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Cross-listing, Volatility and Liquidity: Evidence from a Perfectly Segmented Market

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Abstract

Past evidence show that the impact of cross-listings in foreign markets on the volatility and liquidity of shares in domestic market depends the market transparency (or informational linkage between markets) and the effect of order flow migration from domestic market. Listed companies in Mainland China can issue two different classes of stocks. Before Feb 2001, local A-shares are restricted to domestic investors while foreign B- and H-shares are restricted to foreign investors. Since local A-share market is completely segmented from foreign B-share and H-share markets, this allows us to separate information effect from the order flow migration. Our study uncovers the following findings. First, cross-listings negatively affect stock liquidity as revealed with increased sensitivity of price volatility to volume. Second, only A-shares experience decline in volatility unrelated to volume after cross-listings of foreign shares. Overall, the results suggest that the impacts of cross-listing are not uniformly spread across different classes of investors in the same company.

JEL classification numbers: G15
Keywords: Cross-listing, Volatility, Liquidity, Market segmentation, Chinese Stock Markets.

1 Introduction

The globalization of worldwide capital markets has accelerated dramatically in the past decades. Increasing numbers of companies have their shares cross-listed abroad to broaden their shareholder base and raise capital. Though companies view cross-listings as value enhancing, the change in liquidity and volatility, and the cost of trading associated with order flow migration following cross-listing may adversely affect the quality of the domestic equity market (Domowitz, Glen and Madhavan (1998)). Past

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empirical evidence show that the impact of cross-listings in foreign markets on the volatility and liquidity of shares in domestic market depends the market transparency (or informational linkages between markets) and the effect of order flow migration from domestic market (Pagano (1989), Chowdhry and Nanda (1991), Hargis and Ramanlal (1998), Domowitz, Glen and Madhavan (1998)).

The Chinese stock market is of particular interest. For listed companies in Mainland China, there are two different classes of stocks traded on the exchanges. Before Feb 2001, local A-shares are restricted to domestic investors while foreign (B- and H-) shares are restricted to foreign investors.[2] The restriction imposed in China is therefore unique, as the markets available to domestic and foreign investors are completely segmented from one another. As A-share market is completely segmented from B- and H-share markets, it is expected that cross-listing of foreign shares (A-shares) should not result in significant order flow (trader) migration from the domestic A-share market (foreign B- and H-share markets). On the other hand, as suggested by Domowitz, Glen and Madhavan (1998), market segmentation induced by investment restrictions may create imperfect information linkages among markets and the impacts of cross-listing may be more complex.

This study aims to investigate the cross-listing effect on the volatility and liquidity of domestic A- and foreign B-/H-shares under market segmentation. Our results show that participation and trading by new foreign investors in B-share market reduces the base-level volatility of A-shares that are restricted to domestic investor. However, A-shares also experience a decrease in liquidity. In contrast, neither the fundamental volatility nor the liquidity of foreign B-shares is affected by cross-listing of domestic A-shares. Unlike foreign B-shares, H-shares experience decline in liquidity after listing of domestic A-shares. Overall, cross-listing has negative impact on stock liquidity as revealed with higher sensitivity of price volatility to volume. Second, only A-shares experience decline in volatility unrelated to volume after cross-listings of foreign shares. Consistent with Domowitz, Glen and Madhavan (1998), the market segmentation induced by ownership restrictions seems to create less information transparency among different markets. Our analysis suggests that the impacts of cross-listing are not uniformly spread across different classes of investors and shareholders in the same company.

The rest of this study is organized as follows. Section2 provides a brief review of Chinese stock market. Section 3 presents the sample data. Section 4 presents the model and methodology. Section 5 presents the empirical results. Section 6 summarizes and concludes the study.

2 Brief Review of Chinese Stock Market

In the early 1980s, Chinese government initiated various policies to reform the economy. One critical step the government took was the privatisation and corporatization of state-owned enterprises (SOEs).[3] Selected SOEs were reorganised and formed into limited liability companies with ownership represented by share capital. Initially, the shares were owned by the state and by various entities of the state. Stock market in

[2]On 19 Feb 2001,the Chinese government announced that local Chinese with foreign currency deposit accounts in Chinese banks would be allowed to trade B-shares. The policy was then implemented on 28 Feb (Sun, Tong and Yan (2009)).

[3]Sun and Tong (2003) provides a very good review on China share issue privatisation.

Mainland China originated in 1984 when the first shares were issued to individuals and were then traded in the OTC market in 1986. Since Shanghai Stock Exchange (SHSE) and Shenzhen Stock Exchange (SZSE) were established in 1990 and 1991 respectively, stock market in China expanded rapidly.

There are two different classes of stocks traded on the exchanges. Local A-shares are traded in RMB in the SHSE and the SZSE while foreign B-shares traded in SHSE and in the SZSE are quoted in US$ and in HK$ respectively. Each company's issue is restricted to one of the exchanges; hence, no company is cross-listed on both exchanges. From 1993, overseas listed H-shares are traded in HK$ in the Stock Exchange of Hong Kong (SEHK).Compared with A-share and B-share markets in Mainland China, Hong Kong market are more mature and internationalized.

3 Data

The sample period is from January 1992 to December 2000 for Shanghai and Shenzhen markets and it is from July 1993 to December 2000 for H-shares in Hong Kong. There are 1088 A-shares, 114 B-shares, and 52 H-shares as of December 2000. 86 companies issued both A-share and B-share. 42 and 44 are listed in the SHSE and the SZSE respectively. Among 52 H-shares listed on the SEHK, 19 of them that have A-shares and listed in the SHSE (13) and in the SZSE (6) respectively. This forms our initial sample. To avoid the event clustering effect of different share listings by same company, we exclude thirty and twenty-six stocks from the Shanghai and Shenzhen samples respectively because the listing dates of both A-shares and B-shares are the same or within less than 3 months from one another. By the same token, we also exclude six H-shares with A-share subsequently listed on SHSE. As a result, we have eighteen A-shares with B-share listing, thirteen B-shares with A-share listing and thirteen H-shares with A-share listing. Since 16 December 1996, both Shanghai and Shenzhen Stock Exchanges have imposed a daily price limit of 10 percent based on the previous day's closing price. Recent studies document that price limits delay price discovery, postpone desired trading activity, and create volatility spillovers to post-limit-hit days (Kim and Rhee (1997), Lee and Choi (2001) and Yang and Kim (2001)). The imposition of price limit rule may have affected our results. Because of the price limit rule, we divide our sample period into two: the period before December 1996 (pre-limit period) and the period from January 1997 to December 2000 (post-limit period). As a result, one B-share and two H-shares are further excluded from the investigation because the cross-listings occur very close to the imposition of price limit rule and hence the impact of cross-listing cannot be clearly isolated from that of price limit rule. Accordingly, the sample in pre-limit period consists of fifteen A-shares, three B-shares and seven H-shares. During the post-limit period, the sample consists of three A-shares, nine B-shares and four H-shares.[4]

We collect both A- and B-share daily high, low and closing prices from Taiwan Economic Journal (TEJ) database and H-share daily high, low and closing prices from Datastream

[4]Some Chinese companies also issue ADRs to raise foreign capital and expand the foreign investor base. The underlying shares of the ADRs are either H-shares or B-shares of the company but not A-shares, which can only be held by mainland China nationals. Most Chinese listed companies issued H-share ADRs. Most H-share ADRs are issued with H-shares simultaneously.

International. In addition, we collect the RMB/US and HK/US exchange rates from Datastream International. As A-shares are traded in RMB, while B-shares traded in the SHSE (SZSE) are quoted in US$ (HK$) and H-shares in SEHK are traded in HK$, they are all converted into US$ denomination. The trading volumes of A- and B-shares are collected from TEJ database and those of H-shares from the Datastream International. The daily closing prices are used to calculate the daily raw returns and variances while the daily high and low prices are used to the intraday variances. We also collect trading volume of each market to standardize that of individual stock.

Table 1: Statistics of sample cross-listing stocks, 1992-2000

	Issue Date		Listing Date		Location	No. of shares		Closing price	
Stock	A-share	Foreign	A-share	Foreign		A-share	Foreign	A-share	Foreign
Panel A: A-shares with B-share listing									
Huaxincem	1993/11/06	1994/11/28	1994/01/03	1994/12/09	Shanghai	48	87	0.559	0.190
Jin Jiang	1992/07/15	1993/10/07	1993/06/07	1993/10/18	Shanghai	20	90	2.827	0.450
Lianhua Fibre	1992/06/13	1993/09/18	1992/10/13	1993/09/28	Shanghai	8	30	3.360	0.460
Lujiazui	1992/06/19	1994/11/08	1993/06/28	1994/11/22	Shanghai	63	200	2.813	0.822
Narcissus	1992/06/13	1994/10/25	1993/01/06	1994/11/10	Shanghai	16	100	1.487	0.280
Posts & Tel	1993/08/05	1994/09/30	1993/10/18	1994/10/20	Shanghai	13	60	1.830	0.570
Jinan Qingqi	1993/10/17	1997/05/29	1993/12/06	1997/06/17	Shanghai	307	230	1.520	0.550
Changchai	1994/03/15	1996/08/27	1994/07/01	1996/09/13	Shenzhen	92	100	1.718	0.693
China Vanke	1988/12/28	1993/04/06	1991/01/29	1993/05/28	Shenzhen	106	45	3.186	1.230
Foshan Lighting	1993/10/06	1995/07/01	1993/11/23	1995/08/08	Shenzhen	56	50	1.071	0.775
Gintian	1989/02/28	1993/05/03	1991/07/03	1993/06/29	Shenzhen	68	38	3.783	0.560
Guangdong Elec	1993/10/10	1995/05/30	1993/11/26	1995/06/28	Shenzhen	99	204	0.562	0.556
Hefei	1993/08/30	1996/08/14	1993/10/18	1996/08/28	Shenzhen	69	100	1.473	0.440
Jiangling Motors	1993/10/17	1995/09/13	1993/12/01	1995/09/29	Shenzhen	118	174	0.501	0.189
Nanshan Power	1994/01/03	1994/11/11	1994/07/01	1994/11/28	Shenzhen	17	37	1.258	0.554
Pearl River	1992/01/20	1995/04/12	1992/12/21	1995/06/29	Shenzhen	99	50	0.495	0.333
Dalian Refrig	1993/10/18	1998/02/27	1993/12/08	1998/03/20	Shenzhen	98	115	1.316	0.377
Hubei Sanonda	1993/10/28	1997/04/29	1993/12/03	1997/05/15	Shenzhen	97	100	1.668	0.761
Panel B: B-shares with A-share listing									
Tianjin Marine	1992/07/21	1996/04/02	1996/09/09	1996/04/30	Shanghai	40	90	1.761	0.328
Hainan Airline	1999/10/11	1997/06/16	1999/11/25	1997/06/26	Shanghai	265	71	0.725	0.310
Huangshan Tour	1997/04/17	1996/10/31	1997/05/06	1996/11/22	Shanghai	40	80	2.576	0.898
JinzhouPort	1999/05/07	1998/05/05	1999/06/09	1998/05/19	Shanghai	152	111	1.096	0.194
New Asia	1996/09/13	1994/12/01	1996/10/11	1994/12/15	Shanghai	31	100	1.414	0.486
Worldbest	1997/06/24	1996/07/02	1997/07/03	1996/07/26	Shanghai	40	115	1.310	0.540
Inter'l Enterprise	1996/06/21	1995/09/01	1996/07/08	1995/10/30	Shenzhen	38	50	1.037	0.287
Bengang Steel	1997/11/03	1997/06/10	1998/01/15	1997/07/08	Shenzhen	120	400	0.858	0.185
Changan Auto	1997/05/23	1996/10/16	1997/06/10	1996/11/08	Shenzhen	120	250	1.406	0.429
Guangdong Prov	1998/01/09	1996/07/26	1998/02/20	1996/08/15	Shenzhen	141	203	1.167	0.395
Little Swan	1997/03/18	1996/07/01	1997/03/28	1996/07/18	Shenzhen	60	70	3.375	1.369
Weifu	1998/06/29	1995/08/16	1998/09/24	1995/09/11	Shenzhen	135	68	0.787	0.303
Panel C: H-shares with A-share listing									
Beiren Printing	1994/03/27	1993/07/23	1994/05/06	1993/08/06	Shanghai	50	100	0.786	0.492
Yizheng Chem	1995/01/18	1994/03/14	1995/04/11	1994/03/29	Shanghai	20	1400	0.405	0.359
Tianjin Bohai	1995/06/10	1994/05/03	1995/06/30	1994/05/17	Shanghai	69	340	0.493	0.134
DongFang Elec	1995/07/04	1994/05/19	1995/10/10	1994/06/06	Shanghai	60	170	2.029	0.310
Louyang Glass	1995/09/25	1994/06/21	1995/10/31	1994/07/08	Shanghai	41	250	1.802	0.340
China East Air	1997/10/24	1997/01/28	1997/11/05	1997/02/05	Shanghai	300	1567	0.882	0.233
Angang Newsteel	1997/11/17	1997/07/15	1997/12/25	1997/07/24	Shenzhen	300	890	0.578	0.146
Jilin Chemical	1996/09/24	1995/05/15	1996/10/15	1995/05/23	Shenzhen	50	965	1.285	0.149
Northeast Elec	1995/11/29	1995/06/22	1995/12/13	1995/07/06	Shenzhen	30	258	0.711	0.177
Kelon	1999/06/02	1996/07/15	1999/07/13	1996/07/23	Shenzhen	110	382.99	2.416	1.327
Xinhua	1997/07/24	1996/12/17	1997/08/06	1996/12/31	Shenzhen	12.5	150	1.446	0.407

Panel A shows the statistics of A-shares having B-share listing on the Shanghai and Shenzhen Stock Exchange respectively. Panel B shows the statistics of B-shares having A-share listing on the Shanghai and Shenzhen Stock Exchange respectively. Panel C shows the statistics of H-shares having A-share listing on the Shanghai and Shenzhen Stock Exchange respectively.

No. of shares (million) denotes the number of shares that can be traded in the market around the cross-listing period. Closing prices of shares on cross-listing day are expressed in US dollar.

Table 1 reports some interesting characteristics of the sample. Panel A reports statistics of A-shares with subsequent B-share listing. One characteristic of A-share IPOs is the long delay between issue of IPO shares and the listing of those shares on the stock exchange, in particular those A-shares issued at the earlier time. In contrast, the listing lags of B-share IPOs are much shorter. The average (median) listing lags for A-share IPOs are 207 (91) days respectively. On average B-share IPOs take 25 days to be listed (median = 17 days). For some A-shares, the listing lags are more than two years. For instance, China Vanke issued A-share at the end of 1988 but the shares were listed in January 1991. Similarly, Gintian offered A-shares in February 1989 and later listed the shares in July 1991. The major reason is that there was no stock exchange in Mainland China until early 1990. Most A-shares are listed between 1991 and 1994 (more than half are listed in 1993). Subsequent listings of B-shares distribute evenly between 1993 and 1998. The time lag between listing of A-shares and subsequent B-shares ranges from about four months to more than four years. On average companies issued more B-shares than A-shares. Of the eighteen companies, thirteen of them have floated B-shares more than A-shares. Of the seven Shanghai listed companies, six of them have the amount of B-shares floated in the market more than existing amount of A-shares. Of the remaining eleven Shenzhen listed companies, seven of them have the amount of B-shares floated in the market more than existing amount of A-shares. The average (median) number of B-shares issued are 101 (95) million respectively. In contrast, they are 77 and 69 million for A-shares respectively. All subsequently listed B-shares have much lower closing prices on the first trading day when compared with the closing prices of A-shares. This simply reflects the foreign B-share discounts in Chinese stock market.

Panel B shows the statistics of B-shares with subsequent A-share listings. On average B-share IPOs take 24 days to be listed (median = 23 days). The time lag between the issue date and the listing date for A-shares is shorter than that of A-shares in Panel A. The average (median) listing lag for A-share IPOs is 158 (31) days respectively. Except Tainjin Marine, the listing lags for A-shares range from one week to three months. The B-share listing of companies ranges between 1994 and 1998. Half of companies first list B-shares in 1996. Subsequent listing of A-shares distribute quite evenly between 1996 and 1999. The time lag between listings of B-shares and subsequent A-shares ranges from four months to at most three years. Of the twelve companies, nine of them have floated B-shares more than A-shares. The average (median) number of B-shares issued are 134 (95) million respectively. In contrast, they are 99 and 90 million for A-shares respectively. The foreign B-share discounts in China also exists in the sample as all subsequent listed A-shares have much higher closing prices on the first trading day when compared with the closing prices of existing B-shares on the same day. Therefore, B-shares have much lower prices than A-shares no matter they are listed before or after A-share listing.

Panel C reports the statistics of H-shares with subsequent A-share listing. The listing

lags of H-share IPOs are shorter than those of B-share IPOs in Panel A and B. On average H-share IPOs take 13 days to be listed (median = 14 days). Similar to the sample in Panel B, the listing lags for A-shares are shorter than those of A-shares in Panel A. The average (median) listing lags is 38 (36) days respectively. Listings of H-shares distribute between 1993 and 1997 and subsequent listing of A-shares occurred between 1994 and 1999. Similar to B-shares with subsequent A-share listing in Panel B, the time lag between listing of H-shares and subsequent A-shares ranges from five months to at most three years. All companies issue H-shares more than A-shares. The average (median) number of H-shares issued is 588 (340) million respectively. In contrast, they are 95 and 50 million for A-shares respectively. All subsequent listed A-shares have much higher closing prices on the first day of trading when compared to the closing prices of H-shares on the same day. This means share price discount exists in both foreign B- and H-shares. This reflects the foreign share price discounts (or domestic A-share price premium) prevailing in Chinese stock market.

4 Model and Methodology

We investigate both the short-run and the long-run impact of listing of shares invested by different types of investors. We first employ standard event-study methodology to investigate the short-run impact on the trading volume, volatility and stock returns surrounding the listing day. We formulate a 41-day event window that consists of 20 trading days before and 20 trading days after the listing plus the event day itself. The days are arranged in order and numbered from –20 to 20. Day 0 is the listing day. Daily averages of alternative trading and volatility measures are calculated for each stock *i* in both the post-listing and pre-listing periods. A 'Post-Pre ratio' is computed as follows:

$$POST\text{-}PRE\ Ratio_i = X_{i,\,post} / X_{i,\,pre} \quad \text{for } i = 1,\ldots,n \tag{1}$$

where X_i is the average trading or volatility measure for stock *i.* A *POST-PRE* ratio greater than unity indicates an increase over time in the attribute in question for stock *i.*
We test whether the trading volume and volatility of stocks in the pre-listing period are significantly different from the post-listing period based on the nonparametric Wilcoxon signed rank test. To control for the influence of market trading, we use market adjusted measure of trading volume. The market adjusted trading volume is computed by dividing daily volume of individual stock by the total trading volume of the market on the same day. The daily volatility is calculated based on the absolute value of percentage changes in daily close-to-close prices, $ABS\ (ln(P_{it}/P_{it-1}))$, where P_{it} and P_{it-1} are closing prices on successive trading days. The intraday volatility is calculated based on square of the daily percentage differences between the intraday high and low prices, $ln(H_{it}/L_{it})^2$, where H_{it} and L_{it} are high and low prices of stock *i* on the same trading day. The high/low estimators are superior to the close-to-close estimator because they incorporate the range of dispersion of prices observed over the entire trading day. Parkinson (1980) and Garman and Klass (1980) show that the dispersion of the extreme values is a more efficient estimate of stock return volatility than the traditional close-to-close return volatility. Also, the possibility that changes in volatility after the listing of shares could simply reflect changes in overall market volatility around the time of listing is

investigated. To do so, we investigate standardized volatility measures where each share's pre-listing and post-listing volatilities are divided by the volatilities of the respective market.

Past research show that return volatility and how it varies over time conditionally is systematically related to trading volume, in general (Clark (1973), Epps and Epps (1976), Tauchen and Pitts (1983), Harris (1986, 1987) and Lamoureux and Lastrapes (1990)). To investigate the long-run impact of cross-listing, we adopt the model proposed by Domowitz, Glen and Madhavan (1998) to estimate jointly the change in volatility and liquidity around cross-listing.

Our volatility model is as follows:

$$VAR_{it} = \gamma_{it} + \delta_{it} VAR_{it-1} + \lambda_{it} VOL_{it} + \eta_{it}$$

and

$$\begin{aligned} \gamma_{it} &= \gamma_{i0} + D_{1t}\gamma_{i1} + D_{2t}\gamma_{i2} \\ \delta_{it} &= \delta_{i0} + D_{1t}\delta_{i1} + D_{2t}\delta_{i2} \\ \lambda_{it} &= \lambda_{i0} + D_{1t}\lambda_{i1} + D_{2t}\lambda_{i2} \end{aligned} \quad (2)$$

where VAR_t is volatility estimate on day t, VOL_t is the standardized volume on day t, D_{1t} and D_{2t} are dummy variables which capture pre-listing and post-listing effects respectively. D_{2t} takes the value 0 if day t is before cross-listing and 1 otherwise. We proxy for the price variance term on day t with (1) intraday volatility measured by high/low price and (2) absolute daily return.

In the model, the base-level volatility is captured by γ_{it} and any serial dependence with past volatility by δ_{it}. Following Domowitz, Glen and Madhavan (1998), the conditional volatility process has a transitory component which arises from trading frictions and which is captured in the responsiveness to volume through a parameter λ_{it}. λ_{it} can be interpreted as being inversely related to liquidity, so a positive value reveals lower liquidity and thus lower market quality as volatility is more sensitive to a given change in trading volume. We investigate the impact of cross-listing on volatility and liquidity, depending on the extent of intermarket informational linkages. Past studies document that if intermarket information linkages are good, cross-listing reduces base volatility and increases liquidity, so γ_{i2} and $\lambda_{i2}$are negative. By contrast, if information linkages are extremely poor, cross-listing increases volatility and reduces liquidity, so γ_{i2} and $\lambda_{i2}$are positive. Considerable evidence has shown that there is information flow between the A-share and foreign B-/H-share markets (Chakravarty et al. (1998), Chui and Kwok (1998), Li et al. (2001) and Sjoo and Zhang (2000)). However, it is conceivable that the information linkages are imperfect due to internal market segmentation induced by ownership restrictions (Domowitz et al. (1998)). Therefore, the net impact of cross-listing may be more complex and is an empirical issue. We also expect that current volatility is likely to depend on past volatility, so that $\delta_{i0} > 0$. To estimate the long-term effect, we use a 120-day event window that consists of 60 trading days before and 60 trading days after the listing plus the event day itself. We also introduce the dummy variable D_{1t} for day –15 to day –1 to investigate any impact before listing. Any pre-listing effect on volatility and liquidity will be captured by coefficients γ_{i1} and λ_{i1} respectively. The time-varying parameters for individual stock are estimated on a group basis by using

iterated seemingly unrelated regression (ITSUR) estimation that allows cross correlations across equations.

5 Empirical Results

We first report the univariate results on trading volume, volatility and stock price after cross-listing. The results of multivariate regression model are followed.

5.1 Impacts on Trading Volume and Volatility: Univariate Tests

5.1.1 Effects on trading volume

Prior research in general finds that there is an increase in total and domestic trading volume after cross-listing. By contrast, we find post-listing decline in trading volume of A-shares after B-share listings.

Table 2: Ratios of post and pre-listing trading volume and volatility

	Unadjusted			Market adjusted		
Stock	Volume	H-L	Absolute Returns	Volume	H-L	Absolute Returns
Panel A: A-shares						
Huaxincem	1.646	1.490	1.431	0.985	0.950	0.780
Jin Jiang	1.261	1.110	1.589	0.213	1.024	0.816
Lianhua Fibre	0.990	2.337	1.226	0.500	2.138	1.078
Lujiazui	0.213	0.656	0.479	0.944	1.088	0.864
Narcissus	0.176	0.365	0.253	0.712	1.120	1.221
Posts & Tel	1.026	0.686	0.816	1.179	1.117	1.141
Jinan Qingqi	0.459	0.962	1.181	0.568	1.083	1.446
Changchai	0.682	0.803	0.920	0.414	0.945	1.009
China Vanke	0.350	0.623	0.774	0.560	0.831	0.786
Foshan Lighting	0.828	1.019	0.566	0.443	0.747	0.390
Gintian	1.359	2.079	2.078	0.798	1.294	2.077
Guangdong Elec	0.752	0.554	0.659	0.547	0.734	0.793
Hefei	1.373	1.070	0.966	1.067	0.949	0.837
Jiangling Motors	0.874	1.003	1.253	0.949	0.730	0.757
Nanshan Power	1.025	1.278	1.092	2.261	1.095	0.849
Pearl River	1.768	0.859	1.241	1.041	1.031	1.262
Dalian Refrig	2.483	1.060	1.243	1.149	1.003	1.174
Hubei	0.341	1.323	1.431	0.595	0.777	0.870
Mean	0.978	1.071	1.067	0.829	1.036	1.008
Median	0.932	1.011	1.137	0.755	1.013	0.867
p-value	0.70	0.93	0.58	0.04	1.00	0.77
Panel B: B-shares						
Tianjin Marine	0.448	0.945	1.048	0.699	1.060	1.382
Hainan Airline	0.796	0.494	0.332	1.346	0.516	0.399
Huangshan Tour	0.494	0.802	0.646	0.573	0.536	0.428
JinzhouPort	3.186	1.656	1.440	2.170	1.341	1.270

New Asia	1.883	0.954	0.639	2.506	1.010	0.510
Worldbest	0.425	0.790	1.154	0.714	0.943	1.327
Int'l Enterprise	0.523	0.482	0.355	0.486	1.075	1.135
Bengang Steel	0.944	0.986	0.811	0.745	1.469	1.232
Changan Auto	0.581	1.036	1.271	0.725	1.179	1.980
Guangdong Prov	0.467	0.429	0.440	1.115	1.265	1.577
Little Swan	0.899	1.245	1.239	0.894	0.970	1.134
Weifu	0.365	0.644	0.737	0.709	1.063	1.451
Mean	0.918	0.872	0.843	1.057	1.036	1.152
Median	0.552	0.873	0.774	0.735	1.062	1.251
p-value	0.23	0.18	0.20	0.68	0.38	0.42

Table 2 (Continued)

	Unadjusted			Market adjusted		
Stock	Volume	H-L	Absolute Returns	Volume	H-L	Absolute Returns
Panel C: H-shares						
Beiren Printing	2.504	1.454	1.115	1.548	1.464	1.118
Yizheng Chem	1.384	0.884	0.683	1.218	0.777	0.752
Tianjin Bohai	1.166	0.852	0.758	1.058	0.828	0.791
DongFang Elec	0.592	0.692	0.969	0.768	0.667	0.792
Louyang Glass	2.591	2.032	2.064	2.745	1.722	1.962
China East Air	0.362	0.579	0.405	0.655	1.031	1.026
Angang Newsteel	1.045	1.532	1.737	0.966	1.001	1.025
Jilin Chemical	2.115	1.145	1.534	1.626	0.955	1.467
Northeast Elec	2.357	1.933	1.875	1.910	1.785	1.371
Guangdong Kelon	0.687	1.017	0.902	1.073	0.854	0.528
Shandong Xinhua	3.239	1.989	1.759	2.306	1.041	0.728
Mean	1.640	1.283	1.255	1.443	1.102	1.051
Median	1.384	1.145	1.115	1.218	1.001	1.025
p-value	0.10	0.17	0.24	0.07	0.83	0.97

This table reports the effect of cross-listing on the trading volume and volatility. Panel A reports the effects of B-share listing on A-shares, panel B reports the effects of A-share listing on B-shares and panel C reports the effects of A-share listing on H-shares. The Ratio is the average value of the variable under consideration in the period of 20 trading days after listing divided by the average value of the same variable in the period of 20 trading days before listing. Unadjusted volume is the daily shares traded. Unadjusted intraday volatility denotes the square of the daily percentage differences between the intraday high and low prices. Unadjusted Absolute Returns denotes the absolute daily raw returns. Market adjusted volume is the unadjusted volume divided by the market volume. Market adjusted volatility is the unadjusted volatility divided by the market volatility. p-value denotes significance of Wilcoxon signed rank test.

Panel A of Table 2 reports the effect on A-share trading volume around the listing of B-shares. Of eighteen A-shares, ten of them have the ratio of unadjusted trading volume less than one, which means that trading volume of A-shares decreases after the listing of B-shares. The trading volume of A-shares declines by a median (mean) value of 6.8 percent (2.2 percent). The Wilcoxon signed rank test cannot reject the hypothesis that the ratio is equal to one (p-value = 0.70). After adjusting the market volume, the decline

in A-share trading volume is even more pronounced. Of eighteen A-shares, thirteen of them have the ratio of adjusted trading volume less than one. The A-share trading volume declines by a median (mean) value of 24.5 percent (17.1 percent) around B-share listings, which is significant at the 5 percent level.

The decline in A-share trading volume is somewhat surprising. Since the A-share market is fully segmented from the B-share market, cross-listing should not result in order flow migration to B-share market. A possible explanation is that speculative A-share investors get rid of companies if they issue B-shares. Companies with both A- and B-shares have to undergo more rigorous auditing process and are subject to more stringent disclosure requirements than those with A-share only. Some A-share investors may dislike and leave. Poon et al. (1998) also find that the trading volume of A-shares declines after B-share listing and they attribute the effect to the decline of the (domestic) investor base.

Panel B of Table 2 reports the effect on B-share trading volume around the listing of A-shares. Of twelve B-shares, ten of them have the ratio of unadjusted trading volume less than one. The median (mean) ratio of B-share trading volume is 0.552 (0.918), which means that the trading volume of B-shares declines by a median (mean) value of 44.8 percent (8.2 percent) after the listing of A-shares. The p-value of the Wilcoxon test is 0.23, which means that the decline of unadjusted trading volume is not statistically significant. After adjusting the market volume, the decline in B-share trading volume is less pronounced. Of twelve B-shares, eight of them have the ratio of adjusted trading volume less than one. The B-share trading volume declines by a median value of 26.5 percent after A-share listings. Similar to the result of unadjusted trading volume, the Wilcoxon test cannot reject the hypothesis that the ratio of adjusted trading volume is not significantly different from one (p-value = 0.68). In summary, there is no significant change in the trading activity of B-shares after A-shares are listed.

Panel C of Table 2 reports the effect on H-share trading volume around the listing of A-shares. Of eleven H-shares, eight of them have the ratio of unadjusted trading volume larger than one. The median (mean) ratio of H-share trading volume is 1.384 (1.640), which means that the trading volume of H-shares increases by a median (mean) value of 38.4 percent (64 percent) after the listing of A-shares. After adjusting the market volume, H-share trading volume is still higher after the listing of A-shares. Of eleven H-shares, eight of them have the ratio of adjusted trading volume larger than one. The H-share market-adjusted trading volume increase by a median (mean) value of 21.8 percent (44.3 percent) after A-share listings. A p-value of 0.07 of the Wilcoxon test suggests that the ratio of adjusted trading volume is statistically different from one. The overall results show that there is significant increase in the trading activity of H-shares after A-shares are listed.

Though B-shares and H-shares are issued and traded by foreign investors, the cross-listing of A-shares has different impact on their trading activity. It may be due to the fact that the trading location (Hong Kong) is different from the business location (Mainland China) for H-shares. H-shares are first listed and traded in Hong Kong market. This may create a wide information gap between companies and investors (though they are sophisticated and knowledgeable). Without home-market trading (i.e. in Mainland China), H-share investors cannot observe price information from the indigenous market as the benchmark. The problem is lessen after listing of A-shares so foreign investors are attracted to trade H-shares. Thus, the trading volume of H-shares increases.

5.1.2 Effects on volatility

Most prior research finds post-listing increase in volatility after international cross-listing (Barclay, Litzenberger and Warner (1990), Makhija and Nachtmann (1990), Jayaraman, Shastri and Tandon (1993), Forster and George (1996), Coppejans and Domowitz (2000) and Domowitz, Glen and Madhavan (1998)). In this study, we use two measures to investigate the volatility effect – intraday volatility and daily volatility.

Panel A of Table 2 shows the effect on A-shares volatility around the listing of B-shares. Of eighteen A-shares, ten of them have the ratio of unadjusted intraday volatility and daily volatility larger than one. The median ratio of A-shares intraday volatility (daily volatility) is 1.011 (1.137). The Wilcoxon test cannot reject the hypothesis that the ratios are equal to one (p-value = 0.93 and 0.58 respectively). After adjusting the market trend in volatility, ten (eight) A-shares have the ratio of adjusted intraday volatility (daily volatility) larger than one. The intraday volatility of A-shares increases by median values of 1.3 percent while the daily volatility decreases by 13.3 percent. The overall results show that change in the A-share volatility is insignificant after B-shares are listed.

Panel B of Table 2 reports the effect on B-share volatility around the listing of A-shares. Of twelve B-shares, nine (seven) of them have the ratio of unadjusted intraday volatility (daily volatility) less than one. The unadjusted intraday volatility and the daily volatility of B-shares decrease by median (mean) values of 12.7 and 22.6 percent (12.8 and 15.7 percent) respectively after A-share listing. The Wilcoxon test shows that the decline in the unadjusted volatility is insignificant (p-value = 0.18 and 0.20 respectively). After adjusting the market trend in volatility, eight (nine) of them have the ratio of adjusted intraday volatility (daily volatility) larger than one. The intraday volatility and daily volatility of B-shares increase by median (mean) values of 6.2 and 25.1 percent (3.6 and 15.2 percent) respectively. Again, the Wilcoxon test cannot reject the hypothesis that there is no change in the B-share volatility after A-shares are listed (p-value = 0.38 and 0.42 respectively).

Panel C shows the effect on H-share volatility after the listing of A-shares. Of eleven B-shares, seven (six) of them have the ratio of unadjusted intraday volatility (daily volatility) larger than one. The unadjusted intraday volatility and the daily volatility of H-shares increase by median (mean) values of 14.5 and 11.5 percent (28.3 and 25.5 percent) respectively. After adjusting the market trend in volatility, six (six) of them have the ratio of intraday volatility (daily volatility) larger than one. The increase in H-share adjusted volatility is less pronounced. The intraday volatility and the daily volatility of H-shares increase by median (mean) values of 0.1 and 2.5 percent (10.2 and 5.1 percent) respectively. The Wilcoxon tests cannot reject the hypothesis that the ratios are not significantly different from one (p-value = 0.83 and 0.97 respectively). Overall, there is no change in the H-share volatility after A-shares are listed.

Different from the impact on trading volume, we find no significant change in the volatility of A-shares (foreign shares) after the listing of foreign shares (A-shares).

5.2 Impacts on Volatility and Liquidity: Multivariate Tests

In this section, we apply the model proposed by Domowitz, Glen and Madhavan (1998) to estimate jointly the change in volatility and liquidity around the listing of shares. They use the model to test the ADR cross-listing effects on Mexican market. The results are reported separately for different types of cross-listed shares. We have two measures of

volatility: intraday volatility measured by daily high/low price and absolute daily return. The trading volume of individual stock is standardized by the corresponding market trading volume. For each type of listing, we first report the results for intraday volatility and then followed by those for daily volatility.

5.2.1 Results of A-shares with B-share listings

Panel A of Table 3 shows that the estimates for the intraday volatility model provide support for the decomposition of price volatility. In particular, the base-level or fundamental volatility coefficients γ_0 are positive in each eighteen A-shares and the coefficients that capture the transitory sensitivity to volume, λ_0, are positive in most of the cases. A value of 6614.9 of the Wald test rejects the hypothesis that sets of coefficients (λ_0, δ_0, γ_0) are jointly equal to zero across eighteen A-shares. There is no impact on the pre-listing base-level volatility since coefficients γ_1 of all A-shares are not significant (the Wald value being 10.9). Three A-shares have significant pre-listing liquidity shift coefficients λ_1 (two are positive and one is negative). Following the listing of foreign B-shares, there is a decrease in the intraday base-level volatility (negative γ_2 coefficient) in eleven A-shares and four of them are significant at least at the 10 percent level. Seven A-shares experience an increase in the post-listing base-level volatility (positive γ_2 coefficient) but none of them are significant at the conventional level. The Wald value of 41.93 suggests that coefficients γ_2 are not jointly equal to zero across the eighteen A-shares. The post-listing liquidity shift coefficients (λ_2) are positive in ten A-shares and six of them are significant at the five percent level. Eight A-shares have negative λ_2, in which three of them are significant at the five percent level. The Wald test rejects the hypothesis that coefficients λ_2 are jointly equal to zero across eighteen A-shares (the Wald value being 169.14). Further, the hypothesis that both γ_2 and λ_2 are jointly equal to zero across A-shares is rejected with the Wald value of 223.31.

Panel B reports the results for absolute returns. The results are qualitatively similar but less significant. There is no significant impact on the pre-listing base-level daily volatility. Three A-shares have significant and negative λ_1. Surprisingly, the Wald statistic is not statistically significant. The hypothesis that both sets of γ_1 and λ_1 coefficients are jointly equal to zero across eighteen A-shares is rejected at the five percent level. Three A-shares have significant and negative coefficients γ_2, indicating a decline in the post-listing volatility. However, the χ^2 statistic of the Wald test is not significant. Three (three) A-shares have significant and negative (positive) coefficients λ_2. The hypothesis that coefficients λ_2 are jointly equal to zero across eighteen A-shares is rejected at the five percent level (the Wald value being 50.44). Further, the hypothesis that both γ_2 and λ_2 are jointly equal to zero across A-shares is rejected with the Wald value of 128.91.

Compared with domestic investors, foreign investors are more sophisticated and experienced. Their entry (after B-share listings) reduces base-level volatility of A-shares as price movements and trades of B-shares may provide valuable information to domestic A-share investors. Chui and Kwok (1998) and Sjoo and Zhang (2000) document that returns on B-shares tend to lead A-share returns. Chui and Kwok (1998) explain that the foreign press has more freedom and better facilities for covering news from China than local Chinese press. Sjoo and Zhang (2000) attribute the effect to more experience of foreign investors. However, foreign B-share listing reduces A-share liquidity as revealed with higher sensitivity of price volatility to volume. We believe that this reflects

imperfect information linkages between markets as a result of ownership restrictions imposed.

Table 3: Estimating changes in volatility and liquidity of A-shares around B-share listing

Stock	γ_0	δ_0	λ_0	γ_1	δ_1	λ_1	γ_2	δ_2	λ_2	R^2
Panel A: Intraday Volatility										
Huaxin	0.082**	0.364**	2.355**	-0.061	0.050	-0.794	-0.026	-0.011	-2.150	0.367
	(3.76)	(4.00)	(2.48)	(-1.00)	(0.07)	(-0.28)	(-0.88)	(-0.05)	(-1.27)	
Jin Jiang	0.070**	0.439**	-1.169*	-0.006	-0.421*	2.317**	-0.024	-0.213	9.673**	0.125
	(4.04)	(3.57)	(-1.91)	(-0.19)	(-1.75)	(2.64)	(-1.00)	(-1.18)	(4.24)	
Lianhua	0.088**	0.114	-1.183	-0.093	0.374	18.133	-0.040	-0.102	55.278**	0.262
	(3.00)	(0.49)	(-0.39)	(-1.18)	(0.47)	(0.82)	(-1.10)	(-0.41)	(6.35)	
Lujiazui	0.054**	-0.007	5.472**	-0.044	0.452	-3.184	-0.022	0.427*	-5.177**	0.361
	(2.82)	(-0.08)	(4.69)	(-1.00)	(1.42)	(-1.47)	(-0.90)	(1.83)	(-4.26)	
Narcissus	0.125**	0.186**	6.208	-0.014	0.019	-3.762	-0.086**	0.222	-5.270	0.318
	(5.56)	(2.19)	(1.77)	(-0.18)	(0.08)	(-0.43)	(-2.77)	(0.88)	(-1.37)	
Post & Tel	0.060	0.537**	17.515	-0.080	-0.267	74.155	-0.030	0.131	-18.987	0.423
	(1.56)	(4.58)	(1.06)	(-0.72)	(-1.61)	(1.20)	(-0.69)	(0.54)	(-1.13)	
Jinan Qingqi	0.062**	0.063	2.848**	0.070	-0.435	-4.465	-0.036*	-0.018	10.732**	0.279
	(3.83)	(0.51)	(3.63)	(1.40)	(-1.56)	(-1.02)	(-1.81)	(-0.10)	(3.14)	
Changchai	0.089**	-0.246**	5.823**	0.005	0.044	-3.493	-0.063**	0.377**	11.988**	0.317
	(6.16)	(-2.29)	(4.42)	(0.19)	(0.15)	(-0.78)	(-3.51)	(2.57)	(4.10)	
China Vanke	0.064**	0.237	-0.038	-0.048	0.226	0.403	-0.007	0.152	0.070	0.174
	(3.42)	(1.28)	(-0.55)	(-0.64)	(0.43)	(0.69)	(-0.27)	(0.74)	(0.34)	
Foshan Light	0.027**	0.500**	1.117**	-0.035	-0.357	9.077	0.024	-0.633**	1.007	0.375
	(2.75)	(5.99)	(5.77)	(-1.11)	(-0.83)	(1.35)	(1.56)	(-4.02)	(0.66)	
Gintian	0.032**	0.353	0.077	0.021	-0.365	-0.289	0.003	0.026	1.117**	0.331
	(2.23)	(1.62)	(0.78)	(0.72)	(-0.78)	(-0.92)	(0.18)	(0.11)	(2.45)	
Guangdong Ele	0.031**	0.256**	2.539**	0.017	0.039	-2.918**	0.008	0.019	-1.942**	0.454
	(3.32)	(3.44)	(10.33)	(0.73)	(0.13)	(-4.54)	(0.56)	(0.13)	(-5.50)	
Hefei	0.078**	0.108	4.855**	-0.043	0.328	-1.455	0.024	-0.284	-1.602	0.188
	(3.60)	(0.82)	(3.20)	(-0.84)	(0.86)	(-0.38)	(0.91)	(-1.65)	(-0.72)	
Jiangling	0.035**	0.432**	1.031**	-0.023	0.532	-1.276	0.000	-0.204	-0.500*	0.589
	(2.17)	(6.86)	(5.55)	(-0.47)	(0.93)	(-1.62)	(0.01)	(-1.06)	(-1.89)	
Nanshan	0.144**	0.277**	-5.671	-0.062	-0.629	8.076	-0.085**	-0.196	8.277	0.315
	(4.66)	(3.33)	(-0.89)	(-0.98)	(-1.09)	(0.95)	(-2.37)	(-1.06)	(1.29)	
Pearl	0.027**	0.433**	2.210**	0.012	-0.491**	3.992	-0.021	0.043	1.991	0.474
	(2.74)	(5.45)	(8.14)	(0.31)	(-2.13)	(0.62)	(-1.31)	(0.26)	(1.56)	

Dalian Ref.	0.029**	0.001	19.197**	0.018	-0.571**	22.539**	0.005	0.256	-9.815**	0.378
	(2.96)	(0.01)	(5.17)	(0.89)	(-2.45)	(2.15)	(0.41)	(1.57)	(-2.09)	
Hubei	0.037**	-0.053	6.127**	-0.017	0.714**	-2.698	0.025	-0.076	14.126**	0.402
	(2.20)	(-0.28)	(2.90)	(-0.46)	(2.44)	(-0.56)	(1.22)	(-0.36)	(3.40)	
Wald test: Coefficients across stocks are jointly equal to zero										
Individual	229.36**	182.28**	347.92**	10.9	30.55**	47.36**	41.93**	36.45**	169.14**	
γ_0 , δ_0, λ_0		6614.9**								
γ_1 , λ_1					74.26**					
γ_2 , λ_2								223.31**		

This Table 3 reports the ITSUR estimates and test results of the following model:

$$VAR_{it} = \gamma_{it} + \delta_{it} VAR_{it-1} + \lambda_{it} VOL_{it} + \eta_{it}$$
$$\gamma_{it} = \gamma_{i0} + D_{1t}\gamma_{i1} + D_{2t}\gamma_{i2}$$
$$\delta_{it} = \delta_{i0} + D_{1t}\delta_{i1} + D_{2t}\delta_{i2}$$
$$\lambda_{it} = \lambda_{i0} + D_{1t}\lambda_{i1} + D_{2t}\lambda_{i2}$$

where $VAR_t$is volatility estimate on day t, VOL_t is the standardized volume on day t, D_{1t} is a dummy variable taking the value of one if day t is in the period of fifteen trading days before the listing of share and zero otherwise, D_{2t} is a dummy variable taking the value 0 if day t is before the listing of share and 1 otherwise. The *t*-statistics are reported in parentheses and based on iterated seemingly unrelated regression (ITSUR) estimation. χ^2 is a Wald test of the restriction that the coefficients are jointly equal to zero. ** and * denote significance at the 5% and 10% level respectively.

Panel B: Daily Volatility

Stock	γ_0	δ_0	λ_0	γ_1	δ_1	λ_1	γ_2	δ_2	λ_2	R^2
Huaxin	0.035**	0.214**	0.345	-0.018	-0.316	-0.098	-0.023**	-0.044	0.808	0.169
	(4.04)	(2.33)	(0.79)	(-0.93)	(-0.78)	(-0.08)	(-2.07)	(-0.20)	(1.05)	
Jin Jiang	0.018*	0.290	0.140	-0.019	0.408	0.156	0.008	-0.273	1.325	0.032
	(1.72)	(1.38)	(0.30)	(-0.72)	(0.27)	(0.23)	(0.58)	(-1.18)	(0.76)	
Lianhua	0.022**	0.125	0.063	-0.007	0.188	-3.126	-0.004	0.064	0.233	0.065
	(4.46)	(1.17)	(0.10)	(-0.45)	(0.37)	(-0.69)	(-0.65)	(0.40)	(0.13)	
Lujiazui	0.031**	-0.122	1.570**	-0.020	0.033	-0.269	-0.015	0.137	-1.537**	0.260
	(3.19)	(-1.11)	(2.84)	(-0.92)	(0.13)	(-0.27)	(-1.38)	(0.59)	(-2.65)	
Narcissus	0.042**	0.419**	-2.152	0.066**	-0.773**	-2.552	-0.020*	-0.598**	2.572	0.360
	(4.89)	(4.64)	(-1.42)	(2.19)	(-3.56)	(-0.71)	(-1.83)	(-2.54)	(1.55)	
Post & Tel	0.038**	0.237**	8.442	0.079	-0.070	-52.067*	-0.019	0.005	-9.229	0.231
	(2.54)	(2.44)	(1.13)	(1.58)	(-0.32)	(-1.80)	(-1.13)	(0.02)	(-1.22)	
Jinan Qingqi	0.014**	-0.165	1.759**	-0.001	-0.088	0.270	-0.015	-0.050	6.793**	0.243
	(2.00)	(-1.44)	(3.81)	(-0.06)	(-0.23)	(0.12)	(-1.61)	(-0.28)	(3.30)	
Changchai	0.007	-0.061	3.177**	0.011	-0.336	-0.492	-0.001	-0.068	3.247**	0.243
	(1.20)	(-0.51)	(4.35)	(0.95)	(-1.03)	(-0.20)	(-0.09)	(-0.41)	(2.00)	
China Vanke	0.029**	-0.345**	-0.009	-0.030	0.295	0.307	-0.006	0.579**	-0.055	0.051

	(4.56)	(-2.40)	(-0.29)	(-1.47)	(0.76)	(1.23)	(-0.69)	(3.32)	(-0.62)	
Foshan Light	0.012**	0.278**	0.718**	-0.003	-0.307	0.636	0.000	-0.288	-0.783	0.375
	(2.55)	(3.55)	(6.38)	(-0.17)	(-1.20)	(0.19)	(-0.07)	(-0.94)	(-0.87)	
Gintian	0.016**	0.003	0.031	0.006	-0.207	-0.176	0.003	0.082	0.225	0.058
	(3.08)	(0.02)	(0.65)	(0.58)	(-0.47)	(-1.14)	(0.36)	(0.38)	(1.00)	

Panel B (Continued)

Stock	γ_0	δ_0	λ_0	γ_1	δ_1	λ_1	γ_2	δ_2	λ_2	R^2
Guangdong Ele	0.010**	-0.050	0.980**	-0.001	0.567	-0.992**	0.000	-0.084	-0.401**	0.393
	(2.74)	(-0.60)	(8.66)	(-0.14)	(1.62)	(-3.11)	(0.06)	(-0.57)	(-2.43)	
Hefei	0.008	0.150	3.191**	0.003	0.240	-2.452	0.004	-0.215	0.302	0.210
	(1.01)	(1.18)	(3.72)	(0.16)	(0.57)	(-1.14)	(0.35)	(-1.32)	(0.23)	
Jiangling	0.007	-0.003	0.736**	0.016	0.062	-0.878**	0.000	-0.327	-0.291**	0.484
	(0.93)	(-0.04)	(7.79)	(0.67)	(0.10)	(-2.52)	(-0.03)	(-1.58)	(-2.07)	
Nanshan	0.049**	-0.005	0.462	-0.039*	-0.384	1.671	-0.033**	0.157	-0.098	0.146
	(3.99)	(-0.06)	(0.16)	(-1.85)	(-0.63)	(0.45)	(-2.40)	(0.79)	(-0.03)	
Pearl	0.012**	0.103	1.237**	-0.003	-0.285	0.149	-0.004	-0.118	0.246	0.441
	(2.83)	(1.45)	(8.86)	(-0.14)	(-0.64)	(0.04)	(-0.58)	(-0.60)	(0.37)	
Dalian Ref.	0.000	-0.053	8.812**	0.009	-0.119	-2.547	0.009	-0.459**	2.871	0.272
	(-0.05)	(-0.36)	(3.74)	(0.78)	(-0.49)	(-0.44)	(1.50)	(-2.29)	(0.91)	
Hubei	0.000	0.243	2.337	0.008	-0.184	1.415	0.004	-0.225	8.137**	0.193
	(0.00)	(1.27)	(1.57)	(0.40)	(-0.64)	(0.44)	(0.39)	(-1.03)	(3.02)	
Wald test: Coefficients across stocks are jointly equal to zero										
Individual	161.20**	67.54**	319.35**	18.33	22.10	24.14	24.68	33.74**	50.44**	
γ_0 , δ_0 , λ_0		2204.70**								
γ_1 , λ_1					61.43**					
γ_2 , λ_2								128.91**		

5.2.2 Results of B-shares with A-share listings

Now we investigate the effects of the introduction of domestic A-shares on foreign B- and H-shares. First, we focus the effects on B-shares. Both A- and B-shares are traded on the same stock exchange but are restricted to different types of investors. Because of the data availability, the analysis is carried out based on ten B-shares with the listing of domestic A-shares.

Panel A of Table 4 shows the results based on intraday volatility. We find no evidence of pre-listing impact on both the volatility unrelated to volume and the liquidity of B-shares. The hypothesis that coefficients γ_1 and λ_1 are jointly equal to zero across ten B-shares cannot be rejected (the Wald statistics are 13.42 and 8.72 respectively). After the listing of domestic A-shares, the base-level volatility of six foreign B-shares increases and the increase in two is significant at least at the ten percent level. One B-share experiences significant decline in the base-level volatility. The hypothesis that coefficients γ_2 are jointly equal to zero across ten B-shares is rejected at the five percent level (the Wald value being 22.24). The post-listing liquidity shift coefficients λ_2 are positive for four B-shares, in which two of them are significant at the five percent level. The remaining

six B-shares have negative λ_2 coefficients and two are significant at the five percent level. The Wald tests reject the hypothesis that coefficients λ_2 are jointly equal to zero across ten B-shares.

Panel B summarizes the results for absolute returns. The results are even less pronounced than those for intraday volatility. In short, before A-share listing, the liquidity shift coefficients λ_1 are significantly positive for two B-shares. The χ^2 statistics of the Wald tests in both sets of pre-listing coefficients γ_1 and λ_1 are not significant. We also find no evidence of change in post-listing of base-level volatility and liquidity, as the hypothesis that both γ_2 and λ_2 coefficients are jointly equal to zero across ten B-shares cannot be rejected.

Taken together, participation by new domestic A-share investors does not have significant impact on the market quality of foreign B-shares. As mentioned before, individual investors dominate A-share market. Most of them possess only rudimentary knowledge on stock investments and trade like noise traders who speculate in the stock market. They do not have superior information that foreign investors can exploit. Therefore, there is no impact on the B-share market. Again, the results are also consistent with Chui and Kwok (1998) and Sjoo and Zhang (2000).

The following Table 4 reports the ITSUR estimates and test results of the following model:

$$VAR_{it} = \gamma_{it} + \delta_{it} VAR_{it-1} + \lambda_{it} VOL_{it} + \eta_{it}$$
$$\gamma_{it} = \gamma_{i0} + D_{1t}\gamma_{i1} + D_{2t}\gamma_{i2}$$
$$\delta_{it} = \delta_{i0} + D_{1t}\delta_{i1} + D_{2t}\delta_{i2}$$
$$\lambda_{it} = \lambda_{i0} + D_{1t}\lambda_{i1} + D_{2t}\lambda_{i2}$$

where $VAR_t$is volatility estimate on day t, VOL_t is the standardized volume on day t, D_{1t} is a dummy variable taking the value of one if day t is in the period of fifteen trading days before the listing of share and zero otherwise, D_{2t} is a dummy variable taking the value 0 if day t is before the listing of share and 1 otherwise. The *t*-statistics are reported in parentheses and based on iterated seemingly unrelated regression (ITSUR) estimation. χ^2 is a Wald test of the restriction that the coefficients are jointly equal to zero. ** and * denote significance at the 5% and 10% level respectively.

Table 4: Estimating changes in volatility and liquidity of B-shares around A-share listing

Stock	γ_0	δ_0	λ_0	γ_1	δ_1	λ_1	γ_2	δ_2	λ_2	R^2
Panel A: Intraday Volatility										
Tianjin	0.005	0.595**	0.284	0.021	-1.018**	0.560*	0.025*	-0.169	-0.107	0.427
	(0.57)	(2.45)	(1.17)	(1.04)	(-3.24)	(1.87)	(1.97)	(-0.65)	(-0.40)	
Hainan	0.012	0.262*	11.227**	-0.006	0.118	-4.039	0.019	-0.123	-6.959**	0.246
	(0.95)	(1.90)	(4.29)	(-0.16)	(0.45)	(-0.84)	(1.05)	(-0.67)	(-2.35)	
Huangshan	0.028*	0.367**	0.857*	0.072	-0.110	-0.517	0.015	-0.089	-0.059	0.283
	(1.76)	(2.36)	(1.93)	(1.44)	(-0.30)	(-0.68)	(0.78)	(-0.48)	(-0.09)	
Jinzhou	0.045**	-0.129	2.208**	-0.008	0.626**	0.082	0.059**	0.285	-2.022**	0.369
	(3.61)	(-0.79)	(3.36)	(-0.24)	(2.30)	(0.04)	(2.54)	(1.42)	(-2.65)	
Worldbest	0.708**	0.133	0.211	0.035	-0.462	0.010	-0.043**	0.162	0.726**	0.187
	(4.64)	(1.19)	(0.97)	(1.12)	(-1.30)	(0.02)	(-2.17)	(0.95)	(2.12)	

Inter. Enter	0.217	0.597**	-0.038	-0.012	0.031	2.360	0.007	-0.076	0.675	0.530
	(1.42)	(3.46)	(-0.08)	(-0.25)	(0.16)	(1.62)	(0.31)	(-0.34)	(0.79)	
Bengang	0.056**	0.062	0.134**	-0.057	0.714**	0.091	-0.029	0.337*	0.079	0.268
	(2.64)	(0.43)	(2.38)	(-1.55)	(2.79)	(0.53)	(-1.09)	(1.89)	(0.61)	
Changan	0.036	0.460**	0.371	0.063	-0.357	-0.017	0.049	-0.301	-0.022	0.119
	(1.31)	(2.42)	(0.86)	(1.52)	(-1.30)	(-0.02)	(1.53)	(-1.33)	(-0.04)	
Guangdong Pro	0.055**	0.274**	1.748**	-0.024	0.151	1.619	-0.013	0.170	-1.048	0.242
	(2.85)	(2.15)	(1.98)	(-0.55)	(0.58)	(0.79)	(-0.54)	(0.94)	(-1.01)	
Weifu	0.100**	0.012	-0.408	0.127**	-0.626	-0.595	-0.031	-0.068	1.738**	0.141
	(4.79)	(0.09)	(-0.56)	(2.13)	(-1.58)	(-0.57)	(-1.18)	(-0.39)	(2.08)	
Wald test: Coefficients across stocks are jointly equal to zero										
Individual	76.24**	39.06**	50.03**	13.42	29.30**	8.72	22.24**	10.41	24.88**	
γ_0 , δ_0 , λ_0		913.59**								
γ_1 , λ_1					28.37					
γ_2 , λ_2								41.73**		
Panel B: Daily Volatility										
Tianjin		0.010**	0.086	-0.006	-0.006	-0.454	0.288**	0.005	0.216	-0.011	0.186
		(2.11)	(0.27)	(-0.05)	(-0.64)	(-1.28)	(2.11)	(0.87)	(0.64)	(-0.09)	
Hainan		0.011**	0.221	1.068	0.000	0.138	0.137	-0.003	0.006	-0.097	0.126
		(2.11)	(1.16)	(1.20)	(0.02)	(0.53)	(0.08)	(-0.43)	(0.03)	(-0.10)	
Huangshan		0.010*	0.028	0.645**	0.029*	-0.149	-0.053	0.005	0.059	-0.338	0.233
		(1.82)	(0.18)	(3.22)	(1.92)	(-0.56)	(-0.16)	(0.69)	(0.29)	(-1.17)	
Jinzhou		0.016**	0.380**	0.126	0.004	-0.040	0.626	0.010	-0.030	-0.139	0.130
		(2.58)	(2.66)	(0.36)	(0.22)	(-0.14)	(0.48)	(0.98)	(-0.16)	(-0.34)	
Worldbest		0.030**	-0.105	0.078	0.005	-0.347	-0.142	-0.015	0.210	0.273	0.074
		(3.27)	(-0.80)	(0.55)	(0.29)	(-0.77)	(-0.50)	(-1.32)	(1.14)	(1.22)	
Inter. Enter		0.005	0.393*	0.084	0.010	0.010	0.867	0.009	-0.138	0.109	0.407
		(0.85)	(1.92)	(0.42)	(0.53)	(0.04)	(1.49)	(0.97)	(-0.55)	(0.31)	
Bengang		0.003	0.053	0.077**	0.013	0.135	-0.001	0.006	0.110	-0.016	0.163
		(0.38)	(0.37)	(2.79)	(0.79)	(0.48)	(-0.01)	(0.57)	(0.58)	(-0.26)	
Changan		0.016	-0.021	0.153	0.018	-0.095	-0.175	0.001	0.255	0.207	0.144
		(1.63)	(-0.11)	(0.70)	(1.11)	(-0.30)	(-0.45)	(0.13)	(1.12)	(0.83)	
Guangdong Pro		0.025**	0.215	-0.011	-0.024	0.300	1.713**	-0.010	-0.107	0.152	0.216
		(3.66)	(1.62)	(-0.03)	(-1.38)	(1.23)	(2.16)	(-1.16)	(-0.52)	(0.41)	
Weifu		0.023**	0.285**	0.051	0.012	-0.524*	0.106	0.006	-0.535**	0.138	0.120
		(3.75)	(2.49)	(0.22)	(0.91)	(-1.71)	(0.31)	(0.73)	(-2.78)	(0.52)	
Wald test: Coefficients across stocks are jointly equal to zero										
Individual		57.18**	20.87**	20.82**	9.33	7.65	12.09	7.52	11.74	4.31	
γ_0 , δ_0 , λ_0			464.53**							
γ_1 , λ_1						27.96				
γ_2 , λ_2									12.53	

5.2.3 Results of H-shares with A-share listings

Now, we focus the effects on H-shares. H-shares are traded in Hong Kong while A-shares are traded on the stock exchanges in Mainland China. Because of the data availability, the analysis is carried out based on ten H-shares with the listing of domestic A-shares.

Panel A of Table 5 reports the results of intraday volatility model. We find no pre-listing change on the base-level volatility of H-shares as coefficients γ_1 are not significant across H-shares (the Wald value being 7.74). In contrast, two H-shares have significant and positive pre-listing liquidity shift coefficients λ_1. The χ^2 statistic (18.18) of the Wald test is significant at the ten percent level. After A-shares are listed, one H-share experiences significant decrease in the base-level volatility. The post-listing liquidity shift coefficients λ_2 are positive in eight H-shares and three of them are significant at the five percent level. The Wald test rejects the hypothesis that coefficients λ_2 are jointly equal to zero across ten H-shares (the Wald value being 39.95). The results suggest that H-shares have reduced liquidity as price variability is more sensitive to volume.

Panel B of Table 5 summarizes the results for absolute returns. The results are less pronounced compared with those for intraday volatility. We find no evidence of pre-listing change in both base-level volatility and liquidity of H-shares. The χ^2 statistics of the Wald tests in both sets of coefficients γ_1 and λ_1 are not significant (5.42 and 7.90 respectively). After A-share listing, the liquidity shift coefficients λ_2 are significantly positive for two H-shares. The Wald test rejects the hypothesis that coefficients λ_2 are jointly equal to zero across ten H-shares (the Wald value being 25.73). Again, the results for absolute returns suggest that H-shares have lower liquidity as higher sensitivity of price variability to volume.

All in all, though B-shares and H-shares are invested by foreign investors, we observe different impacts on their market quality after listing of A-shares. We find no significant impact on the market quality of foreign B-shares after listing of A-shares. In contrast, H-shares experience higher sensitivity of price variability to volume. Since H-shares and A-shares are traded at different locations, it is likely that ownership restrictions and different trading locations (Hong Kong vs Mainland China) exacerbate the imperfect information linkages between H-share and A-share markets. Thus, the cross-listing of A-shares results in higher H-share transitory volatility though it is not associated with change in base level volatility.

Table 5 reports the ITSUR estimates and test results of the following model:

$$VAR_{it} = \gamma_{it} + \delta_{it} VAR_{it-1} + \lambda_{it} VOL_{it} + \eta_{it}$$
$$\gamma_{it} = \gamma_{i0} + D_{1t}\gamma_{i1} + D_{2t}\gamma_{i2}$$
$$\delta_{it} = \delta_{i0} + D_{1t}\delta_{i1} + D_{2t}\delta_{i2}$$
$$\lambda_{it} = \lambda_{i0} + D_{1t}\lambda_{i1} + D_{2t}\lambda_{i2}$$

where $VAR_t$is volatility estimate on day t, VOL_t is the standardized volume on day t, D_{1t} is a dummy variable taking the value of one if day t is in the period of fifteen trading days before the listing of share and zero otherwise, D_{2t} is a dummy variable taking the value 0 if day t is before the listing of share and 1 otherwise. The *t*-statistics are reported in parentheses and based on iterated seemingly unrelated regression (ITSUR) estimation. χ^2 is a Wald test of the restriction that the coefficients are jointly equal to zero. ** and *

denote significance at the 5% and 10% level respectively.

Table 5: Estimating changes in volatility and liquidity of H-shares around A-share listing

Stock	γ_0	δ_0	λ_0	γ_1	δ_1	λ_1	γ_2	δ_2	λ_2	R^2
Panel A: Intraday Volatility										
Beiren	0.066**	0.106	17.153	-0.019	-0.591*	54.557	-0.032	-0.027	50.348**	0.213
	(4.34)	(0.86)	(1.38)	(-0.72)	(-1.77)	(1.64)	(-1.64)	(-0.15)	(2.26)	
Yizheng	0.040**	0.376**	2.651	-0.017	0.099	-1.257	0.010	-0.438**	-1.236	0.194
	(2.97)	(2.91)	(1.12)	(-0.76)	(0.44)	(-0.30)	(0.58)	(-2.31)	(-0.47)	
Tianjin	0.044**	-0.015	7.561**	-0.025	0.165	14.326	-0.014	0.138	7.159	0.257
	(5.06)	(-0.13)	(4.33)	(-1.24)	(0.66)	(1.34)	(-1.22)	(0.80)	(1.62)	
DongFang	0.031**	0.131	64.988*	-0.002	-0.111	74.087	-0.002	0.168	2.629	0.124
	(2.17)	(0.70)	(1.87)	(-0.05)	(-0.26)	(0.64)	(-0.10)	(0.79)	(0.05)	
Louyang	0.043**	-0.146	11.656	-0.011	0.336	-5.877	-0.001	0.371*	23.497*	0.236
	(4.00)	(-0.81)	(1.34)	(-0.56)	(1.06)	(-0.14)	(-0.05)	(1.79)	(1.67)	
China East Air	0.093**	0.335**	6.657**	0.212	-0.409	-12.839	-0.031	-0.094	11.357	0.259
	(3.38)	(2.81)	(2.10)	(1.66)	(-1.60)	(-0.51)	(-0.75)	(-0.50)	(1.27)	
Angang	0.169**	0.208*	4.222	-0.026	-0.465	0.066	-0.092**	0.203	-2.269	0.268
	(4.44)	(1.68)	(1.09)	(-0.24)	(-0.73)	(0.01)	(-2.01)	(1.26)	(-0.56)	
Northeast Elec	0.010	0.284*	10.707	0.010	0.421	-60.644	0.010	-0.205	34.802**	0.246
	(1.42)	(1.69)	(1.60)	(0.78)	(1.22)	(-1.20)	(1.02)	(-1.06)	(3.24)	
Kelon	0.040**	0.274**	79.593**	-0.014	-0.304	162.435**	-0.009	-0.033	39.885	0.417
	(3.17)	(2.60)	(5.66)	(-0.53)	(-1.49)	(2.49)	(-0.53)	(-0.21)	(1.49)	
Xinhua	0.102**	-0.038	40.568	-0.047	-0.031	390.925*	0.017	-0.028	210.841**	0.353
	(3.86)	(-0.17)	(1.26)	(-1.04)	(-0.08)	(1.91)	(0.54)	(-0.12)	(4.02)	
Wald test: Coefficients across stocks are jointly equal to zero										
Individual	126.43**	29.07**	67.80**		7.74	11.86	18.18*	11.24	12.62	39.95**
γ_0 , δ_0 , λ_0		1938.30**								
γ_1 , λ_1						26.74				
γ_2 , λ_2									58.93**	
Stock		γ_0	δ_0	λ_0	γ_1	δ_1	λ_1	γ_2	δ_2	λ_2	R^2
Panel B: Daily Volatility										
Beiren		0.025**	0.190	5.399	0.003	-0.661*	8.680	-0.014	-0.240	33.507**	0.194
		(3.56)	(1.54)	(0.86)	(0.21)	(-1.87)	(0.53)	(-1.55)	(-1.32)	(2.95)	
Yizheng		0.013**	0.247**	1.647	0.001	0.229	-2.074	0.003	-0.268	-1.355	0.110
		(2.29)	(2.14)	(1.33)	(0.05)	(0.80)	(-0.95)	(0.46)	(-1.43)	(-0.98)	
Tianjin		0.014**	-0.059	2.738**	-0.010	-0.057	9.540*	-0.001	-0.005	0.177	0.184
		(3.59)	(-0.47)	(3.12)	(-1.23)	(-0.20)	(1.97)	(-0.27)	(-0.03)	(0.08)	
DongFang		0.015**	0.228	10.859	-0.001	0.372	-25.757	0.000	0.251	-13.072	0.173
		(2.51)	(1.53)	(0.66)	(-0.10)	(0.90)	(-0.47)	(0.05)	(1.36)	(-0.58)	
Louyang		0.016**	-0.037	6.192	0.003	0.057	-10.364	0.008	0.064	3.257	0.109
		(3.20)	(-0.21)	(1.37)	(0.26)	(0.17)	(-0.52)	(1.15)	(0.31)	(0.45)	
China East Air		0.031**	-0.346	5.479**	0.077	0.076	-4.614	-0.046**	0.035	19.512**	0.262
		(2.36)	(-1.36)	(2.56)	(0.99)	(0.18)	(-0.30)	(-2.21)	(0.13)	(3.56)	

Angang	0.060**	0.215	-1.046	-0.052	-0.429	4.716	-0.015	-0.192	1.912	0.040
	(2.24)	(0.95)	(-0.32)	(-0.93)	(-0.56)	(0.92)	(-0.48)	(-0.78)	(0.56)	
Northeast Elec	0.007*	0.131	1.242	0.014	-0.060	-10.259	0.000	0.356	6.748	0.194
	(1.79)	(0.60)	(0.33)	(1.34)	(-0.17)	(-0.39)	(0.01)	(1.51)	(1.11)	
Kelon	0.025**	-0.143	42.435**	-0.001	0.297	-30.429	-0.008	0.044	7.530	0.266
	(3.81)	(-1.10)	(4.72)	(-0.06)	(1.21)	(-0.68)	(-0.98)	(0.23)	(0.44)	
Xinhua	0.026**	-0.056	20.132	-0.001	-0.444	87.106	0.006	0.278	28.302	0.220
	(2.74)	(-0.25)	(1.15)	(-0.06)	(-0.95)	(0.76)	(0.48)	(1.16)	(1.01)	
Wald test: Coefficients across stocks are jointly equal to zero										
Individual	81.62**	13.76	45.13**	5.42	7.86	7.90	10.44	9.66	25.73**	
γ_0 , δ_0 , λ_0		650.76**								
γ_1 , λ_1					15.21					
γ_2 , λ_2								30.76*		

6 Conclusion

This study examines the impacts on volatility and liquidity of Chinese companies following cross-listing of shares under market segmentation. In China, domestic companies can issue A-shares, foreign B- or H-shares. A-shares are issued to domestic investors and B-shares and H-shares are issued to foreign investors to raise foreign capital. Past empirical evidence show that the impact of cross-listings in foreign markets on the volatility and liquidity of shares in domestic market depends the market transparency (or informational linkage between markets) and the effect of order flow migration from domestic market. If price information is freely available across markets, cross-listing enhances market quality with lower base volatility and greater liquidity. If market transparency or information linkages are poor between markets, cross-listing results in higher volatility and lower liquidity. Since A-share are completely segmented from B-share and H-share markets, cross-listing of foreign B-shares or H-shares (A-shares) should not result in order flow or traders migration from the domestic A-share market (foreign B-share and H-share markets). The market segmentation allows us to separate information effect from the order flow migration.

Our study uncovers the following major findings. Following the listing of foreign B-shares, existing A-shares experience a decrease in the base-level volatility and in liquidity. In contrast, cross-listing of domestic A-share neither affects the fundamental volatility nor the liquidity of foreign B-shares. Different from the effects on foreign B-shares, H-shares experience lower liquidity after listing of domestic A-shares. Overall, our analysis shows that the change in volatility is due to factors unrelated to trading volume, that, in fact, the change is the consequence of changes in information structure. Consequently, the impacts of cross-listing are not uniformly spread across different classes of investors and shareholders in the same company.

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