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Market liberalization within a country ☆

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ABSTRACT

China's B-share market, which used to be restricted to foreign investors, was partially opened up in February 2001 to Chinese local investors. We take this as a controlled experiment in cross-border trading on a small scale. We find mild but positive effects on the B-share market, with higher volumes, lower levels of volatility, lower bid–ask spreads and more liquidity after liberalization. Between A- and B-shares, price disparities narrowed; the correlation and the co-integration relationships became stronger; and the flow of information became more balanced. More new individual investors entered into the B-share market without crowding out existing institutional investors. Even though the liberalization measure is partial and one-way, it has helped to improve the quality of the B-share market, and our results lend no support to the popular claim that liberalization does nothing but help the existing foreign shareholders to cash out.

1. Introduction

The integration of financial markets through the opening up of domestic markets to foreign investors and cross-border listings is a part of today's mega trend of globalization. Academic studies find substantial benefits in relation to such financial integration. For instance, the cost of capital tends to decline (Henry, 2000a; Bekaert and Harvey, 2000); the information environment tends to improve (Bae et al., 2006); real economic growth increases and consumption growth volatility decreases (Bekaert et al., 2005a, 2006, 2007); and cross-listing to high quality foreign markets helps to mitigate agency problems and enhances governance quality (Doidge et al., 2004).

However, the reaction to this opening up is not without skepticism, especially after the Asian Financial Crisis. Stiglitz (2003) argues that much of the instability in East Asia in the Crisis period was because these countries pursued capital market liberalization prematurely.[1] Specifically, "allowing unfettered flows of speculative capital is extremely risky."[2] Indeed, one main concern for emerging economies when it comes to opening up their markets is the possible contagion effect of disturbances spilling over from developed markets. For instance, Ng (2000) finds significant volatility spillovers from Japan and the US to six Pacific-Basin equity markets. She shows that liberalization events affect the relative importance of the global and regional market factors of spillovers over time. With globalization and regional integration, Baele (2005) finds that even European equity markets face contagion from the US market during

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[1] See also Summers' (2003) opposing views.

[2] "Making globalization work", p. xiii, Stiglitz (2006). See also his "Globalization and its discontents".

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periods of high world market volatility. Bekaert et al. (2005b) set up a two-factor model to disentangle return correlation and contagion (residual correlation in the model). They were still able to find economically significant contagion in Asia during the Crisis period.

To shed more light on the possible impacts of liberalization, in this paper we examine an interesting partial liberalization event within China, in which the Chinese government opened up its B-share market to local investors in 2001. Chinese companies can issue both A-class and B-class shares with identical features. Initially, A-shares were restricted to local Chinese only, and B-shares were restricted to foreigners only, so that the A-share and B-share markets were completely segmented. On February 19, 2001, the Chinese government announced that the B-share market would open up to local Chinese with foreign currency accounts in Chinese banks. The policy was implemented on February 28. The market reaction was electric at the start, as investors immediately began to redeploy their funds and thousands of Chinese investors poured into the B-share market. However, speculative trading became so intense in the first two months that it was said to scare away overseas institutional investors.

Viewed as a small scale, emerging market liberalization phenomenon, we can ask a series of interesting and important questions in relation to this incident: Is market liberalization really beneficial to the liberalized market? Are the benefits transitory or long lasting? Does liberalization benefit all markets, or does it benefit only one at the expense of others? Rigorous study of these questions will help to elucidate the pros and cons of the liberalization policy, and shed light on fundamental issues of financial market integration.

This Chinese experience has another unique and interesting feature: it is a "reverse" liberalization. The typical liberalization setting is that less-developed domestic markets open up to foreign investors; in our case, however, the "foreign" B-share market opens up for "domestic" investors.[3] Analyzing the impacts of this type of reverse liberalization is of potential importance as it is not clear whether reverse liberalization would lead to different consequences. For instance, in the typical liberalization setting, foreign investors are usually more sophisticated and likely to be institutional investors. Their entrance may improve the price discovery process and the efficiency of the less-developed, domestic market. In contrast, in our setting, it is the less sophisticated retail investors entering into the B-share market dominated by foreign institutional investors. As will be seen, however, our results indicate that "reverse" liberalization has the same effect as those predicted for the normal liberalization cases. As long as trading barriers are reduced or eliminated, there are benefits to be gained. Our investigation is quite timely, as a much larger scale reverse liberalization will soon take place, as the China Securities Regulatory Commission (CSRC) issued "Tentative Measures for the Administration of Overseas Securities Investment by Qualified Domestic Institutional Investors" in June 2007, under which Chinese fund management firms and securities companies are allowed to invest in overseas equity markets.[4]

The benefits we are investigating in this study are improvements of market quality. Specifically, we examine changes in liquidity, turnover, volatility, trading cost, price disparity, information linkage, and information flow between Chinese A- and B-shares a year before to a year after the liberalization event. Our results generally show that the B-share market has exhibited higher turnover, lower volatility, lower bid–ask spread, and more liquidity after liberalization. In addition, the turnover, volatility, bid–ask spread, and liquidity of the two markets tend to converge over time. In fact, after liberalization, the price disparities between A- and B-shares have narrowed. Yet, stocks with a *relatively* larger disparity before liberalization continue to have a relatively larger disparity after liberalization. We interpret this as inconsistent with the view that the original B-share investors had been cashing out after the opening up of the B-share market. Further indirect evidence against the cashing-out view comes from the aggregate data. We observed a surge in the number of individual investor accounts entering the B-share market, and also a mild increase in the number of individual investors entering the A-share market after liberalization. Hence, there is no sign that the increase in the number of investors in the B-share market crowded out its existing institutional investors.

Finally, we find that the return correlation and the co-integrating relationships between the two markets have become stronger and tighter. The flow of information between the two markets has also become more balanced. These results indicate that liberalization has benefited the B-share market without adversely affecting the A-share market, and there is no evidence that foreign investors have systematically abandoned the B-share market. All in all, China's experience supports the view that partial liberalization, even the "reverse" liberalization, of a stock market, leads to improvements in the quality of the market in general. However, such improvements are limited, probably due to the partial nature of the liberalization.

Viewed as market liberalization within a country, we have a policy change situation close to a controlled experiment. Different countries have different macro conditions, including legal, political, social and economic environments. These are difficult to control when examining the cross-country liberalization effect. In fact, Henry (2000b) considers the ability to control different macro economic stabilizations to be an important contribution to the study of the market liberalization effect across countries. As both A-share and B-share markets exist within the same country, the legal, political, social and economic environments are the same. In addition, our sample only consists of firms with both A- and B-shares. This means that even firm-level differences across the two markets are controlled. This "perfectly matched" sample allows us to focus on how a "pure" lifting of trade barriers impacts the trading in these two markets. The downside of focusing on one country, of course, is that data observations are fewer and the results may be country-specific.

Our study also relates to the literature on market segmentation and price differentials. Stulz and Wasserfallen (1995), Bailey and Jagtiani (1994), and Domowitz et al. (1998) show that market segmentation can lead to differential demand for identical stocks in different markets, and thus result in different prices. In addition, trading volume, liquidity, volatility, and even the information set

[3] In December 2002, the China Securities Regulatory Commission (CSRC) put forth the Qualified Foreign Institutional Investors (QFII) Scheme so that foreign investors could enter the A-share market under certain restrictions.

[4] Chinese companies can list shares in Hong Kong as H-shares and, similar to the B-share market, the H-share market is completely segmented from the A-share market; the H-shares bear similar price discounts relative to A-shares (Sun and Tong, 2000). Since the CSRC announcement of the QDII scheme on June 20, the H-share market index (technically called the Hang Seng China Enterprises Index) went from 11,905 to 13,200 on July 13, more than a 10% increase in less than a month.

associated with the same stocks in the two segmented markets can be very different. Our study also relates to the cross-market microstructural studies by Hasbrouck (1995), Domowitz et al. (1998), and Arnold et al. (1999). They show how the lifting of trade barriers impacts on the order flow dynamics through time, and subsequently, affects the quality and development of the two markets.

There is a series of studies focusing specifically on China's market segmentation phenomenon. Bailey (1994) first documented that B-share prices generally traded at discounts relative to their corresponding A-share prices. Subsequent studies found, in general, that the cross-sectional differences of the B-share discount was related to differences in the trading attributes of stocks, such as: volatility, turnover, and liquidity (Chen et al., 2001); differences in general supply and demand conditions of A- and B-shares (Sun and Tong, 2000); speculative trading of local investors (Mei et al., 2005); and/or differences in information availability (Chan et al., 2008).

Mei et al. (2005) argue that the prohibition of short-sales of stocks, non-existence of equity derivatives markets, severe constraint of equity issuance and buy-backs, and relatively short history of the stock market in China (opened in the early 1990s) have all contributed to the excitement and interest in stock trading among Chinese local investors, which has led to the speculative nature of their trading. Mei et al. (2005) use A-share turnover rate to capture the speculative trading activities of domestic investors and find it can explain, on average, 20% of the monthly cross-sectional variation of the A–B-share price premium in the period of 1993–2000. They take this as evidence supportive of their hypothesis that domestic investors' speculative motive generates a speculative component in A-share prices. In postulating some of our hypotheses, we also assume the speculative trading of domestic investors and interpret our results accordingly.

The paper proceeds as follows. A brief history of the Chinese equity market is presented in Section 2. Hypotheses regarding the liberalization effect are developed in Section 3. Section 4 explains the data and market quality proxies used in the tests. Section 5 presents the testing techniques and the corresponding results. Section 6 concludes the paper.

2. A brief history of Chinese equity issues

China's two stock exchanges, the Shanghai Stock Exchange (SHSE) and the Shenzhen Stock Exchange (SZSE) were inaugurated in December 1990 and April 1991, respectively. A company may issue five different types of shares in China: State shares, Legal-person shares, Employee shares, A-shares and B-shares. However, only A-shares and B-shares are tradable. A-shares are ordinary equity shares exclusively available to Chinese citizens and domestic institutions. When a company makes its initial public offering (IPO), tradable shares are required to account for no less than 25% of the total outstanding shares.[5]

B-shares are issued to attract foreign capital and traded in either US dollars (on the SHSE) or Hong Kong dollars (on the SZSE), as the Reminbi (RMB) is not convertible under the capital account.[6] Initially, B-shares could only be subscribed by, and traded among, foreign investors.[7] Also, firms could choose to list their B-shares on either the SHSE or SZSE, but not on both.[8] Up to the end of 2002, 111 companies had issued B-shares and 89 of them had also issued A-shares.

Unlike the A-share market, the B-share market had never been very active, as there were too few shares traded to attract big foreign investors. B-share prices traded at a discount in relation to their corresponding A-share prices from the early days. In fact, the B-share discount increased from about 25% in 1994 to 86% right before liberalization. This persistent B-share discount phenomenon is puzzling, and has attracted a lot of attention; yet, it is still largely unresolved.

Various measures have been introduced by the Chinese government to vitalize the market but found to be ineffective. Then, on February 19, 2001, CSRC and the State Administration of Foreign Exchange Bureau (SAFE) announced that starting from February 28, Chinese nationals with existing foreign currency deposit accounts with a domestic commercial bank would be allowed to trade B-shares on the SHSE and SZSE. Those who opened a foreign currency deposit account with a domestic bank after February 19 would only be allowed to trade from June 1, 2001 onwards. However, the policy did not apply to Chinese local institutional investors, who still could not invest in the B-share market. After the announcement, the B-share market was temporarily closed and resumed trading on February 28.

At the beginning, the response was electric, as investors immediately started to redeploy their funds. Thousands of Chinese investors jammed brokerage houses on February 28, 2001 in the hope of buying B-shares.[9] Money poured into the country through wire transfers to residents from friends and relatives abroad. Even the Dollar black market rates shot up. About 10% of the foreign currency deposit was said to have been transferred to the securities market during that period. Shenyin Wanguo Securities Company Limited, one of the largest securities companies in China, reported that around 1500 new B-share trading accounts had been opened outside of Shanghai, and 1000 accounts were opened in Shanghai only two and half hours after banks opened Monday morning (February 26). By late Tuesday, more than 134,000 new B-share trading accounts had been opened in Shanghai

[5] Chinese SOEs have been undergoing the "split-share reform" since 2005. Once a firm has completed such a reform, its non-tradable shares can be traded in two years time.

[6] B-shares are still nominally denominated in RMB, but quoted and traded in USD or HKD.

[7] Technically, investors needed to show a foreign passport and have at least $10,000 deposited in a trading account to buy B-shares. With the new rules, local Chinese now can open a trading account with a minimum of $1000 and a domestic identification card.

[8] There are also *H-shares*, which have been listed in Hong Kong since 1993. *N-shares*, listed on the New York Stock Exchange, are in the form of IPOs or American Depository Receipts (ADRs). N-shares were first issued in September 1992, but the market is very thin. To limit foreign ownership, the Chinese government allowed no more than 49% of a company's convertible shares to be B-, H-, or N-shares until very recently. See Appendix A for the number of listed companies in China.

[9] From the CEIC database, we found that the amount of foreign currency deposits of Chinese households kept increasing throughout our sample period, except in February and March of 2001. In these two months, the deposits dropped by USD0.66 and USD0.26 billion, respectively.

alone, nearly doubling the number of accounts registered there (China Daily, February 27, 2001). Merrill Lynch chief economist Andy Xie commented that the policy was an extremely positive step: "It's going to significantly boost trading volumes and liquidity, and it will encourage investors to 'arbitrage' in the markets, which will lead to much greater efficiency" (CNN.com, February 20, 2001). However, it is important to notice that the opening up was only partial in the sense that the A-share market was still closed for foreign investors, and hence arbitrage could not take place in any real sense. Furthermore, short selling is prohibited in China, which also limits the efficient convergence of A-share and B-share prices. In any event, the trading volume of B-shares on the Shanghai and Shenzhen markets neared 300 billion yuan (US$36.23 billion) in March, higher than that of the A-share market, which is 10 times bigger in terms of market size. As such, Shanghai and Shenzhen B indices shot up sharply in heavy trading. By March 31, the Shanghai B-Share Index jumped 47.7% year-to-date, and the Shenzhen B-Share Index rocketed by 144.3%.

However, there was anecdotal evidence that trading was speculative and vigorous in the first two months of the opened B-share market. Overseas capital was said to withdraw from the B-share market.[10] An anonymous analyst at Credit Lyonnaise Securities said that, aside from a few small institutional investors with limited funds, all others had withdrawn from the market.

Such a mixed picture prompts us to study whether this "one-way" and "reverse" liberalization really benefits the liberalized market, especially after the initial period of turmoil.

3. Hypotheses on the effect of B-share market liberalization

Market liberalization removes barriers between markets. If the barrier removal of the B-share market attracts more orders, the trading volume, liquidity, and information efficiency will increase while trading costs will decrease. However, volatility and risk may or may not decrease due to a possible contagion effect. This may have a feedback effect on the A-share market. Better information linkage between the two markets may attract new capital to flow into the A-share market. A positive feedback dynamic developed across the two markets may improve the efficiency, liquidity, and volume of both markets. However, the situation may be a simple order migration from the A-share market to the B-share market. In this case, the B-share market prospers at the expense of the A-share market. Since only Chinese local investors with foreign currency accounts could buy B-shares, the magnitude of order migration might not be large enough to hurt the A-share market. This leads to our first hypothesis:

H1. The liberalization results in improvements in the B-share market activity and quality without much adverse impact on the A-share market.

By improvements, we mean that the B-share trading volume and liquidity should be higher after liberalization, while transaction costs and B-share discounts should be lower. The volatility of a market depends on the information flow, trading activities, and speculation level. On the one hand, liberalization tends to reduce the B-share market volatility, as it makes the market more transparent and trading activity smoother. On the other hand, more speculative A-share investors pouring into the B-share market could increase the market's volatility. In a cross-country study of stocks in emerging markets, Bae et al. (2004) found that stocks more accessible to foreign investors have higher return volatility, while Li et al. (2006) found a negative relationship between large foreign ownership and return volatility. Hence, the liberalization effect on volatility is uncertain. In any case, H1 implies no change in trading volume, liquidity, transaction costs and volatility for the A-share market after liberalization.

However, if the "reverse" liberalization of the B-share market induces the existing foreign investors to cash out, leaving the B-share market essentially occupied by Chinese local investors, the liberalization would fail to revitalize the B-share market as local investors are still restricted by the foreign currency requirement. In that case, H1 would be rejected.

A related issue is the convergence of the A-share and B-share prices upon liberalization. A full investigation is impossible unless we understand the economic fundamentals of the A–B price disparity phenomenon, and how these factors may change upon liberalization, which leads to the convergence of the A-share and B-share prices. Since it is beyond the current scope of investigation, we focus instead on the set of variables involved in H1, which are also known to affect the price discount, and examine how their *changes* may affect price convergence. We could look at the *levels* of these variables (i.e., the initial values before liberalization), but if liberalization brings changes to these variables, using changes allows liberalization to affect the price discount via these channels.[11]

Sun and Tong (2000) find that relative turnover and relative volatility (B-share over A-share variables) are positively correlated with the price premium, constructed as $(P_B - P_A)/P_A$. Mei et al. (2005) use turnover as a proxy for the degree of speculative trading of Chinese investors and argue for a positive association between speculation and the price premium. If these variables went up when the B-share market opened, the price gap should be narrowed, leading to a positive association between them.

Relative liquidity is another important factor, as Amihud (2002) shows that illiquidity is priced in the market. If B-share market liquidity improves upon liberalization, as we would expect, it should be conducive to B-share price convergence, leading to a *negative* relationship with the B-share discount.

Other than these variable changes, it is interesting to assess any possible linkage between the *initial* price gap and the subsequent B-share discount. It might be "natural" to conceive that stocks with a larger initial price disparity would converge more upon liberalization. However, without knowing what constitutes the price disparity phenomenon in the first place, it is not clear

[10] For instance, foreign shareholders reduced their ownership in the Wuxi Little Swan Co., the Guangdong Provincial Expressway Development Co., and the China International Marine Containers (Group) Co. The Jiangling Motors Corp. announced on April 18 that one of its foreign shareholders sold all 46.2 million shares, or 5.35% of its total equity capital, on the secondary market.

[11] As documented in Table 2, there are significant changes for turnover, liquidity, and bid-ask spread before and after liberalization.

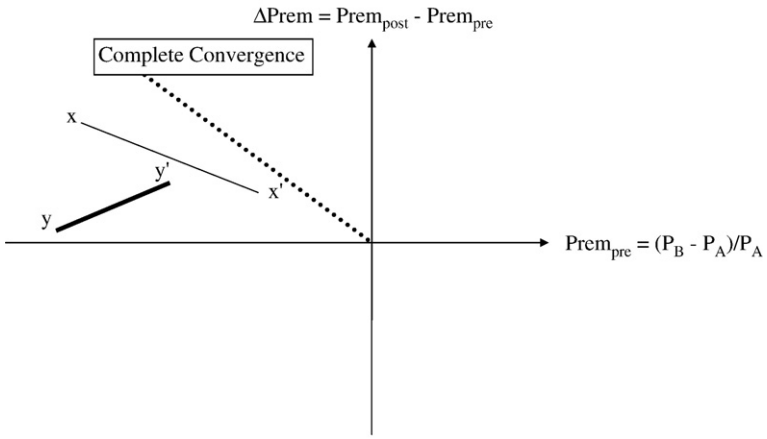

Fig. 1. A graphical illustration of the relationship between the initial price gap between A-share and B-share prices before liberalization ($Prem_{pre}$) and possible changes in the price gap after liberalization (ΔPrem) — H2.

why this has to be the case. The exact linkage is an empirical question, but considering some special cases of positive/negative linkage should be helpful to our interpretation of the subsequent test results.

To facilitate the discussion, we will first define the change in the price premium, ΔPrem, as the difference between the pre-liberalization and the post-liberalization price premium, i.e., $Prem_{post} - Prem_{pre}$, where Prem is $(P_B - P_A)/P_A$.[12] To avoid confusion in the subsequent discussion, it may be the appropriate time here to emphasize that since P_B is smaller than P_A, as mentioned before; "Prem" is always negative in value so that a *low* "Prem" means a *large* discount. At any rate, since our focus is on the impact of liberalization on P_B, a simplification of assuming no impact of liberalization on P_A (i.e., P_A remains the same) is useful.[13] In such a setting, consider an extreme case in which foreign investors sell all of their positions. This will lead to a perfect convergence of A-share and B-share prices,[14] i.e., $\Delta Prem = -Prem_{pre}$, which, when plotting ΔPrem against $Prem_{pre}$, will be a 135-degree line, the dotted line shown in Fig. 1.

With this benchmark, it is clear that foreign investors liquidating their positions *indiscriminately* would result in a *negative* relationship between ΔPrem and $Prem_{pre}$ (the solid $x-x'$ line in Fig. 1), as complete abandonment is an extreme case of indiscriminate sales. In fact, if Chinese local investors *preferentially* enter into the B-share market by way of buying more deeply discounted "cheap" stocks (low $Prem_{pre}$), and less moderately discounted "expensive" stocks (high $Prem_{pre}$), this will also yield a negative relationship.

Yet, some *discriminatory* liquidation by foreign investors might lead to a positive relationship. Consider a "reverse causation" scenario in which foreign investors' sale of B-shares is conditional on the extent of price convergence. For instance, foreign investors are eager to sell in large quantities those initially deeply discounted stocks (presumably these are the stocks foreign investors value less that constitute a deeper price discount) as long as domestic investors can provide enough buying liquidity to absorb the price impact of mass liquidation. On the other hand, they are reluctant to sell those moderately discounted stocks (those they value more) unless domestic investors are willing to pay a "high" price. That is to say, less discounted stocks would demand a proportionally higher price increase compared to more discounted stocks in order to have the same quantity of shares change hands between foreign and domestic investors. Based on such a price-pressure story, we would observe a positive association between ΔPrem and $Prem_{pre}$ (the bold, solid $y-y'$ line in Fig. 1). More importantly, observing such a positive relationship would suggest that foreign investors have not indiscriminately liquidated their positions and left the B-share market (again, if they had, we would observe a negative relationship and, in the extreme case, a perfect convergence), and that they have had marginal impact on the equilibrium price setting of B-shares upon liberalization. As mentioned, the question of which relationship would come out is an empirical one; this constitutes our second hypothesis:

H2. When the B-share market opens up, stocks initially discounted less heavily will converge more, so that the *change* in the B-share price premium after liberalization will be positively correlated with the initial B-share price premium before liberalization, and with the changes in relative turnover, relative volatility, and relative liquidity upon liberalization.

Liberalization tends to increase the correlation between the two markets because it increases the information flow and competition between them. In addition, since the liberalization is "one-way", we expect that the A-share market should have a larger influence on the B-share market after liberalization than before. We hence formulate two more hypotheses:

H3. The correlation between A- and B-share returns increases after liberalization; and

[12] A complete list of the variables used in subsequent tests and the corresponding definitions are listed in Appendix B.

[13] Of course, P_A would likely change after liberalization. However, as long as the change of P_A is small relative to that of P_B, our assumption should not be too restrictive.

[14] We assume that price disparity is completely driven by the different pricing formulas of the domestic and foreign investors.

Table 1
Summary of predicted change on various measures associated with the market quality after the opening up of the B-share market

	Hypothesis 1	Hypothesis 2	Hypothesis 3	Hypothesis 4
Turnover	↑			
Liquidity	↑			
Volatility	?			
Price premium	↑[a]			
Transaction cost	↓			
Relationship between initial B-share price premium and subsequent change in B-share price premium		+		
A- and B-share return correlation			↑	
Influence A→B				↑

[a] Since price premium is negative in value (see Appendix B for the definition), its increase means the value being less negative which, in turn, means more price convergence of A-share and B-share.

H4. The influence of the A-share market on the B-share market should increase more than the influence of the B-share market on the A-share market after liberalization.

By "influence", we specifically refer to volatility spillover and the price discovery process. We expect to observe a significant increase in volatility spillover from the A-share market to the B-share market. For the price discovery role, the situation could be complicated. In general, when a market opens up and attracts more orders, the price discovery process will be enhanced. In that case, the influence of the B-share market on the A-share market should increase after liberalization. Yet, in our case, only local retail investors were allowed to enter the B-share market, as mentioned in Section 2, and they tend to be speculative. The informed, institutional traders remained in the A-share market. To the extent that the informed traders in the A-share market maintain a different pricing model from the foreign investors in the B-share market, the pricing influence from the A-share market could *increase* after liberalization. Which effect will dominate is an empirical question. The null of H4 assumes the second effect to be dominant. In any case, the predictions associated with the above four hypotheses are summarized in Table 1.

4. Data and proxy measures

Our testing sample is composed of paired firms. A total of 86 firms issued both A-class and B-class shares at the end of 2000, but only 81 pairs had enough trading data during our sample period from February 5, 2000 to June 15, 2002.[15] Among them, 41 pairs of stocks trade on the SHSE and 40 trade on the SZSE. We divided our sample period into three sub-periods. The pre-liberalization period indicates the period on or before February 4, 2001, while the post-liberalization period indicates the period on or after June 16, 2001. The days in between belong to the liberalization period. Singling out this sub-period of liberalization is also important for our more long-term analyses on the lasting impact of the liberalization policy, because this is a transitional period during which both the A-share and B-share markets would conceivably be quite volatile. Including this period in the post-liberalization period would likely contaminate the analysis. We have checked the CSRC website for other events during our sample period which might have produced a significant confounding effect and found none. The only event which may have had a significant impact on the A- and B-share markets is the QFII scheme but this was announced and implemented at the end of 2002, as mentioned before, and is out of our sample period. We mainly use daily data from the CSMAR database, but some are from the Taiwan Economic Journal (TEJ) database.

Our tests work mainly on six key market variables, namely turnover, return volatility, price premium, liquidity, and bid–ask spread, as measures of market quality. Trading volume or turnover is the number of shares traded divided by the total number of outstanding A- or B-tradable shares. It is a direct measure of trading activities in the market and is traditionally used as a proxy for liquidity. It has also been used as a measure of the level of speculation in the Chinese market by Mei et al. (2005). Return volatility is the standard deviation of daily returns. It can be used as a measure for risk as well as the level of speculation. As defined above, the B-share price premium is $(P_B - P_A)/P_A$. This definition gives a simple and direct interpretation. For instance, a value of −0.30 indicates a 30% discount of P_B over P_A. The bid–ask spread is the ratio of the bid–ask difference over the midpoint, where the bidding and asking prices are the daily closing bid and ask quotes, respectively. The spread is an important component of the transaction cost and can also be used as a proxy for liquidity. In fact, it is considered as a better measure for liquidity (Hasbrouck, 2006). However, the detailed TAQ data are often not available. Since both Chinese A- and B-share markets are purely order-driven, our daily closing bid and ask quotes are not necessarily binding, but based on a sub-sample of around 40 stocks where we could identify their last transactions of the day being bid or ask, or at the midpoint during the six months in the pre-liberalization period and six months in the post-liberalization period, we found that the bid–ask spreads are mostly binding, as less than 8% of the last transaction prices fall inside the spread on average.[16] As such, the bid and ask quotes can still provide a reasonable indication of the transaction cost in the market.

Illiquidity is not observed directly, and various proxies like turnover, trading volume or value, and firm size have been used in previous studies. However, Lesmond (2005) pointed out that these proxies may capture the effect of variables not related to

[15] To be included in the sample, a firm should have, at least, one month daily trading data before February 5, 2001 for both its A- and B-shares. 4 out of the 81 firms have some missing data during the pre-period. However, deleting these four firms did not change our results.
[16] Results are available upon request.

Table 2
Univariate analysis

Variable	Sample	Observations	Median (mean) Before	Median (mean) During	Median (mean) After	Median (mean) change During–Before	+ve/−ve ratio	Median (mean) change After–Before	+ve/−ve ratio
Turnover	A-Share	81	0.0263	0.0154	0.0099	−0.0106**	13/68	−0.0154**	1/80
			(0.030)	(0.018)	(0.011)	(−0.012)**		(−0.009)	
	B-Share	81	0.006	0.037	0.0075	0.0299**	81/0	0.0017*	59/22
			(0.006)	(0.037)	(0.008)	(0.031)**		(0.002)**	
Volatility	A-Share	81	2.7352	2.1337	2.6312	−0.5351**	13/68	−0.0388	39/42
			(2.747)	(2.280)	(2.638)	(−0.467)**		(−0.109)	
	B-Share	81	3.2456	4.3181	2.9494	0.8847**	75/6	−0.3731**	19/62
			(3.246)	(4.318)	(2.949)	(1.072)**		(−0297)**	
Spread	A-Share	81	0.0008	0.0007	0.0009	−0.0001**	18/63	0.0001*	55/26
			(0.001)	(0.001)	(0.001)	(−0.000)**		(0.001)	
	B-Share	81	0.0084	0.0019	0.0024	−0.0057**	0/81	−0.0051**	0/81
			(0.008)	(0.002)	(0.002)	(−0.006)**		(−0.006)**	
Ntd ratio	A-Share	81	0.0214	0.0222	0.0211	0.0009	40/41	−0.0003	38/43
			(0.020)	(0.021)	(0.021)	(0.001)		(0.001)	
	B-Share	81	0.1072	0.026	0.0389	−0.0778**	0/81	−0.0729**	3/78
			(0.107)	(0.026)	(0.039)	(−0.081)**		(−0.069)**	
Amih ratio	A-Share	81	0.0002	0.0002	0.0005	0.0001*	28/53	0.0003**	78/3
			(0.001)	(0.001)	(0.001)	(0.001)**		(0.001)**	
	B-Share	81	0.0131	0.0122	0.0009	−0.0015	32/49	−0.0053**	0/81
			(0.013)	(0.012)	(0.001)	(−0.001)		(−0.013)**	
Premium	B-Share	81	−0.8014	−0.3915	−0.4662	0.4050**	81/0	0.3309**	81/0
			(−0.794)	(−0389)	(−0.451)	(0.415)**		(0.343)**	

This table presents, in various samples, the number of observations, the mean and median values of daily average turnover, volatility, bid–ask spread, illiquidity, and the price premium of B-shares relative to their corresponding A-shares in relation to the events permitting Chinese nationals to buy B-shares using their foreign currency deposits. The pre-announcement period is from February 5, 2000 to February 4, 2001; the period marked "during" is from February 5, 2001 (10 trading days before the first event) to June 15, 2001 (10 trading days after the last event); the post-event period is from June 16, 2001 to June 15, 2002. B-share prices have been converted to RMB using the relevant daily exchange rate before calculating their bid–ask spreads and premiums. The B-share premium is $(P_B - P_A)/P_A$. The volatility is proxied by the standard deviation of the daily returns in the relevant period. The turnover is the number of shares traded divided by the number of shares outstanding. The bid–ask spread is the daily closing ask price minus the bid price divided by the average of the bid and ask prices. The illiquidity is proxied by two ratios. First, the percentage of zero return trading days, which was derived by dividing the number of trading days with a zero return by the total number of trading days in the relevant period (Ntd ratio). Second, the Amihud ratio, which is the daily ratio of absolute stock return to its dollar trading volume averaged over the relevant period. The *t*-test and Wilcoxon *Z*-test have been employed to test for any significant changes in the mean and median of these variables between any two periods, respectively. The number of positive versus negative changes in median and mean is also shown in the table.
**(*) denotes significance at the 5(10) percent level.

liquidity. He found the non-trading ratio developed by Lesmond et al. (1999) superior to other frequently used measures. The ratio is the number of trading days with zero return over the total number of trading days of the sample period. The idea is that if a stock is more liquid, it will have fewer zero return days. Non-trading is also used by Bekaert et al. (2007) in their study of liquidity and returns in emerging markets. A shortcoming of this measure is that it cannot differentiate as to whether the increase in trading is due to increased information arrival or increased liquidity after liberalization.

An alternative liquidity measure proposed by Amihud (2002) is the daily ratio of absolute stock return to its dollar trading volume averaged over a given period (the Amihud ratio hereafter). Intuitively, this can be interpreted as the daily stock price response associated with one dollar of trading volume. The less the price responds to the trading volume, the more liquid is a stock. This is consistent with Kyle's (1985) concept of illiquidity, i.e., the response of price to order flow, and Silber's (1975) thinness measure, i.e., the ratio of absolute price change to absolute excess demand for trading. After comparing a few alternative liquidity measures, Hasbrouck (2006) concludes that the Amihud ratio appears to be the best liquidity measure constructed out of daily data. We use both the non-trading ratio and the Amihud ratio to proxy liquidity in the following study.

5. Empirical results

5.1. Market quality tests on H1

5.1.1. Univariate tests

We start with simple univariate tests. Specifically, we perform the two-tailed Wilcoxon rank-sum test and the *t*-test to detect possible changes in the median and mean, respectively, of the six impact variables discussed above across the three sub-sample periods, i.e., pre-, during and post-liberalization periods. If the partial liberalization has improved the quality of a market, there will be an increase in trading volume and liquidity, a decrease in spread, and possibly a decrease in volatility. In addition, the price differences between the A- and B-share stocks should be narrower. The results are presented in Table 2.[17]

[17] We only report the full-sample results to save space. The results for the Shanghai and Shenzhen sub-samples are similar.

The first row shows the Wilcoxon test on the changes in turnover across periods. The result indicates that all 81 B-share stocks showed an increase in turnover during the liberalization period. However, such an increase could not be sustained, and the turnover of B-shares dropped in the post-liberalization period. Yet, when comparing the turnover in this period with that in the pre-liberalization period, there was still a significant increase of 0.17% in the median value and 0.2% in the mean value (the "After–Before" column). Hence, the liberalization process has helped to activate the B-share market. On the other hand, the result for A-shares indicates that both the median and mean turnover dropped after liberalization. The median drop is large and of statistical significance at the 5% level. This indicates that B-share market liberalization leads local investors to switch to trading in B-shares. This result may also be due to the spillover of more rational investment behavior from the B-share market to the A-share market, which cooled down the speculative trading activities on the corresponding A-shares.

A-share (B-share) stocks showed a lower (higher) volatility during the liberalization period. Interestingly, A-share stocks resumed the same level of volatility in the post-liberalization period as in the pre-liberalization period, but B-share stocks became significantly less volatile. Notice that the difference in volatility between A- and B-shares was smaller after liberalization than before.

The bid–ask spread was reduced, especially for B-share stocks, upon liberalization. The median A-share spread was reduced by 1 basis point (the "During–Before" column), but widened back to 0.0009 in the post-liberalization period. Yet, the median B-share spread was drastically reduced by 57 basis points and showed no significant change afterwards. Hence, the transaction cost of the B-share market did reduce after liberalization. Again, the A- and B-share spreads became much more similar after liberalization than before.

Both illiquidity measures show a pattern similar to the spread in that the major post-liberalization drop was in the B-share stocks. A reduction in the number of non-trading days occurred across the board for all 81 B-share stocks during the liberalization period. It is true that the non-trading figure rebounded a little in the post-liberalization period, but when compared with the pre-liberalization figure, it was still a drop of 0.07 at the 5% significance level (the "After–Before" column). Notice that there were no significant changes in the non-trading figure of A-share stocks across the three time periods. The Amihud ratio also shows a significant reduction in illiquidity after the liberalization. However, there is also a minor but statistically significant increase in illiquidity for A-shares after the opening up of the B-share market. These factors evidence that the liquidity improvement in the B-share market did not come at much expense to the A-share market. On the other hand, both the non-trading and Amihud ratios of A- and B-shares are much more comparable after than before liberalization. With these results and the above findings on turnover and bid–ask spread, we can conclude that liquidity has improved after liberalization for B-shares.

There was, as expected, a dramatic narrowing in the price gap between the A-share and B-share prices when the B-share market opened up. Although this narrowing of the price gap tended to reverse in the post-liberalization period, our Wilcoxon test shows that the gap was still significantly narrower in this period than in the pre-liberalization period.[18]

Overall, the results in Table 2 support H1, which stated that liberalization leads to a net increase in demand in B-shares, which improves the quality of the B-share market without much adverse impact on the corresponding shares in the A-share market.

5.1.2. SUR test

Although our sample consists of matched A- and B-share pairs, there may still be some factors that would cause a relative change in demand for A-share and B-share stocks; this, in turn, would cause relative changes in our market quality indicators of A-share and B-share stocks, even if there were no B-share market liberalization. For example, if the relative supply of B-shares versus A-shares changed during our sample period, then differential changes in liquidity, turnover, and price discount may occur in the two markets even without liberalization. In addition, it is also possible that local and foreign investors would have very different responses to the change of certain company attributes.

We, therefore, further test H1 by running seemingly unrelated regressions (SUR) to determine whether liberalization effects found in the univariate tests still exist after control for changes in firm characteristics:

$$\begin{aligned}\Delta Y_{a,i} &= \alpha_o + \alpha_1 \Delta Size_{a,i} + \alpha_2 \Delta Leverage_{a,i} + \alpha_3 \Delta ROA_{a,i} + \alpha_4 \Delta ST_{a,i} + \alpha_5 \Delta RS_{a,i} + \alpha_6 \Delta SHSE_{a,i} + \alpha_7 \Delta Float_{a,i} + \alpha_8 \Delta INDD_{a,i} \\ &\quad + \alpha_9 \Delta Dual_{a,i} + \alpha_{10} \Delta DBeta_{a,i} + \alpha_{11} \Delta WBeta_{a,i} + \varepsilon_{a,i} \\ \Delta Y_{b,i} &= \beta_o + \beta_1 \Delta Size_{b,i} + \beta_2 \Delta Leverage_{b,i} + \beta_3 \Delta ROA_{b,i} + \beta_4 \Delta ST_{b,i} + \beta_5 \Delta RS_{b,i} + \beta_6 SHSE + \beta_7 \Delta Float_{a,i} + \beta_8 \Delta INDD_{a,i} \\ &\quad + \beta_9 \Delta Dual_{a,i} + \alpha_{10} \Delta DBeta_{b,i} + \alpha_{11} WBeta_{b,i} + \varepsilon_{b,i}\end{aligned} \tag{1}$$

Not only does SUR allow us to examine the differential impacts on A- and B-shares of the same change in the independent variable, but it also allows us to take into consideration the possible correlation between A- and B-shares residuals. $\Delta Y_{a,i}$ ($\Delta Y_{b,i}$) is the change in the relevant dependent variables such as turnover, volatility, and so forth, of firm *i* in the A-share (B-share) market across the pre- and post-sub-periods. Specifically, ΔY is the difference in the average values of *Y* between the post-liberalization period (i.e., June 16, 2001 to June 15, 2002) and the pre-liberalization period (i.e., February 5, 2000 to February 4, 2001).

The control variables on the right hand side can be categorized into five groups. The first group contains changes in some typical attributes of a firm, such as Size, Leverage, and ROA. Size is the natural log of total assets. We include ΔSize as a control because it is well documented in the literature that Size is positively related to information availability, liquidity, and trading volume, but negatively related to transaction cost. Capital structure is captured by firm leverage, defined as total liabilities over total assets. We

[18] Karolyi and Li (2003) find that the decline in the B-share discount after B-share market liberalization was concentrated in small capitalization stocks and those with substantial past-return momentum.

control for capital structure because it would have some impact on a firm's risk and corporate governance. These, in turn, may affect investors' demand on B-shares relative to A-shares. ROA, the return on assets, reflects the earning power of the firm. It is obvious that a change in earnings may cause changes in demand for a stock. We control for changes in firm characteristics because their impacts on the relevant dependent variables may be systematically different across A-share and B-share stocks of the same firm, although we do not have a prior view of their relationships. For example, local and foreign investors may have different risk tolerances. Even in the absence of market liberalization, an increase in leverage in a firm may be viewed as a good or bad signal in both markets, or a good signal in one market but a bad signal in the other. Similarly, an increase in Size may increase liquidity, information availability, etc., but it may also indicate that the agency problem is more serious. Although an increase in earnings should lead to higher volume, more liquidity, lower volatility, etc. in both A- and B-share markets, the magnitude of change in these variables may be different across different markets.

The second group of control variables reflects a firm's corporate governance. Corporate finance theory states that, all things being equal, firms with good corporate governance will be in greater demand than those without in the stock market. Poor corporate governance is widely viewed as an important cause for the poor performance of listed firms in the Chinese market. It is also conceivable that foreign investors are more sensitive to a firm's corporate governance change than local investors. The percentage state ownership (ST) is the first variable we consider. Sun and Tong (2003) argued that too much state ownership among China's listed companies led to bad corporate governance, and hence poor performance. Float is the percentage of tradable shares in a firm. The Chinese market is plagued by low levels of float. Only one-third of shares in a typical firm were tradable during our sample period. Although non-tradable shareholders (typically the government or other SOEs) are usually the control shareholders in a firm, they do not directly benefit or suffer from stock price movement. Therefore, non-tradable shareholders' interests often do not coincide with those of the tradable shareholders. This leads to many bad corporate governance practices in China. In addition, float would also affect liquidity and trading for a firm (Mei et al., 2005). The other two corporate governance variables included in this group are the percentage of independent directors, INDD, defined as the number of independent directors divided by the total number of board members, and duality, DUAL, where a dummy takes the value of 1 if a company's CEO and Board Chairman positions are served by different people, and zero otherwise. Due to limitations in the data, we do not include additional corporate governance variables.

The third group contains only one variable, the relative B-share supply, RS, which is the ratio of outstanding tradable B-shares to outstanding tradable A-shares for a firm. This needs to be controlled because a change in RS may cause changes in relative demand for A- and B-share stocks even if there is no liberalization. The fourth group also contains one variable, SHSE, the exchange dummy which takes a value of 1 if a firm is listed on the SHSE and zero on the SZSE. This is to allow for possible systematic differences existing in the two exchanges documented in many previous studies (Sun and Tong, 2000; Chen et al., 2001). All independent variables in the above four groups, except SHSE, are the difference between the two-year average values in 2001–2002 and the two-year average values in 1999–2000.

The final group contains two market risk variables: the changes in foreign and domestic betas, $\Delta WBeta_i$ and $\Delta DBeta_i$. The beta is estimated by running market model regressions. Running the daily B-share return against the MSCI return for both pre- and post-liberalization periods for each individual firm, we can obtain the pre- and post-foreign betas. We then take the difference between the post- and pre-betas to get the change in the foreign beta. Similarly, using the daily A-share return and the domestic market return series, we can obtain the change in the domestic beta. The aim of including the betas is to capture possible, unidentified macro risk changes that occurred in the domestic and world markets during our sample period that might affect our results. For instance, our sample period coincided with a period on the global stage of considerable financial reordering, as the tech bust was essentially happening at this point. To the extent that global investors were significantly re-allocating according to the changing risk environment, this might affect the demand in the B-share market even without the market liberalization. Also, our sample period overlapped with a long-lasting bear market in China that started in the second half of 2001, which might change the local demand for A-share stocks. Through including the betas from the market model to control for the changes in domestic as well as foreign market risks, we hope at least partially to alleviate such confounding effects. Needless to say, this control is very rough, but may still be important.[19]

Our SUR results of Eq. (1) are presented in Table 3.[20] The focus is on the regression intercepts, which capture the liberalization effect, i.e., changes in the variables in question after controlling for the changes of various firm-specific characteristics. Very much consistent with the univariate comparisons, we see an increase in turnover for B-share stocks, but a drop in turnover for A-share stocks. These are statistically significant. We also see a statistically significant drop in illiquidity as measured by both the non-trading ratio and the Amihud ratio for B-share stocks, but an insignificant increase in illiquidity proxied by the non-trading ratio, and a statistically significant increase in illiquidity proxied by the Amihud ratio, for A-share stocks. The increase in the Amihud ratio may be taken as weak evidence for the argument that the B-share market improves after liberalization at the expense of A-share stocks. However, the magnitude of increase in the Amihud ratio for A-shares, which is only 0.0004, is much smaller than the absolute value of change in the Amihud ratio for B-shares, which is 0.0265. The significant decrease in turnover for A-share stocks could suggest that A-share stocks suffered while B-share stocks gained after liberalization. Yet, it could also be interpreted to demonstrate that the speculation bubble reduced in the A-share market due to the spillover of the more rational valuation from the B-share market to A-share market because the information linkage became closer between the two markets after liberalization.

[19] We thank the referee for pointing out the complexity of the issue.

[20] Since our focus is on the consequential impact, the results of the comparison between the pre-liberalization and the liberalization periods are not reported to save space, but are available upon request.

Table 3
Seemingly unrelated regression

	△Va	△Vb	△Sa	△Sb	△Spreada	△Spreadb	△Zeroa	△Zerob	△amiha	△amihb
Constant	−0.0129	0.0023	−0.310	−0.172	0.0002	−0.0045	−0.0022	−0.0705	0.0004	−0.0265
	(−3.730)**	(1.707)*	(−1.087)	(−0.645)	(1.375)	(−2.493)**	(−0.345)	(−5.467)**	(4.652)**	(−3.246)**
△Size	−0.0020	0.001	−0.4234	−0.4012	0.0001	0.0016	−0.0034	0.0134	−0.0008	0.0041
	(−0.614)	(0.472)	(−1.550)	(−1.574)	(0.947)	(0.908)	(−0.571)	(1.082)	(−0.903)	(0.520)
△Leverage	−0.0009	0.0011	−0.1092	−0.0734	−0.0008	−0.0007	0.0010	−0.0002	−0.0002	0.0011
	(−0.508)	(1.535)	(−0.709)	(−0.511)	(−0.995)	(0.676)	(0.284)	(−0.034)	(−0.440)	(0.251)
△ROA	−0.0020	0.0003	0.0502	−0.0926	−0.0002	0.0030	0.0012	−0.0054	−0.0002	0.0096
	(−0.448)	(0.179)	(0.139)	(−0.274)	(−1.210)	(1.310)	(0.149)	(−0.330)	(−0.235)	(0.927)
△ST	−0.0233	0.0137	2.0251	−0.2584	0.0032	0.0174	−0.0274	0.0859	0.0005	0.0337
	(−1.595)	(2.407)**	(1.681)*	(−0.230)	(5.012)**	(2.272)**	(−1.034)	(1.578)	(1.341)	(0.979)
△RS	−0.0008	−0.0008	−0.0271	−0.0299	−0.0003	−0.0003	−0.0008 2	−0.0068	0.0002	−0.0022
	(−1.049)	(0.258)	(−0.431)	(−0.510)	(−0.904)	(−0.644)	(−0.547)	(−2.400)**	(1.010)	(−1.230)
SHSE	−0.0015	−0.0013	0.1082	−0.535	−0.0003	−0.0010	−0.0079	−0.0481	−0.0009	0.0059
	(−0.858)	(−1.854)*	(0.757)	(−4.009)**	(−3.566)**	(−1.153)	(−2.519)**	(−7.439)**	(−2.060)**	(1.431)
△FLOAT	0.0114	−0.0026	0.6125	1.0265	0.0002	−0.0044	−0.0072	0.0973	−0.0006	0.0399
	(0.907)	(−0.530)	(0.591)	(1.062)	(0.319)	(−0.674)	(−0.316)	(2.077)**	(−1.848)**	(1.348)
△INDD	0.0067	−0.0007	0.6920	0.1856	−0.0006	−0.0071	0.0334	−0.0118	0.0004	−0.0064
	(0.798)	(−0.223)	(0.994)	(0.286)	(−1.617)	(−1.594)	(2.180)	(−0.374)	(0.183)	(−0.092)
△DUAL	−0.0010	−0.0005	0.1981	−0.0121	−0.0008	−0.0012	0.0027	−0.0236	0.0006	−0.0072
	(−0.441)	(−0.053)	(1.021)	(−0.067)	(−0.824)	(−0.943)	(0.633)	(−2.690)**	(0.973)	(−1.290)
△DBeta	0.0044	0.0034	0.9571	0.1013	0.0002	−0.0004	0.0006	0.0062	0.0002	−0.0007
	(1.325)	(2.633)**	(3.518)**	(0.399)	(1.331)	(−0.233)	(0.092)	(0.507)	(2.143)**	(−1.290)
△WBeta	−0.0001	0.0000	0.0019	0.0007	0.0000	0.0000	0.0003	0.0001	0.0000	0.0001
	(−4.463)**	(−0.678)	(0.779)	(0.314)	(1.353)	(0.148)	(0.640)	(1.151)	(−0.443)	(1.568)
Obs.	81		81		81		81		81	
Adjusted R^2	0.7248		0.4516		0.4901		0.6394		0.5176	

This table reports the results of the following SUR regression analysis for the difference of average turnover, volatility, illiquidity (Ntd and Amih ratios), bid–ask spread, and premium (or discount) before and after the events surrounding the partial liberalization of B-share firms.

$$\Delta Y_{a,i} = \alpha_o + \alpha_1 \Delta Size_{a,i} + \alpha_2 \Delta Leverage_{a,i} + \alpha_3 \Delta ROA_{a,i} + \alpha_4 \Delta ST_{a,i} + \alpha_5 \Delta RS_{a,i} + \alpha_6 \Delta SHSE_{a,i} + \alpha_7 \Delta Float_{a,i} + \alpha_8 \Delta INDD_{a,i} + \alpha_9 \Delta Dual_{a,i} + \alpha_{10} \Delta DBeta_i + \alpha_{11} \Delta FBeta_i + \varepsilon_{a,i}$$

$$\Delta Y_{b,i} = \beta_o + \beta_1 \Delta Size_{b,i} + \beta_2 \Delta Leverage_{b,i} + \beta_3 \Delta ROA_{b,i} + \beta_4 \Delta ST_{b,i} + .\beta_5 \Delta RS_{b,i} + \beta_6 \Delta SHSE + \beta_7 \Delta Float_{a,i} + \beta_8 \Delta INDD_{a,i} + \beta_9 \Delta Dual_{a,i} + \beta_{10} \Delta DBeta_i + \beta_{11} FBeta_i + \varepsilon_{b,i}$$

The whole sample spans from February 5, 2000 to June 15, 2002 and is further divided into three sub-periods: (1) The pre-announcement period from February 5, 2000 to February 4, 2001, (2) the event period from February 5, 2001 (10 trading days before the first event) to June 15, 2001 (10 trading days after the second event), and (3) the post-event period from June 16, 2001 to June 15, 2002. The B-share prices have been converted to RMB using the relevant daily exchange rate before calculating their bid–ask spread. The volatility, *S*, is proxied by the standard deviation of the returns in the relevant period. The turnover, *V*, is the number of shares traded divided by the number of shares outstanding. The bid–ask spread is proxied by the daily closing ask price minus the bid price divided by the average of the bid and ask prices. The illiquidity is proxied by two ratios. The percentage of zero return trading days is the ratio of the number of trading days with a zero return and the total number of trading days in the relevant period. The Amihud ratio is the daily ratio of absolute stock return to its dollar trading volume averaged over the relevant period. Δ is the difference between the post-period average and the pre-announcement period average, i.e., the post-period average − the pre-announcement average. All independent variables except the exchange dummy SHSE are the difference between the two-year average of the period 2001–2002 and the two-year average of the period 1999–2000. Size is proxied by the natural log of the total assets; Leverage is the ratio of total liabilities over total assets; ROA is the return on assets; relative supply, RS, is the ratio of outstanding tradable B-shares to outstanding tradable A-shares; and ST is the level of state ownership. SHSE takes 1 if a firm is listed on the Shanghai Stock Exchange, and zero otherwise. Float is the tradable shares as a percentage of total shares outstanding. INDD is independent director members as a percentage of all board members. Dual takes 1 if a firm's CEO and Board Chairman are separated, and zero otherwise. DBeta ($WBeta_f$) is the domestic (foreign) market risk. *t*-statistics are in parentheses.
**(*) denotes significance at the 5(10) percent level.
Note: Including industry dummies in the regressions gives qualitatively the same results. We do not report these results to save space. However, they are available upon request.

Notice that the changes in volatility for both A-share and B-share stocks become statistically insignificant, while the univariate analysis results of Table 2 do indicate a statistically significant reduction in volatility for B-share stocks. In addition, we see that there is a statistically significant increase in bid–ask spread for A-share stocks in Table 2, but an insignificant intercept for A-share stocks in Table 3. These results suggest that after controlling for changes in other variables, liberalization has no impact on volatility either for A-share or B-share stocks. At the same time, liberalization significantly reduces transaction costs (bid–ask spread) for B-share stocks, but has no impact on transaction costs for A-share stocks.

We do not discuss the estimates for control variables as our focus is on the intercepts. One thing worth noting is that changes in the variables in question for SHSE listed stocks are systematically different from those listed in Shenzhen, as the SHSE dummy is statistically significant from zero for most dependent variables. However, it is not significant for the change in the B-share premium, which means that the price increases of B-share stocks listed on the SHSE and SZSE are comparable. In any case, our overall SUR results lend further support to H1.[21]

[21] Instead of using difference data as control variables, we have also tried to use the pre-liberalization level data. The results on the intercept are qualitatively the same.

5.2. Price convergence test on H2

5.2.1. Basic results

In this section, we test H2 on the possible linkages in price premiums before and after liberalization. Before we do so, we present, in Fig. 2, a simple plot of the average price premium of stocks listed on the SHSE and SZSE over our sample period.

Fig. 2 clearly shows that B-shares in both the Shanghai and Shenzhen stock markets had an average price discount of 80% against their corresponding A-shares before liberalization in February 2001. Then, the discount reduced quickly to 30% around late March, and subsequently stabilized in the range of 40%–50%. At any rate, we set up the following cross-sectional regression equation to examine factors inducing the change in premium caused by liberalization:

$$\begin{aligned}\Delta Prem_i = {} & \beta_o + \beta_1 Prem_{i,\mathrm{pre}} + \beta_2 \Delta RV_i(\text{or } \Delta RD_i) + \beta_3 \Delta RSpd_i(\text{or } \Delta RNtd_{a,i} \text{ or } \Delta RAmih_{a,i}) + \beta_4 \Delta RS_i + \beta_5 \Delta DBeta_{i,w} \\ & + \beta_6 \Delta DBeta_{i,d} + \beta_7 SHSE_i + \beta_8 \Delta Size_i + \beta_9 \Delta Lev_i + \beta_{10} \Delta ROA_i + \beta_{11} \Delta FLOAT_i + \beta_{12} \Delta INDD_{a,i} + \beta_{13} \Delta Dual_{a,i} + \varepsilon. \end{aligned} \quad (2)$$

The first row of independent variables in the equation contains the key variables to test H2. If domestic investors dominated the B-share market after liberalization, the coefficient of the pre-liberalization B-share premium, $\mathrm{Prem}_{i,\mathrm{pre}}$, β_1 should be negative, as they would buy more of those stocks with lower $\mathrm{Prem}_{i,\mathrm{pre}}$, leading to a larger $\Delta\mathrm{Prem}_i$. If foreign investors still affected the B-share price at the margin after liberalization, then β_1 should be positive, i.e., stock with a higher B-share premium before liberalization should still have a higher premium after liberalization.

$\Delta\mathrm{RV}_i$ and $\Delta\mathrm{RD}_i$ are the two alternative proxies for the change in relative speculation of stock i. RD_i is stock i's B-share return standard deviation relative to its A-share return standard deviation; and RV_i, is stock i's B-share turnover relative to its A-share turnover. According to Mei et al. (2005), the relative speculation should be positively related to the B-share premium. Hence, we infer that the change in relative speculation is positively related to the change in B-share premium.

$\Delta\mathrm{RNtd}_i$, $\Delta\mathrm{RAmih}_i$, and $\Delta\mathrm{RSpd}_i$ are three alternative proxies for the change in relative illiquidity of stock i. RNtd is the fraction of zero return days of the B-share stock relative to the fraction of zero return days of the corresponding A-share in the relevant period. RAmih is the Amihud ratio for the B-share stock relative to the Amihud ratio of the corresponding A-share stock. RSpd is the average of the B-share bid–ask spread relative to the average of the corresponding A-share bid–ask spread in the relevant period. Since relative illiquidity is commonly assumed to be negatively related to the B-share premium, we expect that the change in relative illiquidity should be negatively related to the change in the B-share premium.

As mentioned above, the relative supply of tradable shares, ΔRS, needs to be controlled for, as it may cause changes in relative demand for A- and B-share stocks even without liberalization. In fact, Sun and Tong (2000) found that RS is negatively correlated with Prem.

To control for the change in market risk, we include changes in the world and domestic market risk differential between the corresponding B- and A-shares, respectively. Following Bailey and Jagtiani (1994), we obtain the world market risk differential $\mathrm{DifBeta}_{iw}$ and the domestic market risk differential $\mathrm{DifBeta}_{id}$ by running the following time series regressions for pre- and post-liberalization periods, respectively.

$$R_{bit} - R_{ait} = \beta_{oit} + \beta_{iw} R_{wt} + \beta_{id} R_{dt} + \varepsilon_{it} \quad (3)$$

where $R_{bi} - R_{ai}$ is the differential between stock i's B-share return and its A-share return; R_w and R_d are the world market (MSCI World Index) return and domestic market (Combined SHSE and SZSE) return, respectively. β_{iw} and β_{id} are the world and domestic market risk differentials, $\mathrm{DifBeta}_{iw}$ and $\mathrm{DifBeta}_{id}$, respectively. Correspondingly, $\Delta\mathrm{DifBeta}_{iw}$ and $\Delta\mathrm{DifBeta}_{id}$ are the change in β_{iw} and the change in β_{id} before and after liberalization. "SHSE" is a listing dummy which takes the value of one if the stock is traded on the Shanghai Stock Exchange and zero otherwise.

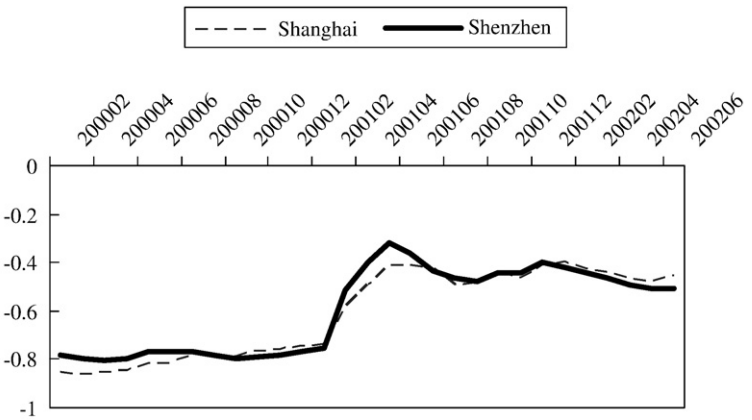

Fig. 2. B-Share premium (discount) overtime (February 2000–June 2002). The B-share premium (discount) is the equal-weighted individual B-share premium (discount) which is defined as $(P_B - P_A)/P_A$ for each stock exchange.

In addition, we control for the change in CG variables such as "Float", "INDD", and "DUAL". It is quite possible that the quality of corporate governance affects the price gap. For instance, foreign investors place heavier discounts to shares of those companies that are of poorer governance quality while domestic investors are less sophisticated and/or more speculative so that the governance factor has low weighting in their pricing formula. We also control for the change in traditional control variables like "$Leverage_i$", "$Size_i$", and "ROA_i". SHSE is the exchange dummy. All of these variables are defined as in Eq. (1).[22]

The regressions in Panel A are the basic model that excludes CG variables, the exchange dummy SHSE, and the three traditional firm-specific variables "$Leverage_i$", "$Size_i$", and "ROA_i". One focus is the coefficient of $Prem_{pre}$, which ranges from 0.24 to 0.31 in the six specifications; all of these results are significant at the 10% level or better. The results indicate that the higher the B-share price premium before market liberalization, the greater the increase in the B-share premium after liberalization. This accepts the null of H2, and suggests that foreign investors did not abandon the B-share market in general, and still have an important influence on the pricing of B-shares after liberalization. The proxies for the change in speculation, ΔRV_i, and ΔRD_i, are mostly insignificant except that ΔRV_i is positive and significant in Model 3, indicating that the larger the increase in the ratio of B-share turnover over to A-share turnover, the larger the increase in the B-share premium. This is consistent with Mei et al.'s argument that the B-share discount is caused by high speculative activities in the A-share market. However, no strong conclusion can be made, as the proxies for speculation in the other specifications are all insignificant. Among the three alternative proxies for illiquidity, only ΔAmih has a significant and negative impact on ΔPrem, as shown in Models 3 and 6, indicating the more illiquid the B-share is relative to the A-share, the smaller the increase in the B-share premium. Again, no strong inference can be made, as the other two proxies for illiquidity are not significant at all. The change in relative supply has the expected negative sign, but is insignificant in all six specifications. However, both beta differential variables enter significantly negative in all regression specifications and, conceivably, the domestic beta differential change brings much larger economic impact to the change in price convergence. This negative relationship is expected when the B-share market betas increase relative to the A-share market betas after liberalization, and the B-share price should go down, generating an opposite force to the price convergence.

Panel B reports the regression results of the full model. For the firm-specific variables, ΔSize and ΔLev do have some impact on ΔPrem, but the basic relationships between $\Delta Prem_i$, and the key testing variables established in the Panel A regressions are qualitatively the same. Specifically, $Prem_{pre}$ is still positive and even more significant. On the other hand, none of the three CG variables is significant. One possible reason is that the CG variables do not successfully capture the governance quality of our sample firms. Another possibility is that these variables did not change much over the liberalization period. In fact, when we regress using the governance variables ROA, LEV, SIZE, and RS at level terms, the results are essentially the same, and the only significant variables are still the pre-liberalization B-share premium ($Prem_{pre}$), relative supply (RS), domestic beta ($Beta_d$), and Amihud's illiquidity measure (Amid) with the same sign.

The analysis so far ignores possible interactive effects between $Prem_{pre}$ and other firm-specific explanatory variables. If these variables were to affect ΔPrem (the precise reason for putting them in as control), it is likely that their changes upon liberalization would also be affected by $Prem_{pre}$. For instance, for stocks with high $Prem_{pre}$, relative volatility change (ΔRD) may have a stronger, positive effect on ΔPrem than for stocks with low $Prem_{pre}$. Hence, we need to control for such interactive effects in order to see the overall linkage between ΔPrem and $Prem_{pre}$ more clearly.

It turns out that the only significant, interactive effect found is through relative turnover change (ΔRV) as shown by the interactive term, $Prem_{pre}$*ΔRV in Panel C. Notice that not only does the interactive term enter significantly into all specifications, but ΔRV itself also becomes statistically significant. For instance, ΔRV generally bears no statistical significance in Panel B where the interactive term has not been included. Once put in, the coefficient of ΔRV increases to 0.88 with a highly significant *t*-value of 3.43, which means that stocks with a larger increase in relative turnovers upon liberalization exhibit greater price convergence. On the other hand, the coefficient of the interactive term itself is 1.07 with an also highly significant *t*-value of 3.37. Apparently, ΔRV has a nonlinear relationship with ΔPrem that depends on $Prem_{pre}$. For stocks with a smaller initial price gap (i.e., larger $Prem_{pre}$) before liberalization, the positive impact of ΔRV on ΔPrem is stronger. Notice that the sign of $Prem_{pre}$ becomes negative when $Prem_{pre}$*ΔRV is included, but the coefficients generally lack statistical significance.

As emphasized when establishing H2, we do not have good understanding of the price disparity phenomenon. Hence, the situation could be complicated and the results in Table 4 should hence be interpreted with care. Price convergence upon liberalization, ΔPrem, is likely to be driven by various factors other than the initial price gap, $Prem_{pre}$. Some key stock-specific variables like turnover and liquidity affect price discount *and* change drastically upon liberalization. Hence, it is important to look at the changes of these variables. On the other hand, we have done some simple robust checks (not reported) and the results do not seem to be systematically driven by some deeply discounted stock pairs.[23] All in all, our results are not supportive of the view that this reversed and partial liberalization only helped foreign investors to cash out and leave the B-share market.

[22] The correlation matrix of all regressors (not reported) indicates that the correlation coefficients are generally below 0.4. However, some correlation coefficients between CG variables and others are above 0.5.

[23] We split our sample into "Low" for stock pairs with initial premium ($Prem_{pre}$) below the median of the whole sample and "High" for those above the median. The "Low" group hence includes big discount stocks and we contrast it with the "High" group on key independent variables. Other than RS, ROA, and liquidity variables, the two groups do not exhibit very different characteristics before liberalization. A similar comparison on variable changes also shows that only turnover and liquidity variables have large differences between the two groups.

Table 4
Cross-sectional regression results on price premium

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Panel A. The basic model						
Constant	0.5667	0.5618	0.4914	0.5980	0.5925	0.5483
	(4.530)***	(4.428)***	(4.128)***	(4.791)***	(4.666)***	(4.603)***
$Prem_{ipre}$	0.2995	0.2968	0.2447	0.3157	0.3116	0.2820
	(1.997)**	(1.971)*	(1.734)*	(2.060)**	(2.020)**	(1.938)*
$\triangle RV_i$ (relative turnover)	0.0309	0.0310	0.0402			
	(1.423)	(1.430)	(1.968)*			
$\triangle RD_i$ (relative volatility) volatility)				−0.0243	−0.0258	−0.0187
				(−0.630)	(−0.660)	(−0.513)
$\triangle RSpd_i$ (relative spread)	0.0004			−0.0001		
	(0.101)			(−0.039)		
△Notrd (relative zero return days)		−0.0005			−0.0006	
		(−0.208)			(−0.234)	
△Amih (relative Amihud ratio)			−0.0003			−0.0003
			(−3.280)***			(−2.931)***
$\triangle RS_i$ (relative supply)	−0.0084	−0.0098	−0.0111	−0.0104	−0.0106	−0.0120
	(−0.742)	(−1.191)	(−1.459)	(−1.262)	(−1.287)	(−1.550)
$\triangle DifBeta_{i,w}$ (world market beta differential)	−0.0007	−0.0007	−0.0005	−0.0008	−0.0008	−0.0006
	(−1.916)*	(−1.803)*	(−1.432)	(−2.036)**	(−1.940)*	(−1.627)
$\triangle DifBeta_{i,d}$ (home market beta differential)	−0.0958	−0.0971	−0.1240	−0.0794	−0.0809	−0.1073
	(−3.271)***	(−3.230)***	(−4.375)***	(−2.260)**	(−2.312)**	(−3.148)***
Observation	81	81	81	81	81	81
Adjusted R^2	0.1788	0.1792	0.2829	0.1608	0.1614	0.2481
Panel B. The full model						
Constant	0.5810	0.5773	0.4810	0.5811	0.5807	0.5322
	(3.807)***	(3.802)***	(3.363)***	(3.656)***	(3.682)***	(3.578)***
$Prem_{i,pre}$	0.3383	0.3523	0.2693	0.3202	0.3355	0.2985
	(1.845)*	(1.924)*	(1.609)	(1.654)*	(1.726)*	(1.652)*
$\triangle RV_i$ (relative turnover)	0.0149	0.0251	0.0373			
	(0.608)	(1.058)	(1.680)*			
$\triangle RD_i$ (relative volatility)				−0.0328	−0.0319	−0.0148
				(−0.681)	(−0.682)	(−0.336)
$\triangle RSpd_i$ (relative spread)	−0.0002			−0.0001		
	(−0.383)			(−0.249)		
△Notrd (relative zero return days)		−0.0026			−0.0025	
		(−0.869)			(−0.829)	
△Amih (relative Amihud ratio)			−0.0003			−0.0002
			(−3.526)***			(−2.345)**
$\triangle RS_i$ (relative supply)	−0.0084	−0.0085	−0.0116	−0.0097	−0.0098	−0.0003
	(−0.742)	(−0.752)	(−1.113)	(−0.853)	(−0.865)	(−3.165)***
$\triangle DifBeta_{i,w}$ (world beta differential)	−0.0009	−0.0009	−0.0007	−0.0009	−0.0009	−0.0008
	(−2.180)**	(−2.089)**	(−1.950)**	(−2.221)**	(−2.137)**	(−1.994)*
$\triangle DifBeta_{i,d}$ (home beta differential)	−0.0842	−0.0867	−0.1081	−0.0676	−0.0704	−0.0933
	(−2.522)**	(−2.609)**	(−3.451)***	(−1.815)*	(−1.920)*	(−2.652)**
SHSE	0.0150	0.0237	0.0260	0.0100	0.0191	0.0256
	(0.753)	(1.095)	(1.425)	(0.440)	(0.804)	(1.218)
$\triangle Size_{i,}$	0.0455	0.0478	0.0493	0.0534	0.0547	0.0549
	(1.375)	(1.474)	(1.657)*	(1.568)	(1.654)*	(1.784)*
$\triangle Leverage_i$	0.0316	0.0355	0.0312	0.0340	0.0368	0.0313
	(1.647)	(1.818)*	((1.798)*	(1.674)*	(1.852)*	(1.742)*
$\triangle ROA_{i,}$	0.0216	0.0295	0.0300	0.0158	0.0211	0.0144
	(0.463)	(0.642)	(0.728)	(0.341)	(0.469)	(0.351)
$\triangle FLOAT_I$	0.0511	0.0475	0.1023	0.0630	0.0606	0.0992
	(0.363)	(0.340)	(0.790)	−0.440)	(0.426)	(0.741)
$\triangle IND_{i,}$	0.0198	0.0200	0.0132	0.0014	−0.0012	−0.0121
	(0.228)	(0.237)	(0.169)	(0.016)	(−0.014)	(−0.153)
$\triangle DUAL_{i,}$	−0.0053	−0.0077	−0.0131	−0.0101	−0.0125	−0.0155
	(−0.229)	(−0.332)	(−0.618)	(−0.424)	(−0.523)	(−0.694)
Observation	81	81	81	81	81	81
Adjusted R^2	0.1496	0.1589	0.2826	0.1428	0.1507	0.2536

	Model 1	Model 2	Model 3	Model 4
Panel C. The full model (with the interactive dummy variable "$Prem_{ipre}$ $\triangle RV_i$")*				
Constant	0.0147	0.0138	0.0172	−0.0758
	(0.067)	(0.063)	(0.079)	(−0.379)
$Prem_{i,pre}$	−0.3885	−0.3884	−0.3691	−0.4436
	(−1.524)	(−1.513)	(−1.442)	(−1.786)*

Table 4 *(continued)*

	Model 1	Model 2	Model 3	Model 4
Panel C. The full model (with the interactive dummy variable "$Prem_{ipre}*\triangle RV_i$")				
$\triangle RD_i$ (relative volatility)	−0.0502	−0.0515	−0.0512	−0.0312
	(−1.137)	(−1.134)	(−1.155)	(−0.772)
$\triangle RV_i$ (relative turnover)	0.8822	0.8807	0.8717	0.9142
	(3.451)***	(3.416)***	(3.393)***	(3.931)***
$\triangle RSpd_i$ (relative spread)		−0.0001		
		(−0.142)		
$\triangle Notrd_i$ (relative zero return days)			−0.0021	
			(−0.753)	
$\triangle Amih_i$ (relative Amihud ratio)				−0.0003
				(−3.857)***
$Prem_{i,pre}*\triangle RV_{i,pre}$	1.0737	1.0718	1.0593	1.0956
	(3.374)***	(3.340)***	(3.312)***	(3.787)***
$\triangle RS_i$ (relative supply)	−0.0095	−0.0094	−0.0095	−0.0121
	(−0.893)	(−0.886)	(−0.894)	(−1.259)
$\triangle DifBeta_{i,w}$ (world beta difference)	−0.0011	−0.0011	−0.0011	−0.0010
	(−2.917)***	(−2.887)***	(−2.797)***	(−2.719)***
$\triangle DifBeta_{i,d}$ (home beta difference)	−0.0606	−0.0598	−0.0621	−0.0911
	(−1.741)*	(−1.688)*	(−1.776)*	(−2.793)***
$SHSE_{ii}$	−0.0055	0.0063	0.0011	0.0089
	(−0.264)	(−0.289)	(0.048)	(0.461)
$\triangle Size_{ii}$	0.0535	0.0546	0.0563	0.0558
	(1.744)*	(1.713)*	(1.814)*	(1.999)**
$\triangle Leverage_i$	0.0393	0.0401	0.0430	0.0384
	(2.195)**	(2.115)**	(2.309)**	(2.362)**
$\triangle ROA_i$	0.0424	0.0443	0.0501	0.0515
	(1.005)	(0.995)	(1.151)	(1.341)
$\triangle FLOAT_{i,}$	0.0483	0.0472	0.0448	0.0873
	(0.365)	(0.354)	(0.337)	(0.724)
$\triangle IND_{i,}$	0.0018	0.0040	0.0039	0.0009
	(0.022)	(0.049)	(0.049)	(0.013)
$\triangle DUAL_i$	−0.0053	−0.0053	−0.0072	−0.0104
	(−0.239)	(−0.235)	(−0.324)	(−0.513)
Observation	81	81	81	81
Adjusted R^2	0.3953	0.3955	0.4006	0.5080

This table reports the results of the regression analysis on price premium before and after the partial liberalization of the B-share market.

$$\Delta Prem_i = \beta_o + \beta_1 Prem_{i.\mathrm{pre}} + \beta_2 \Delta RS_i + \beta_3 \Delta RSpec_i + \beta_4 \Delta RIlliq_i + \beta_5 \Delta DifBeta_{\mathrm{iw}} + \beta_6 \Delta DifBeta_{\mathrm{id}} + \beta_7 SHSE + \beta_n \Delta CG_{\mathrm{variables}} + \beta_m \Delta control\ variables_i + \varepsilon_i.$$

The whole sample spans from February 5, 2000 to June 15, 2002. The pre-liberalization period spans from February 5, 2000 to February 4, 2001, and the post-liberalization period spans from June 16, 2001 to June 15, 2002. The event period from February 5, 2001 (10 trading days before the first event) to June 15, 2001 (10 trading days after the second event) is excluded. The B-share prices have been converted to RMB using the relevant daily exchange rate. The price premium, Prem, is $(P_B - P_A)/P_A$. $Prem_{i,post}$ is the average price premium of Stock i across the post-liberalization period. $Prem_{i,pre}$ is the average price premium of Stock i across the pre-liberalization period. Relative Supply is the ratio of outstanding tradable B-shares to outstanding tradable A-shares. The speculation is proxied by two variables. The first is the turnover, i.e., the number of shares traded divided by the number of shares outstanding, and the second is the return volatility, which is proxied by the standard deviation of stock returns in the relevant period. The relative turnover, RV, is the ratio of B-share turnover to the corresponding A-share turnover, while the relative volatility (RD) is the ratio of B-share volatility to the corresponding A-share volatility. The illiquidity has three alternative proxies: the daily bid–ask spread, which is the daily B-share closing ask price minus the bid price divided by the average of the bid and ask price; the percentage of zero return days in the relevant trading period, which is the ratio of the number of trading days with a zero return to the total number of trading days; and the Amihud ratio, which is the daily ratio of absolute stock return to its dollar trading volume averaged over the relevant period. The relative bid–ask spread (RSpd) is the ratio of the average daily B-share bid–ask spread to the corresponding A-share spread over the relevant period. The relative zero return days (RNtd) is the ratio of the corresponding percentage of B-share zero return days over the A-share zero return days. The relative Amihud ratio (RAmih) is the B-share Amihud ratio over the corresponding A-share Amihud ratio. The relative Beta differentials are measured as the difference between B-share and A-share world market betas ($DifBeta_{i,w}$), and the difference between B-share and A-share domestic market betas ($DifBeta_{i,d}$). The difference for all above variables is the difference between the post-period average and the pre-announcement period average, i.e., the post-period average — the pre-announcement average. All other control variables, except for the exchange dummy SHSE, are the difference between the two-year average of the period 2001–2002 and the two-year average of the period 1999–2000. Size is proxied by the natural log of total assets; Leverage is the ratio of total liabilities over total assets; and ROA is the return on assets. Float is the tradable shares as a percentage of total shares outstanding. INDD is independent director members as a percentage of all board members. Dual takes 1 if a firm's CEO and Board Chairman positions are separated, and zero otherwise. SHSE takes 1 if a firm is listed on the Shanghai Stock Exchange, and zero otherwise. *t*-statistics are in parentheses.
*, **, *** denote significance at the 10, 5, and 1% levels, respectively.

5.2.2. Foreign investors' accounts

A more direct test of H2 is to look at the actual change in shareholdings of foreign investors before and after liberalization. Unfortunately, we do not have such data, but the TEJ database provides semi-annual data on the holdings of the top ten shareholders of each company, and these shareholders are labeled as either "domestic" or "foreign". We assume that "foreign" major shareholders hold B-shares only. We then construct the variable "BSH", which is the ratio of the total shareholding of these "foreign" investors over the total number of outstanding, tradable B-shares. We insert "ΔBSH", the difference of BSH in pre- and post-liberalization periods, in place of $Prem_{\mathrm{pre}}$ in Eq. (2) and re-run the regression.

Table 5
Cross-sectional regression results on major shareholding and price premium

	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	0.2895	0.3137	0.3111	0.3061	0.2787
	(8.309)***	(8.351)***	(8.404)***	(7.108)***	(7.408)***
$\triangle BSH_i$,(major holdings of B-shares)	0.0017	0.0043	0.0057	0.0043	0.0044
	(2.093)**	(2.349)**	(2.864)***	(2.326)**	(2.522)**
$\triangle RD_i$ (relative volatility)	−0.0422	−0.0394	−0.0610	−0.0419	−0.0241
	(−0.979)	(−0.927)	(−1.391)	(−0.996)	(−0.593)
$\triangle RV_i$ RV_i(relative turnover)	0.0365	0.0079	−0.0010	0.0085	0.0152
	(1.570)	(0.271)	(−0.036)	(0.289)	(0.550)
$\triangle RSpd_i$ (relative spread)			−0.0011		
			(−1.650)		
$\triangle Notrd_i$ (relative zero return days)				−0.0013	
				(−0.368)	
$\triangle Amih_i$ (relative Amihud ratio)					−0.0003
					(−2.775)***
$\triangle BSH_i * \triangle RV_i$		−0.0039	−0.0052	−0.0038	−0.0043
		(−1.597)	(−2.081)**	(−1.571)	(−1.869)*
$\triangle RS_i$ (relative supply)	−0.0141	−0.0095	−0.0196	−0.0110	−0.0122
	(−0.762)	(−0.513)	(−1.019)	(−0.574)	(−0.698)
$\triangle WBeta_{i,w}$ (world beta difference)	−0.0009	−0.0009	−0.0008	−0.0008	−0.0007
	(−2.176)**	(−2.213)**	(−2.134)**	(−2.128)**	(−1.940)*
$\triangle DBeta_{i,d}$ (home beta difference)	−0.0935	−0.0914	−0.0709	−0.0900	−0.1110
	(−2.386)**	(−2.363)**	(−1.770)*	(−2.297)**	(−2.986)***
SHSE	−0.0101	−0.0105	−0.0259	−0.0076	0.0040
	(−0.494)	(−0.522)	(−1.181)	(−0.346)	(0.205)
$\triangle Size_{i,}$	0.0618	0.0619	0.0789	0.0636	0.0615
	(1.880)*	(1.908)*	(2.351)**	(1.926)*	(2.010)**
$\triangle Leverage_i$	0.0212	0.0226	0.0370	0.0249	0.0244
	(1.142)	(1.234)	(1.844)*	(1.277)	(1.409)
$\triangle ROA_i$,	−0.0082	−0.0022	0.0278	0.0021	0.0103
	(−0.191)	(−0.052)	(0.609)	(0.047)	(0.255)
$\triangle FLOAT_{i,}$	0.2537	0.2557	0.2327	0.2520	0.2554
	(1.894)*	(1.935)*	(1.779)*	(1.887)*	(2.048)**
$\triangle IND_{i,}$	0.1236	0.1189	0.1464	0.1216	0.1029
	(1.360)	(1.325)	(1.628)	(1.340)	(1.212)
$\triangle DUAL_{i,}$	−0.0162	−0.0114	−0.0117	−0.0128	−0.0166
	(−0.634)	(−0.447)	(−0.468)	(−0.493)	(−0.691)
Observation	70	70	70	70	70
Adjusted R^2	0.3910	0.4180	0.4459	0.4194	0.4906

This table reports the results of the regression analysis on price premium before and after the partial liberalization of the B-share market.

$$\Delta Prem_i = \beta_o + \beta_1 \Delta BSH_i + \beta_2 \Delta RS_i + \beta_3 \Delta RSpec_i + \beta_4 \Delta RIlliq_i + \beta_5 \Delta DifBeta_{iw} + \beta_6 \Delta DifBeta_{id} + \beta_7 SHSE + \beta_n \Delta CG_{variables} + \beta_m \Delta control\ variables_i + \varepsilon_i.$$

The whole sample spans from February 5, 2000 to June 15, 2002. The pre-liberalization period spans from February 5, 2000 to February 4, 2001, and the post-liberalization period spans from June 16, 2001 to June 15, 2002. The event period from February 5, 2001 (10 trading days before the first event) to June 15, 2001 (10 trading days after the second event) is excluded. The B-share prices have been converted to RMB using the relevant daily exchange rate. The price premium, Prem, is $(P_B - P_A)/P_A$. $Prem_{i,post}$ is the average price premium of Stock i across the post-liberalization period. $Prem_{i,pre}$ is the average price premium of Stock *i* across the pre-liberalization period. BSH is the ratio of the total shareholding of the 10 largest "foreign" investors over the total number of outstanding tradable B-shares. Supply is the ratio of outstanding tradable B-shares to outstanding tradable A-shares. The speculation is proxied by two variables. The first is the turnover, i.e., the number of shares traded divided by the number of shares outstanding, and the second is the return volatility, which is proxied by the standard deviation of stock returns in the relevant period. The relative turnover, RV, is the ratio of B-share turnover to the corresponding A-share turnover, while the relative volatility (RD) is the ratio of B-share volatility to the corresponding A-share volatility. The illiquidity has three alternative proxies: the daily bid–ask spread, which is the daily B-share closing ask price minus the bid price divided by the average of the bid and ask prices; the percentage of zero return days in the relevant trading period, which is the ratio of the number of trading days with a zero return to the total number of trading days; and the Amihud ratio, which is the daily ratio of absolute stock return to its dollar trading volume averaged over the relevant period. The relative bid–ask spread (RSpd) is the ratio of the average daily B-share bid–ask spread to the corresponding A-share spread over the relevant period. The relative zero return days (RNtd) is the ratio of the corresponding percentage of B-share zero return days over the A-share zero return days. The relative Amihud ratio (RAmih) is the B-share Amihud ratio over the corresponding A-share Amihud ratio. The relative Beta differentials are measured as the difference between B-share and A-share world market betas ($DifBeta_{i,w}$), and the difference between B-share and A-share domestic market betas ($DifBeta_{i,d}$). The difference for all the above variables is the difference between the post-period average and the pre-announcement period average, i.e., the post-period average − the pre-announcement average. All other control variables, except for the exchange dummy SHSE, are the difference between the two-year average of the period 2001–2002 and the two-year average of the period 1999–2000. Size is proxied by the natural log of total assets; Leverage is the ratio of total liabilities over total assets; and ROA is the return on assets. Float is the tradable shares as a percentage of total shares outstanding. INDD is independent director members as a percentage of all board members. Dual takes 1 if a firm's CEO and Board Chairman positions are separated, and zero otherwise. SHSE takes 1 if a firm is listed on the Shanghai Stock Exchange, and zero otherwise. *t*-statistics are in parentheses.
*, **, *** denote significance at the 10, 5, and 1% levels, respectively.
Note: Excluding the term $\triangle RD_i$ (relative volatility) produces qualitatively the same results.

Recall that when we postulated H2, we argued that if foreign investors are reluctant to sell high premium stocks (less drop in BSH after liberalization) unless their share prices go up considerably, and are more eager to sell low premium stocks even with a minimal price increase, we should observe a positive relationship between "ΔPrem" and "ΔBSH". The results in Table 5 confirm this conjecture.

Model 1 is the basic specification, but with a complete set of control variables. The coefficient of "ΔBSH" is significantly positive with a *t*-value of 2.09. Hence, stocks that foreign investors hold onto more (less drop in BSH) after liberalization tend to have a big price increase.

We also add an interactive term, ΔBSH*ΔRV, in the rest of the specifications as in Table 5. The purpose, again, is to examine the possibility that ΔBSH affects ΔPrem through ΔRV. In Models 2 to 5, the interactive term enters uniformly negatively into the regressions, although not always with statistical significance. Hence, for stocks with a smaller change in B-share holdings, the positive impact of ΔRV on ΔPrem is weaker. On the other hand, ΔBSH remains uniformly and significantly positive in all specifications. All in all, our results are supportive of H2.

However, we need to emphasize the limitation of the data used in this test. First, TEJ does not separate shareholding records of the A-share tranche and the B-share tranche of a company. As such, we cannot analyze the domestic shareholding situation of B-

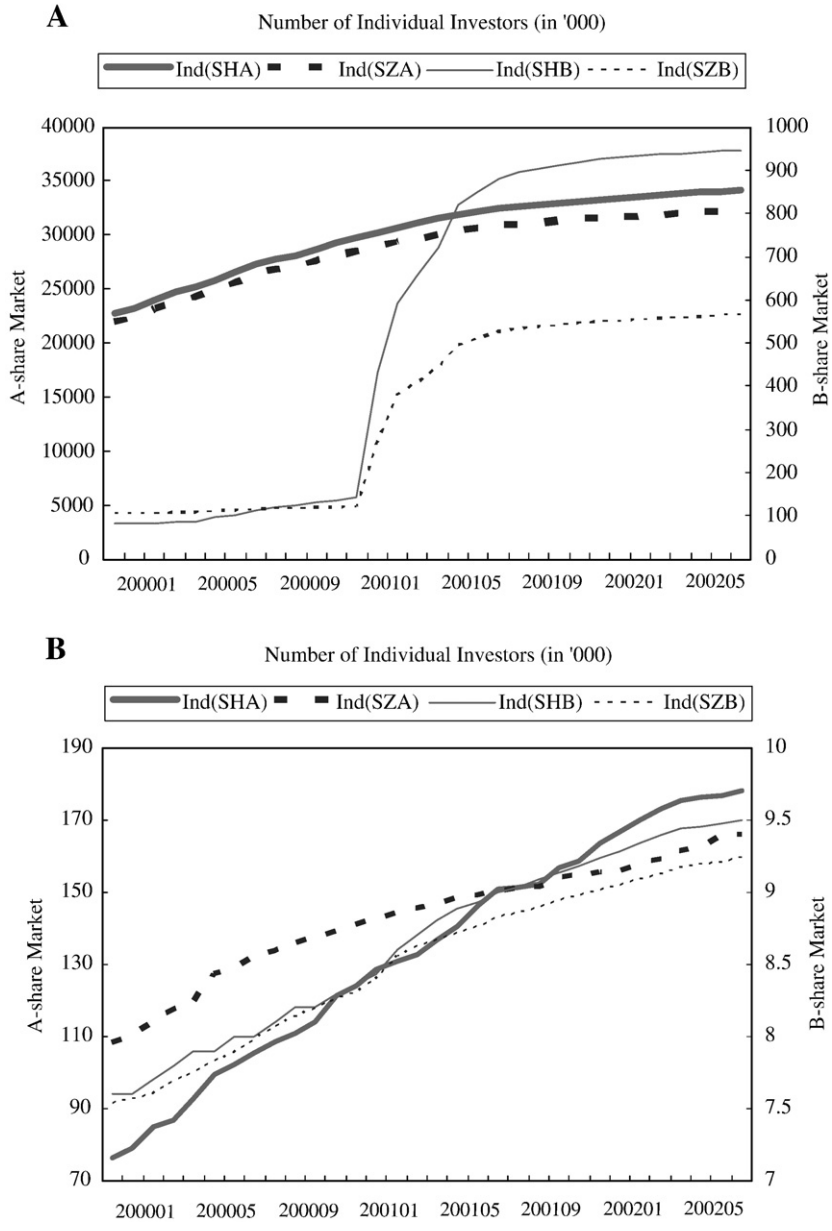

Fig. 3. Number of Investors through Time (January 2000–June 2002).

shares upon liberalization because we simply cannot identify whether the "domestic" shareholding record is on A-shares, B-shares, or even both. Second, even for foreign shareholdings, we do not know the shareholding situation of the "smaller" foreign investors who may hold a large portion of outstanding B-shares in aggregate. Third, some major foreign institutions may hold *non-tradable* B-shares. For instance, the database shows that the Thailand Zhengda Group held 287 million B-shares of the Dajiang Company (SHSE code 900919) in December 2000, but the total outstanding, tradable B-shares only numbered 60 million while the tradable and non-tradable B-shares of this company summed around 676 million. Apparently, the Thailand Zhengda Group held a significant portion of non-tradable B-shares. Yet, the database does not give the breakdown of tradable and non-tradable shares. Needless to say, only the holding of tradable shares matters in price setting, and hence in the testing of our hypothesis. The results of this particular test are indicative at best.

When we look at the number of investment accounts opened in the A-share and B-share markets over our sample period, we also find some indication that foreign investors did not abandon the B-share market.[24]

We show a monthly plot in Fig. 3. In Panel A, the bold solid and dotted lines represent the number of accounts in the Shanghai and Shenzhen A-share markets, respectively. The thin solid and dotted lines represent the number of accounts in the Shanghai and Shenzhen B-share markets, respectively. It can be seen that when the B-share markets opened up around February 2001, the number of *individual* accounts in the B-share markets shot up, especially in the Shanghai B-share market. These accounts may have been opened by individual Chinese or foreign investors. Since the B-share market was always open to the latter group of investors, the sudden rise in numbers more likely came from the former group of investors. However, these investors do not seem to have switched from the A-share markets, as the number of individual A-share accounts (the bold lines) rose steadily through time.

There were no particular changes in the number of *institutional* accounts, local or foreign, around the period of liberalization. The number rose steadily through time, as shown in Panel B. There is no sign that foreign institutional investors left the B-share markets (and closed their accounts) after the markets were opened up to Chinese local investors, as all lines moved up steadily over time. However, this does not preclude the possibility that foreign investors might liquidate some portfolios without closing their accounts. In fact, anecdotal evidence does indicate some liquidation. For instance, the Treasury International Capital (TIC) system of the US Treasury shows that there was a net total amount of USD57 million of equity portfolio flow from China to the US during February, March, and April of 2001.[25] The annual figures from the International Financial Statistics of the IMF on foreign equity investment in China (series 78bmd) also show a significant drop in 2001.[26] However the liquidation seems to have been short-lived.

5.3. Impact on cross-market linkage

5.3.1. Bivariate GARCH test on H3 and H4

To examine the possible changes in inter-market information links between A-share and B-share stocks during our sample period, we use the bivariate GARCH model to examine the change in the links due to liberalization. We follow Karolyi and Stulz's (1996) approach and run the following bivariate GARCH(1, 1) model with a constant conditional correlation formulation on paired A-share stocks and B-share stocks in aggregate. Daily data for the whole sample period from February 5, 2000 to June 15, 2002 are used in the regression.

$$\begin{aligned}
R_{a,t} &= \alpha_{ao} + \alpha_{a1}R_{a,t-1} + \alpha_{a2}R_{wt} + \alpha_{a3}R_{dt} + \alpha_{a4}D_1 + \alpha_{a5}D_2 + \varepsilon_{a,t}\\
R_{b,t} &= \alpha_{bo} + \alpha_{b1}R_{b,t-1} + \alpha_{b2}R_{wt} + \alpha_{b3}R_{dt} + \alpha_{b4}D_1 + \alpha_{b5}D_2 + \varepsilon_{b,t}\\
h_{aa,t} &= \beta_{ao} + \beta_{a1}h_{aa,t-1} + \beta_{a2}\varepsilon^2_{a,t-1} + \beta_{a3}\varepsilon^2_{b,t-1} + \beta_{a4}D_1\varepsilon^2_{a,t-1} + \beta_{a5}D_1\varepsilon^2_{b,t-1} + \beta_{a6}D_2\varepsilon^2_{a,t-1} + \beta_{a7}D_2\varepsilon^2_{b,t-1}\\
h_{bb,t} &= \beta_{bo} + \beta_{b1}h_{bb,t-1} + \beta_{b2}\varepsilon^2_{b,t-1} + \beta_{b3}\varepsilon^2_{a,t-1} + \beta_{b4}D_1\varepsilon^2_{a,t-1} + \beta_{b5}D_1\varepsilon^2_{b,t-1} + \beta_{b6}D_2\varepsilon^2_{a,t-1} + \beta_{b7}D_2\varepsilon^2_{b,t-1}\\
h_{ab,t} &= \left[\rho_{ab,0} + \rho_{ab,1}D_1 + \rho_{ab,2}D_2\right]\sqrt{(h_{aa,t}h_{bb,t})}
\end{aligned} \tag{4}$$

Individual stock return is the logarithmic difference in daily stock prices. R_a (R_b) is the return of the equally weighted *portfolio* of all A (B) individual stock returns in the matched sample. R_w and R_d in the mean equation are the world and domestic market returns. R_w is the MSCI World Index return converted into RMB using the daily RMB/USD exchange return data. R_d is the combined domestic market return of all A-share stocks on both the SHSE and SZSE. These factors are included to control for market wide changes both at home and abroad.[27] Given the information link, the above formulation allows the information, as proxied by the unconditional volatility in the variance equations, ε^2, to affect the other market. We put in two event dummies to capture possible changes in the correlation structure in the liberalization process: D_1 takes the value of one from February 5, 2001 onwards, and zero otherwise; while D_2 takes the value of one from June 16, 2001 onwards, and zero otherwise. h_{aa} and h_{bb} are conditional variances of A-share and B-share returns, respectively.[28] h_{ab} is the conditional covariance that captures the extent of co-movement

[24] The data comes from the CEIC DRI database of McGraw-Hill.

[25] Before and after this period, the situation tends to be the opposite, i.e., there was a net inflow of equity flow from the US into China. We thank the referee for drawing our attention to the data.

[26] The series for China starts in 1997. The figures in USD millions are 5657 (1997), 765 (1998), 612 (1999), 6912 (2000), 849 (2001), 2249 (2002), 7729 (2003), 10,923 (2004), and 20,346 (2005).

[27] We would like to thank the referee for suggesting this to us.

[28] We use a symmetric rather than an asymmetric specification such as Nelson's (1991) E-GARCH model, Glosten et al.'s (1993) model or Kroner and Ng's (1998) asymmetric dynamic covariance (ADC) model to make the estimation more manageable when we examine the volatility spillover between the two markets across pre- and post-liberalization periods. By doing so, we assume away, say, the possibility that a negative return shock will lead to a higher subsequent volatility and covariance than a positive shock.

of the two markets, which is our focus of the test. If the two markets have become more integrated, $\rho_{ab,1}+\rho_{ab,2}$ is expected to be significantly positive in the covariance equation.

Table 6 presents the results. The first major column shows the results of portfolios A and B formed from equally weighted A-share and B-share returns, respectively. It is clear in the mean equation that the world equity market return, R_w, has a significant and positive impact on R_b, but not on R_a, which is consistent with the fact that the A-share market is segmented from the world market. On the other hand, the domestic market return, R_d, has a positive and highly significant impact on both R_b and R_a. The first dummy variable D_1 is not statistically significant. This is understandable as R_d in the equation should filter out the market wide change during the volatile liberalization period. However, the second dummy variable D_2 shows a decrease in the B-share return,

Table 6
Bivariate GARCH estimation

	Full sample		Shanghai sample		Shenzhen sample	
	Ra	Rb	Ra	Rb	Ra	Rb
Constant	0.0210	0.1825	−0.0035	0.2834	−0.0617	0.1198
	(0.756)	(1.757)*	(−0.080)	(2.411)**	(−1.035)	(1.867)*
AR(1)	0.0331	0.0246	0.0332	0.0198	0.0313	−0.0031
	(2.738)**	(0.835)	(1.837)*	(0.701)	(1.699)*	(−0.070)
$R_{m,world}$	0.0119	0.2227	−0.0233	0.2281	0.0012	0.2135
	(0.568)	(3.571)**	(−0.816)	(3.168)**	(0.041)	(1.862)*
$R_{m,China}$	0.9571	1.0010	0.9332	0.9256	0.9769	1.0366
	(83.88)***	(20.95)***	(56.19)***	(20.30)***	(69.14)***	(24.45)***
D_1	0.0048	0.1262	0.1377	0.3996	−0.0128	0.2756
	(0.119)	(0.559)	(1.287)	(1.562)	(−0.374)	(1.026)
D_2	−0.0276	−0.3962	−0.1253	−0.7711	0.0725	−0.5904
	(−0.587)	(−1.882)*	(−1.247)	(−3.245)**	(1.435)	(−5.346)***
Constant	0.0617	0.5255	0.1248	0.3875	0.0699	1.3249
	(4.716)**	(3.289)**	(4.176)**	(3.2382**	(5.434)**	(7.473)**
$H(t-1)$	0.4634	0.5955	0.5166	0.6816	0.3358	0.3725
	(6.628)**	(7.546)**	(6.233)**	(13.473)**	(6.139)**	(3.226)**
$\varepsilon^2_{i,t-1}$	0.6130	0.2300	0.3811	0.2322	0.4535	0.2326
	(4.367)**	(3.196)**	(3.983)	(3.958)	(12.650)**	(3.862)**
$D_1*\varepsilon^2_{i,t-1}$	0.0881	0.1471	0.1546	0.0543	0.2287	0.4212
	(0.462)	(1.519)	(1.018)	(0.809)	(2.1929)*	(1.218)
$D_2*\varepsilon^2_{i,t-1}$	0.5816	−0.1791	0.4405	−0.1008	0.5194	−0.4616
	(2.740)**	(−1.651)*	(2.577)**	(−1.323)	(3.355)**	(−2.019)**
$E^2_{j,t-1}$	−0.0034	−0.5752	0.0007	−0.1745	0.0082	0.6761
	(−1.001)	(−0.742)	(0.139)	(−0.574)	(0.894)	(0.784)
$D_1*\varepsilon^2_{j,t-1}$	0.0050	0.5183	0.0056	0.3183	0.0770	0.2373
	(0.937)	(2.531)**	(0.384)	(3.104)**	(0.911)	(1.669)*
$D_2*\varepsilon^2_{j,t-1}$	−0.0016	−0.3543	−0.0096	−0.3157	−0.0056	−0.6738
	(−0.366)	(−0.457)	(−0.645)	(−1.039)	(−1.450)	(−0.782)
Rho	0.1215		0.2430		0.1398	
	(1.935)*		(4.367)***		(1.780)*	
Rho*D_1	−0.0981		−0.0545		−0.0602	
	(−0.851)		(−0.515)		(−1.205)	
Rho*D_2	0.5045		0.3896		0.3440	
	(4.465)***		(3.728)***		(3.578)***	
Wald test	8.113***		3.054*		10.243***	
Function	−511.33		−711.12		−536.48	
Observations	539	539	539	539	539	539
Chi-square	50.858***	0.938	24.992***	0.167	53.734***	4.293**
Q(12)	114.855***	17.772**	72.427***	6.578	107.065***	40.471***
Q(24)	155.795***	38.457**	110.658***	29.286	125.762***	61.216***

This table presents the results of the bivariate GARCH of the following model:

$$R_{a,t} = \alpha_{ao} + \alpha_{a1}R_{a,t-1} + \alpha_{a2}R_{w,t} + \alpha_{a3}R_{d,t} + \alpha_{a4}D_1 + \alpha_{a5}D_2 + \varepsilon_{a,t}$$
$$R_{b,t} = \alpha_{bo} + \alpha_{b1}R_{b,t-1} + \alpha_{b2}R_{w,t} + \alpha_{b3}R_{d,t} + \alpha_{b4}D_1 + \alpha_{b5}D_2 + \varepsilon_{b,t}$$
$$h_{aa,t} = \beta_{ao} + \beta_{a1}h_{aa,t-1} + \beta_{a2}\varepsilon^2_{a,t-1} + \beta_{a3}\varepsilon^2_{b,t-1} + \beta_{a4}D_1\varepsilon^2_{a,t-1} + \beta_{a5}D_1\varepsilon^2_{b,t-1} + \beta_{a6}D_2\varepsilon^2_{a,t-1} + \beta_{a7}D_2\varepsilon^2_{b,t-1}$$
$$h_{bb,t} = \beta_{bo} + \beta_{b1}h_{bb,t-1} + \beta_{b2}\varepsilon^2_{a,t-1} + \beta_{b3}D_1\varepsilon^2_{b,t-1} + \beta_{b4}D_1\varepsilon^2_{a,t-1} + \beta_{b5}D_1\varepsilon^2_{b,t-1} + \beta_{b6}D_2\varepsilon^2_{a,t-1} + \beta_{b7}D_2\varepsilon^2_{b,t-1}$$
$$h_{ab,t} = \left[\rho_{ab,0} + \rho_{ab,1}D_1 + \rho_{ab,2}D_2\right]\sqrt{(h_{aa,t}h_{bb,t})}.$$

R_a (R_b) is the return of the equally weighted portfolio of all A (B) stocks in the matched sample. R_w and R_d denote the world and China's domestic market returns in RMB, respectively. The unconditional volatility in the variance equation, ε^2, in one market is allowed to affect the other market. The variable $\varepsilon^2_{i,t-1}$ in the table stands for own-market lagged volatility, so that for the "R_a column (R_b column)" it stands for the $\varepsilon^2_{a,t-1}(\varepsilon^2_{b,t-1})$ term in the GARCH equation above. The variable $\varepsilon^2_{j,t-1}$ in the table stands for cross-market lagged volatility, so that for the "R_a column (R_b column)" it stands for the $\varepsilon^2_{b,t-1}(\varepsilon^2_{a,t-1})$ term in the GARCH equation. D_1 and D_2 are the two event dummies. D_1 takes the value of one from February 5, 2001 onwards, and zero otherwise; while D_2 takes the value of one from June 16, 2001 onwards, and zero otherwise. The Wald test is on the restriction of the sum of "Rho*D_1" and "Rho*D_2" being equal to zero.
*,**,*** denote significance at the 10, 5, and 1% levels, respectively.

but not in the A-share return in the post-liberalization period. This indicates that liberalization led to a lower return for B-share stocks, but has no impact on A-share returns.

Our focus, however, lies on the correlation coefficients in the covariance equation. The correlation coefficient of 0.12 with a *t*-value of 1.94 suggests that the market-adjusted A-share and B-share returns were correlated before liberalization, as expected. Interestingly, the correlation did not increase during liberalization, as captured by the insignificant interactive dummy $\rho^* D_1$. The coefficient is −0.09 with a *t*-value of −0.85. This is conceivable, as this period was particularly volatile. Investors jumped into the B-share market to take advantage of perceived "under-priced" stocks. This price pressure was unique to the B-share market and, hence, tended to weaken the correlation between the two markets. Once the situation stabilized and Chinese investors were present in both the A-share and B-share markets, the linkage between the two markets strengthened, as revealed by the coefficient of the second interactive dummy variable, $\rho^* D_2$, which captures the post-liberalization period. This coefficient is 0.50 with a *t*-value of 4.46, which is statistically significant at the 1% level. Notice that the correlation coefficient has a net increase of 0.41 (=0.504 −0.098) from the pre-liberalization period to the post-liberalization period, and this is highly significant as indicated by the Chi-square test statistic shown in the table. The increase in correlation coefficient in the post-liberalization period supports our H3: the correlation coefficient between A- and B-share returns increases after liberalization.

The parameters in the variance equations also show interesting features. For the overall sample, $D_1^* \varepsilon_{i,t-1}^2$ is insignificant in both A-share and B-share portfolio equations, indicating that the (unconditional) volatility of A-shares did not change during the liberalization period. $D_2^* \varepsilon_{i,t-1}^2$ has a coefficient of 0.58 (*t*-value being 2.74) in the A-share portfolio equation and −0.17 (*t*-value being −1.65) in the B-share portfolio equation. This means the A-share volatility increased while the B-share volatility declined in the post-liberalization period.

The results concerning cross-market influence are important for understanding flows of information across markets. For the full-sample h_{aa} and h_{bb} regressions, the insignificant $\varepsilon_{j,t-1}^2$ means that, prior to the opening up of the B-share market, the volatility in one market did not influence the other market on the next day. When the market opened up, the A-share volatility had a strong, positive influence on the next-day B-share volatility, as $D_1^* \varepsilon_{j,t-1}^2$ has a coefficient of 0.51 (*t*-value being 2.53) on the next-day h_{bb}, but has no significant influence on the next-day h_{aa} (a coefficient of 0.005 with a *t*-value of 0.94). $D_2^* \varepsilon_{j,t-1}^2$ is not significant in either the h_{aa} or h_{bb} regression, implying that the cross-market influence remains the same after the opening up of the B-share market. The results for the Shanghai sub-group and the Shenzhen sub-group, as shown in the second and third major columns, respectively, are qualitatively similar.[29]

5.3.2. Vector error-correction model (VECM) on H4

The second part of H4 on the increase in influence of the A-share market is about the price discovery process. As the liberalization is one-way, we expect that the A-share market would play a more important role in the price discovery process after liberalization. We follow Hasbrouck (1995) and Eun and Sabherwal (2003) in constructing the following vector error-correction model (VECM) to test the hypothesis:

$$\Delta P_t^a = \alpha_0^a + \alpha_1^a \left(P_{t-1}^a + \beta^* P_{t-1}^b\right) + \sum_{i=1}^{q} \beta_i \left(\Delta P_{t-1}^a\right) + \sum_{i=1}^{q} \gamma_i \left(\Delta P_{t-1}^b\right) + \varepsilon_t^a \tag{5}$$

$$\Delta P_t^b = \alpha_0^b + \alpha_1^b \left(P_{t-1}^a + \beta^* P_{t-1}^b\right) + \sum_{i=1}^{q} \beta_i \left(\Delta P_{t-1}^a\right) + \sum_{i=1}^{q} \gamma_i \left(\Delta P_{t-1}^b\right) + \varepsilon_t^b$$

By the nature of the co-integrating relationship, α_1^a and α_1^b tend to have opposite signs. If the absolute value of α_1^a (i.e., $|\alpha_1^a|$) is greater than α_1^b, the B-share market has a bigger impact on A-share prices than the opposite which, in turn, means that the B-share market places a more important role in terms of price discovery. This is because the error-correction term, as a deviation from the long-run equilibrium of A-share and B-share prices, tends to pull the share prices back to the long-run co-integrating relationship. Such adjustments are captured by the coefficients of the error-correction term, α_1^a and α_1^b. If $|\alpha_1^a|$ is greater than α_1^b, the correction is done more through an adjustment in the prices of the A-shares than the B-shares. This will occur if new information is incorporated in the B-share market first, causing a temporary deviation in the prices of the A-shares and B-shares from their long-run co-integrating, (−1, 1) relationship. The above regression is repeated for each firm in our sample in both the pre- and post-liberalization periods.

In Table 7, we present a summary of the co-integrating relationship of the A-share and B-share prices before and after the liberalization periods based on Johansen's method (1991, 1995). We apply the 5% critical value of Osterwald-Lenum (1992) on the Johansen trace statistics to determine whether a co-integrating relationship exists.

The first major column shows that there were only 13 pairs of Shanghai stocks and 14 pairs of Shenzhen stocks with a co-integrating relationship in the pre-liberalization period. However, after liberalization, the number of co-integrating pairs jumped to 28 for the Shanghai group and 33 for the Shenzhen group. This clearly indicates that before the B-share market opened up, the A-share and B-share prices of many firm pairs did not move according to the same set of information, as the market was almost totally segmented. However, as the B-share market began to open up, the information flowed more effectively across the two markets and many more firm pairs started moving together. More Shenzhen than Shanghai stocks have a co-integrating relationship both before and after liberalization.

[29] So far, our Bivariate GARCH model assumes a constant correlation coefficient within each of the sub-periods, which may be too restrictive. Hence, we also try the Dynamic Correlation Coefficient (DCC) method proposed by Engle (2002), which allows the correlation coefficient to change over time. The results, without reporting here to save space, indicate that the correlation coefficient is generally higher in the post-liberalization period than before and shows a mild upward trend after liberalization, suggesting that the correlation between the A-share and B-share markets becomes higher after liberalization. This result is consistent with the reported results using constant correlation specification.

Table 7
Estimation of alpha and beta values of the vector error-correction model

	No. of co-integrating 0firms			Beta value		Alpha value (unrestricted)				Alpha value (restricted)			
	SHSE	SZSE	Percentile	SH	SZ	SHA	SHB	SZA	SZB	SHA	SHB	SZA	SZB
Pre	13	14	50%	−2.2207	−1.3130	−0.0013	0.0015	−0.0026	0.0005	−0.0014	0.0013	−0.0095	0.0011
Post	28	33	25%	−1.6858	−1.2723	−0.0135	0.0145	−0.0248	0.0094	−0.0184	0.0112	−0.0241	0.0104
			50%	−1.5054	−1.1125	−0.0098	0.0171	−0.0185	0.0156	−0.0124	0.0151	−0.0176	0.0155
			75%	−1.1945	−0.9593	−0.0051	0.0214	−0.0132	0.0193	−0.0065	0.0213	−0.0113	0.0196

The "alpha" and "beta" estimates come from the following vector error-correction model (VECM):

$$\Delta P_t^a = \alpha_o^a + \alpha_1^a\left(P_{t-1}^a + \beta^* P_{t-1}^b\right) + \sum_{i=1}^{q} \beta_i\left(\Delta P_{t-1}^a\right) + \sum_{i=1}^{q} \gamma_i\left(\Delta P_{t-1}^b\right) + \varepsilon_t^a .$$

$$\Delta P_t^b = \alpha_o^b + \alpha_1^b\left(P_{t-1}^a + \beta^* P_{t-1}^b\right) + \sum_{i=1}^{q} \beta_i\left(\Delta P_{t-1}^a\right) + \sum_{i=1}^{q} \gamma_i\left(\Delta P_{t-1}^b\right) + \varepsilon_t^b$$

"Alpha" is the coefficient of the error-correction term. Hence, α_1^a and α_1^b are the coefficients of the error-correction term in the equations of the change in A-share prices, ΔP_a, and the change in B-share prices, ΔP_b, respectively. "Beta" is the co-integrating vector between A-share and B-share prices.

The second major column presents the estimated normalized co-integrating vectors (the β value in Eq. (5)) averaged in various percentiles over the two periods of liberalization. Since only 13 pairs of Shanghai stocks and 14 pairs of Shenzhen stocks in the pre-liberalization period were co-integrated, we provide only the median value of the normalized vectors. For the 13 Shanghai pairs, the figure is −2.22; for the 14 Shenzhen pairs, it is −1.31. Notice that the theoretical co-integrating vector should be (−1, 1), as A-share and B-share stocks are two classes of shares with equal rights that are issued by the same company. As the actual vectors are different, it is clear that the A-shares and B-shares are priced differently. This is especially the case for the Shanghai stocks. Yet, after liberalization, the median value of the co-integrating vector for the Shanghai stocks dropped to −1.50 and the Shenzhen stocks dropped to −1.11. Hence, the long-run price relationship between the A-share and B-share stocks became tighter after the opening up of the B-share market. Further evidence for this is the fact that the range of the co-integrating values was relatively tight, from −2.10 and −1.49 of the 5th percentile to −0.89 and −0.88 of the 95th percentile for the Shanghai and Shenzhen groups, respectively. Again, the A- and B-share price relationship was tighter for Shenzhen firms.

The third major column shows the coefficients of the error-correction term in the VECM (the α value in Eq. (5)) averaged in various percentiles over the two periods of liberalization. Again, we only present the median values in the pre-liberalization period due to the small number of co-integrated firms. The median values of the coefficients of the error-correction term for the Shanghai A-share and B-share groups are −0.0013 and 0.0015, respectively. This means that the relative impact on the A-share and B-share markets was similar. In the post-liberalization period, the median values of the coefficients of the error-correction term for the Shanghai A-share and B-share groups are −0.0098 and 0.0171, respectively. The B-share coefficient is now larger than the absolute value of the A-share coefficient. Hence, the A-share market has had a bigger impact on the B-share market than the other way round.

The situation is different for the Shenzhen stocks. The A-share coefficient α_1^a was −0.0026, whereas the B-share coefficient α_1^b was 0.0005 before liberalization. Since the absolute value of the A-share coefficient was much larger than the value of the B-share coefficient, the impact of the B-share prices was larger on the A-share prices than vice versa. Such a result seems counter-intuitive, as the B-share markets were less liquid with lower trading volume and higher bid–ask spread than the A-share markets; one would expect more price discovery to occur in the A-share markets. However, we have to note that the number of co-integrating pairs is quite limited; hence, the estimates may not be accurate, and the difference may not bear statistical significance. Even if the B-share market did perform a more important price discovery role before liberalization, it may not be that inconceivable, as will be explained later.

In the meantime, we observe that the situation changed after the opening up of the B-share market when many more A-share investors (most of them probably noise traders if following Mei et al.'s (2005) view) poured into the B-share market in Shenzhen. The A-share coefficient is −0.0185 and the B-share coefficient is 0.0156. Although the A-share coefficient is still larger in absolute value, the difference in absolute value between the two coefficients is much less than before liberalization. This also indicates that the impact of the A-share market is relatively larger than before.

The last major column shows the equivalent α estimates when we restrict the co-integrating vector (−1, 1) in the VECM. Since our sample period is relatively short, the β estimates may be imprecise, causing a corresponding imprecision in the α estimates.[30] The new, restricted α estimates show a similar picture, demonstrating that the A-share market became more important in terms of the information discovery function after liberalization, and that this is especially so for the Shanghai market.

Our result is also consistent with the plots in Fig. 2, which show that the number of individual accounts in the B-share markets shot up, especially in the Shanghai B-share market, and that this increase came from individual Chinese investors. When Chinese investors moved into the B-share market and traded according to the A-share pricing formula, it is conceivable that the influence of the A-share market on the B-share market was enhanced. In other words, B-share prices that were not very responsive to the price

[30] We thank the referee for pointing this out and suggesting the restriction approach to obtain more precise α estimates.

movements of A-shares before liberalization now became more responsive to A-share price movements due to the presence of the Chinese investors in the B-share market after liberalization.

Overall, the GARCH and co-integration results support H3 and H4, suggesting that opening up the B-share market does improve information linkages between the A-share and B-share markets, although only to a limited extent.

Before concluding the discussion, we want to explain the possibility of the B-share market playing a *relatively* more important price discovery role *before* its liberalization, and the A-share market playing a *relatively* more important price discovery role *after* liberalization. When a market is dominated by informed traders, as is likely the case for the B-share market, since it was mainly for foreign institutional investors before liberalization, it might have less liquidity, lower trading volume, and higher spread. This is because noise traders know that they would be in a disadvantageous position when trading in such a market.[31] On the other hand, the A-share market was filled with retail investors and highly speculative.[32] They raised the noise level in the A-share market, and hence the information quality in the A-share market was relatively low compared to the B-share market, which had fewer noise traders before liberalization. When some of these noise traders moved to the B-share market after liberalization, on the margin, they would have also raised the noise level in the B-share market and simultaneously reduced the noise level in the A-share market. That might be part of the reason that the price discovery role reversed upon liberalization. This is consistent with Mei et al.'s (2005) finding that before the opening up of the B-share market, speculative bubbles were only revealed in the A-share market; however, after opening up, speculative bubbles also appeared in the B-share market.

Admittedly, this explanation can hardly be complete, as differences in institutional and structural factors between the Shanghai and the Shenzhen markets may also have affected the price discovery functions of the two markets, so that we observe, for instance, that the importance of the B-share market in price discovery is more salient in the Shenzhen market than in the Shanghai market. This possibility and the possible differences between the Shanghai and Shenzhen markets are beyond the scope of this study.

6. Conclusion

China's B-share market, which used to be restricted to foreign investors, was opened up in February 2001 to Chinese local investors. This opening up was partial, one-way and "reversed" in the sense that the B-share market that dominated by foreign institutional investors opened to the Chinese local individual investors. We regard this development as a controlled experiment in cross-border trading on a small scale. Our study controlled for all legal, political, social, economic, and even firm-level differences across the two markets, and experimented with the effects of lifting the trade barrier on order flow dynamics through time. We examined how this, in turn, affected the quality and, hence, the development of the two markets. We found some mild but positive results for the B-share market. The period after liberalization saw higher trading volumes and liquidity with lower volatility and bid–ask spreads. All of these variables also tended to converge with those of the A-share market. Furthermore, price disparities between A- and B-shares narrowed, the return correlation increased, and the co-integrating relationship became stronger and tighter. The flow of information between the two markets also became more balanced.[33] There was no sign that these investors switched from the A-share market, or that they crowded out existing institutional investors in the B-share market.

Overall, even this partial and reversed liberalization measure has helped to improve the quality of the B-share market, and this has not come at the expense of the A-share market. Yet, the improvements are limited, and there is no sign that many foreign investors were subsequently attracted to the B-share market. The lackluster performance of the B-share market is said to be due to illiquidity. Our results show that allowing local investors to enter the B-share market to boost its liquidity did not totally solve the problem. The fact that there is still a gap in price between A- and B-shares after liberalization hints at the fundamental weakness of the B-share market. A plot of more recent data in Fig. 4 may be illuminating. For the sake of comparison, we also include the plot of the average price gap between the A-shares and H-shares, the Chinese stocks traded in Hong Kong, although this is not the focus here.

Both B-shares and H-shares were roughly trading at an 80% price discount relative to their corresponding A-shares in 2000. When the B-share market opened up in 2001, the B-share price discount narrowed dramatically to 30% and then gradually stabilized at the 40% discount level. Yet, the A–H price gap narrowed only gradually. This is probably due to the economic recovery of Hong Kong since 2003. Although the H-share market is always much more liquid and heavily traded than the B-share market, the plot reveals that the average A–H price gap is almost always wider than the A–B price gap. Hence, trading volume and liquidity are unlikely to be key factors in the discount phenomenon. On the other hand, since short selling is possible only in the H-share market, and not in either the A-share or B-share market (though a pilot scheme of short selling has recently been implemented, as

[31] This is consistent with the classic model of Glosten and Milgrom (1985): "Generally, ask prices increase and bid prices decrease if the insiders' information becomes better, or the insiders become more numerous relative to liquidity traders …" (p.74). Notice that, in extreme cases, trading can dry up to the point that the market simply shuts down: "(I)f the insiders are too numerous or their information is too good relative to the elasticity of liquidity traders' supplies and demands, there will be no bid and ask prices at which trading can occur and the specialist can break even. Then, the equilibrium bid price is set so low and the ask price so high as to preclude any trade" (p.74).

[32] As Ng and Wu (2005) point out, the Chinese markets are dominated by individual investors as compared to developed equity markets with polarization between individual and institutional investors. In their sample period from April 2001 to September 2002, institutional trades occupied only 0.32% of the total number of trades and 6.16% of the total trade value. Fig. 1 also shows that the total number of retail accounts in the A-share markets (SHSE and SZSE together) sums 50 to 60 million, while the equivalent number for institutions is merely 0.3 million.

[33] One may argue that convergence per se does not necessarily mean an improvement in market quality, as the convergence may be due to the influx of highly speculative domestic investors, turning the less speculative B-market into a more speculative, A-market-like B-market. This may be true if foreign investors essentially left the B-market. However, the influx of Chinese investors also improves the B-market liquidity; this could increase its attractiveness to foreign investors.

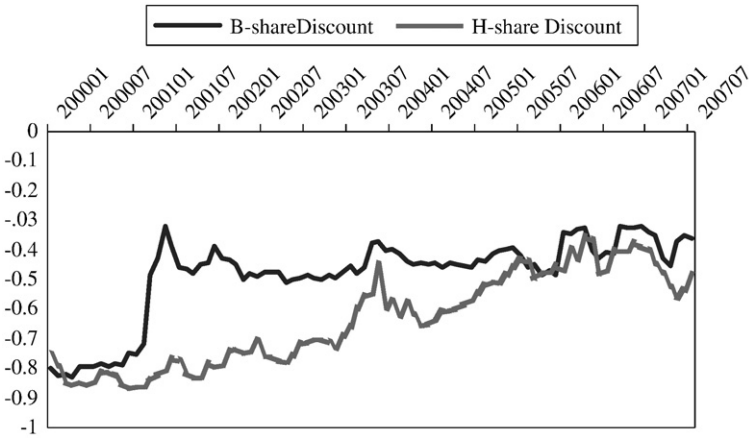

Fig. 4. B-share versus H-share premium/discount (January 2000–December 2007). The time period is from Jan. 2000 to Dec. 2007. The negative values indicate discount from both A-shares and A-shares. The B-share premium (discount) is the equal-weighted individual B-share premium (discount) which is defined as $(P_B - P_A)/P_A$. The H-share premium (discount) is the equal-weighted individual B-share premium (discount) which is defined as $(P_H - P_A)/P_A$.

will be mentioned shortly), to the extent that short selling improves pricing efficiency and reduces the likelihood of stock over-valuation, H-share prices are less likely to be over-valued relative to both A-share and post-liberalized B-share prices. As such, it is conceivable that the A–H price gap tends to be wider than the A–B price gap after B-market liberalization.

Finally, we should mention that the Chinese government has made a series of efforts to improve the quality of stock markets and reduce their trade barriers. To enhance the quality of corporate governance in China, the CSRC issued the Code of Corporate Governance for Listed Companies in China on January 7, 2001 and the tentative Code of Corporate Governance for Securities Companies in China on December 15, 2003. In May 2003, the QFII scheme was implemented, which many perceived as being a potentially useful and stronger push for market quality. The scheme allows qualified foreign institutions to bring in foreign currencies and convert them to *Renminbi* to invest in the A-share stock market, as well as in the bond market.[34] The hope is that opening up the markets to foreign institutional investors will boost the confidence of investors and bring in fresh liquidity from overseas. Furthermore, QFII will help in the push for more market transparency and better corporate governance. Its counterpart, the QDII (qualified domestic institutional investors) scheme, was launched by SAFE in July 2006, and allows qualified financial institutions to raise Renminbi funds from domestic individuals and institutions to buy foreign currency from SAFE for overseas investment restricted to fixed-return financial products.[35] There was a trial program launched by the CSRC, also in July 2006, to allow brokerages of net assets of at least 1.2 billion yuan to offer the services of short selling and margin trading. As for the split-share reform implemented in 2005, mentioned above, after two years, more than US$200 billion of mostly state-owned stocks have now become tradable. This is perceived as part of the reason for the major correction of the A-share market starting in March 2008. In any case, it will be very interesting to see how these schemes of opening up trade barriers across markets and investors complements the liberalization policy of opening up the B-share market to Chinese local investors to raise the vigor and quality of China's stock markets.

Appendix A. Number of listed companies in China (1993–2002)

	Shanghai			Shenzhen			China (total)			Hong Kong
	A-share	B-share	A_B pairs	A-share	B-share	A_B pairs	A-share	B-share	A_B pairs	H-share
1992	33	9	9	24	9	9	57	18	18	0
1993	101	21	21	76	20	19	76	41	40	6
1994	169	33	32	118	25	22	287	58	54	15
1995	184	36	32	127	34	26	311	70	58	18
1996	287	42	35	227	43	34	514	85	69	25
1997	372	50	41	348	51	35	720	101	76	42
1998	425	52	42	400	54	38	825	106	80	43
1999	471	54	42	450	54	40	921	108	82	46
2000	559	55	43	499	58	43	1058	113	86	52
2001	636	54	43	494	56	45	1130	110	88	60
2002	705	54	45	494	57	45	1199	111	90	75

[34] The scheme was designed by SAFE and announced by the CSRC on November 5, 2002. The first approval of a total amount of US$775 million was given in May 2003 to the first batch of five applicants, namely UBS ($300m), Nomura ($50m), Citigroup Global Markets ($75m), MSDW ($300m), and Goldman Sachs ($50m). The scheme appears to have been quite successful. By March 2007, the total number of approved QFII was 52 and the total investment quotas granted were close to US$10 billion.

[35] So far, 11 domestic banks, seven foreign banks, 11 insurance companies and one mutual fund have been granted QDII status with investment quotas totaling over US$10.3 billion.

Appendix B. Variable definitions

Appendix B.1. Table 2

Amih (Amihud ratio): the daily ratio of absolute stock return to its dollar trading volume averaged over a month.

Ntd (non-trading ratio): the ratio of trading days with zero return over the total number of trading days in a month.

Premium: $(P_B - P_A)/P_A$. Notice that since P_B is smaller than P_A throughout our sample period, "Prem" is typically negative in value so that low "Premium" means large discount.

Spread: the daily bid–ask spread, which is the daily B-share closing ask price minus the bid price divided by the average of the bid and ask prices.

Turnover: the number of shares traded divided by the number of shares outstanding.

Volatility: the standard deviation of daily stock returns.

Appendix B.2. Tables 3–5

Δ: the difference between the average post-liberalization and the average pre-liberalization values.

DBeta: the firm beta estimate from the market model with the China domestic market index as the market index.

DifBeta_{iw} and DifBeta_{id}: differential world beta (β_{iw}) and differential domestic beta (β_{id}), respectively, obtained from running the regression, $R_{bit} - R_{ait} = \beta_{oit} + \beta_{iw} R_{wt} + \beta_{id} R_{dt} + \varepsilon_{it}$.

DUAL: a dummy variable that takes the value of 1 if a company's CEO and Board Chairman positions are served by different people, and zero otherwise.

Float: the percentage of tradable shares.

INDD: the number of independent directors divided by the total number of board members.

Leverage: total liabilities over total assets.

RAmih: the ratio of the Amihud ratio for the B-share stock to the Amihud ratio of the corresponding A-share stock.

RD: the ratio of B-share volatility to its A-share volatility.

RNtd: the ratio of the fraction of zero return days of the B-share stock to the fraction of zero return days of the corresponding A-share in the relevant period.

ROA: net income over total assets.

RS: the ratio of outstanding tradable B-shares to outstanding tradable A-shares of a firm.

RSpd: the ratio of the average of the B-share bid–ask spread to the average of the corresponding A-share bid–ask spread.

RV: the ratio of B-share turnover to its A-share turnover.

Size: the natural log of total assets.

ST : percentage of state share ownership.

SHSE: the exchange dummy which takes a value of 1 if a firm is listed on the SHSE and zero on the SZSE.

WBeta: the firm beta estimate from the market model with MSCI as the world market index.

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