shares are traded on the Stock Exchange of Hong Kong (SEHK). Non-tradable (legal-entity) foreign shares are owned by foreign institutional investors.[4] All foreign shares have the same monetary claims and voting rights as A-shares do. Based on the regulation, total foreign ownership in any firm cannot exceed 49%. Bringing foreign investors into the ownership structure of a firm is not only intended to attract foreign capital, but also to enhance the management quality of the firm. This ownership structure opens the Chinese equity market *partially* while still exerts governmental control over international capital flows. Likely, this explains why the 1997 Asian financial crisis did not substantially affect China's stock market while it was like a big earth quake in all the other major Asian markets.

Although the domestic and foreign markets are segmented, the mainland China's economy becomes more and more integrated into the world economy. Therefore, Chinese stock investors may have incentive to hedge the risk from the world stock markets. Trading a firm's foreign shares may carry international market information which may impact on the pricing of domestic shares of the firm, though there is no trade between domestic investors and foreign investors. As stock volatility is mainly

[3] At the end of April 2005, the China Security Regulatory Commission (CSRC), the regulator of China's securities and futures industry announced a pilot program to sell off stat-owned shares, which is intended to make all the shares tradable on the markets. However, this is the third time that the Chinese government has attempted to sell off state-owned shares, and both of the previous attempts failed due to negative market reactions.

[4] In our sample, no firm issued any N-shares. One exception is that the Tianjin Zhongxin Pharmaceutical Co. (local stock code: 600329) issued A-shares in Shanghai and also issued shares on the Singapore Stock Exchange. This firm's foreign tradable shares are treated as H-shares in our analysis.

driven by information, it is possible that foreign investors, though only trading in foreign share markets, could still have impacts on A-share return volatility.

3. Data and Preliminary Analysis

The data used in this paper are mainly taken from *Shenzhen Guo Tai An Information Technology Co*. database which covers all firms listed in mainland China. The sample for this study spans the period from January 1994 to January 2002.[5] The data for the world market index and the Asian market index are retrieved from the Datastream.

Table 1 presents the numbers of listed firms with different classes of shares at the end of each December from 1993 to 2001. In our sample, all firms have issued A-shares on either SHSE or SZSE. No firm is cross-listed in the two stock exchanges. Some of the sampled firms also issued foreign shares: B-shares or H-shares and/or non-tradable foreign shares. Column 2 gives the numbers of firms with B-shares, some of which may have also issued non-tradable foreign shares. For reference, the last column displays the numbers of firms having both B-shares and non-tradable foreign shares. Unlike B-share firms, firms with H-shares, in column 3, have never issued non-tradable foreign shares. Firms with non-tradable foreign shares as their only foreign ownership are shown in column 4. Adding columns 2, 3 and 4 together yields column 5, the total number of firms with foreign ownership at the end of each year. It is noted that no firm has issued both B-shares and H-shares. Our grouping is intended to classify the total number of firms with foreign ownership (column 5) into three categories: B-shares (column 2), H-shares only (column 3) and Non-tradable foreign

[5] We deliberately exclude in our sample the initial two years of data from the database for the following reason. The Shanghai Stock Exchange was inaugurated on 19 December 1990 and Shenzhen Stock Exchange started provisional trading on 3 April 1991 and formally opened on 4 July 1991. On 30 November 1991, Shanghai Vacuum Electronics Inc. issued the first B-shares in China. On 29 June 1993, Tsingtao Brewery listed its H-shares on the Stock Exchange of Hong Kong, and became the first mainland China incorporated state-owned enterprise to list in Hong Kong. Therefore, we start our sample from December 1993.

shares only (column 4). This classification is exhaustive and mutually exclusive.[6] Column 6 reports the numbers of firms with A-share. These firms include all of the firms having foreign shares in column 5. Figure 1 offers a graphical demonstration of the classification. The rounded rectangular stand for all of A-share firms in our sample, i.e., column 6 of Table 1. Each oval represents the number of firms with each class of foreign shares. Oval with B-share firms is column 2, oval with H-share firms is column 3 and oval with non-tradable foreign share firms subtracting its intersection with the oval with B-share firms is column 4. The intersection is column 7 of Table 1.

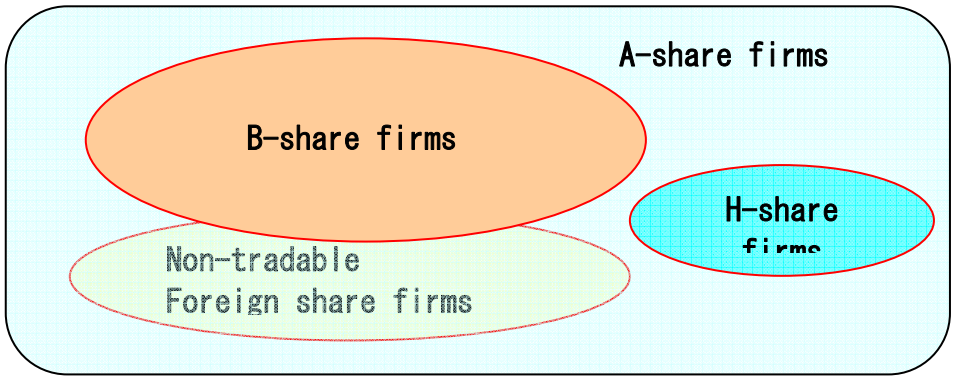

Fig. 1: Firms with different classes of shares

The number of A-share firms in column 6 of Table 1 increases dramatically from 176 in December, 1993 to 1135 in December, 2001. The number of firms having issued different classes of foreign shares also rises quickly during the whole sample period: Firms with B-shares go up steadily from 35 to 88, firms with H-shares climb from 3 to 25 and the number of firms with non-tradable foreign ownership (as their only foreign ownership) grow from 8 to 44. Regarding the firms with foreign ownership, there is a steady growth from 46 in 1993 to 120 in 1997 and 157 in 2001. Converting the numbers of firms into percentages, however, we see that the proportion of firms with

[6] In fact, we can also classify the firms with foreign ownership in some other ways. For example, we can put firms with both B-shares and Non-tradable foreign shares into the third category (column 4) rather than the first category (column 2). As tradable foreign shares should carry more information than non-tradable foreign shares to this analysis, we believe that our current classification makes better sense than the other ways. In addition, we have done robust tests with the other classifications and our conclusion remains the same.

foreign ownership to the total number of A-share firms drops slowly from 26% in 1994 to about 14% in 2001. Similarly, the ratio of firms with tradable foreign ownership to the total number of A-share firms begins with 22% in 1993 and ends with 10% in 2001. It means that there are *relatively* fewer and fewer firms issuing foreign shares, though the absolute number of such firms increases quickly over time. This unbalanced increase in the number of firms may reduce the significance of our findings, if any, to the effect of foreign ownership on A-share return volatility. Our results appear to be conservative, if we can find any significant effect of foreign ownership on A-share return volatility.

Table 2 reports the summary statistics of the numbers of different classes of foreign shares as a percentage of total numbers of shares outstanding during the sample period. In each panel of Table 2, we use the firms with a particular class of foreign ownership to calculate the statistics. For example, in Panel A, we have the sample mean of 23.56% in 1993. To obtain the sample mean, we first calculate the ratio of the number of B-shares to the total number of shares outstanding for each B-share firm. Then we average the ratios over all B-share firms. The average ratio is 23.56% based on 35 B-share firms in 1993. The other entries in the table could be understood similarly. Table 2 shows that average B-shares are less than 30%. The average H-shares take a little more than 30% except in 1994, while the average non-tradable foreign ownership is higher than 20% before 1998 and lower than 20% in and after 1998. Basically, the median of the proportions for each class of foreign ownership is not far from its mean, except for non-tradable foreign shares in 1999. The range of proportions for B-shares is large, between 7.08% and 49.94%, that for H-shares is narrower, between 19.35% and 46.33%, and that for non-tradable foreign ownership is large too, from slightly higher than 0% to 46.16%. It is noted that 0% in column 6 is a rounding number, which is actually slightly more than 0%. During the whole sample period, no firm has more than 50% of any single category of foreign ownership.[7] This is another major difference between the firms listed in mainland China and those in other emerging stock markets.

[7] There are six firms in the sample where the total foreign ownership of both B-shares and non-tradable legal-entity shares exceeds 50%.

The monthly return volatility of stock *i* is defined as

$$Vol_{i,t} = 21 \times \frac{1}{D_t} \sum_{d=1}^{D_t} [\ln(P_{i,d} + Div_{i,d}) - \ln(P_{i,d-1})]^2 \quad (1)$$

where $P_{i,d}$ is the daily closing price of the stock; $Div_{i,d}$ is the dividend or any income distribution for the stock on day d and D_t is the number of trading days for stock i in month t. Usually, there are 21 trading days each month, and we normalize the monthly return volatility based on 21 trading days.[8]

Table 3 displays the summary statistics for A-share return volatility. Panel A of the table presents the summary statistics for A-share return volatility with respect to four groups of firms which have different classes of ownership. The first group is marked with "A-shares only." This group comprises firms which have issued A-shares but not foreign shares. The second group is named "B-shares." In this group, we consider A-share return volatility for all the firms having issued B-shares (it is noted that some of the firms have issued non-tradable foreign shares too, to be consistent with Tables 1 and 2). Similarly, we define "H-shares only" and "Non-tradable foreign shares only" groups. Each of the groups corresponds to one of those in Tables 1 and 2. The whole sample period is divided into four sub-sample periods: from January 1994 to June 1997 (before the 1997 Asian financial crisis); from July 1997 to June 1998 (during the 1997 Asian financial crisis); from July 1998 to January 2001 (after the 1997 Asian financial crisis); from February 2001 to January 2002 (after the B-share markets were opened to domestic Chinese investors).

Cross-sectionally, we expect to see the effect of foreign ownership on A-share return volatility. Over the whole sample period, it seems clear that A-share return volatility of firms having issued foreign ownership is *larger* than that of firms with only A-shares, though the volatility difference between "A-shares only" and "H-shares only" is small (2.12 – 2.03 = .09). It seems that the data suggest A-share return volatility would be

[8] We also tried some other measures of stock return volatility, such as taking the first order autocorrelation into account or simply summing up the squared daily returns over each month. It is found that our results are robust with respect to all of these different definitions. As such, we only take this simple form of volatility measure in this paper.

higher if the firm has issues of foreign shares. However, this relationship does not hold in all of the sub-sample periods. In the first sub-sample period, i.e., before the Asian financial crisis, A-share return volatility for "A-shares only" is much higher than that for "B-shares" and that for "H-shares only", though it is smaller than that for "Non-tradable shares only." During the Asian financial crisis period (i.e., the second sub-sample period), the difference of A-share return volatility between any two groups is small. A-share return volatility for "A-shares only" is slightly larger than that for "B-shares" and is slightly smaller than that for "H-shares" and is much smaller than that for "Non-tradable foreign shares only." The two sub-sample periods after the Asian financial crisis are basically consistent with the evidence in the whole sample period, except for H-shares in the period between February 2001 and January 2002. The estimates of median statistics show a similar pattern to those of the mean statistics, as seen in the last column. The overall results in Panel A of Table 3 seem to suggest that foreign ownership has a roughly positive effect on A-share return volatility during and after the Asian financial crisis, though the pattern is not always stable in the sub-sample periods. The large difference between mean and median in the table implies that the distribution of our current volatility measure is far from being normal. This is why we will take the logarithm transformation of the volatility measure in the next section so as to make it, as the dependent variable, closer to a normally distributed random variable.

It should be noted that most firms with foreign shares are relatively large firms (even at the time of their IPOs). As firm size is negatively related to its return volatility, we next control firm size before making the comparison. In Panel B of Table 3, we offer summary statistics of return volatility for size-matched "A-share only" firms. However, firm size is often not a clear concept for Chinese firms. As mentioned before, on average two-thirds of shares in a firm are non-tradable. It is difficult, if not impossible, to calculate the market value of these non-tradable shares. For example, current reforms in selling off non-tradable domestic shares offer big price discounts. In most cases, A-share prices drop substantially while non-tradable share holders compensate A-share holders with additional shares or options to gain the tradable right. As Chinese experience is unique, there is little theory/empirical evidence to

support the exercise. One possible exception is a recent working paper by Chen and Xiong (2001) who document discounts of more than two-thirds of average price for non-tradable shares owned by domestic institutions over A-shares, based on auctions and private transfers. In this study, instead of finding the exact size of a firm, we use the total asset value of the firm as an approximation of its size. More precisely, firm size is defined as ln(total asset value/RMB10^6) in this paper, where total asset value is the accounting book value of the firm and changes once a year. The mean, standard deviation and median of firm sizes are reported in the last three columns of the table. To understand the table clearly, the first row in each sample period is A-share return volatility of firms having issued B-shares. This number is carried over from Table 3 to make our comparison easier. We randomly select, from "A-shares only" firms, the same number of firms as that of B-share firms, with equal or similar firm sizes. We call this group of selected firms "Matched A-shares (B)" in the table. Similarly, we do "Matched A-shares (H)" and "Matched A-shares (Non-tradable foreign shares)." Overall, the firm sizes of the "Matched A-shares" groups are close to those of groups of firms for each class of foreign ownership, based on both mean and median. As the total number of "A-shares only" firms is not sufficiently large, sometimes the match is rough, especially for H-shares. Though the match is not perfect, the A-share return volatility pattern in this panel seems much clearer and cleaner than that in Panel A. The return volatility of "Matched A-shares" is always smaller than A-share return volatility of firms with foreign ownership, except for H-shares in the periods before and immediately after the Asian financial crisis. We will examine the issue in detail in the next two sections by using regression analysis. Before doing so, we shall discuss the control variables.

Many variables could affect a firm's return volatility. Some are specific to Chinese firms while others are common in many economies. Table 4 offers a brief summary of the major controlling variables. The notations and format in this table are the same as in Panel A of Table 3. The first two variables are state-owned and (domestic) legal-entity owned shares, respectively. Column 3 reports the sample mean of the proportions of the number of state-owned shares to the total number of shares outstanding while column 4 is similarly calculated and is the sample mean for legal-

entity shares. These two variables are unique to Chinese firms. Firm size is clearly a relevant variable, as we have shown in Panel B of Table 3, as well as in the volatility literature. Contemporary return is related to return volatility as documented by Duffee (1995). He finds a positive relationship between contemporary stock return and volatility. It is well-known that *Turnover* and *Leverage* are positively related to stock return volatility. To be consistent with the definition of volatility, we define *Turnover* similarly,

$$Turnover_{i,t} = 21 \times \frac{1}{D_t} \sum_{d=1}^{D_t} \left(\frac{\text{Trading Volume}_{i,d}}{\text{Number of A-shares Outstanding}_{i,d}} \right).$$

Due to space limitation, some of the control variables are not reported in the table. Now we move to regression analysis.

4. Regression Analysis

This section examines whether foreign ownership has an effect on A-share return volatility. We control those variables affecting stock return volatility in the literature. The following time-series and cross-sectional regression is estimated first:

$$\begin{aligned} \ln(Vol_{i,t+1}) = {} & \alpha + \rho_1 D_{i,t}^F + \beta_1 ST_{i,t} + \beta_2 LP_{i,t} + \beta_3 Size_{i,t} + \beta_4 Leverage_{i,t} \\ & + \beta_5 \ln(Turnover_{i,t}) + \beta_6 r_{i,t+1} + \beta_7 Age_{i,t} + \beta_8 \ln(Vol_{i,t}) + \beta_9 t \\ & + \sum_{k=1}^{21} \gamma_k Industry_{i,t}^k + \sum_{k=1}^{12} \delta_k Month_{i,t}^k + \sum_{k=1}^{2} \tau_k Exchange_{i,t}^k + \varepsilon_{i,t}, \end{aligned} \qquad (2)$$

subject to $\sum_{k=1}^{21} \gamma_k = 0$, $\sum_{k=1}^{12} \delta_k = 0$, and $\sum_{k=1}^{2} \tau_k = 0$, where $\ln(Vol_{i,t+1})$ is the natural logarithm of monthly return volatility of A-share for firm i in month $t+1$, $D_{i,t}^F$ is a dummy variable of foreign ownership. It takes value 1 if firm *i* at time *t* has any class of foreign ownership. Otherwise, it takes value 0. $ST_{i,t}$ is the proportion of the number of state-owned shares to the total number of shares outstanding, while $LP_{i,t}$ is the proportion of the number of domestic legal-entity owned shares to the total number of shares outstanding. The two variables could affect stock return volatility because they measure the relative supply of the tradable domestic shares in a firm. When $ST_{i,t}$ and

$LP_{i,t}$ are high, the supply is small and likely return volatility is high. $Size_{i,t,}$ is the natural logarithm of total assets/RMB 10^6. $Leverage_{i,t}$, financial leverage, is debt-to-asset ratio of firm i in month t. It is the book value of the total liabilities divided by the book value of the total assets for the firm. $Turnover_{i,t}$ is the turnover variable defined at the end of the last section. The variable, $r_{i,t+1}$, is the contemporaneous return of firm i's A-share in month t+1. The use of this variable in regression (2) is advocated by Duffee (1995). $Age_{i,t}$ is the natural logarithm of the number of months firm *i* has been listed in one of the two stock exchanges. Pastor and Veronesi (2003) find that this variable is a significant volatility predictor in US stock markets cross-sectionally. They call the effect "age effect." Volatility is quite persistent as found in all ARCH type models. We include the lagged dependent variable, $\ln(Vol_{i,t})$, to capture the volatility persistence. From Table 3, we can immediately observe a downward volatility trend over the whole sample period. This phenomenon seems contradictory to the finding by Campbell, Lettau, Malkiel and Xu (2001) for US stock markets. They find an upward trend in average stock return volatility. This downward trend in average stock return volatility in China's markets may deserve further study, but we do not examine it in this paper. Instead, we use a trend variable, *t*, in our regression to capture the effect. $Industry_{i,t}^{k}$, $Month_{i,t}^{k}$, and $Exchange_{i,t}^{k}$ are dummy variables for industry,[9] month and exchange. All dummy variables are set to one if the observation of the dependent variable belongs to the relevant category, and zero otherwise. It is known that restriction on the dummy variables within each category is used to avoid perfect multicolinearity. The regression model is estimated by using Generalized Method of Moments (GMM) methods (Hansen, 1982), which impose few distribution assumptions and account for the autocorrelation and conditional heteroskedasticity.

Table 5 presents the parameter estimates of the regression. Over the whole sample period, the results indicate that return volatility is positively related to foreign ownership. The coefficient estimate of $D_{i,t}^{F}$ is 0.0539, and is significantly different from

[9] Industry classification is based on the China Securities Regulatory Commission (CSRC) standards, and there are 21 industries altogether.

zero. Looking at each sub-sample period, we find that the relationship in the first sub-sample period is positive but insignificant while it is positive and significant in all other sub-sample periods. Recalling Table 3, we see that stock return volatility of "A-shares only" or "Matched A-shares" is actually larger than that of A-shares with foreign ownership in the first sub-sample period, except for those firms with non-tradable foreign shares. Before the Asian financial crisis, firms listed only in A-share markets are more volatile than firms with foreign shares. As China's stock markets were re-established in the early 1990s, it seems that firms in the early stage of the stock markets are much more volatile, and therefore it is hard to extract a significant relationship between the foreign ownership and stock return volatility. The economic reform in mainland China, starting from the early 1980s, was a great experiment in transforming a planned economy into a market economy. No one really knew exactly what would happen in the process of economic reform. It seems to be naïve to have anticipated that domestic investors in China would understand international markets at the time of the establishment of Chinese stock market. Consequently, there could be little reaction of A-share returns to shocks from international stock markets in the first sub-sample period. Another possible reason is that in the early stage of the Chinese stock market, the volatilities of individual stocks are quite high, as the data have shown, so that the shocks from international stock markets cannot be clearly identified. There had been much talk in the media about the 1997 Asian financial crisis. Domestic investors should have learned from the crisis and the volatilities of individual firms in China were dramatically reduced after the first sub-sample period. This may explain what we observed from the data.

The effects of state and (domestic) legal-entity ownership are all in right sign, but their significance is unstable over the different sub-sample periods. The coefficients of *Size*, *Leverage* and ln(*Turnover*) give the correct signs and are significant except for *Turnover* in the last sub-sample period. The size effect also supports our size-matching exercise in Panel B of Table 3. These results are consistent with the evidence found in other stock markets. The contemporaneous monthly return is significantly positive on return volatility during all sample periods but the last one. This is basically consistent with the claim by Duffee (1995) who documents a positive relationship between the

two variables. He points out that expected return and risk are positively related so that their realizations have a common component. Unlike in Pastor and Veronesi (2003), age effect is positive, except in the first sub-sample period. There are at least two possible reasons for this phenomenon. First, the quality of later-listed firms seems to be better than that of older firms, which are associated with lower return volatility. Second, we use both age and time trend in the regression, which might form a complicated non-linear trend. Therefore, the age effect here does not mean exactly the same as that in Pastor and Veronesi (2003). It is noted that our regression analysis is not purely cross-sectional. As we use it only as a control variable, we do not explore it further in this study. The lagged dependent variable and time trend both have a strongly significant effect on return volatility. The interesting phenomenon is the downward trend of return volatility. It is known that turnover is positively related to return volatility, as we have also shown above. From Table 4, we see that *Turnover* has a downward trend over the whole sample period. It implies that at least part of the downward-trend in return volatility is due to the downward trend in *Turnover*. However, the strongly significant time trend variable indicates that ln(*Turnover*) is far from explaining the declining return volatility over time. By the way, we do not include the trend variable for the two short sample periods: July 1997 to Jun 1998, and March 2001 to January 2002. The reason is that we already include month dummies in our regressions. For each of the two one-year periods, time trend would capture exactly the same effect of month dummies. The adjusted R-square of the regression is .37 for the whole sample period and ranges from .39 to .65 during all sub-sample periods. Overall, our findings in Table 5 suggest that foreign ownership has a significant effect on A-share return volatility during and after the Asian financial crisis, while the effect cannot be clearly extracted from the data before the crisis.

Given that we have the information about different classes of foreign ownership, we next consider separating out the effects of each class of foreign ownership on A-share return volatility. We run the following regression,

$$\ln(Vol_{i,t+1}) = \alpha + \rho_1 D^B_{i,t} + \rho_2 D^H_{i,t} + \rho_3 D^{NT}_{i,t} + \beta_1 ST_{i,t} + \beta_2 LP_{i,t} + \beta_3 Size_{i,t}$$
$$+ \beta_4 Leverage_{i,t} + \beta_5 Turnover_{i,t} + \beta_6 r_{i,t+1} + \beta_7 Age_{i,t} + \beta_8 \ln(Vol_{i,t}) \qquad (3)$$
$$+ \beta_9 t + \sum_{k=1}^{21} \gamma_k Industry^k_{i,t} + \sum_{k=1}^{12} \delta_k Month^k_{i,t} + \sum_{k=1}^{2} \tau_k Exchange^k_{i,t} + \varepsilon_{i,t},$$

where the notations are the same as in (2) except that we have three, instead of one, foreign ownership dummy variables. $D^B_{i,t}$ is a dummy variable taking value 1 if firm *i* at time *t* has issued B-shares and taking value 0 otherwise. $D^H_{i,t}$ and $D^{NT}_{i,t}$ are dummy variables similarly defined for H-shares and Non-tradable foreign shares only, respectively. The three classes of foreign ownership correspond to the classification in Tables 2 and 3.

The estimation results of regression Equation (3) are reported in Table 6. We see clearly that the effect of foreign ownership on A-share return volatility is mainly due to B-shares and H-shares. Non-tradable foreign shares play little role as they are almost always insignificant during all sample periods. As the A-share markets cannot gain the information of non-tradable foreign shares through trading, it is not surprising to find the non-tradable foreign dummy is insignificant. So our analysis next would concentrate on B-share and H-share dummies. Both of them are significant during the whole sample period, as well as after the Asian financial crisis. They are both insignificant before the Asian financial crisis. This is consistent with our findings in Table 5. During the Asian financial crisis, we find that H-share dummy is significant while B-share dummy is not. The other statistics are close to those in Table 5. For example, all adjusted R^2 in the two tables show little difference. It is, however, interesting to see if the two dummy variables, B-share and H-share dummies, have the same effect on A-share return volatility. To ascertain this, we test if we have $\rho_1 = \rho_2$, by using Wald test. The results are given below R^2s in Table 6. They are significantly different except in the period before the Asian financial crisis. In other words, the effects of the two different classes of foreign ownership on A-share return volatility are different during and after the financial crisis.

Unlike in Bae et al. (2004), we also have in this study the exact number of each class of foreign shares. Next we examine whether the additional information add any value to our analysis. Consider the following regression, [10]

$$\begin{aligned}\ln(Vol_{i,t+1}) = {} & \alpha + \rho_1 Prop^B_{i,t} + \rho_2 Prop^H_{i,t} + \rho_3 Prop^{NT}_{i,t} + \beta_1 ST_{i,t} + \beta_2 LP_{i,t} + \beta_3 Size_{i,t} \\ & + \beta_4 Leverage_{i,t} + \beta_5 Turnover_{i,t} + \beta_6 r_{i,t+1} + \beta_7 Age_{i,t} + \beta_8 \ln(Vol_{i,t}) \\ & + \beta_9 t + \sum_{k=1}^{21} \gamma_k Industry^k_{i,t} + \sum_{k=1}^{12} \delta_k Month^k_{i,t} + \sum_{k=1}^{2} \tau_k Exchange^k_{i,t} + \varepsilon_{i,t},\end{aligned} \tag{4}$$

subject to $\sum_{k=1}^{21} \gamma_k = 0$, $\sum_{k=1}^{12} \delta_k = 0$, and $\sum_{k=1}^{2} \tau_k = 0$. The notations here are the same as in (3) except that we replace dummy variables $D^B_{i,t}, D^H_{i,t}$ and $D^{NT}_{i,t}$ in (3) with $Prop^B_{i,t}, Prop^H_{i,t}$ and $Prop^{NT}_{i,t}$, respectively. $Prop^B_{i,t}$ is the proportion of the number of B-shares to the total number of shares outstanding. $Prop^H_{i,t}$ and $Prop^{NT}_{i,t}$ are similarly defined.

We summarize briefly the estimation results of (4) in Table 7. To save space, we only report the estimates of foreign ownership variables and adjusted R^2. In Panel A, we take all of A-share firms while in Panel B, we only take firms issuing at least one class of foreign ownership. Panel A gives similar significant results of foreign ownership to those in Table 6, though the magnitudes are different. The qualitative claim is essentially the same from Panel A of this table and Table 6. In Panel B, most of the estimates for foreign ownership are insignificant. Putting the two panels together, we conclude that whether a firm's A-share return volatility is high or low depends on whether this firm has tradable foreign shares, rather than how many tradable foreign shares this firm has issued. In other words, the dummy variables for the different classes of foreign ownership capture essentially the same effect as using the exact proportional foreign ownership in running our regressions.

[10] From February 2001, domestic investors in China who hold foreign currency were eligible to purchase B-shares. Therefore, there is a drawback in this study in using the proportion of B-shares as a proxy for foreign ownership; after that time, a proportion of B-shares would be owned by domestic investors in China. However, it should not have an impact on the results using the dummy variable as an indication of firms' foreign ownership.

5. Further Analysis with Volatility Decomposition

The results so far show that the existence of tradable foreign ownership has a positive effect on A-share return volatility except during the period before the Asian financial crisis. The stock markets trading foreign shares (in either the B-share markets in Shenzhen and Shanghai or H-share market in Hong Kong) could transfer the volatility of the foreign shares to A-shares. In this section, we decompose the total volatility of a firm into two components: one is systematically associated with international stock markets while the other is orthogonal to it. It should be pointed out that this decomposition is similar to, but not the same as, the conventional decomposition of total volatility into systematic risk and idiosyncratic risk. Roughly, we describe the two components of A-share volatility as foreign component and domestic component. Apparently, foreign component is systematic, while the domestic component includes both domestic systematic and firm-level volatilities. We examine in this section which of the two components of A-share volatility is related to foreign ownership.

To construct the two components of A-share volatility, we run a two-factor model below,

$$R_{i,d} = \alpha_i + \beta_i R_d^{WM} + \gamma_i R_d^{AM} + e_{i,d} \tag{5}$$

where R_d^{WM} and R_d^{AM} are the daily returns of the world stock market index and the Asian stock market index, respectively. To make the analysis clear, R_d^{AM} is already orthogonalized to R_d^{WM}. We ran a linear regression of R_d^{AM} on R_d^{WM} and the regression residual is denoted as R_d^{AM} again for simplicity here. The daily estimated residual, $\hat{e}_{i,d}$, of (5) is used to construct the monthly domestic component, $Vol_{i,t}^D$ of volatility based on Equation (1) in which we replace $[\ln(P_{i,t}) - \ln(P_{i,t-1})]$ by $e_{i,t}$. The foreign component, $Vol_{i,t}^F$, of total volatility is generated from $Vol_{i,t}$ -$Vol_{i,t}^D$. Due to the segmentation of China's stock markets, the correlations between the two stock market index returns and the return of China's stock market index (from the Datastrem) are close to zero. The correlation between R_d^{WM} and the return of Chinese stock market

index is -.0265 and the correlation between R_d^{AM} and the return of Chinese stock market index is .0403, for the whole sample period. Similar magnitudes of the correlations are found for the sub-sample periods too. This means that the world and Asian market factors are roughly orthogonal to the domestic stock market factor.

Next we examine the relationship between $Vol_{i,t}^F$ and foreign ownership and that between $Vol_{i,t}^D$ and foreign ownership. We replace the dependent variable in Equation (3) by one of the two components, for example, $Vol_{i,t}^F$, to form the following regression,

$$\begin{aligned}\ln(Vol_{i,t+1}^F) = {} & \alpha + \rho_1 D_{i,t}^B + \rho_2 D_{i,t}^H + \rho_3 D_{i,t}^{NT} + \beta_1 ST_{i,t} + \beta_2 LP_{i,t} + \beta_3 Size_{i,t} \\ & + \beta_4 Leverage_{i,t} + \beta_5 Turnover_{i,t} + \beta_6 r_{i,t+1} + \beta_7 Age_{i,t} + \beta_8 \ln(Vol_{i,t}^F) \\ & + \beta_9 t + \sum_{k=1}^{21} \gamma_k Industry_{i,t}^k + \sum_{k=1}^{12} \delta_k Month_{i,t}^k + \sum_{k=1}^{2} \tau_k Exchange_{i,t}^k + \varepsilon_{i,t},\end{aligned} \tag{6}$$

where all of the independent variables are the same as in Equation (3). The results of this estimation are reported in Table 8.

The main message from the two panels in Table 8 is that foreign ownership affects the foreign volatility component of total volatility, while the domestic component of total volatility is not systematically affected by foreign ownership. One implication of the results is the following: although Chinese stock market is segmented, A-share returns of a firm with tradable foreign shares can still be subject to shocks from foreign share markets through trading in its foreign shares. This means that the initial set-up of the segmented stock markets by the Chinese government cannot fully immunize against the de-stabilizing effects of international stock markets.

Before the end of this section, we tried various robust analyses and summarize the main results briefly here. Our regression analyses from Eq. (2) to Eq. (6) are robust with respect to various specifications. For example, “age effect” is not consistent with Pastor and Veronesi’s (2003) claim. If we delete this variable, our regression results

are qualitatively the same and our claim still holds steady. We have also tried different definitions of stock return volatility. Using $r^2_{i,t}$, instead of $Vol_{i,t}$, would not change our conclusion. It should be noted that $r^2_{i,t}$ can be problematic sometimes, as $r^2_{i,t} = 0$ can happen, and therefore $\ln(r^2_{i,t})$ does not make sense. We have to delete these observations before running the regressions.

6. Conclusion

Economic reform in mainland China has focused on the transition of her planned economy to a market-oriented economy over the past two or three decades. The stock market of China, re-established in the early 1990s, is one of the most important parts of the reform. Apart from many other emerging stock markets, Chinese stock market is segmented for domestic and foreign investors. It is probably the only emerging stock market in Asia that was not (seriously) hurt by the 1997 Asian financial crisis. One possible reason is that foreign capital flows cannot "come and go quickly" in the segmented stock market. The arguments made in the literature, such as in Bae et al. (2004), does not apply to Chinese stock market. This paper examined the issue in the segmented Chinese stock market: Does foreign ownership has an impact on individual stock return volatility in the domestic market?

After investigating the issue for the period from January 1994 to January 2002, we find that foreign ownership is positively related to A-share return volatility during the whole period. Our further examination shows that this relationship holds steady during and after, but not before, the 1997 Asian financial crisis. There are at least two possible reasons for the weak relationship in the early stage of Chinese stock market. The stock market was totally new to domestic investors in the early 1990s. Due to the market segmentation, it might be hard, if not impossible, for domestic investors to understand the international stock markets in the early days of Chinese stock market. Consequently, there could be little reaction of A-share returns to shocks from international stock markets in the first sub-sample period. Another possible reason is that in the early stage of Chinese stock market, the volatilities of individual stocks are

quite high, as shown in Panel A of Table 3, due to extensive speculation, so that the shocks from international stocks markets could not be clearly identified. There was much talk in the media about the 1997 Asian financial crisis. Domestic investors learned from the crisis and the volatilities of individual firms in China were largely reduced after the first sub-sample period. Therefore, shocks from international stock markets could be carried over to the domestic stocks through trading of the foreign shares of Chinese firms.

It seems that the higher A-share return volatility associated with tradable foreign ownership is mainly due to the information transfer from international stock markets to the domestic stock market. To confirm this idea, we decompose the total return volatility of an A-share stock into two components: One is associated with the changes of foreign stock market indices while the other is domestic in nature. Our results suggest that on average, the higher return volatility of A-shares with tradable foreign ownership come form international stock markets, not the domestic stock market or firm-specific information. We interpret the result as follows: As China's economy becomes more and more integrated into the world economy, it is possible that domestic stock investors would also like to hedge against international stock market risk. The domestic investors could do so for firms with tradable foreign shares which provide information flows from international stock markets to the domestic stock market. It is noted that non-tradable foreign shares do not have any impact on the domestic stock return volatility. This is again consistent with our story. Our results are robust with respect to controlling for firm and industry factors, different measures of return volatility, etc. The evidence seems to suggest that although stock market segmentation can possibly prevent stock market crises caused by international capital flows, it is still subject to international stock market risk.

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Table 1

Numbers of listed firms with different classes of shares

Year	B-shares (including non-tradable foreign ownership)	H-shares only	Non-tradable foreign shares only	All foreign ownership	A-shares	Both B-shares and Non-tradable foreign shares
1993	35	3	8	46	176	9
1994	54	6	12	72	287	14
1995	58	11	13	82	311	13
1996	69	14	24	107	514	14
1997	76	17	27	120	719	14
1998	80	18	18	116	824	9
1999	82	19	15	116	919	8
2000	86	19	36	141	1059	13
2001	88	25	44	157	1135	8

This table presents the numbers of firms with different classes of shares in each December from 1993 to 2001. B-shares are traded among foreign investors in either the Shanghai Stock Exchange or the Shenzhen Stock Exchange while A-shares are traded among domestic investors in the two stock exchanges. H-shares are traded in the Stock Exchange of Hong Kong. Non-tradable foreign shares are owned by foreign institutions.

Table 2
Summary statistics of foreign ownership (%)

	Year	No firms	Mean	Std. Dev.	Min	Max	Median
B-shares	1993	35	23.56	9.88	7.08	41.12	24.52
	1994	54	26.54	10.39	7.08	47.68	26.88
	1995	58	26.74	9.97	8.88	47.68	27.23
	1996	69	27.90	9.55	8.88	47.68	27.90
	1997	76	28.56	9.83	8.88	48.21	27.62
	1998	80	28.90	9.85	8.88	48.21	28.05
	1999	82	28.53	10.33	8.88	49.94	27.31
	2000	86	28.05	9.79	8.88	49.94	27.31
	2001	88	29.20	9.76	8.88	49.94	27.62
H-shares only	1993	3	32.44	5.81	26.97	38.54	31.82
	1994	6	29.06	5.23	25.00	38.54	26.69
	1995	11	30.72	5.24	25.00	38.54	29.54
	1996	14	32.22	5.58	25.00	42.66	31.37
	1997	17	32.58	5.13	25.00	42.66	32.20
	1998	18	32.59	4.98	25.00	42.66	32.44
	1999	19	33.31	5.77	25.00	46.33	32.69
	2000	19	32.32	5.38	25.00	46.33	31.82
	2001	25	30.70	5.67	19.35	46.33	30.15
Non-tradable foreign shares only	1993	8	26.61	11.63	3.84	44.84	27.11
	1994	12	30.57	10.79	3.84	44.84	30.79
	1995	13	29.46	10.20	3.70	43.17	28.68
	1996	24	25.90	12.04	2.00	46.13	26.23
	1997	27	24.91	11.66	2.00	46.13	25.00
	1998	18	18.40	13.76	0.59	43.17	20.45
	1999	15	13.89	16.08	0.00	43.17	4.33
	2000	36	18.43	12.59	0.00	46.16	17.47
	2001	44	18.64	11.98	0.00	46.16	18.37

The table presents summary statistics of different classes of foreign ownership for all firms having issued foreign shares in each December from 1993 to 2001. For each firm with one category of foreign ownership as specified in Table 1, we calculate the ratio (in percentage form) of the number of shares with this category of foreign ownership to the total number of tradable shares (including both A-shares and foreign shares). This table gives mean, standard deviation, minimum, maximum and median of the ratios.

Table 3
Summary statistics of A-share return volatility

Panel A: All "A-share only" firms

Shares	Period	Volatility (×100)		
		Mean	Std. Dev.	Median
A-shares only	1994.01-2002.01	2.03	3.04	1.19
B-shares		2.36	3.39	1.42
H-shares only		2.12	3.33	1.28
Non-tradable foreign shares only		2.31	3.20	1.37
A-shares only	1994.01-1997.06	3.90	5.28	2.32
B-shares		3.57	4.54	2.08
H-shares only		3.65	5.75	1.95
Non-tradable foreign shares only		4.02	4.93	2.46
A-shares only	1997.07-1998.06	1.74	1.10	1.46
B-shares		1.70	1.14	1.40
H-shares only		1.78	1.39	1.27
Non-tradable foreign shares only		1.85	1.13	1.67
A-shares only	1998.07-2001.02	1.60	1.62	1.05
B-shares		1.75	1.59	1.24
H-shares only		1.65	1.40	1.20
Non-tradable foreign shares only		1.66	1.64	1.13
A-shares only	2001.03-2002.01	1.30	2.40	0.74
B-shares		1.67	4.02	0.90
H-shares only		1.20	1.33	0.70
Non-tradable foreign shares only		1.30	1.73	0.74

Panel A of this table presents the summary statistics of (domestic) A-share return volatility. All A-share firms are categorized into four groups: firms without any foreign ownership; firms with B-shares (some of which also issued non-tradable foreign shares as in Table 1); firms with H-shares; and firms with non-tradable foreign shares (as their only foreign ownership). The whole sample period is divided into four sub-sample periods: from January 1994 to June 1997 (before the 1997 Asian financial crisis); from July 1997 to June 1998 (during the 1997 Asian Financial Crisis); from July 1998 to January 2001 (after the Asian financial crisis); and from February 2001 to January 2002 (after the opening of B-share markets to domestic Chinese investors).

Panel B: Size-matched "A-shares only" firms

		Volatility (×100)			Firm Size =Ln(Total Assets/RMB10^6))		
Shares	Period	Mean	Std. Dev.	Median	Mean	Std. Dev.	Median
B-shares	1994.01-2002.01	2.36	3.39	1.42	7.38	0.81	7.38
Matched A-shares (B)		2.23	3.28	1.26	7.37	0.81	7.37
H-shares only		2.12	3.33	1.28	8.33	1.23	8.21
Matched A-shares (H)		1.96	2.81	1.10	8.25	1.07	8.21
Non-tradable foreign shares only		2.31	3.20	1.37	6.56	0.79	6.58
Matched A-shares (Non-tradable foreign shares)		2.18	2.75	1.25	6.57	0.79	6.57
B-shares	1994.01-1997.06	3.57	4.54	2.08	7.14	0.80	7.14
Matched A-shares (B)		3.73	4.90	2.13	7.11	0.79	7.15
H-shares only		3.65	5.75	1.95	7.94	1.51	8.00
Matched (H)		3.70	4.55	2.33	7.90	1.21	7.96
Non-tradable foreign shares only		4.02	4.93	2.46	6.18	0.71	6.23
Matched A-shares (Non-tradable foreign shares)		3.85	4.09	2.48	6.18	0.70	6.23
B-shares	1998.07- 2001.02	1.70	1.14	1.40	7.38	0.76	7.31
Matched A-shares (B)		1.61	1.08	1.37	7.37	0.76	7.31
H-shares only		1.78	1.39	1.27	8.34	1.07	8.16
Matched A-shares (H)		1.48	1.10	1.16	8.24	0.98	8.20
Non-tradable foreign shares only		1.85	1.13	1.67	6.52	0.76	6.53
Matched A-shares (Non-tradable foreign shares)		1.62	0.93	1.40	6.52	0.76	6.53
B-shares	2001.03-2002.01	1.75	1.59	1.24	7.50	0.76	7.47
Matched A-shares (B)		1.51	1.50	1.00	7.50	0.76	7.46
H-shares only		1.65	1.40	1.20	8.47	1.04	8.35
Matched A-shares (H)		1.44	1.50	0.91	8.39	0.96	8.34
Non-tradable foreign shares only		1.66	1.64	1.13	6.57	0.70	6.60
Matched A-shares (Non-tradable foreign shares)		1.58	1.60	1.05	6.57	0.70	6.60

Panel B (To be continued) Size-matched "A-shares only" firms

B-shares	2001.03-2002.01	1.67	4.02	0.90	7.62	0.84	7.61
Matched A-shares (B)		1.10	1.28	0.62	7.62	0.84	7.62
H-shares only		1.20	1.33	0.70	8.58	1.17	8.40
Matched A-shares (H)		1.00	1.00	0.62	8.49	1.05	8.40
Non-tradable foreign shares only		1.30	1.73	0.74	7.07	0.75	7.06
Matched A-shares (Non-tradable foreign shares)		1.26	1.41	0.71	7.07	0.75	7.06

Panel B of this table presents the summary statistics of return volatility of A-shares which are size-matched to B-shares. In each year, we randomly choose the same number of A-shares to B-shares with similar sizes or the closest sizes. Normally, they are among the large-sized A-share firms, since most B-share firms are large-sized firms. On the row with "B-shares", we report the statistics for B-shares. On the next row with "Matched A-shares (B), we give the statistics for the size-matched A-shares (with respect to the B-shares). Similarly, we report H-shares and Matched A-shares (H), and Non-tradable foreign shares and matched A-shares (Non-tradable foreign shares). Firm size statistics are reported in the last three columns. The sample periods are categorized according to the note on Panel A of this table.

Table 4
Summary statistics of independent variables

Shares	Period	State-shares (%)	Legal-entity shares (%)	Firm Size ln(Total Assets/10^6)	Monthly Return (%)	Monthly Turnover (%)	Leverage (D/A ratio)
		Mean	Mean	Mean	Mean	Mean	Mean
A-shares only	1994.01-2002.01	30.54	32.18	6.63	0.59	51.47	0.44
B-shares		32.56	20.77	7.38	0.33	50.31	0.47
H-shares only		37.19	18.77	8.33	-0.32	52.83	0.42
Non-tradable foreign shares only		13.28	32.58	6.56	0.36	52.34	0.47
A-shares only	1994.01-1997.06	31.13	32.18	6.29	1.63	95.13	0.45
B-shares		34.54	19.83	7.14	0.77	66.83	0.46
H-shares only		40.11	15.96	7.94	-0.83	84.01	0.39
Non-tradable foreign shares only		6.73	34.15	6.18	1.85	83.76	0.46
A-shares only	1997.07-1998.06	31.73	31.47	6.34	1.56	56.15	0.45
B-shares		33.28	19.85	7.38	0.00	40.97	0.46
H-shares only		38.80	17.59	8.34	-0.47	42.64	0.42
Non-tradable foreign shares only		12.68	31.96	6.52	0.69	49.34	0.47
A-shares only	1998.07-2001.02	28.70	34.35	6.71	1.72	43.98	0.43
B-shares		30.97	22.47	7.50	1.49	46.26	0.48
H-shares only		32.61	23.28	8.47	1.46	46.48	0.45
Non-tradable foreign shares only		14.42	34.73	6.57	1.63	46.33	0.51
A-shares only	2001.03-2002.01	33.10	28.07	6.98	-3.39	22.27	0.44
B-shares		31.25	19.62	7.62	-3.18	30.82	0.50
H-shares only		41.84	13.80	8.58	-3.34	29.96	0.40
Non-tradable foreign shares only		20.37	28.17	7.07	-3.42	22.81	0.45

This table presents the summary statistics of our control variables: proportional state ownership, proportional domestic legal-entity ownership, firm size, monthly return, monthly turnover and leverage ratio for listed Chinese A-share companies at the end of each December. The sample periods are categorized according to the note of Panel A of Table 3.

Table 5
Regression results with foreign ownership

Sample period	1994.01-2002.01	1994.01-1997.06	1997.07-1998.06	1998.07-2001.02	2001.03-2002.01
Independent variable					
Intercept	-2.1285	-2.7037	-3.1911	-2.6638	-2.5145
	*-44.69***	*-31.06***	*-42.23***	*-33.48***	*-29.5***
Dummy ^{F} (ρ_1)	0.0539	0.0195	0.0372	0.0593	0.1020
	*4.77***	*0.89*	*2.21***	*3.98***	*5.78***
Proportional state shares	0.0733	0.1023	0.0811	0.0542	0.1091
	*2.48***	*1.77**	*1.89**	*1.56*	*2.48***
Proportional legal shares	0.0613	0.0827	0.0279	0.0734	0.0852
	*2.08***	*1.35*	*0.63*	*2.15***	*1.95**
Size	-0.0530	-0.0166	-0.0865	-0.0562	-0.0760
	*-11.99***	*-1.93**	*-11.36***	*-5.05***	*-11.39***
Leverage	0.2159	0.1082	0.2367	0.1482	0.2598
	*11.08***	*2.41***	*7.14***	*6.57***	*6.98***
Ln(Turnover)	0.0405	0.2025	0.1558	0.1192	0.0171
	*5.26***	*14.12***	*12.88***	*15.41***	*1.59*
Monthly return	1.0096	1.6882	1.5328	1.5939	-0.9834
	*17.52***	*25.39***	*22.33***	*30.25***	*-7.12***
Age	0.0408	-0.0112	0.1060	0.0943	0.0219
	*5.96***	*-0.87*	*16.38***	*13.37***	*3.42***
Lagged Vol	0.3806	0.1760	0.1958	0.3300	0.4086
	*47.61***	*10.93***	*12.29***	*35.82***	*26.88***
Time trend	-0.0072	-0.0094		-0.0151	
	*-21.47***	*-8.02***		*-22.17***	
Adjusted R Square	0.3648	0.3932	0.5101	0.4632	0.6482

This table presents the estimation results of the following time-series and cross-sectional regression model:

$$\begin{aligned}\ln(Vol_{i,t+1}) = {} & \alpha + \rho_1 D_{i,t}^{F} + \beta_1 ST_{i,t} + \beta_2 LP_{i,t} + \beta_3 Size_{i,t} + \beta_4 Leverage_{i,t} \\ & + \beta_5 \ln(Turnover_{i,t}) + \beta_6 r_{i,t+1} + \beta_7 Age_{i,t} + \beta_8 \ln(Vol_{i,t}) + \beta_9 t \\ & + \sum_{k=1}^{21} \gamma_k Industry_{i,t}^{k} + \sum_{k=1}^{12} \delta_k Month_{i,t}^{k} + \sum_{k=1}^{2} \tau_k Exchange_{i,t}^{k} + \varepsilon_{i,t},\end{aligned}$$

subject to $\sum_{k=1}^{21} \gamma_k = 0$, $\sum_{k=1}^{12} \delta_k = 0$, and $\sum_{k=1}^{2} \tau_k = 0$, where $Vol_{i,t+1}$ is the natural logarithm of monthly return volatility of A-share for firm i in month $t+1$, $D_{i,t}^{F}$ is a dummy variable of foreign ownership. $ST_{i,t}$ is the proportion of the number of state-owned shares to the total number of shares outstanding, while $LP_{i,t}$ is the proportion of the number of domestic legal-entity owned shares to the total number of shares outstanding. $Size_{i,t,}$ is the natural logarithm of total assets. $Leverage_{i,t}$, financial leverage, is debt-to-asset ratio of firm i in month t. It is the book value of the debt

divided by the book value of the total assets. $Turnover_{i,t}$ is the monthly average of the daily ratios of the A-share monthly trading volume to the total number of A-shares outstanding for firm i in month t. The variable, $r_{i,t+1}$, is the contemporaneous return of firm i's A-share in month t. $Age_{i,t}$ is the natural logarithm of the number of months firm i has been listed in one of the two stock exchanges. $Industry_{i,t}^{k}$, $Month_{i,t}^{k}$, and $Exchange_{i,t}^{k}$ are dummy variables for industry, month, and exchange. Along each line of an independent variable, the coefficient estimate of the variable is reported while its Newy-West t-ratio is given under it.

The * and ** represent 10% and 5% significance levels respectively. These notations are applicable to all of the following tables too.

Table 6
Regression results with different classes of foreign ownership

Sample period	1994.01-2002.01	1994.01-1997.06	1997.07-1998.06	1998.07-2001.02	2001.03-2002.01
Independent variable					
Intercept	-2.1100	-2.7173	-3.1673	-2.6224	-2.4806
	*-43.78***	*-30.74***	*-41.21***	*-30.9***	*-28.8***
Dummy ^{B} (ρ_1)	0.0551	0.0071	0.0160	0.0587	0.1639
	*3.94***	*0.27*	*0.84*	*3.36***	*7.34***
Dummy ^{H} (ρ_2)	0.1058	0.0299	0.1769	0.1285	0.0936
	*4.09***	*0.57*	*3.76***	*3.65***	*2.56***
Dummy ^{NT} (ρ_3)	0.0240	0.0593	0.0325	0.0293	-0.0087
	1.35	*1.77**	*1.17*	*1.18*	*-0.3*
Prop. state shares	0.0685	0.1138	0.0804	0.0535	0.0973
	*2.32***	*1.95**	*1.86**	*1.54*	*2.22***
Prop. legal shares	0.0578	0.0894	0.0255	0.0727	0.0786
	*1.96**	*1.45*	*0.57*	*2.13***	*1.8**
Size	-0.0558	-0.0155	-0.0935	-0.0630	-0.0797
	*-12.29***	*-1.78**	*-11.75***	*-5.21***	*-11.81***
Leverage	0.2196	0.1042	0.2508	0.1542	0.2599
	*11.23***	*2.28***	*7.53***	*6.73***	*6.99***
Ln(Turnover)	0.0399	0.2026	0.1555	0.1176	0.0125
	*5.18***	*14.13***	*12.87***	*15***	*1.15*
monthly return	1.0094	1.6880	1.5292	1.5916	-0.9883
	*17.52***	*25.39***	*22.3***	*30.17***	*-7.18***
Age	0.0407	-0.0104	0.1091	0.0945	0.0173
	*5.94***	*-0.8*	*16.78***	*13.36***	*2.7***
Lagged Vol	0.3807	0.1757	0.1939	0.3302	0.4073
	*47.62***	*10.91***	*12.18***	*35.82***	*26.85***
Time trend	-0.0072	-0.0094		-0.0150	
	*-21.37***	*-8.04***		*-21.86***	
Adjusted R-square	0.3649	0.3932	0.5110	0.4631	0.6490
Wald test (χ^2 -test)					
$\rho_1 = \rho_2$	3.38*	0.17	11.59**	4.36**	3.16*
$\rho_1 = \rho_3$	2.19	1.84	0.28	0.99	24.17**
$\rho_2 = \rho_3$	6.77**	0.22	7.39**	5.26**	5.11**

This table reports the estimation results of the following time-series and cross-sectional regression model:

$$\ln(Vol_{i,t+1}) = \alpha + \rho_1 D_{i,t}^{B} + \rho_2 D_{i,t}^{H} + \rho_3 D_{i,t}^{NT} + \beta_1 ST_{i,t} + \beta_2 LP_{i,t} + \beta_3 Size_{i,t} + \beta_4 Leverage_{i,t} + \beta_5 \ln(Turnover_{i,t}) + \beta_6 r_{i,t+1} + \beta_7 Age_{i,t} + \beta_8 \ln(Vol_{i,t}) + \beta_9 t + \sum_{k=1}^{21} \gamma_k Industry_{i,t}^{k} + \sum_{k=1}^{12} \delta_k Month_{i,t}^{k} + \sum_{k=1}^{2} \tau_k Exchange_{i,t}^{k} + \varepsilon_{i,t},$$

subject to $\sum_{k=1}^{21} \gamma_k = 0$, $\sum_{k=1}^{12} \delta_k = 0$, and $\sum_{k=1}^{2} \tau_k = 0$. The notations here are the same as in Table 5. $D_{i,t}^{x}$ is a dummy variable of *x*-class foreign ownership, and *x* =*B*, *H* or *NT*.

Table 7
Regression results with proportional foreign ownership

Sample period	1994.01-2002.01	1994.01-1997.06	1997.07-1998.06	1998.07-2001.02	2001.03-2002.01
Panel A: All A-share firms					
Independent variable					
Prop. B shares	0.1333	-0.0620	-0.0315	0.1274	0.5301
	*2.96***	*-0.71*	*-0.5*	*2.2***	*7.08***
Prop. H shares	0.2990	0.0906	0.4973	0.3472	0.3057
	*3.8***	*0.54*	*3.49***	*3.3***	*2.64***
Prop. other foreign shares	0.0992	0.1475	0.1346	0.1009	0.0153
	1.44	*1.35*	*1.53*	*1.03*	*0.12*
Adjusted R-square	0.3648	0.3932	0.5110	0.4630	0.6489
Panel B: Firms with at least one class of foreign ownership					
Independent variable					
Prop. B shares	0.0802	-0.3111	-0.1697	-0.0699	0.5711
	0.76	*-1.43*	*-1.05*	*-0.55*	*3.66***
Prop. H shares	0.2640	-0.2173	0.4438	0.1689	0.4155
	*2.1***	*-0.7*	*2.1***	*1.07*	*2.25***
Prop. other foreign shares	0.1848	-0.0475	0.1328	-0.0582	0.0713
	1.42	*-0.2*	*0.7*	*-0.33*	*0.31*
Adjusted R Square	0.3355	0.4053	0.5770	0.4457	0.6115

This table reports the estimation results of the following time-series and cross-sectional regression model:

$$\begin{aligned}\ln(Vol_{i,t+1}) = {} & \alpha + \rho_1 Prop^B_{i,t} + \rho_2 Prop^H_{i,t} + \rho_3 Prop^{NT}_{i,t} + \beta_1 ST_{i,t} + \beta_2 LP_{i,t} + \beta_3 Size_{i,t} \\ & + \beta_4 Leverage_{i,t} + \beta_5 \ln(Turnover_{i,t}) + \beta_6 r_{i,t+1} + \beta_7 Age_{i,t} + \beta_8 \ln(Vol_{i,t}) \\ & + \beta_9 t + \sum_{k=1}^{21} \gamma_k Industry^k_{i,t} + \sum_{k=1}^{12} \delta_k Month^k_{i,t} + \sum_{k=1}^{2} \tau_k Exchange^k_{i,t} + \varepsilon_{i,t},\end{aligned}$$

subject to $\sum_{k=1}^{21} \gamma_k = 0$, $\sum_{k=1}^{12} \delta_k = 0$, and $\sum_{k=1}^{2} \tau_k = 0$. The notations here are the same as in Table 6 except that we replace dummy variables $D^B_{i,t}, D^H_{i,t}$ and $D^{NT}_{i,t}$ in (3) by $Prop^B_{i,t}, Prop^H_{i,t}$ and $Prop^{NT}_{i,t}$, respectively. $Prop^B_{i,t}$ is the proportion of the number of B-shares to the total number of shares outstanding. $Prop^H_{i,t}$ and $Prop^{NT}_{i,t}$ are similarly defined. Panel A uses all A-share firms in running the regression while Panel B takes only those of firms with any class of foreign ownership in running the regression.

Table 8
Regression results with volatility decomposition

Panel A: Dependent Variable is Foreign Volatility Component, Vol^F

Sample period	1994.01-2002.01	1994.01-1997.06	1997.07-1998.06	1998.07-2001.02	2001.03-2002.01
Independent variable					
Intercept	-4.7088	-5.1337	-5.9389	-5.2227	-5.3595
	*-69.7***	*-39.33***	*-43.18***	*-43.43***	*-41.8***
Dummy ^{B} (ρ_1)	0.0645	-0.0233	0.0565	0.0542	0.1927
	*2.99***	*-0.61*	*1.29*	*1.83**	*4.99***
Dummy ^{H} (ρ_2)	0.1477	0.0500	0.2050	0.1198	0.1999
	*3.87***	*0.7*	*2.1***	*2.1***	*3.16***
Dummy ^{NT} (ρ_3)	0.0521	0.0581	-0.0013	0.1141	0.0478
	*1.86**	*1.14*	*-0.02*	*2.41***	*1.02*
Prop. state shares	0.0387	0.0502	0.0067	0.0238	0.1164
	0.84	*0.56*	*0.07*	*0.39*	*1.46*
Prop. legal shares	0.0616	0.0116	-0.0238	0.0701	0.1195
	1.34	*0.12*	*-0.24*	*1.15*	*1.49*
Size	-0.0969	-0.0151	-0.1234	-0.1033	-0.1430
	*-13.86***	*-1.14*	*-7.19***	*-5.92***	*-11.85***
Leverage	0.4466	0.0344	0.3602	0.2789	0.6688
	*13.75***	*0.49*	*4.79***	*6.47***	*11.53***
Ln(Turnover)	0.1072	0.2621	0.2842	0.2038	0.1160
	*10.61***	*15.28***	*13.6***	*17.61***	*7.42***
Monthly return	1.6832	2.6170	2.3093	2.3153	-2.4879
	*19.99***	*28.99***	*16.22***	*25.33***	*-12.37***
Age	0.0946	0.0100	0.1805	0.1440	0.0878
	*10.45***	*0.56*	*12.11***	*13.41***	*7.82***
Lagged Vol	0.1301	0.0065	0.0352	0.1249	0.1776
	*20.98***	*0.5*	*2.97***	*17.79***	*16.16***
Time trend	-0.0125	-0.0211		-0.0207	
	*-26.48***	*-11.25***		*-19.59***	
Adjusted R-square	0.2351	0.3426	0.2643	0.2910	0.4328
Wald test (χ^2 -test)					
$\rho_1 = \rho_2$	4.19**	0.99	2.22	1.38	0.01
$\rho_1 = \rho_3$	0.14	1.97	0.74	1.19	6.16**
$\rho_2 = \rho_3$	4.16**	0.01	3.41*	0.01	3.9**

Panel A of this table reports the estimation results of the following time-series and cross-sectional regression model:

$$\ln(Vol^F_{i,t+1}) = \alpha + \rho_1 D^B_{i,t} + \rho_2 D^H_{i,t} + \rho_3 D^{NT}_{i,t} + \beta_1 ST_{i,t} + \beta_2 LP_{i,t} + \beta_3 Size_{i,t} + \beta_4 Leverage_{i,t} + \beta_5 \ln(Turnover_{i,t}) + \beta_6 r_{i,t+1} + \beta_7 Age_{i,t} + \beta_8 \ln(Vol^F_{i,t}) + \beta_9 t + \sum_{k=1}^{21} \gamma_k Industry^k_{i,t} + \sum_{k=1}^{12} \delta_k Month^k_{i,t} + \sum_{k=1}^{2} \tau_k Exchange^k_{i,t} + \varepsilon_{i,t},$$

subject to $\sum_{k=1}^{21} \gamma_k = 0$, $\sum_{k=1}^{12} \delta_k = 0$, and $\sum_{k=1}^{2} \tau_k = 0$.

Panel B: Dependent Variable is Domestic Volatility Component, Vol^D

Sample period	1994.01-2002.01	1994.01-1997.06	1997.07-1998.06	1998.07-2001.02	2001.03-2002.01
Independent variable					
Intercept	-2.8702	-3.5036	-4.0836	-3.6746	-2.5647
	*-21.84***	*-47.66***	*-76.46***	*-17.17***	*-5.44***
Dummy ^{B} (ρ_1)	-0.1308	0.0221	0.0051	-0.0647	-0.2592
	*-2.24***	*0.84*	*0.26*	*-0.77*	*-1.04*
Dummy ^{H} (ρ_2)	-0.2163	0.0356	0.1957	-0.0018	-0.2698
	*-4.04***	*0.66*	*4.25***	*-0.03*	*-1.95**
Dummy ^{NT} (ρ_3)	-0.1392	0.0839	0.0449	-0.3841	-0.3560
	-1.4	*2.44***	*1.57*	*-1.73**	*-1.27*
Prop. state shares	-0.0311	0.1237	0.1023	-0.0922	-0.2544
	-0.32	*2.14***	*2.38***	*-0.56*	*-0.65*
Prop. legal shares	-0.2164	0.1166	0.0281	-0.2031	-0.4066
	*-1.88**	*1.91**	*0.64*	*-1.02*	*-0.98*
Size	0.1541	-0.0135	-0.1015	0.0826	0.2178
	*6***	*-1.49*	*-12.2***	*2.62***	*3.79***
Leverage	-1.9567	0.1098	0.2686	-1.4492	-4.0462
	*-6.89***	*2.33***	*7.79***	*-4.62***	*-4.98***
Ln(Turnover)	0.2601	0.3365	0.2445	0.3211	0.1226
	*20.19***	*28.6***	*27.66***	*23.04***	*1.78**
Monthly return	1.1196	1.5465	1.3905	1.7346	0.6566
	*11.29***	*22.38***	*20.97***	*10.69***	*0.65*
Age	-0.0586	0.0060	0.1327	0.0626	-0.1163
	*-3.05***	*0.45*	*20.86***	*2.7***	*-2.7***
Lagged Vol	0.1138	0.0084	0.0018	0.0465	0.2720
	*5.49***	*5.18***	*1.27*	*2.09***	*5.05***
Time trend	-0.0127	-0.0104		-0.0284	
	*-19.51***	*-9.16***		*-16.45***	
Adjusted R-square	0.0918	0.3697	0.4977	0.0633	0.1781
Wald test (χ^2 -test)					
$\rho_1 = \rho_2$	2.33	0.06	17.15**	0.72	0
$\rho_1 = \rho_3$	0.01	2.47	1.55	1.64	0.07
$\rho_2 = \rho_3$	0.55	0.58	8.22**	2.7	0.1

Panel B of this table reports the estimation results of the following time-series and cross-sectional regression model:

$$\ln(Vol^D_{i,t+1}) = \alpha + \rho_1 D^B_{i,t} + \rho_2 D^H_{i,t} + \rho_3 D^{NT}_{i,t} + \beta_1 ST_{i,t} + \beta_2 LP_{i,t} + \beta_3 Size_{i,t}$$
$$+ \beta_4 Leverage_{i,t} + \beta_5 \ln(Turnover_{i,t}) + \beta_6 r_{i,t+1} + \beta_7 Age_{i,t} + \beta_8 \ln(Vol^D_{i,t})$$
$$+ \beta_9 t + \sum_{k=1}^{21} \gamma_k Industry^k_{i,t} + \sum_{k=1}^{12} \delta_k Month^k_{i,t} + \sum_{k=1}^{2} \tau_k Exchange^k_{i,t} + \varepsilon_{i,t},$$

subject to $\sum_{k=1}^{21} \gamma_k = 0$, $\sum_{k=1}^{12} \delta_k = 0$, and $\sum_{k=1}^{2} \tau_k = 0$.