ESSAYS ON CROSS-LIST PRICE DISPARITY AND MARKET EFFICIENCY IN EMERGING MARKET

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ABSTRACT OF THE DISSERTATION

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This dissertation includes two essays on emerging market.

The first paper takes Chinese firms cross-listed in China mainland and Hong Kong as A-share and H-share between 1999 and 2013 as sample to look at the price disparity change and determination. This paper firstly finds that relative supply of stocks can explain up to 53% of the price disparity between A-share and H-share. The large supply of stocks in China mainland market can lead to narrow price disparity (low A-H price premium), and this factor can absorb the effects from other factors in previous literature, such as liquidity, speculation and political risks. This paper further tests several natural experiments of related policy changes that took place in China mainland in the sample period, namely IPO halts and stock reform, and confirms that real or expected stock supply change can significantly affect A-H price disparity.

The second paper uses the intraday data based efficiency measures such as Hasbrouck Price Error (1993), and CRS (2005) related measures to investigate the Chinese stock markets between 1999 and 2013, to examine price efficiency in China. The first finding is that it takes between 70 minutes and 200

minutes for Chinese listed stocks converge to price efficiency, and Hasbrouck Price Error measure (1993) shows that around 40% price change is not accounted to random walk, which indicates about 4 times poorer efficiency than that in US. There is not significant improvement in market efficiency during the sample period. This paper finds out that the firms with low state-owned share percentage and low concentrated shares have better price efficiency, which indicates low information asymmetry from firm share structure helps improve stock price efficiency. This paper further tests several related institutional changes, and finds that share ownership reform and allowance of margin trading make price efficiency better while opening market to foreign investors by QFII policy does not.

The findings in both papers in this dissertation offer important implications on asset pricing, corporate governance and policy making in emerging markets, especially those not fully open to worldwide and with high information asymmetry.

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1.1 Introduction

The global capital market has experienced accelerating cross-border capital flows over the past 30 years. Cross-listing is one of the important financing strategies for companies to going abroad. A lot of studies show that the benefits obtained from cross-listing usually outweigh the additional costs associated with the process, as firms that list shares on multiple exchanges gain access to capital sources abroad with lower costs of capital (Errunza and Miller (2000), Foerster and Karolyi (1999)) among other benefits. Theoretically, if international capital markets are perfectly integrated, cross-listed shares should have the same return and risk characteristics, as they share the same fundamental values, and thus the prices should not be affected by the trading location (Jorion and Schwartz (1986), Gultekin, Gultekin and Penati (1989)). However, in reality, restrictions on foreign ownership, information asymmetry between domestic and foreign investors, language and cultural differences, and other direct or indirect barriers lead to segmented markets.

The difference in prices between the A- and H-share prices, Chinese firms dual-listed in China mainland (as A-share)and Hong Kong (as H-share), becomes more and more important question recently, as China has experienced the fastest economic growth for years and the capital market developed accordingly, while Hong Kong is one of the traditional financial centers in Asia.

China mainland and Hong Kong share the same languages and cultures, and the exchanges have similar trading hours, besides that the two shares have same voting rights and dividend payments if they are issued by same company. Those characters control familiarity bias, culture difference, language difference, and information flow lag in the previous cross-listing literature (Coval and Moskowitz (1999), Grinblatt and Keloharju (2001), Wang and zhou (2014)). If the A-shares and the H-shares are issued by a same firm, then they have same fundamental information and thus they should have same prices according to cash flow pricing method. However, the two markets are segmented and only open to different groups of investors by institutional barriers in China, as individual foreigners are not allowed to purchase A-shares directly, and Chinese citizens can hardly invest in Hong Kong directly because of capital constraints. Foreign investors can only access the A-share market under the Qualified Foreign Institutional Investor program (QFII), which allows approved foreign institutional investors to access the A-share market under quotas system. The program starts from 2002, and the quota gradually increase to around 5% of market value of A-share market recently. Similarly, investors in the mainland are not allowed to invest abroad except the Qualified Domestic Institutional Investor (QDII) program, which allows Chinese institutions and residents to entrust certain Chinese commercial banks or mutual funds to invest on financial products overseas under quota system too. Since the quota is quite limited, the two markets are almost segmented.

There are several established explanations for why a price difference exists between domestic and foreign stock markets, including differences in

liquidity conditions (Chan and Kwok (2005)), different risk premiums due to the segmentation between the two markets (Hietala (1989), Bailey (1994) and Fernald and Rogers (2002)), different investment opportunities (Domowitz, Glen and Madhavan (1997) and Sun and Tong (2000)), different information sets (Chakravarty, Sarkar and Wu (1998) and Cai, McGuinness and Zhang (2011)) and different market conditions (Ma (1996), Chakravarty, Sarkar and Wu (1998) and Wang and Jiang (2004), Fong, Wong and Yong (2010) and Arquette, Brown and Burdekin (2008)). However, no consensus has reached, only liquidity could be the most popular factor to explain cross-list price disparities.

It is quite surprising that the basic economic factors to determine price, supply and demand, are not the focus of the studies. Even through China is the second largest economy around the world, and the largest emerging market, as a socialism country, it has a unique institutional environment that differs from other economies. To keep state control of the firm, most listed firms initially are only partially privatized and ownership is often highly concentrated in the hands of a single investor associated with the central or local government, or state-owned enterprise (SOE), which are not tradable, which leads to about two third of shares were not tradable until the share ownership reform between 2005 and 2006. On the other hand, Chinese citizens can hardly to invest in the other countries, because China government has strict capital restriction on capital outflow from citizens to overseas. Given that current situations of Chinese financial markets offer citizens quite limited investment opportunities, which is largely different from financial markets in developed areas including Hong Kong,

the supply and demand factors should play an important role in explaining stock price disparities between on Chinese market and on other markets. Karolyi and Li (2003) and Karolyi, Li and Liao (2009) study the deregulation of B-share market in China which is solely open to foreign investors until 2001, and open to Chinese citizens afterward. The new coming group of investors increases the demand of the stocks and the B-share price discount to A-share shrinks significantly.

This paper takes a close look at the effects of the share supply on the A-H share price, and thus offers two contributions to the previous literature. Firstly, the study extends previous investigations into the determinants of A-H share discounts by explicitly examining the role of supply of stocks, and confirms share supply affects price disparity. The second contribution of this paper is that it explicitly tests IPO roles on the secondary market in term of supply of stocks. To the best of my knowledge, this is the first paper to consider IPO effects on the disparity of the stock prices not only in Chinese market but also in cross-listing literature, which offers policy implication for government, firms and investors.

The next section provides a brief description of Institutional background of A- and H-shares. Section 3 describes Literature, Background and Hypothesis Development. Section 4 describes the data in the paper. Section 5 and section6 are the estimation method introduction and test results. Section 7 offers some additional question for robustness check. Section 8 concludes.

1.2 Related Institutional background of A- and H-shares

The two share types in this paper are A-shares listed in Shanghai stock exchange or Shenzhen stock exchange, and H-shares as listed on Hong Kong Exchanges and Clearing Limited's board. For a given dual-listed Chinese company, the tradable and non-tradable shares' nominal values (customarily set at RMB1.00), exchange-adjusted dividend entitlements, voting rights and capitalization benefits all rank equally for both A-shares and H-shares. However, the tradable A-shareholders are separate and distinguishable from H-shareholders, because of China's capital account constraint which, prevents Chinese investors to directly invest overseas. On the other hand, international investors, including those from Hong Kong, can trade H-shares, but can only enter the A-share market through a highly restrictive Qualified Foreign Institutional Investor (QFII) scheme. Within this context, direct exchange of A- and H-shares is not permissible. The firms listing on the Chinese mainland must also be of Chinese legal origin and therefore conform to PRC securities' and companies' laws. The H-label alerts investors to the distinct regulatory protocols imposed on such firms and the CSRC must approve an issuer for potential H listing. The separate listing provisions also apply. Then the differential trading right issue has promoted a valuation gap in the shares pricing, with A-shares generally at a premium to corresponding H-prices (Birtch and McGuinness (2008), Arquette Brown and Burdekin (2008)).

Besides A-share and H-share, Chinese firms can issue a third tradable stock type, the B-share. The B-market was established in the early 1990s to

allow foreign investors access to Chinese SOE companies' stock listed in Shanghai stock exchange or Shenzhen stock exchange. The B-shares are denominated in US Dollars in Shanghai stock exchange or Hong Kong Dollars in Shenzhen stock exchange. Until 2001, the Chinese regulatory authorities prohibited domestic investors from transacting B-shares. The restriction was removed in February 2001, and then the B-share market is open to both domestic and foreign investor. Although both B-share and H-share are designed for foreign investors, the two markets are different in several aspects. Firstly, the B-share market was established along with the A-share market in the early 1990s, and it is regulated and operated by CSRC, but the Hong Kong market is totally independent from the Chinese government. Secondly, the B-share market is small with only 114 shares thinly traded, while around 1,500 firms are listed on the Hong Kong Security Exchange, and among them half are from China, contributing to 56.6% of the capitalization of the market. Finally, since February 19, 2001 Chinese domestic investors have been able to trade B-shares as well, although the A- and B-shares of the same firm are still not interchangeable, while the access to H-shares are still quite limited for Chinese domestic investors.

In reality, the B-market is of less importance for the Chinese investors than the A- and H-share markets due to limited market size and liquidity. Moreover, the last B-share IPO goes back to 1998, which means there is no new stock supply for more than 10 years, so the function of B-share market is not complete. So this paper focuses on the A- and H-share price disparity. The

detailed statistic of the magnitude of A-H share price disparity change is in the next section.

1.3 Literature, Background and Hypothesis Development

Despite the H-share market being considerably more liquid and more important as a source of capital funding than the B-market, empirical analyses of cross listing in Chinese markets put most focus on A- and B-issuers. The literature starts from Bailey (1994) who looks at the brief history of Chinese stock markets since they established B-share for foreign investors and points out discounts of B-shares trade to A-shares are correlated across firms and related to similar premiums in other Asian markets. The papers after that include Chakravarty, Sarkar and Wu (1998), Sun and Tong (2000), Chen, Lee and Rui (2001), Zhang and Zhao (2004), Chan, Menkveld and Yang (2008) and Chen, Chong, Lu and Wang (2008) among others. Chakravarty, Sarkar and Wu (1998) shows B-share discount is related to the variance of B-returns and media coverage. Sun and Tong (2000) note a widening B-discount with the listing of H- and Red-Chip stocks. Chen, Lee and Rui (2001) point to a greater focus on fundamentals and the presence of trading costs, such as illiquidity, as drivers behind the price disparity, and further it is A-share premium rather than B-share discounts as B-share price is closer to the fundamental value. Zhang and Zhao (2004) and Karolyi, Li and Liao (2009) find that B-discounts correlate with China's overall political risk level, in term of percentage of SOE. Chan, Menkveld and Yang (2008) construct measures of information asymmetry based on market

structure models for A- and B-share prices between 2000 and 2001 and demonstrate that information asymmetry can explain about 40% of B-share price discount. Ahlgren, Sjo and Zhang (2009) document a rising co-integration relation between A- and B-share prices, especially after 2001. Fernald and Rogers (2002) attribute low Chinese expected returns to the limited alternative investments available in China, and argue that the generally higher level and volatility of domestic share prices is consistent with the simplest asset pricing model, and then they find that foreigners pay a lower relative price for companies with a higher proportion owned by the state after controlling various company characteristics.

As more and more Chinese firm listed in both A-share market and H-share market, there are some papers studying the price difference between A- and H-shares. Arquette, Brown and Burdekin (2008) examine the behavior of H-share discounts for 30 cross-listing firms, and 11 of them also had ADR listings in US during the sample period. Their findings indicate a steep fall in both H- and ADR discounts, especially from early 2000 to mid-2005. The authors account the shrinking discount to a firming in expectations of Renminbi (RMB) exchange rate appreciation and overall market sentiment effects. Burdekin and Redfern (2009) use various proxies for market sentiment to examine how such effects correlate with B-, H- and ADR price discounts over the recent 2003–2007 period. Cai, McGuinness and Zhang (2011) use a combination of macro factor, such as liberalization of China’s capital account, and micro factors as market sentiment and transaction costs to explain the co-integration relationship between the two

markets' prices. Their results show that public policy, particularly capital account and exchange rate management reforms, and corporate governance initiatives have most efficiency gains in the pricing of A- and H-shares. Chang, Luo and Ren (2013) develop a model to incorporate the beneficial informational role and the possible harmful anchoring role by the reference price. Their empirical investigation utilizes the IPO data of cross-listed Chinese firms, and finds that market participants fail to fully adjust for the difference in costs of capital between the A-share and H-share markets due to the anchoring bias. Their study provides another way to understand the influence of market segmentation on the pricing of cross-listed shares. Fang and Jiang (2013) study the effects of short-sale constraints and differences of opinions, which proxies by idiosyncratic return volatility and monthly turnover rate, on the price premium of dual listed Chinese A-H shares. The analysis mainly follows the Miller's model, and finds that dual listed Chinese A-shares with high level of differences of opinions and short-sale constraints tend to be overvalued.

Following the previous cross-listing literature and considering the capital market conditions in China, the hypothesis in paper are developed below.

Even through China is fast growing economy, the second largest economy around the world and the largest emerging market, but unlike many other developed markets, historically, equity ownership in a listed Chinese firm can have as many as five different classes: state-owned shares, legal-person shares, employee shares, tradable A-shares, and shares only available to foreign investors such as B-shares and H-shares. There is only less than one third of

shares were tradable before the share ownership reform between 2005 and 2006, and the others are non-tradable shares held by investors associated with the central or local government, or state-owned enterprise (SOE) to keep state control of the firm. The other types of financial markets, such as bond market, future market, are even younger and underdeveloped compared with equity market. What's more, as Chinese securities market is far from liberalized, Chinese citizens can hardly to invest in the other countries because of the tight control on inward and outward capital accounts. Given huge increase in capital from fast economy development meets limited investment resources, stock supply and demand become imbalanced. Chang, Luo and Ren (2013) proposes that the excessive demand for securities relative to the limited supply in the Chinese stock market pushes domestic Chinese investors to require relatively lower returns on A-share investments. Following this idea, one of the central hypotheses is:

Supply Hypothesis (Central hypothesis 1)

> *There is a negative relation between relative stock supply between A-share and H- share and the A-H price premium.*

In most developed markets, for example in US and Japan, IPO mechanism is registration-based, under which firms can be listed as long as they meet specific legal and financial requirements. In contrast, IPO in China are timed by Chinese regulators, such as China Securities Regulatory Commission (CSRC), as administration-based IPO system is applied. In the current

administration approval mechanism, the listing process in China can include about 10 rounds of reviews lasting several years before an IPO candidate receives approval from the securities regulator, so the firms aren't free to list at will. The extreme cases to show the difference in the systems is CSRS halted IPO for eight times since the stock markets established. The recent halt is the longest one which from November 3, 2012 to January 2014, lasting 15 months. The sample covers 5 events among the 8 halts.

Newly issued stocks are the supply to secondary market through IPOs, so when IPO is paused by regulators, there is no new supply available in the market, and relative excess demand would drive price high. H-share are listed on Hong Kong stock exchange and not regulated by CSRS, so based on the different IPO mechanism, the hypothesis is:

IPO halts Hypothesis (Central hypothesis 2)

> *A-H premium is higher during the period when IPOs are halted than the normal period.*

The other related event is stock ownership reform between 2005 and 2006. The whole process of the reform is summarized below. As described in the first part, Chinese stock market before the stock reform in 2005 had a split share structure where around 70% of listed firms' outstanding shares were non-tradable, because when Chinese Stock Markets were initially set up to help state owned enterprises to raise capital without lose control of the firm. The Chinese government tried to deal with the problem of split share structure in 1999 and

2001, but failed[1]. The 2005 reform adopted the new strategy of forcing non-tradable share holders to pay compensation to tradable share holders in exchange for the right to sell their shares. In each firm, the non-tradable share holders can negotiate with the tradable share holders to figure out specific plan for compensation[2]. To dilute any possible stock overhang from massive sale of shares from non-tradable share holders, they could only trade limited shares gradually according to the lockup period. To be specific, there is a twelve-month lockup period for the holders of non-tradable share in order to reduce the impact of a possible stock overhang due to a massive future sale of shares. In the two years after expiration of the lock-up, non-tradable share holders owning more than 5% of the listed companies were further prohibited from trading on the stock exchange more than 5% (10%) of the company's total share capital within 12 (24) months. By the end of 2006, and thus within the announced deadline, the restructuring process was virtually completed, the reform represented over 97% of total Chinese A-share market capitalization.

No matter what type of compensation or how lock-up periods arrange, the final result of the reform is huge increase in free float A-shares in the following

[1] In the first attempt, two companies were selected to sell their state shares to the floating shareholders. The experiment did not meet the investors' expectations and within 15 days from the announcement of the transfer program the share price of the two companies had fallen by about 40%. The second attempt failed in 2001 because the proposal envisaged an equal pricing for tradable and non-tradable shares.

[2] The specific procedures of the reform follows the steps: 1. each company had to make a compensation proposal that would be discussed among shareholders during a period of trading suspension; 2. the proposal would then be publicly announced, but not implemented, and trading in the shares restarted. After a few weeks, a shareholders' meeting would be called and the compensation proposal would pass only if approved by a majority of two thirds of the votes of TS holders; 3. Trading restarted and the compensation are paid out after the final vote.

one to three years, which is similar to IPO lock-up period cases. Field and Hanka (2002) and Ofek and Richardson (2000) find the negative stock returns at and after IPO lock-up expiration. Compared with IPO investors, the most of non-tradable share holders are related to the firms as state share owners or legal share owners, and their costs to getting the shares are extremely low, and after receiving dividends for years, the effective costs may even below 0, so they have even stronger motivation than the normal IPO shareholders. When the previous non-tradable share holders were able to sell the stocks after lock-up period, the excess supply would lower stock price. As the non-tradable shares can only transform to A-share, but not to H-share, the reform only affected A-share market but not H-share market, so such asymmetric increase in stock supply could affect stock price premium. The expectation of the final results would be realized in the market right after the reform plan was finally determined and publicly announced. The related hypothesis should be:

Stock reform hypothesis (Central hypothesis 3)

> *A-H share premium decreases for the stocks after the reform plan is announced.*

Based on the previous literature, some expectation can be drawn on the control variables in the paper. The first kind of control variables are on share structure. Demsetz (1968) points out, when firm ownership is concentrated, the limited free float shares lead to fewer trades and thus a fall in liquidity. Since the H-shareholders are the foreign investors, who have more alternative investment

opportunities and thus make more rational decisions, they would give lower price to the firms with poor liquidity. The first two hypotheses are:

Free Float Hypothesis (control variable 1)

There is a negative relationship between the proportion of free float percentage and the A-H price premium.

Concentration Hypothesis (control variable 2)

There is a positive relationship between share concentration and the A-H price premium.

State-Owned shares (SOE) are highly concentrated ownership in China. Besides that, SOEs are characterized by lower governance transparency and by less effective corporate governance mechanisms (Shleifer and Vishny (1997), La Porta, Silanes and Shleifer (1999), Johnson, La Porta, Silanies and Shleifer (2000)) and lower financial transparency (Bushman and Theodore (2004), Wang, Wong and Xia (2008), Chaney, Faccio, Parsley (2011)), which may also create information asymmetries between domestic and foreign investors. Karolyi, Li and Liao (2009) consider SOE as political risk in China. Qi, Wu and Zhang (2000) find that firm performance is positively related to the proportion of legal person shares but negatively related to the proportion of shares owned by the state as the result of corporate governance. Since the H-shareholders are the more rational investors, they would give lower price to the firms with lower financial

transparency, poor corporate governance and more political risks. The hypothesis about proportion of SOE could be below:

SOE Hypothesis (control variable 3)

> *There is a positive relationship between the proportion of state-owned share percentage (SOE) and the A-H price premium.*

The second kind of control variables are market variables. Besides the unique institutional settings in China, the Chinese securities market is still underdeveloped, and most of the investors in China are individual investors, and thus are relatively unsophisticated compared with the investors in Hong Kong market. Mei, Scheinkman and Xiong (2005) use A- and B- share to examine the theories about speculative trading, and find that trading caused by investors' speculative motive can help explain a significant fraction of the price difference between the dual-class shares. To be specific, they find that A-share turnover is positive correlated with the A-B share disparity in the period of 1993-2000, and explains about 20% of the premium. The condition that A-shares open Chinese citizen and H-shares open to foreign investors is quite similar to the A and B share case in their paper, so the related hypothesis should be:

Speculation Hypothesis (control variable 4)

> *There is a positive relationship between the relative turnover rate of A-share to H-share and the A-H price disparity.*

The other kind of control is related with change of investors. As mentioned in the first part, capital markets in Chinese mainland and Hong Kong are segmented because of the restrictions by Chinese government. However, the barriers are loosened little by little through Qualified Foreign Institutional Investors policy (QFII) and Qualified Domestic Institutional Investor (QDII) programs. The qualified foreign institutional investor (QFII) program permits overseas institutional investors to buy A-shares by allowing stock market quota approved by CSRC. A-share market gradually opened to foreign institutions by increases in quota more than 10 times from 2003. The last increase was in April 2012, and the quota is up to 150 billion USD, representing about 5% in total market value of A-share market. Participation of foreign investors may improve information environment by increasing competition amongst informed investors, and thus stock prices incorporate information more efficiently (Subrahmanyam (1991), Holden and Subrahmanyam (1992) and Spiegel and Subrahmanyam (1992), Stoll (2000), Back, Cao and Willard (2000)). Stulz (1999) also argues that liquidity in local financial market is likely to improve as a result of better information disclosure and higher trading activity by international financial institutions, and then as better and more relevant information is reflected in prices. Given the belief that A-share market may be overpriced due to limited supply of investment opportunities and over-speculation, foreign investors suppose to make the A-share less overpriced. To test the effect of QFII program, the hypothesis is

QFII Hypothesis (control variable 5)

Foreign institutional investors' participation (by QFII program) lowers A-H share premium.

On April 13, 2006, the Chinese government announced the Qualified Domestic Institutional Investor (QDII) scheme, allowing Chinese institutions and residents to entrust certain Chinese commercial banks and mutual funds to invest on financial products overseas. On May 11, 2007, Chinese government announced an expansion for QDII investment scope, under which banks can now offer stock-related products under certain restrictions. By the end of February 2012, the total quota of QDII has grown to 75.2 billion U.S. dollar, which is greater than the approved capital amount of QFII.

QDII mitigates the investment barriers between the Chinese domestic market and the foreign market to some extent, so it alleviates the shortage of investment opportunities for Chinese investors. Hence, the A-share price should move towards H-share. The hypothesis about this policy is:

QDII Hypothesis (control variable 6)

Foreign investment opportunities (by QFII program) lower A-H share premium.

The fourth kind of control is related with allowance of margin trading in A-share market from 2010. China government lifted partially bans of short sell and margin buy on March 31, 2010, by allowing 90 qualified stocks on a designated list to be sold short and purchased on margin. This list was revised twice in 2010, and was then expanded to include 280 constituent stocks and 7 exchange-traded

funds in December 2011, and the most recent expand occurred in 2013 is allowing 300 stocks in Shanghai stock exchange and Shenzhen stock exchange to be short sold or bought on margin.

Diamond and Verrecchia (1987) suggest short sellers are rational informed traders, so their trading promotes efficiency by moving mispriced securities closer to their fundamentals. In other models, short sellers are found to use manipulative and predatory trading strategies to maximize their profits, and then result in less informative prices (Goldstein and Guembel (2008). Most empirical studies about US market suggest that short sellers are informed traders. Using either monthly short interest data (Asquith and Meulbroek (1995), Dechow, Hutton, Meulbroek and Sloan (2001), Desai, Ramesh, Thiagarajan and Blachandran (2002), Asquith, Pathak, and Ritter (2005)) or shorting flow data (Christophe, Ferri, and Angel (2004), Boehmer, Jones, and Zhang (2008), Diether, Lee, and Werner (2008), Boethmer and Wu (2013)), the results from previous literature show that short sellers have value-relevant information and that their trading helps correct overvaluation. Chang, Luo and Ren (2013) study lift of short selling bans in China, finding that stocks experience negative returns when added to the list and that Short-sellers trade to eliminate overpricing by selling stocks with higher contemporaneous returns following a downward trend. On the other side, buying on margin provides investors money to buy the underpriced stocks, and thus to correct underpricing, which tends to increase A-share price. Since the H shares in the sample are free to margin trade or short

sell in Hong Kong, the policy change only A-share price and thus the A-H price premium, and the related hypothesis is:

Short selling Hypothesis (control variable 7)

> *Allowance of short selling in A-share market decreases A-H share premium.*

Margin trading Hypothesis (control variable 8)

> *Allowance of buying on margin in A-share market increases A-H share premium.*

1.4 Data

In this paper, the sample includes all the firms having both A-share and H-share at the same time. The sample period spans from 1999 to 2013, and for each firm, the firm specific period starts on the listing date of either the A- or H-shares of each firm, whichever was later. The market data, including daily prices, dividend payments, trading volume of both A- and H-shares, are from GTA Information Technology Company, Data stream and Bloomberg. The share ownership data, including total shares, state-owned shares, free float shares, top 1, top 3 and top 10 share holdings, are also from GTA dataset. The margin data are from Shanghai and Shenzhen stock exchanges. The QFII and QDII quota data are from the Chinese State Administration of Foreign Exchange. The A-H

share price premium is foreign exchange rate adjusted, defined as

$\rho_{it} = \frac{P_{it}^{A} - P_{it}^{H} X_{t}}{P_{it}^{A}}$, where X_t is the exchange rate between Chinese RMB and the Hong Kong dollar, P_{it}^{A} is the daily closing price of A-share of firm i, and P_{it}^{H} is the daily closing price of H-share of firm i. Both the A- and H-shares holders receive the same amount of dividends denominated in RMB at the same time, so the prices have already reflected the dividend effect. The A-H share price premium is the focus variable in this paper, and it is daily variable.

(Figure 1.1)

Figure 1.1 plots the A-H price disparity level through years. From the price disparity definition, it is easy to interpret that the positive measure indicates A-share price is higher than H-share price for the same firm, while negative is H-share price is higher. The measure of 1 means A-share price is twice as H- share price, and of 0 means A-share and H-share have same foreign exchange adjusted price. The graph shows that A-share price is consistently higher than H-share price on simple average, and this is the reason the A-H price disparity can also called price premium. The curve starts from nearly 1, which means A-share price was almost twice as H-share price, going down to close to 0. The overall downward trend indicates A-H price disparity is becoming narrow and closer. This paper will look at the price disparity on firm level and explore the reasons.

The variable related to the main hypothesis is the rate of A-share percentage to H-share percentage (AtoH), which is annual frequency variable. The other control variables to test in this paper include daily frequency variables

and annual frequency variables. The daily frequency variables are daily turnover rates of A-shares and H-shares (turnover_A, turnover_H and AtoH_turn), QFII quota and QDII quota (QFII and QDII), daily borrowed money balance and stock balance (money_bal and stock_bal), and annual frequency variables are state owned share percentage (SOE), free float share percentage (float), A-share percentage and H-share percentage (A_share and H_share) , QFII quota and QDII quota (QFII_quota_annual and QDII_quota_annual). There are several variables related with share concentration in the dataset, including Top 1 (Top1) and Top3 (Top3) shareholdings, Herfindahl index 1 (H1), Herfindahl index 3 (H3), Herfindahl index 5 (H5), Herfindahl index 10 (H10). Expecting the highly correlation among the measures, this paper uses principal component analysis to construct a new measure to capture the main component of all the related variables. The new measure is called concentration (concentration) in this paper, and constructed as

$$Concentration = 0.176*Top1 + 0.146*Top3 + 0.177*H1 + 0.18*H3 + 0.18*H5 + 0.18*H10$$

Table 1.1 is the statistic description of the variables. Panel A is the detailed statistics of A-H share price disparity year by year. A-H share piece disparity deceases gradually on average, indicating the prices are getting closer. Panel B is the statistics about all the variables introduced above. A-H share piece disparity is 0.44 on average, which means the A-share price is about 44% higher than H share price. Panel C is the correlation of the variables.

(Table 1.1)

1.5 Estimation methods

1.5.1 multivariate regressions

This paper first uses multivariate regression. The regressions don't consider effects on A-H premium of the two directly related events, IPO halts and stock reform, but the general effects of the factors. It means that, in this part, the regression is simply run with the whole sample period, which is between 1999 and 2013, and with all the firms having both A-shares and H-shares listed. The structure of the sample data is that there are 14 years in total and hundreds of firms in each year. As the sample contains more than 10 years and the firms may be vary in many aspects, two-way fixed effect with firm-by-year control is best method to capture the roles of explanatory variables, because any omitted firm-wide factors in a given year are controlled in this method, which are excluded from drivers of the results. The regression model is below, and the firm fixed effects are absorbed through first differencing when analyzing.

$$Premium_{it} = \gamma_0 + \gamma_1 * AtoH\_perc_{it} + \gamma_2 * A\_percent_{it} + \gamma_3 * H\_percent_{it} + \gamma_4 * SOE\_perc_{it} + \gamma_5 * float\_percent_{it} + \gamma_6 * concertation_{it} + \gamma_7 * logturn\_A_{it} + \gamma_8 * logturn\_H_{it} + \gamma_9 * AtoH\_turn_{it} + \gamma_{10} * QFII\_quota\_annual_{it} + \gamma_{11} * QDII\_quota\_annual_{it} + \gamma_{12} * money\_bal_{it} + \gamma_{13} * stock\_bal_{it} + v_{it}$$

$$v_{it} = u_i + w_t + e_{it} \qquad i = 1, \dots, N, \qquad t = 1, \dots, T$$

The subscript i denotes firm and t denotes year. The dependent variable is A-H price premium, which is annualized by average in every year for each firm. Similarly, all the daily variables, including *logturn_A, logturn_H, Aturn_to_Hturn, money_bal and stock_bal*, are annualized in the same measure, so the data structure is firm-year panel data.

Based on the hypothesis in part 3, the central hypothesis of supply indicates γ_1 should be negative. The hypothesis about share structure variables of free float percentage, concentration and SOE mean γ_4, γ_5, γ_6 are positive, negative and positive respectively. The speculation hypothesis indicates γ_7, γ_8, γ_9 are positive, negative and positive respectively. Opening market and margin trading should lower the premium, so γ_{10}, γ_{11}, γ_{12}, γ_{13} should be negative.

1.5.2 Event study

The second experiment in this paper is using event study to test two events directly affecting the stock supply on the A-share market. The events are IPO halts and stock reform. The IPO halts hypothesis predicts A-H premium is higher during the period when IPOs are halted than the normal period. To compare halt period and normal period, there are two event dates, which are the halt starts and halt ends. According to the hypothesis, the premium should increase after every halt starts and decrease after every halt ends. To capture the whole picture around the events and make the results convincing, this paper tests several event windows: 5 days, 10 days, 15 days, 30 days, 45 days, 60 days, 90 days and 250 days. Each event window is symmetric around the event dates, including the number of trading days before and after the event but not the event day. The various event windows can control the short-term and mid-term firm characteristics. The comparable measure is the average premium for each firm during the sample period. The criterion is the significance of premium difference between before and after the event.

The event study of stock reform follows the same idea of tests of IPO halts, but the event day is the day when the reform plan is officially announced and the stock restarts to trade. Since every firm has its own stock reform procedure, the event day for each firm varies. The event windows for each firm are same as in IPO halts, which are 5 days, 10 days, 15 days, 30 days, 45 days, 60 days, 90 days and 250 days before and after the event day but not including event day.

1.6 Results

1.6.1 General results

Table 1.2reports the results of testing first central hypothesis together with control variable hypothesis. The two-way fixed effect regression contains all the observations in the paper, which are all the firms having both A-shares and H-shares listed between 1999 and 2013, but not considers IPO halts and stock reform. The dependent variable is the A-H price premium, and explanatory variables include the central variable, ratio of A-share percentage to H-share percentage (AtoH), and all the other control variables which are state owned share percentage (SOE), free float share percentage (float), A-share percentage and H-share percentage (A_share and H_share), share concentration (concentration), QFII quota and QDII quota (QFII and QDII), turnover rates of A-shares and H-shares (logturn_A, logturn_H and AtoH_turn), borrowed money balance and stock balance (money_bal and stock_bal). All the variables are firm-annual variables. The table contains a series of univariate and then one multivariate specification with coefficient estimates, associated t-statistics and the R-square.

(Table 1.2)

Relative share supply (AtoH) is the only firm characteristic that consistently significantly affects the A-H price disparity at 99% confidence in both

univariate and multivariate regressions even controlling the important variables in the previous literature, which strongly support the central hypothesis that sufficient supply of A-share tends to lower the A-H price premium. There are several control variables that have also significantly effects. Free float percentage (float_perc) is significant, but not at 99% confidence level and the negative sign is consistent with the prediction. Speculation also plays a significant role. Relative turnover rate of A-share to H-share (AtoH_turn) is strongly positive, as turnover, representing speculation, pushes stock price high, which is consistent with Mei, Scheinkman and Xiong (2005) exam on A-B share price disparity. The univariate regressions test A-share turnover and H-share turnover separately, and find out surprisingly that speculation in H-share market is the real factor. State-owned share percentage (SOE) is positive in univariate regression, but negative in multivariate one, so the effect is not as strong as Karolyi, Li and Liao (2009). The reason may be their paper just focus on two month in 2001, but in long term as in this paper, the factor is not significant. Opening markets factor, QFII quota and QDII quota (QFII and QDII), are significantly negative in univariate regressions, but not consistent in multivariate regression. This means the open-up policies may help to make price disparity smaller, but the effective as supply and speculation. Share concentration (concentration) and margin trading (money_bal and stock_bal) are not significant or consistent, so they have little effect on the price disparity.

1.6.2 Event study results

The effects of the policies that directly or expectedly change stock supply, which are IPO halts and stock reform are studied in this part. To study the effect of policies, the sample period are divided into before and after the event by the event date, and the results are the comparisons between the two. The sample covers all the A-H pair of stocks affected by the policies. The event windows in each table include 5 days, 10 days, 15 days, 30 days, 45 days, 60 days, 90 days and 250 days before and after the events. The table reports average premium across the firms before and after the event dates (before and after), average of the difference between before and after the events of the firm (Diff), and associated t-statistics (t).

(Table 1.3)

Tables 3 panel A to panel E are the results of event studies on the A-H price premium change around 5 times of IPO halt starts. The event dates are July 31, 2001, August 26, 2004, May 25th 2004, December 6, 2008 and November 3, 2012. The averages of the premiums increase after IPOs are paused by government, in most of the event windows if not all the windows, as predicted. Panel A shows the 5-day average of A-H premium increases from 0.836 to 0.849 after IPO first pause, and t-statistics (8.33) indicates the increase is quite significant. The other event windows exhibits same increasing results, which confirms the first IPO halt lead higher A-H share price premium. The other panels also show the similar pattern in the other IPO halt starts. The A-share

premium generally decreases through time, but the trend is not monotonous. The premiums around the fourth IPO halts in 2009 are less than the ones around the third IPO halts in 2005 and 2006. However, a close scrutiny around the events still finds the premiums significantly increase around the events, no matter of market condition and effects of other factors, which clearly supports the hypothesis that IPO halts larger A-H price disparity. Table 1.4 is the results of other side of IPO halts: when IPOs restart after pause. When IPOs resume, the share supply becomes normal, and A-H price premium should be lower back. Panel A to panel D are the results of event studies around IPOs restart after the period of the halts. There are 4 events instead of 5 as in table 1.3, because the last IPO halt ends in January 2014, but the sample period covers only to the end of 2013. The results support this expectation: the averages of the premiums significantly decrease after IPOs resume, in most of the event windows. Combining the separate event studies on IPOs pause and resume, it is safe to conclude that A-H premium is higher during the period when IPOs are halted than the normal period, as predicted in part 3.

(Table 1.4)

The same study method is applied when it comes to stock reform. The event date for each firm is selected as the day when trading restarts after the final plan is announced and the compensation to tradable shareholders are paid out. Different firms have their own schedule of stock reform, so the event days for each firm varies, which is different from the studies on IPO halts in which all the firms share the same event dates. The event dates of stock reform span from

2005 to 2010, but more than 90% of the firms have announced the reform plan and finished compensation by the end of 2006. During the negotiation periods before, the shareholders may have different expectations on the compensation plan besides increase in float shares at the end, so expectation on share supply increase is contaminated. The period after reform plan determined and compensation paid out, as used in this paper, is much cleaner than negotiation period, because only expectation on free float share increase in one or two years is left. Table 1.5 describes A-H price premium change around stock reform event days. The averages of the premiums significantly decrease after stock reform in all the windows, and the significant difference indicates that expectation on free float share increase can also drags down the premium as predicted.

(Table 1.5)

Plotting the average A-H price premium in various windows around the event dates can offering more direct impressions about the premium change due to the events. Figure 2.1 to Figure 2.5 are the five plots of premiums around IPO starts. Figure 3.1 to figure 3.4 are around IPO ends. Figure 4 is the around stock reform. No matter how the trends change in long term, the premium changes support the hypothesis around the events. The graphs give out the most straightforward evidence of effect of stock supply on A-H price disparity.

(Figure 1.2)

(Figure 1.3)

Some caution needs to be exercised in interpreting the results of the event studies. Event study assumes that the event is reflected in stock prices, and focus on how asset prices respond to information released during a public announcement of the event. However, Bhattacharya, Daouk, Jorgenson, and Kehr (2000) summarize four scenarios in which stock prices may not reflect news. One of them is that even a stock market is efficient, and the news is value-relevant, the news could be partially or even completely anticipated, which also called information leakage. The empirical studies confirm huge information leakage in emerging markets. Huberman and Schwert (1985) document that about 85 percent of the Israeli indexed bond price reaction occurs from 2 to 5 weeks before the inflation announcement, and remaining 15 percent is reflected during 2 weeks after the announcement, which means 85% the news contained in CPI announcement had been anticipated. Similarly, Bhattacharya, Daouk, Jorgenson, and Kehr (2000) find that in Mexican Stock Exchange, corporate news announcements don't have any significant effects on stock returns, volatility and trading volumes, because insider trading causes prices to fully incorporate the information before its public release. Chinese stock market experiences similar situation. Miller, Li, Eden and Hitt (2008) state that because Chinese stock market is relatively new, under-regulated, and segmented from outside, test results suggest significant existence of information leakages where informed traders engaged in transactions based on non-public information due to weak regulatory environments. The figures around the events in this paper also indicate information leakage. In most of the events, the A-H share price premium

significantly changes in predicted direction before the event days, as long as more than 50 days. Considering such information leakage, the changes around the event days in various windows still reflect the policy effects, and they reinforce the proposed hypotheses in the paper.

1.7 Robustness

1.7.1 IPO halts timing

IPO halts serve as important event studies to support the effect of stock supply on A-H share price disparity. Securities regulators in China mainland have controlled the flow of IPOs, and tend to speed approval of new listings when market conditions are hot, as in normal IPO cycle. However, in the market with limited investment opportunities and over-speculation at same time, as in Chinese A-share market, this control measure often results in frenzied buying and high prices, and thus speculation effect may over the supply effect. Conversely, they tend to restrict IPO supply when investor sentiment is low to support stock prices. Then it is normal to think the market condition of A-share could be factor to influence IPO halts, which lead to endogenous relationship between IPO halts and A-share price and thus A-H price disparity. According to the media report, the reasons of the IPO halts are listed in table 1.6. Only the fourth IPO halts in this paper related to the market condition. Figure 5 also plots the market performs during the sample period. It is obvious that only the fourth IPO halt occurred when market is not stable. Considering the effects of IPO halts

are consistent among the five times, potential endogenous relationship between IPO halts and A-H price disparity doesn't affect the results.

1.8 Conclusions

Study on price disparity among cross-listed securities has been a long lasting interesting topic. There are several popular explanations existing, including differential liquidity, differential risks, and asymmetric information effects among cross-listed stocks. Since the stocks are traded in different markets, it is hard to find a uniform answer to determine the price disparity without considering different institutional backgrounds of the markets. This paper takes Chinese firms cross-listed in China mainland and Hong Kong as A-share and H-share as example to look at the price disparity under specific institutional settings and related policy effects on it. Given that China mainland stock markets are almost separated from worldwide financial markets, the investment opportunities are different for China mainland investors and foreign investors. The first contribution of this paper is that relative supply of stocks can explain up to 53% of the price disparity between A-share and H-share. The large supply of stocks in China mainland market can lead to narrow price disparity, or say the low A-H price premium. The other factors from previous literature, such as liquidity, speculation degree and political risks are also tested with A-H share price disparity in the paper, and most of them are consistent with prediction form the papers that the firms with low liquidity, high speculation, high political risks tend to have high A-H price premium, or large price disparity. However, relative

supply between A-share and H-share can totally absorb the effects of these factors. This is the first paper confirming that under constraints of investment opportunities, relative stock supply play the determinant role in price disparity.

This paper further tests several natural experiments of related policy changes that took place in China mainland. IPOs directly decide the supply of stocks in secondary market. Test results show that IPO halts, which mean lower stock supply, lead to higher price premium than normal period. The other institutional change, stock reform, shifts non-tradable shares to tradable shares in secondary market, and thus increases stock supply. Even through the real shifts happen in one to three years, the investors' expectation forms from the reform plan is determined, so price disparity decreases after stock reform. The effect of relative supply is also confirmed in this institutional change. The findings on important role of relative supply of stocks offer evidence in international asset pricing models with investment opportunity binding constraints for researchers. What's more, the results provide direct pricing evidence for the firms that want to list or cross-list in developing countries, especially those not fully open to worldwide. Last but not least important the policy event studies give out policy implications to the market regulators.

Table 1. 1 Statistic description

This table is the statistic description of the variables. Panel A is the detailed statistics of A-H share price disparity year by year. Panel B is the statistics about all the variables introduced in part 4, including rate of A-share percentage to H-share percentage (AtoH), turnover rates of A-shares and H-shares (turnover_A, turnover_H and AtoH_turn), QFII quota and QDII quota (QFII and QDII), borrowed money balance and stock balance (money_bal and stock_bal), state owned share percentage (SOE), free float share percentage (float), A-share percentage and H-share percentage (A_share and H_share) , QFII quota and QDII quota (QFII and QDII) and share concentration (concentration). Panel C is the correlation of the variables.

Panel A: A-H price disparity by year

year	N	Mean	Median	Max	Min	Skewness	Kurtosis
1999	19	0.855	0.881	0.973	0.623	-0.802	0.386
2000	19	0.889	0.896	0.976	0.785	-0.250	-1.441
2001	24	0.838	0.837	0.941	0.733	-0.003	-0.167
2002	27	0.801	0.794	0.938	0.581	-0.602	1.401
2003	29	0.689	0.704	0.894	0.233	-1.212	2.614
2004	30	0.588	0.616	0.883	0.170	-0.385	-0.600
2005	31	0.432	0.459	0.847	0.004	-0.181	-0.924
2006	38	0.348	0.406	0.795	-0.084	-0.117	-1.439
2007	52	0.489	0.521	0.871	0.120	0.104	-0.842
2008	58	0.489	0.524	0.860	-0.019	-0.324	-0.930
2009	62	0.452	0.511	0.857	-0.092	-0.424	-0.903
2010	67	0.324	0.341	0.853	-0.233	-0.195	-1.027
2011	73	0.327	0.355	0.849	-0.304	-0.076	-0.897
2012	83	0.304	0.271	0.859	-0.211	0.231	-0.950
2013	84	0.226	0.196	0.865	-0.274	0.261	-0.907

Panel B: Summary description of all variables

Variable	Mean	Std	Median	Skewness	Kurtosis
premium	0.446	0.307	0.480	-0.330	-0.898
AtoH (%)	1.523	1.546	0.923	1.552	2.509
A_share (%)	0.372	0.286	0.254	0.403	-1.454
H_share (%)	0.285	0.106	0.282	1.123	7.811
SOE (%)	0.286	0.268	0.324	0.159	-1.553
float (%)	0.662	0.268	0.576	0.132	-1.513
concentration	0.389	0.148	0.408	-0.029	0.082
QFII ($millions)	208.761	152.283	185.950	0.731	-0.672
QDII ($millions)	541.094	290.279	647.420	-1.039	-0.226
turnover_A	0.020	0.026	0.013	4.461	28.651
turnover_H	0.008	0.006	0.006	3.497	30.736
AtoH_turn	6.689	12.489	2.956	5.458	41.170
money_bal (RMB millions)	396.369	385.125	212.095	4.872	28.326
stock_bal (thousands)	869.087	1046.367	270.382	6.465	54.038

Panel C: Correlation of the variables

	premium	AtoH	A_share	H_share	SOE	float	concentration	AtoH_turn	money_bal	stock_bal
premium	1									
AtoH	-0.391	1								
A_share	-0.356	0.890	1							
H_share	0.127	-0.525	-0.372	1						
SOE	0.205	-0.629	-0.800	-0.022	1					
float	-0.325	0.749	0.936	-0.039	-0.877	1				
concentration	0.026	-0.195	-0.323	0.119	0.404	-0.338	1			
AtoH_turn	0.298	-0.223	-0.234	0.071	0.153	-0.221	-0.049	1		
money_bal	-0.320	0.340	0.286	-0.104	-0.226	0.262	-0.226	-0.101	1	
stock_bal	-0.231	0.290	0.250	-0.133	-0.182	0.217	-0.189	-0.083	0.755	1

Table 1. 2 Two-way fixed effect regression

This table shows the results of two-way fixed effect regression (firm-fixed effect and year-fixed effect). The sample period is between 1999 and 2013. The dependent variable is the average of daily A-H premiums for each firm in one year, and explanatory variables are relative of A-share percentage to H-share percentage (AtoH), state owned share percentage (SOE_perc), free float share percentage (float_percent), concentration (concentration), QFII quota and QDII quota(QFII and QDII), turnover rates of A-shares and H-shares (turnover_A, turnover_H and AtoH_turn), borrowed money balance and stock balance (money_bal and stock_bal). Two-way fixed effect estimator coefficients are reported and Heteroskedasticity-robust t-statistics are reported in parentheses below the coefficients. “R_square” is the R-square for each model. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
AtoH	-0.035***													-0.067***
	(-5.19)													(-6.05)
SOE		0.066*												-0.466***
		(1.77)												(-3.49)
float			-0.091											-0.249*
			(-2.53)											(-1.94)
A_share				-0.012										
				(-1.05)										
H_share					0.0005									
					(0.03)									
concentration						0.012								0.079
						(0.10)								(0.64)
QFII							-0.006***							0.0010
							(-3.62)							(0.91)
QDII								-0.01***						-0.0032
								(-3.62)						(-1.24)
turnover_A									-0.010					-0.318
									(-0.04)					(-1.12)
turnover_H										-2.859**				-2.59**
										(-2.50)				(-2.23)
AtoH_turn											0.0014***			0.0012**
											(2.72)			(2.19)
money_bal												-0.0025		-0.0047**
												(-1.41)		(-1.99)
stock_bal													0.418	1.165
													(0.64)	(1.38)
R_square (%)	52.71	53.14	53.22	52.85	52.74	52.93	53.15	52.79	52.71	54.53	52.71	52.71	52.71	57.01

Table 1. 3 Event study _ IPO halt starts

This table is the results of event studies on the A-H price premium change around 5 times of IPO halt starts. The sample covers the all the A-H pair of stocks effected by the policies. The event periods are 5 days, 10 days, 15 days, 30 days, 45 days, 60 days, 90 days and 250 days before and after the event dates. Panel A is statistics of the A-H premium around the first IPO halt start. The event date is July 31, 2001. The columns "before", "after" and "Diff" are the average of A-H price disparity before, after the events and the difference between before and after respectively. The columns "t" is the t-statistics of the difference of the averages between before and after the events. *,**,*** represent 10%, 5% and 1% significance of difference. Panel B, C, D, E are the results of the following four IPO halt starts, and they are of the same structure of panel A, but the event dates are August 26, 2004, May 25, 2005, December 6, 2008 and November 3, 2012 respectively.

Panel A First IPO halt start (July 31, 2001)

Event window (days)	Before	After	Diff (after - before)		t-stat
5	0.8363	0.8490	0.0126	***	8.33
10	0.8412	0.8483	0.0109	***	5.81
15	0.8435	0.8481	0.0087	***	4.57
30	0.8302	0.8493	0.0232	***	8.24
45	0.8211	0.8529	0.0359	***	9.10
60	0.8132	0.8569	0.0479	***	10.10
90	0.8194	0.8512	0.0358	***	9.09
250	0.8177	0.8607	0.0345	***	5.48

Panel B Second IPO halt start (August 26, 2004)

Event window (days)	Before	After	Diff (after - before)		t-stat
5	0.5766	0.5874	0.0108	***	5.18
10	0.5754	0.5948	0.0194	***	5.28
15	0.5720	0.5977	0.0257	***	5.43
30	0.5713	0.5940	0.0227	***	4.60
45	0.5707	0.5963	0.0256	***	4.60
60	0.5652	0.5967	0.0315	***	4.59
90	0.5533	0.6051	0.0518	***	5.77
250	0.5105	0.6057	0.0960	***	6.64

Panel C Third IPO halt start (May 25, 2005)

Event window (days)	Before	After	Diff (after - before)		t-stat
5	0.4213	0.4238	0.0025		0.48
10	0.4126	0.4272	0.0146	**	2.35
15	0.4149	0.4277	0.0127	*	1.94
30	0.4150	0.4329	0.0179	**	2.23
45	0.4029	0.4454	0.0425	***	5.13
60	0.3866	0.4489	0.0622	***	7.16
90	0.3864	0.4574	0.0710	***	7.45
250	0.4102	0.4982	0.0880	***	6.57

Panel D Fourth IPO halts (December 6, 2008)

Event window (days)	Before	After	Diff (after - before)		t-stat
5	0.4958	0.5215	0.0341	***	7.42
10	0.4944	0.5322	0.0378	***	7.31
15	0.4839	0.5420	0.0580	***	8.40
30	0.4681	0.5367	0.0685	***	8.29
45	0.4710	0.5371	0.0661	***	7.59
60	0.4819	0.5285	0.0466	***	5.70
90	0.5017	0.5117	0.0100		1.45
250	0.4661	0.4999	0.0309	***	3.82

Panel E Fifth IPO halts (November 3, 2012)

Event window (days)	Before	After	Diff (after - before)		t-stat
5	0.2333	0.2448	0.0116	***	4.56
10	0.2368	0.2477	0.0109	***	3.62
15	0.2369	0.2492	0.0122	***	3.58
30	0.2253	0.2621	0.0369	***	8.49
45	0.2205	0.2707	0.0494	***	10.40
60	0.2216	0.2872	0.0646	***	12.43
90	0.2180	0.2994	0.0794	***	13.46
250	0.2424	0.3313	0.0876	***	10.57

Table 1. 4 Event study _ IPO halt ends

This table is the results of event studies on the A-H price premium change around 5 times of IPO halt ends. The sample covers the all the A-H pair of stocks effected by the policies. The event periods are 5 days, 10 days, 15 days, 30 days, 45 days, 60 days, 90 days and 250 days before and after the event dates. Panel A is statistics of the A-H premium around the first IPO halt end. The event date is July 31, 2001. The columns "before", "after" and "Diff" are the average of A-H price disparity before, after the events and the difference between before and after respectively. The columns "t" is the t-statistics of the difference of the averages between before and after the events. *,**,*** in "sig" column represent 10%, 5% and 1% significance of difference. Panel B, C, D, E are the results of the following four IPO halt starts, and they are of the same structure of panel A, but the event dates are August 26, 2004, May 25th 2004, December 6, 2008 and November 3, 2012 respectively.

Panel A First IPO halt end (November 2, 2001)

Event window (days)	Before	After	Diff (after - before)		t-stat
5	0.8206	0.8116	-0.0090	***	-4.77
10	0.8261	0.8127	-0.0134	***	-5.86
15	0.8280	0.8130	-0.0149	***	-6.05
30	0.8331	0.8167	-0.0164	***	-5.89
45	0.8444	0.8199	-0.0244	***	-7.05
60	0.8496	0.8174	-0.0281	***	-7.42
90	0.8497	0.8053	-0.0379	***	-8.31
250	0.8416	0.7927	-0.0418	***	-7.20

Panel B Second IPO halt end (January 23, 2005)

Event window (days)	Before	After	Diff (after - before)		t-stat
5	0.4947	0.4917	-0.0030		-0.61
10	0.5015	0.4838	-0.0177	**	-2.64
15	0.5077	0.4814	-0.0237	***	-3.16
30	0.5135	0.4784	-0.0314	***	-3.68
45	0.5207	0.4785	-0.0389	***	-4.63
60	0.5228	0.4751	-0.0443	***	-5.10
90	0.5287	0.4704	-0.0540	***	-5.19
250	0.5727	0.4287	-0.1383	***	-9.30

Panel C Third IPO halt end (June 2, 2006)

Event window (days)	Before	After	Diff (after - before)		t-stat
5	0.4164	0.4014	-0.0077	***	-2.00
10	0.4253	0.3921	-0.0156	***	-3.13
15	0.4283	0.3921	-0.0186	***	-3.42
30	0.4306	0.3683	-0.0446	***	-6.49
45	0.4214	0.3582	-0.0650	***	-7.49
60	0.4134	0.3565	-0.0694	***	-6.93
90	0.3768	0.3478	-0.0537	***	-5.12
250	0.3697	0.3912	-0.0025		-0.14

Panel D Fourth IPO end (June 29, 2009)

Event window (days)	Before	After	Diff (after - before)		t-stat
5	0.4721	0.4687	-0.0034		-1.09
10	0.4830	0.4696	-0.0133	***	-3.48
15	0.4934	0.4600	-0.0294	***	-6.10
30	0.4908	0.4456	-0.0418	***	-6.83
45	0.4793	0.4506	-0.0254	***	-3.87
60	0.4636	0.4603	0.0003		0.04
90	0.4397	0.4810	-0.0397	***	-5.81
250	0.4128	0.5095	-0.0855	***	-8.86

Table 1. 5 Event study _ stock reform

This table is the results of event studies on the A-H price premium change around stock reform. The sample covers the all the A-H pair of stocks effected by the policies. The event day is the day when the reform plan is officially announced and the stock restarts to trade. The event periods are 5 days, 10 days, 15 days, 30 days, 45 days, 60 days, 90 days and 250 days before and after the event dates. The columns “before”, “after” and “Diff” are the average of A-H price disparity before, after the events and the difference between before and after respectively. The columns “t” is the t-statistics of the difference of the averages between before and after the events. *,**,*** in “sig” column represent 10%, 5% and 1% significance of difference.

Event window (days)	Before	After	Diff (after - before)		t-stat
5	0.4377	0.3140	-0.1237	***	-5.56
10	0.4366	0.3162	-0.1205	***	-5.27
15	0.4366	0.3193	-0.1173	***	-5.11
30	0.4387	0.3356	-0.1031	***	-4.42
45	0.4388	0.3462	-0.0926	***	-4.10
60	0.4349	0.3561	-0.0788	***	-3.55
90	0.4348	0.3658	-0.0690	***	-3.17
250	0.4231	0.3720	-0.0443	*	-1.74

Table 1. 6 Background of IPO halts

This table summarizes the backgrounds of each IPO halts.

IPO halt time	Period	Background
1	2001/7/31 - 2001/11/2	The State Council issued *the Interim Measures of the State Council on the Management of Reducing State Shares Held and Raising Social Security Funds*, stating that SOEs would privatize 10% of state owned shares in IPOs and seasoned cash offerings. The price of state owned shares would be set equal to the issue price. IPOs were halted on October22, 2001 after 16 SOEs practiced the interim measures, and invited tremendous adverse market reaction.
2	2004/8/26 - 2005/1/23	The State Council issued *Some Opinions of the State Council on Promoting the Reform, Opening and Steady Growth of Capital Markets* as a blue print of the reform. IPOs are halted before the official reform plan announced by government.
3	2005/5/25 - 2006/6/2	*The Notice of the China Securities Regulatory Commission on Piloting the Share Trading Reform of Listed Companies* marked the official start of the split share structure reform. The first batch of pilot firms are four companies, Sany Heavy Industry, Tongfang Co., Zijiang Enterprise Group, and Jinniu Energy Resources. The second pilot batch included 42 companies. Instead of directly selling state- owned shares to public investors, the reform aimed to convert all non-tradable shares into legitimate tradable shares paying negotiated considerations to tradable share- holders.
4	2008//12/6 - 2009/6/29	Shanghai and Shenzhen Composite Index droped by more than 60% from 2007 because of financial crisis and large IPOs issuance. CSRS paused IPOs to stabilize the market.
5	2012/11/3 – 2014/1/15	CSRS initiated a large scale of IPO self inspection and verification In order to implement the relevant requirements of the *Guiding Opinions on Further Deepening Reforms in the New Stock Issue System*, effectively boost information disclosure-based IPO system reform and improve the quality of information disclosure

Figure 1. 1 A-H price disparity

The figure plots the A-H price disparity level through years. The A-H share price premium is foreign exchange rate adjusted, defined as $\rho_{it} = \frac{P_{it}^{A} - P_{it}^{H} X_t}{P_{it}^{A}}$, where X_t is the exchange rate between Chinese RMB and the Hong Kong dollar, P_{it}^{A} is the daily closing price of A-share of firm i, and P_{it}^{H} is the daily closing price of H-share of firm i. The solid line plots the A-H premium level.

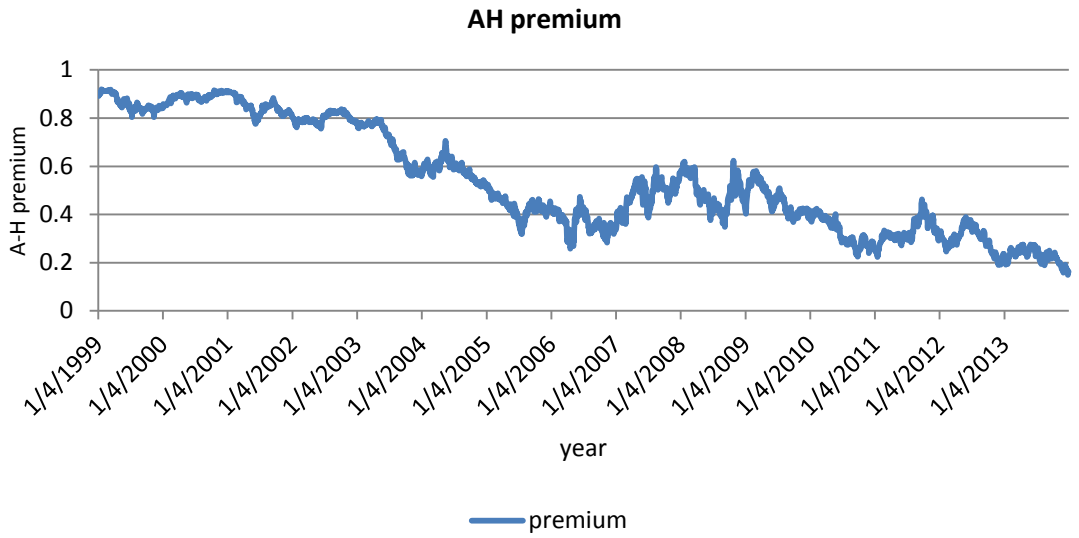
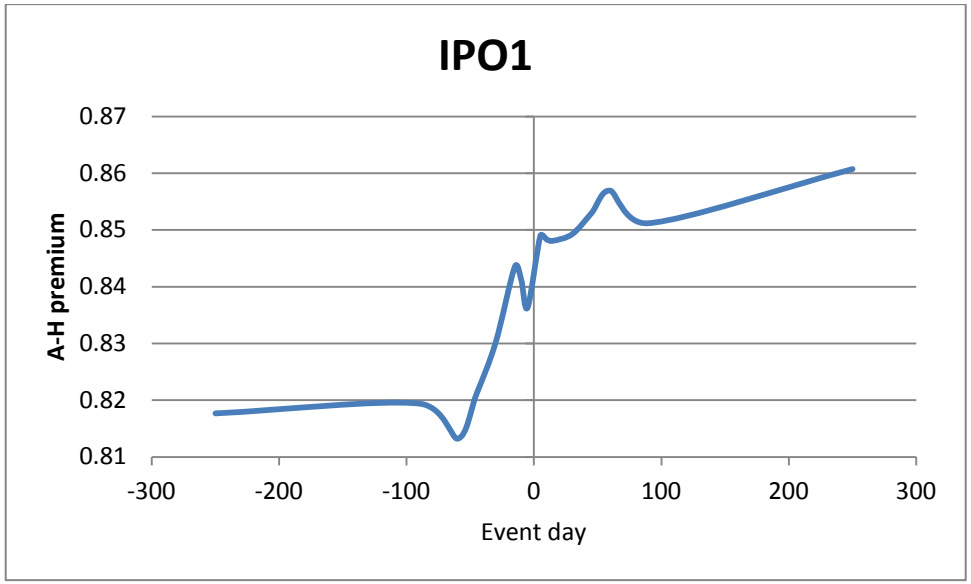


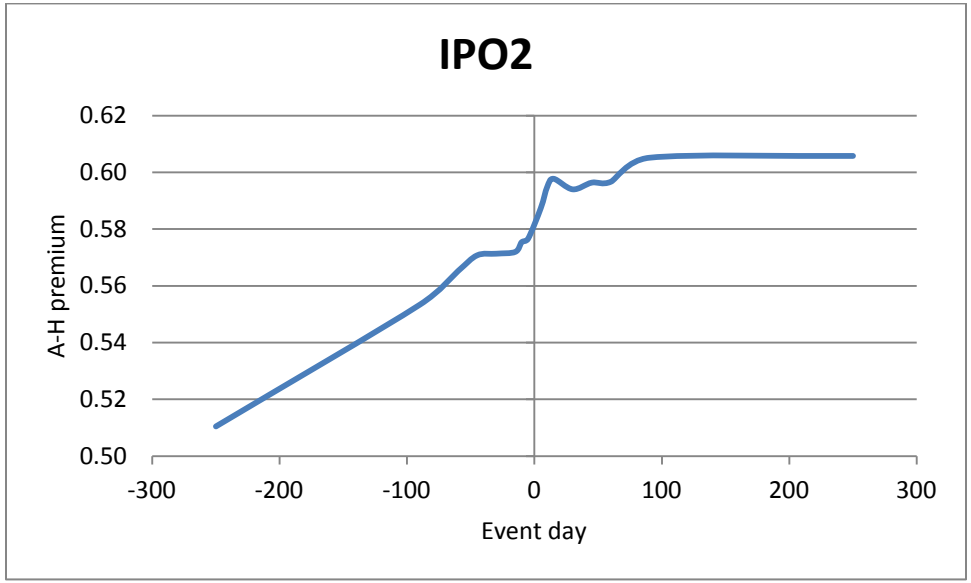
Figure 1. 2 Event study of IPO halts start

The figures plot the A-H price disparity level around the 5 IPO halts start. The event dates are July 31, 2001, August 26, 2004, May 25, 2005, December 6, 2008 and November 3, 2012 respectively. The event periods are 5 days, 10 days, 15 days, 30 days, 45 days, 60 days, 90 days and 250 days before and after the event dates. The A-H share price premium is foreign exchange rate adjusted, defined as $\rho_{it} = \frac{P_{it}^{A} - P_{it}^{H} X_t}{P_{it}^{A}}$, where X_t is the exchange rate between Chinese RMB and the Hong Kong dollar, P_{it}^{A} is the daily closing price of A-share of firm i, and P_{it}^{H} is the daily closing price of H-share of firm i. The solid line plots the A-H premium level.

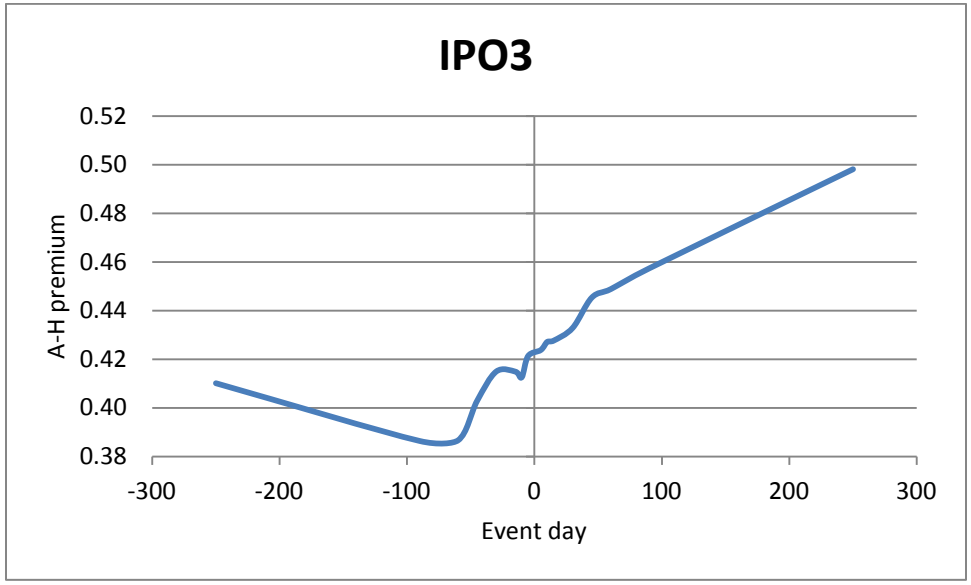
Panel A: First IPO halt start (July 31, 2001)



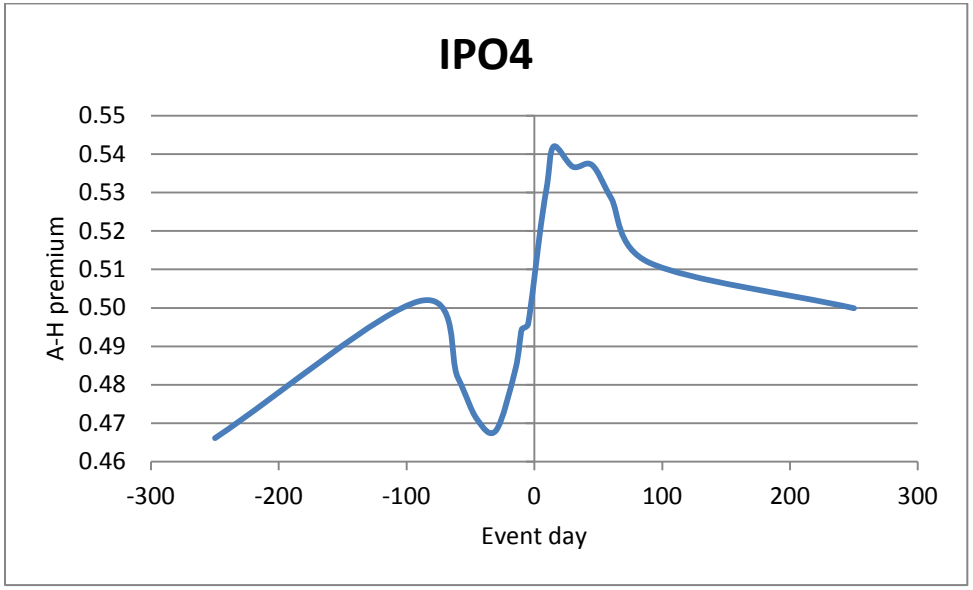
Panel B: Second IPO halt start (August 26, 2004)



Panel C: Third IPO halt start (May 25, 2005)



Panel D: Fourth IPO halts (December 6, 2008)



Panel E: Fifth IPO halts (November 3, 2012)

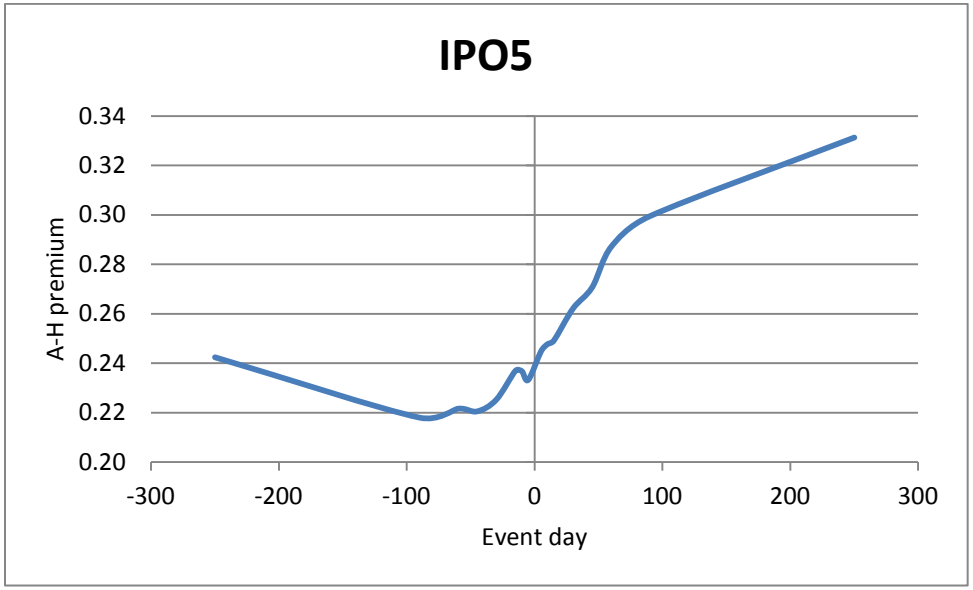
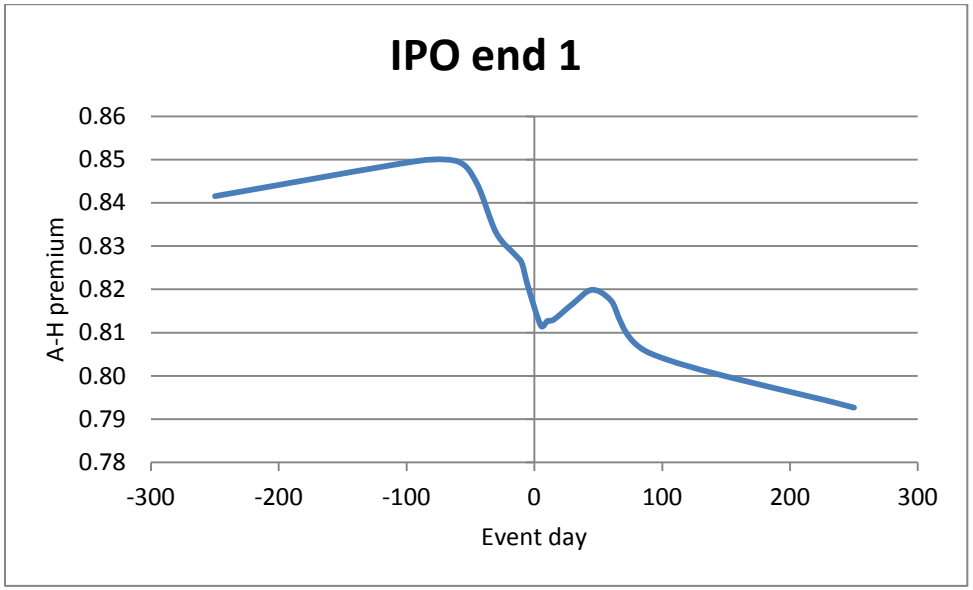


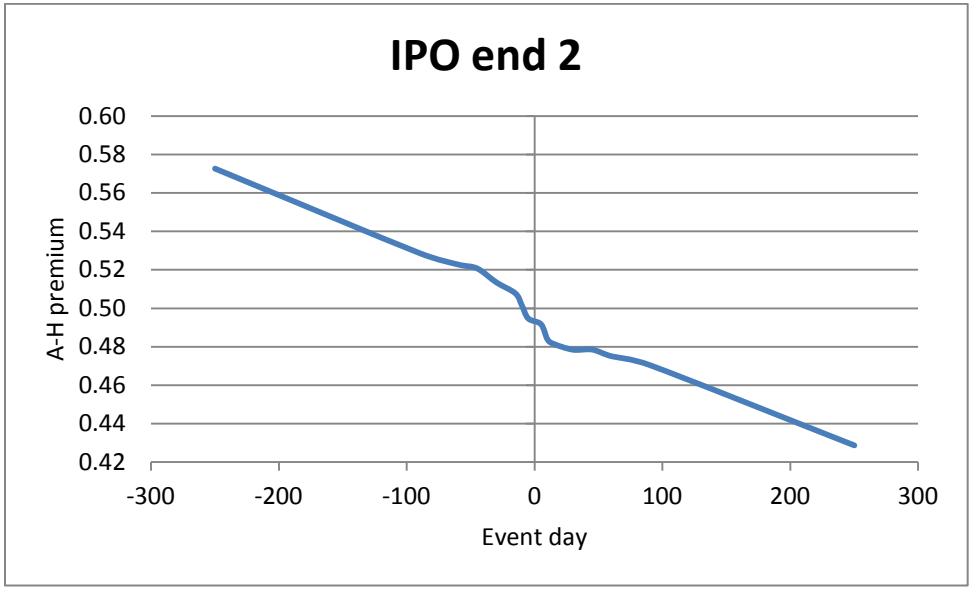
Figure 1. 3 Event study of IPO halts end

The figures plot the A-H price disparity level around the 4 IPO halts start. The event dates are November 2, 2001, August 26, 2004, May 25th 2004, December 6, 2008 and November 3, 2012 respectively. The event periods are 5 days, 10 days, 15 days, 30 days, 45 days, 60 days, 90 days and 250 days before and after the event dates. The A-H share price premium is foreign exchange rate adjusted, defined as $\rho_{it} = \frac{P_{it}^{A} - P_{it}^{H} X_{t}}{P_{it}^{A}}$, where X_t is the exchange rate between Chinese RMB and the Hong Kong dollar, P_{it}^{A} is the daily closing price of A-share of firm i, and P_{it}^{H} is the daily closing price of H-share of firm i. The solid line plots the A-H premium level.

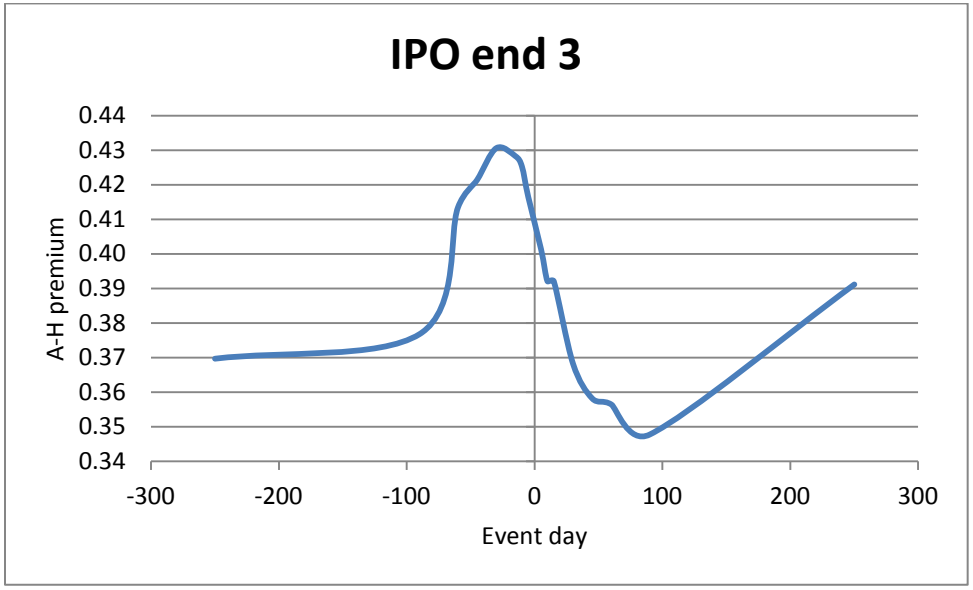
Panel A: First IPO halt end (November 2, 2001)



Panel B: Second IPO halt end (January 23, 2005)



Panel C: Third IPO halt end (June 2, 2006)



Panel D: Fourth IPO end (June 29, 2009)

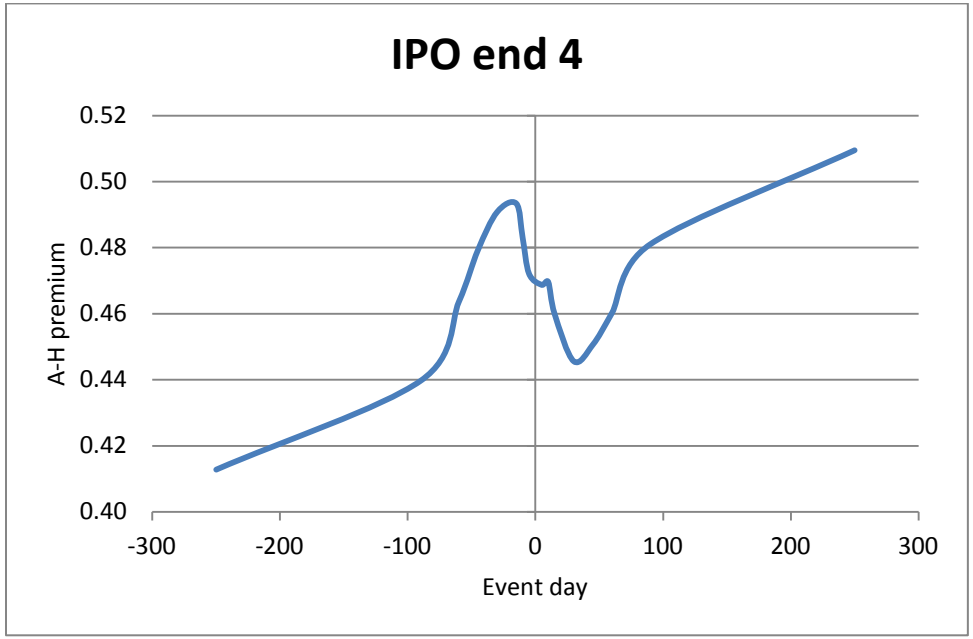


Figure 1. 4 Event study of IPO stock reform

The figure plots the A-H price disparity level around stock reform of each firm. The event periods are 5 days, 10 days, 15 days, 30 days, 45 days, 60 days, 90 days and 250 days before and after the event dates. The A-H share price premium is foreign exchange rate adjusted, defined as $\rho_{it} = \frac{P_{it}^{A} - P_{it}^{H} X_{t}}{P_{it}^{A}}$, where X_t is the exchange rate between Chinese RMB and the Hong Kong dollar, P_{it}^{A} is the daily closing price of A-share of firm i, and P_{it}^{H} is the daily closing price of H-share of firm i. The solid line plots the A-H premium level.

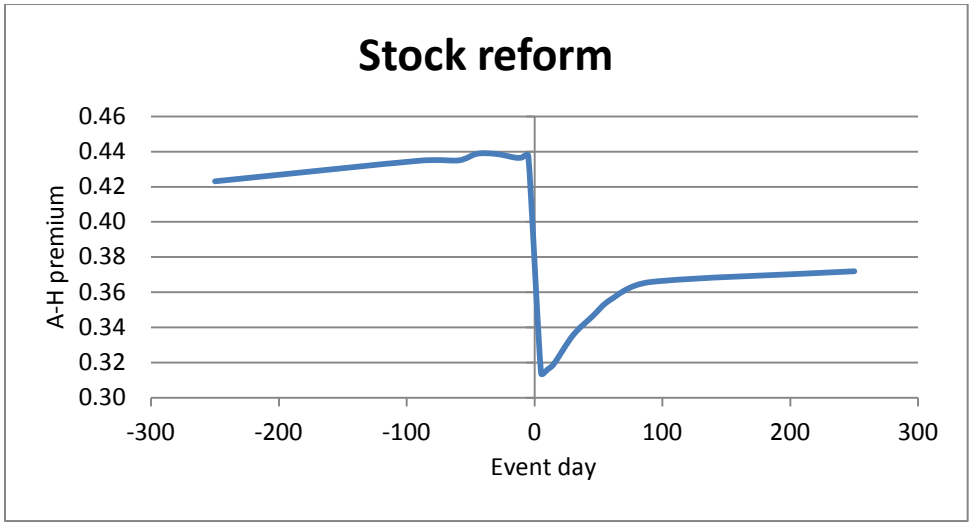
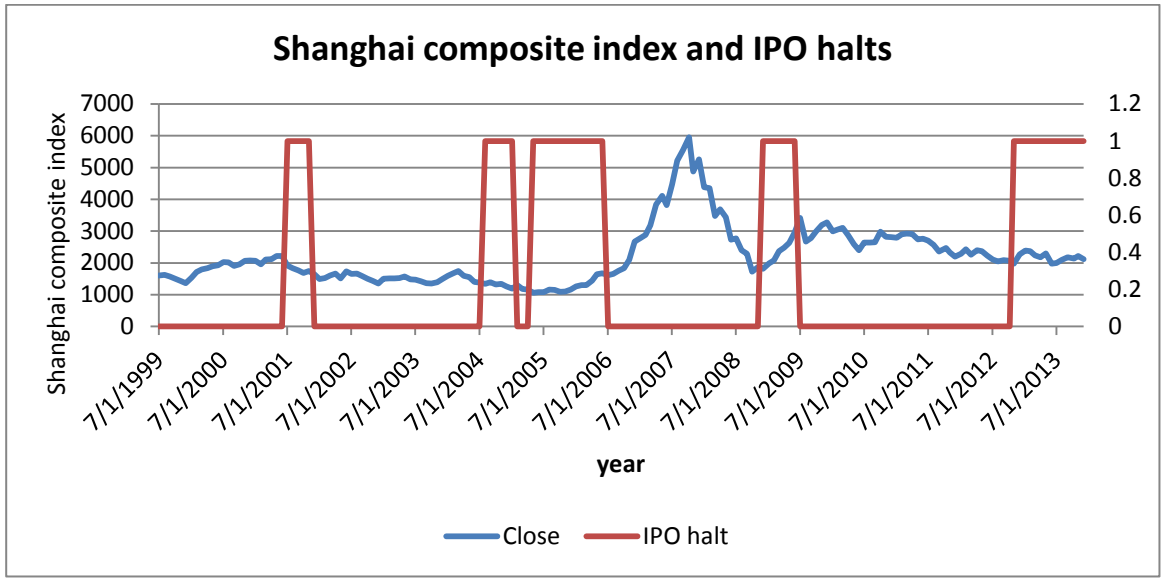


Figure 1. 5 IPO halts and Shanghai composite index

The figure plots the Shanghai composite index during the sample period. The blue line is Shanghai composite index level. The red line shows the IPO halts periods.



CHAPTER 2: Evidence on Market Efficiency in Emerging markets: a Sample from China

2.1 Introduction

The market efficiency, including information efficiency, prices efficiency, is a key attribute of capital markets that can have significant implications for the real economy, as more efficient stock prices more accurately reflect a firm's fundamentals and can guide firms to make better-informed investment and financing decisions.

In a recent speech, Burton Malkiel suggests the Chinese stock market is far from efficient, by stating that "There is considerable serial correlation. The markets are nowhere near a random walk." In academia, the conventional knowledge is that emerging markets are less efficient than developed markets. Bekaert and Harvey (2002) give a survey about the academic evidence for greater inefficiency in the emerging markets than that in developed counterparts by the three aspects: higher serial correlations (Harvey (1995)), information leakage prior to public announcements (Bhattacharya, Daouk, Jorgenson, and Kehr (2000)) and high returns to cross-sectional characteristic trading strategies (Rouwenhorst (1999); Van der Hart, Slagter, and Van Dijk (2003)). On the other side, Grinffin, Kelly and Nardari (2010) use a variety of methods to test efficiency, including the random walk tests, and returns to trading strategies, and suggest that individual stock and portfolio returns in emerging markets do not deviate more from a random walk than those in developed markets in both daily and

weekly frequencies, which inconsistent with the conventional wisdom that emerging markets are places for more profitable trading strategies and where prices exhibit more predictability and departures from a random walk. However, Chordia, Roll and Subrahmanyam (hereafter CRS) (2005) show it takes only less than an hour to become efficient even in the US markets, so the daily and weekly measures in Grinffin, Kelly and Nardari (2010) may not capture the difference between the difference between developed markets and emerging markets. Even though there are tons of papers studying market efficiency in the developed markets, the efficiency in the emerging markets is still far from consensus.

Besides that, because the emerging stock markets are growing and developing, in which policy or regulation imposed or banned may help the market develop faster and healthier is a real and crucial question for the market regulators, testing market efficiency in emerging markets has a lot of policy implications. For the emerging markets, where the stock markets are developing and far from mature, regulators may impose policies to keep market not manipulated and to protect small investors, however, the regulations could be frictions in markets on the other side, so the effects of the regulations are crucial for the regulators. For the western developed markets, the effects of regulations are also important. In the recent example of the 2007–09 financial crises, most regulators around the world intervened financial markets to some extent, such as imposing bans on short selling (Boehmer and Wu (2013), Baber and Pagano (2013), Marsh and Payne (2012), Bris, Goetzmann and Zhu (2007)) among other

quantitative easing policies. It also becomes normal that regulators take actions when extreme case happens in the developed markets.

China is the second largest economy around the world, and the largest emerging market. At same time, as a socialism country, it has a unique institutional environment that differs from other economies. Most listed firms are only partially privatized and corporate ownership is often highly concentrated in the hands of a single investor associated with the central or local government, or a government controlled so called state-owned enterprise (SOE) until the share ownership reform between 2005 and 2006. The Chinese stock markets were almost segmented from overseas, and are opening up step by step. Chinese market governor, the China Securities Regulatory Committee (CSRC), imposed a stringent ban on short-sell to prevent over speculation since Chinese stock started until March 31, 2010, and the ban is gradually lifted step by step. The institutional changes above offers several natural experiment to test the policy effects on market efficiency.

This paper offers three contributions to the previous literature. Firstly, it will be the first study to use various high frequency measures of efficiency to investigate the Chinese stock markets to see how fast the stock price incorporates the information. The results give distinct evidence to the debate about the market efficiency in the emerging market. Secondly, this paper explicitly links price efficiency and share ownership, namely state-owned share percentage, share concentration, free float percentage among others, which offers support to the link between share structure and information asymmetry.

Thirdly, this paper tests effects of several policies and regulation changes on market efficiency. The data from 1999 to 2013 in this paper offers us an opportunity to cover several policy changes occurred in China, such as share ownership reform, QFII policy, suspension of IPO and lift of short-sell ban, which don't happen in most markets around world because of institutional backgrounds, but they are interesting topics in financial market development and have strong political implication, which also becomes important in developed market after the financial crisis in 2008. Chinese stock market offers a rare but perfect sample for empirical studies on the effects of the policies and regulations.

The next section provides a brief description of Institutional background together with related literature and proposes hypothesis. Section 3 introduces high frequency measures of efficiency used in this paper. Section 4 describes the data in the paper. Section 5 and section6 are the estimation method introduction and test results. Section 7 offers some additional question for robustness check. Section 8 concludes.

2.2 Background, literature and hypothesis development

CRS (2005), CRS (2008), Visaltanachoti and Yang(2010) and Chung and Hrazdil (2012) find the intraday return predictability are related with firm size, trading volume, price level, price volatility and informational asymmetry in trading. Beside those factors, this paper further looks at the effects of share ownership factors on price efficiency. Previous literature has already implied such

connection. Demsetz (1968) points out that when firm ownership is concentrated, there is a limited free float and consequently there are fewer trades, leading to a fall in liquidity. On the other side, tons of papers relate price efficiency with liquidity (Bernstein (1987), Fang, Noe and Tice (2009) among others), and CRS (2008) also confirm that greater liquidity engendering a higher degree of informational efficiency in term of return predictability of order flows. Combining the two strands of papers, a link share ownership structure to market efficiency can be established. Saffi and Sigurdsson (2011) document the connection by finding Firms with high market capitalization, large free float, and high liquidity (measured by low bid-ask spreads and fewer zero-return weeks) are also associated with less price delay, which is one of the traditional market efficiency measure from weekly returns. Based on the previous papers, the prediction about first share ownership factor could be:

Free Float Hypothesis:

The proportion of free float shares has positive effect on the efficiency.

Existing empirical studies also use institutional ownership as a measure of investor informativeness. Attig, Fong, Gadhoum, Lang (2006) and Fan and Wong (2002) confirm that the degree of information asymmetry increases with ownership concentration in Canada and in Korea. Besides those, Edmans (2009) suggests that block size may be more relevant, because concentrated stakes are necessary to incentivize investors to gather information. Bushee and Goodman (2007) and Parrino, Sias, and Starks (2003) also confirm that larger shareholders

are more informed. Considering the ownership situation in China, the largest shareholders are state owned enterprise for most of the listed firms, but they are not tradable before the stock ownership reform and not actively traded as individual investors after the reform (the reform is described later in this section). The result of such ownership structure is that the stocks are mostly traded by the investors with information disadvantage. Besides that state-owned shares are concentrated and non-tradable, there is a lot of literature indicating that SOEs are characterized by lower governance transparency and by less effective corporate governance mechanisms (Shleifer and Vishny (1997), La Porta, Silanes and Shleifer (1999), Johnson, La Porta, Silanies and Shleifer (2000)) and lower financial transparency (Bushman and Theodore (2004), Wang, Wong and Xia (2008), Chaney, Faccio, Parsley (2011)), which may also create information asymmetries, and thus lower price efficiency. The hypothesis could be:

Concentration Hypothesis:

Share concentration has negative effect on the efficiency.

SOE Hypothesis:

The proportion of State-Owned Enterprises (SOE) shares has negative effect on the efficiency.

There are 4 important institutional changes in Chinese stock market covered by the sample period in this paper. In this section, the institutional changes are summarized and academic literature about efficiency change

according to the regulation is reviewed, and then testable hypothesis are proposed.

The first event is stock ownership reform. As described in the first part, Chinese stock market before the stock reform in 2005 had a split share structure where around 70% of listed firms' outstanding shares were non-tradable, because when Chinese stock markets were initially set up to help state owned enterprises to raise capital without lose control of the firm. The Chinese government tried to deal with the problem of split share structure in 1999 and 2001, but failed[1]. The 2005 reform adopted the new strategy of forcing non-tradable share holders to pay compensation to tradable share holders in exchange for the right to sell their shares. In each firm, the non-tradable share holders can negotiate with the tradable share holders to figure out specific plan for compensation[2]. To dilute any possible stock overhang from massive sale of shares from non-tradable share holders, they could only trade limited shares gradually according to the lock-up period. To be specific, there is a 12-month lock-up period for the holders of non-tradable share in order to reduce the impact of a possible stock overhang due to a massive future sale of shares. In the two

[1] In the first attempt, two companies were selected to sell their state shares to the floating shareholders. The experiment did not meet the investors' expectations and within 15 days from the announcement of the transfer program the share price of the two companies had fallen by about 40%. The second attempt failed in 2001 because the proposal envisaged an equal pricing for tradable and non-tradable shares.

[2] The specific procedures of the reform follows the steps: 1. each company had to make a compensation proposal that would be discussed among shareholders during a period of trading suspension; 2. the proposal would then be publicly announced, but not implemented, and trading in the shares restarted. After a few weeks, a shareholders' meeting would be called and the compensation proposal would pass only if approved by a majority of two thirds of the votes of TS holders; 3. Trading restarted and the compensation are paid out after the final vote.

years after expiration of the lock-up, non-tradable shareholders owning more than 5% of the listed companies were further prohibited from trading on the stock exchange more than 5% (10%) of the company's total share capital within 12 (24) months. By the end of 2006, and thus within the announced deadline, the restructuring process was virtually completed, the reform represented over 97% of total Chinese A-share market capitalization.

Many studies suggest that this split share structure creates a number of problems. 1. A conflict of interest between controlling (non-tradable) and minority (tradable) shareholders because the wealth of controlling shareholders is insulated from the share price, and at same time, non-tradable share made the major shareholders relatively indifferent to stock price movements due to the impossibility to sell the shares (Fan and Wong (2002), Sun and Tong (2004), Cheung (2006), Jian and Wong (2010), Jiang (2010)); 2. The limited free float made the market extremely illiquid and volatile (Demsetz (1968)).

No matter what type of compensation or how lock-up periods arrange, the final result of the reform is that the previous non-tradable state owned shares turn into tradable shares in market in the following one to three years. As controlling non-tradable shareholders have definite expectation of trading their shares on the market, their holdings would have real value directly related to stock price, so their interests align with stock performance, and thus they would take more care on the secondary markets. For example, they may convey more information into market to make stock price more consistent with firm operating condition by communicating with institutional investors to let them realize the real

situation of the firm. As stated before that large shareholders are have more information than the individual investors, (Edmans (2009), Bushee and Goodman (2007) and Parrino, Sias, and Starks (2003)), the change of their attitude is able to bring more information into market, and thus make the stock price more efficient. In addition to attitude change of controlling shareholders, the several month negotiation of reform plan also convey important information about the firms, which could also improve price efficiency. This paper takes a look at the reform effects by proposing the hypothesis below:

Stock reform Hypothesis:

> *The efficiency increases after the trading continues after reform plan announced and compensation paid.*

The second event is opening market to foreign institutional investors by Qualified Foreign Institutional Investors policy (QFII). As mentioned before, capital markets in Chinese mainland are segmented from overseas because of the restrictions by Chinese government. The regulators intend to propel more rational investment by inviting foreign institutional investors, so gradually loosen the restrictions through Qualified Foreign Institutional Investors policy (QFII). Prior to the QFII program, foreign investors could invest only in the B-share market which is also separated from A-share market and the market value is less than 2% of total market value of A-share market, so foreign investor participation in B-share market can hardly affect investment behavior in the whole market. In contrast, QFII program allows Chinese stock quota to foreign institutional

investors to buy China mainland listed stocks in A-share market. The quota increases more than 10 times from 2003, when the program was initiated, and the quota is up to 150 billion USD in April 2012, representing about 5% in total market value of A-share market and keeping growing.

Stoll (2000) states two primary mechanisms for foreign institutional investors to affect market. The first channel is changing the level of trading activity on the market (real frictions effect), which assumes foreign institutional investors bring more trade, and then the increase in trading activity will reduce real friction costs by spreading fixed real costs over more trades. The second channel is changing the information environment on the market (informational frictions effect), which assumes foreign institutional investors have different information set from local investors. If foreign investors are regarded as informed traders, the other investors would be concerned about the potential losses of trading against informed traders, and thus bring about an increase in spreads, which is an adverse selection effect. Stulz (1999) also argues that liquidity in local financial market is likely to improve as a result of better information disclosure and higher trading activity by international financial institutions, and then as better and more relevant information is reflected in prices, there should be a decrease spreads due to the lower price uncertainty, which is a price discovery effect. Besides above, there are a number of theoretical works predicting that as a result of the presence of more informed traders, there will be greater information efficiency which results in higher trading liquidity. Kyle (1985) develops a theoretical model to study the effect of informed traders and their

information advantage on liquidity and price efficiency. Using an augmented version of Kyle's model, Mendelson and Tunca (2004) demonstrate that as prices reflect more information about the security's value, there is a reduction in the risk of trading the security which leads to greater liquidity trading. The process by which information is disseminated through increased trading is known as information efficiency. A number of papers show that information efficiency is improved by competition amongst informed investors (Subrahmanyam (1991), Holden and Subrahmanyam (1992) and Spiegel and Subrahmanyam (1992)). Subrahmanyam (1991) develops a model which predicts that as the number of informed traders increase, the stock price becomes less sensitive to the order flow. Spiegel and Subrahmanyam (1992) generalizes the model of Subrahmanyam (1991) by endogenizing liquidity trades based on hedging needs and demonstrate that the greater competition amongst traders results in higher liquidity. Holden and Subrahmanyam (1992), Foster and Viswanathan (1996), and Back, Cao and Willard (2000) further investigate the effect of multiple informed traders acting strategically on liquidity. These studies share the common finding of faster incorporation of information into prices caused by increased competition amongst investors, particularly when there are a large number of informed investors with perfectly correlated signals. Based on the previous literature, the hypothesis can be proposed as:

QFII Hypothesis:

> *Foreign institutional investors' participation has positive effect on the efficiency.*

The third event is some of stocks are allowed to be margin traded from 2010. China government lifted partial short sell on March 31, 2010, by allowing 90 qualified stocks on a designated list to be sold short and purchased on margin. This list was first revised twice in 2010, and then expanded to include 280 constituent stocks and seven exchange-traded funds in December 2011. The most recent expansion occurred in 2013, which allowed 300 stocks to be short sold or bought on margin in Shanghai stock exchange and Shenzhen stock exchange.

Academia studies have different views on short sellers and the effects of their trading activities on price discovery and market quality. Diamond and Verrecchia (1987) suggest short sellers are rational informed traders, so their trading promotes efficiency by moving mispriced securities closer to their fundamentals. In other models, short sellers are found to use manipulative and predatory trading strategies to maximize their profits, and then result in less informative prices (Goldstein and Guembel (2008)) or overshooting of prices (Brunnermeier and Pedersen (2005)). Most empirical studies about US market suggest that short sellers are informed traders. Using either monthly short interest data (Asquith and Meulbroek (1995), Dechow, Hutton, Meulbroek and Sloan (2001), Desai, Ramesh, Thiagarajan and Blachandran (2002), Asquith, Pathak, and Ritter (2005)) or shorting flow data (Christophe, Ferri, and Angel (2004), Boehmer, Jones and Zhang (2008), Diether, Lee, and Werner (2008), Boethmer and Wu (2013)), their results show that short sellers have value-relevant information and that their trading helps correct overvaluation. Chen and

Rhee (2010) and Marsh and Payne (2012) examined the relation between short sale and market efficiency in China, Hong Kong, and UK, and find short-selling helps market to be efficient. Beber and Pagano (2013) study 16,491 stocks in 30 countries during the financial crises, and conclude short-selling bans are detrimental for liquidity especially for small stocks, slow price discovery and fail to push up stock prices except in US markets. However, the countries are mostly developed countries, as they imposed bans during crises rather than the cases of lifting bans in emerging markets. Chang, Luo and Ren (2013) study lift of bans in China, but they focus more on the stock price reaction, and just use variance ratio and R square to test efficiency. Besides that, they don't test speed to market efficiency and they don't use tick data. Based on the previous research, testable hypothesis could be:

Margin Trading Hypothesis:

Efficiency improved after margin trading allowed.

2.3 Measures of efficiency

The idea of high-frequency measures of the relative informational prices efficiency is to test how closely stock prices move relative to a random walk. Unlike the longer-horizon measures which are based on daily and weekly returns to check the speed of public information is incorporated into prices over horizons, the input data of which determine the efficiency times range from one month to

years, the high-frequency measures use second-interval data, which allows testing intraday price efficiency. As technology develops and trading activity increases, market could become more and more efficient, or become efficient in shorter time, so shorter time price efficiency could be more suitable than the traditional low frequency price efficiency measures. There are two kinds of measures tested in this paper—the pricing error as suggested by Hasbrouck (1993) and the return prediction (Chordia, Roll, and Subrahmanyam (2005)), which are computed from tick data to capture the temporary deviations from random walk. This section illustrates these measures.

2.3.1 Chordia, Roll, and Subrahmanyam (2005)

Chordia, Roll, and Subrahmanyam (2005) measure is the absolute value of quote midpoint return autocorrelations. The idea is that an efficient price process assumes that stock prices follow a random walk, so the quote midpoints should not be predicted, that is lower return prediction power indicates greater price efficiency. Chordia, Roll, and Subrahmanyam (2005) first propose to test how long it takes the market to be weak-form efficiency in above idea, and exam various intervals (5-min, 10-min, 15-min, 30-min and 60-min). The model they applied is regression of lag return and/or lag order imbalance on current return, and the significance of the coefficient indicated the market efficiency. Chordia, Roll, and Subrahmanyam (2008) apply the same method, but add liquidity into consideration, which are the product of order imbalance and spread ($prod\_oib\_sprd$). Visaltanachoti and Yang (2010) take speed of market efficiency

as ordinal variable of 1, 2, 3, 4, 5, 6, 7 or 8 to represent unprediction of current return by 5, 10, 15, 30, 60, 90, 120 or more than 120-min, and relate such ordinal speeds to some firm characteristics. Chung and Hrazdil (2012) refine CRS (2005) by applying real time that it takes for past order imbalance to lose significance in prediction of current returns. A lower value of such convergence time means more market efficient. To be specific, they introduce lower bound as the time when order imbalance prediction first becomes insignificant, and upper bound as the shortest interval where order imbalance is significant and it remains insignificant in all the longer intervals. The upper and lower bound are not necessarily same when the returns are volatile and thus prediction is not persistent, so the lower bound is downward biased in this case. Effective time is the midpoint of upper bound and lower bound to adjust such downward bias. In this paper, the lower bounds and effective times are used as CRS method market efficiency measures. Considering Chinese market may not be as efficient as US market, the efficiency intervals are taken longer than the previous papers on US markets, so the intervals are 5-minute, 10-minute, 15- minute, 30-minute, 60-minute, 90-minute and 240-minute. The prediction models applied in the paper follow Chung and Hrazdil (2012) and CRS (2005) to see the order imbalance prediction on return. The determination of lower bound and effective time exactly follows CRS (2005) and Chung and Hrazdil (2012) to find the time when order imbalance prediction power losses. All the CRS kind of models in previous literature are listed below. The first 4 models are the kind of lag return prediction of current return. The first one is the prediction regression without any

control variables (CRS (2005)); the second and third models are the regression controls lagged value and volume order imbalance (CRS (2005)); the fourth one is with both lagged order imbalance and liquidity control (CRS (2008)). The fifth to eighth models are used in Chung and Hrazdil (2012), which are the lagged order imbalance prediction of current return. The four models are the regressions of value and volume order imbalance on current return with and without lagged return control.

$$ret = \beta_1 \cdot retlag$$

$$ret = \beta_2 \cdot retlag + \beta_3 \cdot oib\_value\_lag$$

$$ret = \beta_4 \cdot retlag + \beta_5 \cdot oib\_vol\_lag$$

$$ret = \beta_6 \cdot retlag + \beta_7 \cdot oib\_value\_lag + \beta_8 \cdot prod\_oib\_sprd$$

$$ret = \beta_9 \cdot oib\_value\_lag$$

$$ret = \beta_{10} \cdot oib\_value\_lag + \beta_{11} \cdot retlag$$

$$ret = \beta_{12} \cdot oib\_vol\_lag$$

$$ret = \beta_{13} \cdot oib\_vol\_lag + \beta_{14} \cdot retlag$$

2.3.2 Hasbrouck (1993)

The Hasbrouck measure assumes that the observed price can be decomposed into an efficient price and the pricing error:

$$P_t = m_t + s_t$$

m_t is the security's expected value conditional on all available information at transaction time t, so it reflects new information and is assumed to follow a random walk. s_t measures the deviation relative to the efficient price, so it captures non-information-related market frictions. The model assumed s_t to be a zero-mean covariance-stationary process, and it can be serially correlated or correlated with the innovation from the random walk of efficient prices. As the expected value of price error is zero, the standard deviation represents deviations from the efficient price, and thus can be interpreted as a measure of price efficiency. Empirically, Hasbrouck (1993) uses a vector autoregression (VAR) model to separate changes in the efficient price from temporary price errors, and the variance of the pricing error can be computed. To be specific, the VAR equation system with 5 lags is below:

$$r_t = a_1 r_{t-1} + a_2 r_{t-2} + \cdots + b_1 x_{t-1} + b_2 x_{t-2} + \cdots + v_{1,t}$$

$$x_t = c_1 r_{t-1} + c_2 r_{t-2} + \cdots + d_1 x_{t-1} + d_2 x_{t-2} + \cdots + v_{2,t}$$

Where r_t is the change in price and x_t is a vector of trading variables, including trade sign indicator, trading volume, and signed square root of trading volume. $v_{1,t}$ and $v_{2,t}$ are serially uncorrelated disturbances. The above VAR can be represented by current and lagged disturbances as

$$r_t = a_0^* v_{1,t} + a_1^* v_{1,t-1} + a_2^* v_{1,t-2} + \cdots + b_0^* v_{1,t} + b_1^* v_{1,t-1} + b_2^* v_{1,t-2} + \cdots$$

$$x_t = c_0^* v_{1,t} + c_1^* v_{1,t-1} + c_2^* v_{1,t-2} + \cdots + d_0^* v_{1,t} + d_1^* v_{1,t-1} + d_2^* v_{1,t-2} + \cdots$$

Then the pricing error can be expressed as

$$s_t = \alpha_0 v_{1,t} + \alpha_1 v_{1,t-1} + \cdots + \beta_0 v_{2,t} + \beta_1 v_{2,t-1} + \cdots$$

$$\alpha_j = -\sum_{k=j+1}^{\infty} a_k^* \quad and \quad \beta_j = -\sum_{k=j+1}^{\infty} b_k^*$$

To make the pricing error measure comparable among stocks, Boehmer and Wu (2013) calculate the variance of the pricing error as $\sigma_s^2 = -\sum_{j=0}^{\infty}[\alpha_j, \beta_j] Cov(v) \begin{bmatrix}\alpha_j \\ \beta_j\end{bmatrix}$, and use ratio $\frac{\sigma_s}{\sigma_p}$ to reflect deviations from the efficient price to control cross-sectional differences in price volatility, and thus the ratio serves as the measure of the informational efficiency of prices. A smaller ratio means a more efficient stock price, because the pricing error is inversely related to price efficiency. This paper follows the exact same VAR method of Hasbrouck (1993) to find variance of the pricing error, and then use the ratio as in Boehmer and Wu (2013) to find the final standardized price error.

2.4 Data

This paper uses the tick data of Chinese stock markets which are information about intraday trades and quotes. Specifically, the data include stock code, stock name, time, transaction price and volume, bid price and volume, ask price and volume. Unlike tick data in the TAQ data in US market, the two exchanges in China update quote and trade information to all subscribers through satellite services at 5-s intervals. Since the exchanges use an open limit order book, one would expect that for the most liquid stocks several different orders may come in and cross within the 5-s interval, but the illiquid stocks may not have orders in the interval and thus no record for the interval. The result is that some quotes and trades are aggregated when reported by the exchanges.

The sample covers all the A-shares listed in Shanghai and Shenzhen stock exchanges, and the sample period in this paper is from 1999 to 2013.

The CRS measures are based on the return prediction power, and technically on the significance of the coefficients from the regressions. Different test periods contain different number of observations, and thus significances change. Take a simple example, for one firm, considering testing 5 minute efficiency within one year, there are around 12000 observations, while testing within one month, there are around 1000 observations. When the same model is regressed, it can be expected that the significances of one year regression should be stronger than the counterparts of one month regression, because of more observations, which can be interpreted as prediction power is stronger, and thus one year efficiency should worse than one month efficiency. However, the conclusion just comes out as statistical results, and it doesn't make economic sense, so CRS efficiency cannot be compared between different sample period lengths. CRS measures are in this paper calculated for specific sample period. When looking at the whole picture of price efficiency in Chinese market, and comparing with US markets, the measures follow CRS (2005) and Chung and Hrazdil (2012) regression the models year by year and thus are the annual frequency variables. When exploring the links between price efficiency and share ownership, the same annual variables are applied to match frequency of the ownership data. The policy event studies in later part require different event windows, so the CRS measures are calculated specifically for each event windows.

Hasbrouck (1993) price error just requires 5 lags, and daily frequency has already enough observations, so they are calculated daily first and average for the required periods. Specifically, the measure is averaged by year for data description and regression, and by required event windows in the event studies.

The stock market and financial data, including daily prices, dividend payments, trading volume, are from GTA dataset of GuoTaiAn (GTA) Information Technology Company. The share ownership data, including total shares, state-owned shares, free float shares, top 1, top 3 share holdings, are also from GTA dataset. The margin data are from Shanghai and Shenzhen stock exchanges. The QFII and QDII quota data are from the Chinese State Administration of Foreign Exchange. The variables to test in this paper include daily frequency variables and annual frequency variables. The daily frequency variables are closing price (PRC), market value (MV), trading volume (VA), QFII quota and QDII quota (QFII and QDII), borrowed money balance and stock balance (money_bal and stock_bal), and annual frequency variables are state owned share percentage (SOE), free float share percentage (float), A-share percentage and H-share percentage (A_percent and H_percent), QFII quota and QDII quota (QFII_quota_annual and QDII_quota_annual). There are several variables related with share concentration in the dataset, including Top 1 (Top1) and Top3 (Top3) shareholdings, Herfindahl index 1 (H1), Herfindahl index 3 (H3), Herfindahl index 5 (H5), Herfindahl index 10 (H10). Expecting the highly correlation among the measures, this paper uses principal component analysis to construct a new measure to capture the main component of all the related

variables. The new measure is called concentration (concentration) in this paper, and constructed as

$$Concentration = 0.176*Top1 + 0.146*Top3 + 0.177*H1 + 0.18*H3 + 0.18*H5 + 0.18*H10$$

Even though the daily and annual data can go back earlier than 1999, the sample period starts in 1999 to make variable link to tick data and high frequency efficiency measures.

2.5 Estimation methods

2.5.1 multivariate regressions

This paper first uses multivariate regression. The regression doesn't consider the effects of the policies on price efficiency, but the general effects of the factors. The regressions run with the whole sample period, which is between 1999 and 2013, and with all the firms having A-shares listed in Shanghai or Shenzhen stock exchanges. The variables in this part are all transformed into annual frequency, specifically, CRS measures are regressed by year, and daily variables are averaged by year. The structure of the sample data is that there are 14 years in total and hundreds of firms in each year. As the sample contains more than 10 years and the firms may be vary in many aspects, two-way fixed effect with firm-by-year control is best method to capture the roles of explanatory

variables, because any omitted firm-wide factors in a given year are controlled in this method, which are excluded from drivers of the results. The regression model is below, and the firm fixed effects are absorbed through first differencing when analyzing.

$$Efficiency_{it} = \gamma_0 + \gamma_1 * SOE_{it} + \gamma_2 * float_{it} + \gamma_3 * concentration_{it} + \gamma_4 * QFII_{it} + \gamma_5 * money\_bal_{it} + \gamma_6 * stock\_bal_{it} + \gamma_7 * PRC_{it} + \gamma_8 * MV_{it} + \gamma_9 * VA_{it} + v_{it}$$

$$v_{it} = u_i + w_t + e_{it} \qquad i = 1, \dots, N, \qquad t = 1, \dots, T$$

The subscript i denotes firm and t denotes year. Noticing high CRS measures or price error mean low efficiency, the hypothesis can be interpreted into the prediction of the signs of coefficients. The hypothesis about share structure variables, SOE, concentration and free float percentage, indicate $\gamma_1,\ \gamma_2,\ \gamma_3$ are positive, positive and negative respectively. Opening market and margin trading should improve efficiency, so $\gamma_4,\ \gamma_5,\ \gamma_6$ should be negative. The predictions on the control variables from previous papers indicate $\gamma_7,\ \gamma_8,\ \gamma_9$ are negative.

2.5.2 Event study

The second experiment in this paper is using event study to test the policy events covered in the sample period. The events are stock reform, opening

market to foreign investors and allowance of margin trading as introduced in section 2.

The event day of stock reform is chosen as the day when the reform plan is officially announced and the stock restarts to trade. Since every firm has its own stock reform procedure, the event day for each firm varies. To capture the whole picture around the events and make the results convincing, this paper tests several event windows: 5 days, 10 days, 15 days, 30 days, 45 days, 60 days, 90 days and 250 days before and after the event day but not including event day. Each event window is symmetric around the event dates, including the number of trading days before and after the event but not the event day. The various event windows can control the short-term and mid-term firm characteristics. The comparable measure is the average premium for each firm. The criterion is the significance of premium difference between before and after the event.

The event study of margin trading follows the same idea and procedure as the study of stock reform, but the sample firms are the firms in the list allowed to be margin traded. The event date is March 31st 2010, on which the stocks in the list can be margin traded for the first time. The event windows are the same as stock reform study: 5 days, 10 days, 15 days, 30 days, 45 days, 60 days, 90 days and 250 days before and after the event day but not including event day.

The event study of QFII also follows the same idea and procedure, but since the policy is applied for the whole market, the sample firms are all the firms listed as A-shares. The event dates are May 27th 2003, May 30th 2007 and April

3rd 2012, on which regulators release the quotas. The event windows are 5 days, 10 days, 15 days, 30 days, 45 days, 60 days, 90 days and 250 days before and after the event days but not including event days.

It should be noted that among the three policy events studied in this paper, opening market policy change can be represented by QFII quota, and margin trading can be represented by borrowed money balance and stock balance, so these two events can be studied with both regression and event study method. However, stock reform cannot be directly represented by any variable, so event study is the only way to check its effect on efficiency.

2.6 Results

2.6.1 Price efficiency in China

Table 2.1 shows the means of various price efficiency measures year by year in Chinese market. Hasbrouck price errors are around 0.4, which means there are around 40% of price change are not explained by random walk. Comparing with Boehmer and Wu (2013) finding that the daily average ratio of 1,361 NYSE-listed common stocks from January 2005 to December 2007 is 9.5%, the price error in Chinese markets is around 4 times larger than that in US market, and thus market efficiency is lower. The next four columns are description of the lag return prediction of current return. To be specific, the columns are results of regression models without control variable, with value order imbalance control, with volume order imbalance control and with both value

order imbalance and effective spread respectively. The upper part is CRS lower bound, and the lower part is CRS effective time as defined in part 3. The unit of the lower bound and effective time is minute, which means the stock becomes efficient generally between 10 minutes and 50 minutes for lower bound and between 30 minutes and 150 minutes for effective time. The following four columns are description of the lag order imbalance prediction of current return, which are regression models of value order imbalance without control variable, value order imbalance with return control, volume order imbalance without control variable and volume order imbalance with return control respectively. The structure is same as that of return prediction: the upper part is CRS lower bound, and the lower part is CRS effective time. The lower bounds spread between 70 minutes and 200 minutes, while effective times are even longer between 100 minutes and 220 minutes.

(Table 2.1)

The pioneer work in this kind of measure, CRS(2005), tests speed of convergence to market efficiency by examining 150 of the largest and actively traded NYSE firms and finds that the lower bound is between 10 minutes to 30 minutes. The following papers explicitly stating the efficiency time are: Visaltanachoti and Yang (2010) testing NYSE-listed foreign stocks finds out 30 minutes to 60 minutes are the efficiency time for the sample; and Chung and Hrazdil (2012) finds out small firms take 20 minutes longer than large firms in NYSE and on Arca. Comparing the statistics in US markets, it is easy to say that stock efficiency in China is worse than that in US, as the speed of convergence

to price efficiency in China is about 4 times longer than that in US. After examining both kinds of efficiency measures, it comes to an interesting conclusion that price efficiency in China is about 4 times worse than that in US.

(Figure 2.1)

Figure 2.1plots the efficiency measures through years. Graph A is the graph for Hasbrouck price error. It decreases through time even through not very monotonous. Graph B is the graphs for lower bounds of CRS lag return predictions. All the four models are plotted in the same graph, and it is easy to see they follow the same trend, which is slightly decreases but not significant. Graph C is the graphs for effective times of CRS lag return predictions, and they similar to the graphs in Graph B, but more stable and the downward trends almost disappear. Graph D and graph E are the graphs of lower bounds and effect times, and there are no downward trends either. In sum, only Hasbrouck price error shows improvement in efficiency, while the CRS measures are not, so price efficiency doesn't significantly improve as stock market develops fast in China.

The following parts study the effect of various factors on price efficiency.

2.6.2 Regression results

Table 2.2 reports the results of testing first central hypothesis together with the control variable hypothesis. The two-way fixed effect regression contains all the observations in the paper, which are all the firms having both A-shares

listed between 1999 and 2013. The dependent variables are the efficiency measures. Panel A is the results of Hasbrouck Price Error, and panel B and C are the results of CRS measures, CRS lower bound and effective time of return prediction of value and volume order imbalance, which follow CRS (2005) and Chung and Hrazdil (2012). The explanatory variables in every panel are same, namely, state owned share percentage (SOE), free float share percentage (float), share concentration (concnetration), QFII quota and QDII quota (QFII and QDII), money balance and stock balance borrowed (money_bal and stock_bal) and the control valuables price (PRC), market value (MV) and trading volume (VA). All the variables are firm-annual variables. The table contains a series of univariate and then one multivariate specification with coefficient estimates, associated t-statistics and the R-square.

(Table 2.2)

The results show that state-owned share percentage and concentration are consistently significantly negative for all the three measures at 99% confidence in both univariate and multivariate regressions even controlling the important variables in the previous literature, meaning firms with high state-owned shares and with concentrate share structure tend to trade with price efficiency. These results strongly support the central hypothesis that the firms with high information asymmetry leads to low price efficiency on market. Free float percentage is significantly negative in univariate regressions, but not significant in multivariate regressions in all three measures, which means free float percentage has effect on price efficiency, but not as strong as the

information asymmetry factors. The event variables are not as consistent as the share ownership factors. Opening up market through QFII program doesn't improve price efficiency, because QFII quota increases CRS efficiency time significantly and also increases price error in multivariate regression. The results of margin trades are not monotonous either. The borrowed money balance and stock balance are indeed lower CRS efficiency time, but not Hasbrouck price error. The control variables are significantly affect price efficiency in term of the three measures in Chinese market as in US markets: price coefficient is negative means firms with high price have lower price error and shorter CRS efficiency time and thus better price efficiency; market value coefficient is negative means large firms have better price efficiency; trading volume coefficient is negative means active trading leads better price efficiency.

2.6.3 Event study results

The effects of the policies, such as stock reform, opening stock market and allowance of margin trading, are studied in this part. The efficiency measures are same as the ones in the regression: Hasbrouck price error, CRS lower bound and effective time of return prediction of order imbalance. To study the effect of policies, the sample period will be separated into before and after the event by the event date, and the results are the comparisons between the two. The sample covers all the A-shares affected by the policies. The event windows in each table include 5 days, 10 days, 15 days, 30 days, 45 days, 60 days, 90 days and 250 days before and after the events. The table reports average premium across the firms before and after the event dates (before and after), average of

the difference between before and after the events of the firm (Diff), and associated t-statistics (t).

(Table 2.3)

Table 2.3 shows the results of stock reform effect. The event date for each firm is the day when trading restarts after the final plan is announced and the compensation to tradable shareholders are paid out. The firms have their own schedule of stock reform, so the event days for each firm are different. The event dates of stock reform span from 2005 to 2010, but more than 90% of the firms have announced the reform plan and finished compensation by the end of 2006. During the negotiation periods before the event days, the non-tradable shareholders and tradable shareholders discuss based on the whole situation of the company to form a detailed reform plan. The non-tradable shareholder expect to have the shares to trade in one to three years after reform plan determined, so they have much more motivation to participate into secondary market, and thus bring more information into market, and thus price efficiency improves. The table shows the four out of five efficiency measures decrease after non-tradable shareholders participation for 10 days to 45 days event windows, and t-statistics indicates the decrease is quite significant in those event windows. However, the effect seems to weaken, and disappears in 90 days window. It can be interpreted as the controlling non-tradable shareholders fully release their information in 90 days. It should e noted that the magnitude of CRS efficiency times, including lower bound and effective time, increase through time, however, as explained in part 3, the increase should be largely due to increase in the

number of observations, so it doesn't mean price efficiency is worse in the longer sample periods.

(Table 2.4)

Margin trading and QFII program can also be tested in this method. Table 2.4 shows the results of margin trading. The event date is March 31st 2010, on which the stocks in the list can be margin traded for the first time. The samples are the firms in the list allowed to be margin traded. The table structure is same as table 3. The results mean most of the efficiency measures decreases after the firms allowed to be margin traded, which is consistent with the studies in US markets (Boehmer and Wu (2013)). Table 2.5 shows three QFII policy effects. The event dates are May 27th 2003, May 30th 2007 and April 3rd 2012, on which regulators release the quotas to foreign institutions, and sample firms are all the firms listed as A-shares. The comparisons between before and after the events show that the efficiency worse in the first two events and effect of the third one is mixed. The results are consistent with QFII quota tests in two way fixed effect regressions that participation of foreign investors cannot improve price efficiency.

(Table 2.5)

2.7 Conclusions

Financial market efficiency is long and continuing debate for both academia researchers and industry practitioners. Comparing with the tons of

paper using daily or weekly data to weak-form efficiency (Fama (1970)), CRS(2005) show it takes only less than one hour for US stocks to be efficient, so the intraday data based efficiency measures offers better evidences on weak-form market efficiency than the traditional weekly data based efficiency measure. Besides that, it is believed that market efficiency in emerging markets is worse than that in developed markets, but most of papers focus on the developed markets, and the detailed conditions of efficiency in the emerging markets and comparison with developed counterparts are still not clear.

This paper uses the intraday data based efficiency measures such as Hasbrouck Price Error (1999), and CRS (2005) related measures to investigate the Chinese stock markets to see the how fast the stocks converge to price efficiency. One of the findings in this paper is that it takes between 70 minutes and 200 minutes for Chinese listed stocks converge to price efficiency. Comparing the statistics in US markets, which are 15 minutes to 60 minutes to be efficient, it is evident that stock efficiency in China is worse than that in US, as the speed of convergence to price efficiency in China is about 4 times longer than that in US. Similarly, Hasbrouck Price Error measure (1993) shows that around 40% price change is not accounted to random walk, which is also about 4 times higher than that in US. The sample in this paper spans from 1999 to 2013, and there is not significant improvement in market efficiency in term of the measures applied during the sample period.

This paper also tries to indentify the factors affecting the stock price efficiency. The predicting variables from the papers in US, such as price level,

firm size and trading volume, are also play significant role in China as in US. Controlling these effects, this paper finds out that Share ownership of the firms is quite important to determine the market efficiency as the firms with high state-owned share percentage and high concentrated shares have low price efficiency. More free-float shares also help to decrease convergence time but the effect is not as strong as SOE and concentration. Since SOE percentage and share concentration are related with information asymmetry, the results can be interpreted as low information asymmetry from firm share structure tend to help stock price incorporate new information fast and thus converge to price efficiency in shorter time.

Given Chinese unique institutional background of financial market, this paper further test several related institutional changes happened in the sample period, including share ownership reform, implementation of QFII policy and lift of short-sell ban. The event studies show decrease in SOE, increase free float share by stock reform and margin trading significantly shorten the efficiency convergence time and thus improve price efficiency. However, opening up A-share market by QFII (Qualified Foreign Institutional Investors) policy doesn't improves market efficiency in term of the measures in this paper, and participation of foreign investors longer the efficiency convergence time in two out three quota releases, which is contrast to regulators' expectation.

Even through the policy effects are tested in China, which didn't happen in most markets around world, the results still have important policy implications for both emerging markets and developed markets. For the emerging markets like

China, the stock markets are developing and far from mature, and there are some institutional problems which leave chance for over speculation or market manipulation among other problems. To keep justice in the market and protect small investors, market administrators, for example CSRS in China, impose regulations to curb over trading activities, however, the regulations put frictions into the markets at same time, so the effects of the regulations are important for the administrators. For the western developed markets, the effects of regulations are also important, as most regulators around the world intervened the stock markets during the 2007–09 crises by imposing bans on short selling at different dates in different countries, on different sets of targeted stocks, and the results of the intervention have been wildly studied (Boehmer and Wu (2013), Baber and Pagano (2013), Marsh and Payne (2012), Bris, Goetzmann and Zhu (2007)). The results of this paper offer more possible changes of regulations if there is extreme case happening in the developed markets, besides short selling ban.

Table 2. 1 Statistic description

This table is the statistic description of the variables in the paper. The sample period is from 1999 to 2013. The sample firms are all the firms listed as A-share. Panel A the means of various price efficiency measures year by year. The upper part of the first column is Hasbrouck price error. The lower part of the first column is the number of firms in each year. The next four columns are description of the lag return prediction of current return: regression models without control variable, with value order imbalance control, with volume order imbalance control and with both value order imbalance and effective spread respectively. The upper part is CRS lower bound, and the lower part is CRS effective time. The last four columns are description of the lag order imbalance prediction of current return: regression models of value order imbalance without control variable, value order imbalance with return control, volume order imbalance without control variable and volume order imbalance with return control respectively. The upper part is CRS lower bound, and the lower part is CRS effective time. Panel B is the statistics about all the variables introduced in part 4, including state owned share percentage (SOE), free float share percentage (float), share concentration (concentration), QFII quota (QFII), borrowed money balance and stock balance (money_bal and stock_bal), stock price (PRC), firm size (MV) and trading volume (VA). Panel C is the correlation of the variables.

Panel A: Efficiency measure description

	Price Error (%)	lag return prediction (minute)				lag OIB prediction (minute)			
Year	PE	LB no control	LB control OIB_value	LB control oib_vol	LB control oib liquidity	oib_value LB no control	oib_value LB control ret	oib_vol LB no control	oib_vol LB control ret
1999	0.455	24.805	28.322	28.779	32.785	129.919	161.113	126.091	161.650
2000	0.427	16.304	22.169	22.254	28.284	184.887	192.779	185.454	192.722
2001	0.447	22.669	28.676	28.663	39.270	217.353	223.936	216.297	224.147
2002	0.453	16.088	22.288	22.816	27.596	217.791	225.104	217.953	225.303
2003	0.465	16.626	18.184	21.369	23.754	74.778	175.447	75.257	187.682
2004	0.461	22.808	25.925	25.943	27.364	211.410	211.762	211.674	211.894
2005	0.456	19.740	22.780	22.758	19.359	163.319	164.062	164.022	164.941
2006	0.426	10.011	13.366	13.377	14.989	155.533	156.126	156.041	156.972
2007	0.386	42.170	42.286	42.424	47.714	160.755	161.151	160.993	161.547
2008	0.389	41.691	42.678	42.544	47.437	166.621	167.573	167.916	169.172
2009	0.384	22.576	23.395	23.398	22.874	133.448	133.636	133.663	133.806
2010	0.374	15.800	15.849	15.849	16.606	142.501	142.842	142.877	143.278
2011	0.401	14.198	15.761	15.756	15.382	165.532	166.184	166.110	167.101
2012	0.417	13.927	15.890	15.892	22.349	193.595	194.157	194.255	194.817
2013	0.412	13.146	14.178	14.168	22.047	195.553	196.403	196.451	197.253
year	Number of firms	EFF no control	EFF control OIB_value	EFF control oib_vol	EFF control oib liquidity	oib_value EFF no control	oib_value EFF control ret	oib_vol EFF no control	oib_vol EFF control ret
1999	919	36.686	40.155	40.407	47.997	140.451	167.538	138.097	167.934
2000	1048	33.452	34.301	33.552	45.281	186.909	193.743	187.717	193.686

2001	1117	32.197	40.526	42.524	56.768	218.604	224.402	217.377	224.534
2002	1200	38.272	47.672	48.441	53.547	221.348	226.231	221.659	226.431
2003	1263	33.877	34.525	36.744	42.021	106.171	178.192	108.046	189.347
2004	1361	46.725	48.605	48.614	53.198	212.456	212.770	212.682	212.968
2005	1365	28.910	32.408	32.366	38.004	166.471	167.238	167.174	168.117
2006	1412	31.613	34.809	34.815	47.077	156.422	156.983	156.930	157.862
2007	1507	131.062	131.207	131.163	134.603	162.719	163.115	162.937	163.491
2008	1572	137.633	138.361	138.295	140.785	166.783	167.735	168.077	169.334
2009	1677	65.642	68.632	68.642	68.669	134.780	134.999	134.994	135.140
2010	1719	33.522	33.464	33.432	38.784	144.062	144.372	144.372	144.782
2011	2226	28.868	30.570	30.540	34.210	166.571	167.262	167.147	168.151
2012	2456	57.387	58.411	58.488	68.270	193.858	194.420	194.518	195.079
2013	2469	68.730	69.717	69.715	79.487	195.802	196.652	196.700	197.502

Panel B: Summary description of explanatory variables

Variable	MEAN	STD	Median	Skewness	Kurtosis
SOE (%)	0.205	0.250	0.026	0.777	-0.893
float (%)	0.571	0.266	0.497	0.476	-1.116
concentration	0.281	0.142	0.253	0.779	0.255
QFII ($millions)	160.030	153.591	130.180	0.901	-0.332
money_bal (RMB millions)	235.294	422.166	124.231	6.378	63.476
stock_bal (thousands)	313.823	965.237	51.266	11.964	196.137
prc	12.269	10.268	9.576	4.470	41.678
MV (RMB millions)	8232	5869	2750	49	3711
VA (RMB millions)	52	119	23	13	330

Panel C: Correlation of the variables

	pe	oib_value EFF	oib_vol EFF	SOE	float	concentration	QFII	money_bal	stock_bal	prc	MV	VA
pe	1											
oib_value EFF	0.164	1										
oib_vol EFF	0.172	0.961	1									
SOE	0.175	0.041	0.047	1								
float	-0.208	-0.064	-0.070	-0.483	1							
concentration	0.088	0.020	0.022	0.474	-0.396	1						
QFII	-0.243	0.002	-0.004	-0.448	0.427	-0.110	1					
money_bal	-0.022	-0.072	-0.074	-0.060	0.124	-0.019	0.200	1				
stock_bal	0.020	-0.053	-0.054	-0.041	0.086	-0.009	0.129	0.642	1			
prc	-0.235	-0.128	-0.134	-0.089	-0.144	0.054	0.056	0.049	-0.002	1		
MV	0.029	-0.058	-0.060	0.042	0.020	0.115	0.033	0.121	0.118	0.067	1	
VA	-0.178	-0.206	-0.212	-0.045	0.156	-0.015	0.152	0.313	0.211	0.200	0.372	1

Table 2. 2 Two-way fixed effect regression for the whole sample period

This table shows the results of two-way fixed effect regression (firm-fixed effect and year-fixed effect). The sample period is between 1999 and 2013. The dependent variables are Hasbrouck price error, CRS effective times of value order imbalance prediction and of volume order imbalance prediction in the three panel tables. The explanatory variables are same for the three: state owned share percentage (SOE), free float share percentage (float), concentration (concentration), QFII quota and QDII quota (QFII and QDII), price (PRC), market value (MV) and trading volume (VA), borrowed money balance and stock balance (money_bal and stock_bal). Two-way fixed effect estimator coefficients are reported and Heteroskedasticity-robust t-statistics are reported in parentheses below the coefficients. “R_square” is the R-square for each model. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Dependent variable: Price Error

SOE	float	concentration	QFII	money_bal	stock_bal	prc	MV	VA	R_square
0.054***									36.84%
(32.84)									
	-0.058***								36.83%
	(-47.33)								
		0.141***							36.82%
		(33.36)							
			-0.066***						36.82%
			(-30.18)						
				-0.0033					36.83%
				(-1.12)					
					0.173				36.83%
					(1.29)				
						-0.0010***			36.83%
						(-23.59)			
							-0.011***		36.89%
							(-9.91)		
								-0.012***	36.82%
								(-39.14)	
0.018***	-0.011	0.018***	0.180***	-0.00048	0.324**	-0.0003***	0.021**	-0.003***	37.33%
(8.66)	(-0.61)	(4.22)	(48.31)	(-1.49)	(2.23)	(-9.99)	(-2.08)	(-10.06)	

Panel B: Dependent variable: OIB_value prediction

SOE	float	concentration	QFII	money_bal	stock_bal	prc	MV	VA	R_square
21.301***									16.34%
(8.97)									
	-11.064***								15.72%
	(-6.08)								
		70.864***							15.99%
		(11.65)							
			0.0169***						15.81%
			(5.40)						
				-1.300***					15.75%
				(-3.15)					
					-46.557**				15.76%
					(-2.45)				
						-0.889***			15.64%
						(-15.39)			
							-10.379***		15.67%
							(-6.49)		
								-11.770***	15.64%
								(-26.93)	
13.962***	-25.082	22.872***	0.183***	-2.127***	-26.870***	-0.0963	3.892**	-7.798***	17.39%
(4.07)	(-0.87)	(3.25)	(30.15)	(-4.02)	(-1.14)	(-1.59)	(-2.37)	(-15.82)	

Panel C: Dependent variable: OIB_vol prediction

SOE	float	concentration	QFII	money_bal	stock_bal	prc	MV	VA	R_square
23.737***									16.60%
(10.07)									
	-12.750***								15.91%
	(-7.06)								
		75.037***							16.18%
		(12.43)							
			0.0141***						16.00%
			(4.56)						
				-1.360***					15.94%
				(-3.32)					
					-50.446***				15.95%
					(-2.67)				
						-0.951***			15.82%
						(-16.58)			
							-10.854***		15.85%
							(-6.83)		
								-12.189***	15.82%
								(-28.13)	
15.158***	-39.733	23.391***	0.184***	-2.055***	-30.085	-0.147**	3.976**	-7.942***	17.71%
(4.46)	(-1.38)	(3.36)	(30.75)	(-3.93)	(-1.29)	(-2.48)	(-2.45)	(-16.28)	

Table 2. 3 Event study _ stock reform

This table is the results of event studies on the price efficiency measures change around 5 times of IPO halt starts. The sample covers all the A-shares listed during the event windows. The event day is the day when the reform plan is officially announced and the stock restarts to trade. The event periods are 5 days (5d), 10 days (10d), 15 days (15d), 30 days (30d), 45 days (45d), 60 days (60d) and 90 days (90d) before and after the event dates. The columns “before”, “after” and “Diff” are the average of A-H price disparity before, after the events and the difference between before and after respectively. The columns “t” is the t-statistics of the difference of the averages between before and after the events. *,**,*** represent 10%, 5% and 1% significance of difference.

Event window (days)	Measure	Before	After	Diff (after - before)		t-stat
5	value oib_EFF_TIME	25.6629	16.3218	-8.2835	***	-5.56
5	value oib_LB	16.5280	7.4880	-7.7791	***	-6.94
5	vol oib_EFF_TIME	25.9059	16.4035	-8.4470	***	-5.67
5	vol oib_LB	16.5397	7.4761	-7.7990	***	-6.96
5	Price Error	0.4213	0.4164	-0.0057		-1.66
10	value oib_EFF_TIME	36.4755	19.3521	-15.0877	***	-9.40
10	value oib_LB	28.2893	12.2727	-13.9035	***	-10.10
10	vol oib_EFF_TIME	36.3783	19.4059	-15.0299	***	-9.37
10	vol oib_LB	28.1960	12.3285	-13.8477	***	-10.04
10	Price Error	0.4187	0.4158	-0.0006		-0.21
15	value oib_EFF_TIME	40.0117	23.1061	-14.8983	***	-9.23
15	value oib_LB	32.0568	15.9450	-14.1906	***	-9.92
15	vol oib_EFF_TIME	40.0136	23.0622	-14.9442	***	-9.25
15	vol oib_LB	32.0568	15.9330	-14.2026	***	-9.93
15	Price Error	0.4186	0.4166	-0.0007		-0.27
30	value oib_EFF_TIME	43.8500	35.6519	-6.0825	***	-3.64
30	value oib_LB	37.2650	27.3445	-7.7273	***	-5.00
30	vol oib_EFF_TIME	43.7179	35.6479	-5.9510	***	-3.57
30	vol oib_LB	37.2572	27.3206	-7.7432	***	-5.02
30	Price Error	0.4208	0.4184	-0.0013		-0.56
45	value oib_EFF_TIME	53.0012	44.0670	-6.6089	***	-3.63
45	value oib_LB	44.7824	35.2951	-7.0415	***	-4.08
45	vol oib_EFF_TIME	53.0653	44.2823	-6.4115	***	-3.51
45	vol oib_LB	44.8135	35.4864	-6.8341	***	-3.94
45	Price Error	0.4252	0.4197	-0.0046	**	-2.28
60	value oib_EFF_TIME	59.3184	54.1069	-3.0044		-1.54
60	value oib_LB	51.6344	45.9290	-3.3971	*	-1.76
60	vol oib_EFF_TIME	59.3978	54.2843	-2.9087		-1.49
60	vol oib_LB	51.5840	46.0965	-3.1778		-1.65
60	Price Error	0.4278	0.4191	-0.0079	***	-4.34
90	value oib_EFF_TIME	73.7442	73.2416	1.5829		0.74
90	value oib_LB	65.5448	65.8054	2.6077		1.19

90	vol oib_EFF_TIME	74.0050	73.4211	1.4932		0.69
90	vol oib_LB	65.7767	65.9848	2.5478		1.16
90	Price Error	0.4326	0.4178	-0.0144	***	-8.75

Table 2. 4 Event study _ margin trading

This table is the results of event studies on the price efficiency measures change around allowance of margin trading in 2010. The sample covers all the A-shares listed during the event windows. The event date is March 31st 2010, on which the stocks in the list can be margin traded for the first time. The event periods are 5 days (5d), 10 days (10d), 15 days (15d), 30 days (30d), 45 days (45d), 60 days (60d) and 90 days (90d) before and after the event dates. The columns “before”, “after” and “Diff” are the average of A-H price disparity before, after the events and the difference between before and after respectively. The columns “t” is the t-statistics of the difference of the averages between before and after the events. *,**,*** represent 10%, 5% and 1% significance of difference.

Event window (days)	Measure	Before	After	Diff (after - before)		t-stat
5	Price Error	0.3929	0.3984	0.0038		1.06
5	value oib_LB	7.1339	5.0000	-2.1339		-1.50
5	vol oib_LB	7.1339	5.0000	-2.1339		-1.50
5	value oib_EFF_TIME	14.8640	13.7552	-1.1088		-0.44
5	vol oib_EFF_TIME	14.8954	13.8494	-1.0460		-0.41
10	Price Error	0.3915	0.3996	0.0091	***	3.32
10	value oib_LB	13.7657	9.3096	-4.4561	**	-2.69
10	vol oib_LB	13.9540	9.3096	-4.6444	***	-2.78
10	value oib_EFF_TIME	20.3243	18.6925	-1.6318		-0.65
10	vol oib_EFF_TIME	20.4498	18.6925	-1.7573		-0.70
15	Price Error	0.3892	0.3977	0.0083	***	3.22
15	value oib_LB	19.7071	13.0753	-6.6318	***	-3.54
15	vol oib_LB	19.9582	13.0753	-6.8828	***	-3.60
15	value oib_EFF_TIME	25.0418	22.8975	-2.1444		-0.79
15	vol oib_EFF_TIME	25.7322	22.8975	-2.8347		-1.03
30	Price Error	0.3902	0.3951	0.0051	**	2.50
30	value oib_LB	32.9707	20.3138	-12.6569	***	-5.13
30	vol oib_LB	32.9707	20.3138	-12.6569	***	-5.13
30	value oib_EFF_TIME	39.9372	26.1192	-13.8180	***	-4.65
30	vol oib_EFF_TIME	39.9372	26.1192	-13.8180	***	-4.65
45	Price Error	0.3905	0.3914	0.0010		0.56
45	value oib_LB	37.8452	22.9707	-14.8745	***	-6.17
45	vol oib_LB	38.2845	22.9707	-15.3138	***	-6.28
45	value oib_EFF_TIME	45.7950	29.1736	-16.6213	***	-5.57
45	vol oib_EFF_TIME	45.6381	29.1736	-16.4644	***	-5.56
60	Price Error	0.3918	0.3927	0.0011		0.77
60	value oib_LB	46.8410	25.1255	-21.7155	***	-7.63
60	vol oib_LB	46.8410	25.1255	-21.7155	***	-7.63
60	value oib_EFF_TIME	55.1987	30.0000	-25.1987	***	-8.08
60	vol oib_EFF_TIME	55.3870	30.0000	-25.3870	***	-8.13
90	Price Error	0.3948	0.3931	-0.0013		-1.00
90	value oib_LB	60.6695	29.2259	-31.4435	***	-9.43

90	vol oib_LB	60.9205	29.2259	-31.6946	***	-9.47
90	value oib_EFF_TIME	66.7259	34.3096	-32.4163	***	-9.71
90	vol oib_EFF_TIME	67.1025	34.3096	-32.7929	***	-9.79

Table 2. 5 Event study _ QFII

This table is the results of event studies on the price efficiency measures change around three time QFII releases by Chinese regulators. The sample covers all the A-shares listed during the event windows. The event dates are May 27th 2003, May 30th 2007 and April 3rd 2012, on which regulators release the quotas to foreign institutions. The event periods are 5 days (5d), 10 days (10d), 15 days (15d), 30 days (30d), 45 days (45d), 60 days (60d) and 90 days (90d) before and after the event dates. . Panel A is statistics of the price efficiency measures around the first QFII release. The columns “before”, “after” and “Diff” are the average of A-H price disparity before, after the events and the difference between before and after respectively. The columns “t” is the t-statistics of the difference of the averages between before and after the events. *,**,*** represent 10%, 5% and 1% significance of difference. Panel B and C are the results of the other two QFII quota releases, and they are of the same structure of panel A, but the event dates are May 30th 2007 and April 3rd 2012 respectively.

Panel A: first QFII quota release (May 27th 2003)

Event window (days)	Measure	Before	After	Diff (after - before)		t-stat
5	Price Error	0.4500	0.4260	-0.0244	***	-7.16
5	value oib_LB	3.5505	4.6909	1.1413	*	1.78
5	vol oib_LB	3.4962	4.6825	1.1873	*	1.86
5	value oib_EFF_TIME	17.3580	18.5359	1.2040		0.84
5	vol oib_EFF_TIME	16.6813	16.5831	-0.0732		-0.05
10	Price Error	0.4417	0.4323	-0.0098	***	-3.85
10	value oib_LB	6.5957	14.7164	8.1328	***	8.11
10	vol oib_LB	6.8254	14.8290	8.0159	***	8.07
10	value oib_EFF_TIME	14.9436	29.0784	14.1708	***	10.80
10	vol oib_EFF_TIME	15.2715	29.4058	14.0727	***	10.66
15	Price Error	0.4351	0.4431	0.0077	***	3.55
15	value oib_LB	14.2523	16.1417	1.9131	*	1.73
15	vol oib_LB	14.6115	16.1625	1.5748		1.37
15	value oib_EFF_TIME	22.3559	30.5542	8.2581	***	5.82
15	vol oib_EFF_TIME	22.4290	30.5458	8.1767	***	5.64
30	Price Error	0.4300	0.4561	0.0270	***	13.57
30	value oib_LB	18.6836	33.1784	14.5280	***	8.99
30	vol oib_LB	19.3023	33.6598	14.3901	***	8.72
30	value oib_EFF_TIME	28.3804	55.3195	26.7836	***	14.74
30	vol oib_EFF_TIME	28.2205	57.0539	28.6905	***	15.53
45	Price Error	0.4243	0.4651	0.0425	***	23.73
45	value oib_LB	37.4525	52.6958	15.6042	***	7.34
45	vol oib_LB	37.0892	54.5507	17.8458	***	8.17
45	value oib_EFF_TIME	51.7692	71.3211	19.9833	***	9.28
45	vol oib_EFF_TIME	51.3295	73.6974	22.6938	***	10.34
60	Price Error	0.4318	0.4688	0.0387	***	24.31
60	value oib_LB	53.9068	77.2705	23.8125	***	9.51
60	vol oib_LB	55.2063	77.7213	22.9708	***	9.10

60	value oib_EFF_TIME	68.6304	94.1168	25.9146	***	10.73
60	vol oib_EFF_TIME	69.6060	95.4652	26.2896	***	10.82
90	Price Error	0.4437	0.4799	0.0381	***	24.01
90	value oib_LB	55.0288	97.5427	42.8268	***	16.11
90	vol oib_LB	80.5437	105.8259	25.7619	***	8.95
90	value oib_EFF_TIME	63.9642	112.7807	48.9779	***	19.69
90	vol oib_EFF_TIME	90.7249	120.1465	29.8147	***	11.16

Panel B Second QFII quota release (May 30th 2007)

Event window (days)	Measure	Before	After	Diff (after - before)		t-stat
5	Price Error	0.3836	0.4386	0.0433	***	3.87
5	value oib_LB	6.3872	59.7224	53.8499	***	25.59
5	vol oib_LB	6.4098	60.0666	54.1780	***	25.62
5	value oib_EFF_TIME	14.1673	89.3523	76.2010	***	35.34
5	vol oib_EFF_TIME	14.1447	89.8575	76.7383	***	35.49
10	Price Error	0.3882	0.4095	0.0133	*	1.92
10	value oib_LB	23.4804	88.9801	66.0891	***	29.57
10	vol oib_LB	23.4470	89.8748	67.0322	***	29.66
10	value oib_EFF_TIME	27.3981	99.0556	72.2062	***	32.21
10	vol oib_EFF_TIME	27.3592	100.1970	73.4057	***	32.49
15	Price Error	0.3848	0.3968	0.0113	**	2.41
15	value oib_LB	29.0478	96.9715	68.0475	***	28.65
15	vol oib_LB	29.1360	97.7323	68.7305	***	28.75
15	value oib_EFF_TIME	32.4173	106.6149	74.1741	***	31.64
15	vol oib_EFF_TIME	32.4816	107.5457	75.0538	***	31.85
30	Price Error	0.3862	0.3931	0.0048		1.31
30	value oib_LB	41.4145	114.3162	73.2127	***	29.50
30	vol oib_LB	41.4218	114.9602	73.9069	***	29.64
30	value oib_EFF_TIME	45.4934	122.1038	76.8021	***	31.57
30	vol oib_EFF_TIME	45.4751	122.9740	77.7530	***	31.85
45	Price Error	0.3893	0.3865	-0.0020		-0.76
45	value oib_LB	56.2545	119.7592	65.0950	***	27.01
45	vol oib_LB	56.2901	121.1395	66.4609	***	27.39
45	value oib_EFF_TIME	61.0210	126.4414	67.0252	***	28.40
45	vol oib_EFF_TIME	61.0157	127.9044	68.5172	***	28.88
60	Price Error	0.3914	0.3846	-0.0062	***	-2.94
60	value oib_LB	65.3012	119.3956	56.6655	***	23.75
60	vol oib_LB	64.9858	120.3827	57.9927	***	24.24
60	value oib_EFF_TIME	70.1736	125.3290	57.6255	***	24.58
60	vol oib_EFF_TIME	69.8370	126.5272	59.1891	***	25.24
90	Price Error	0.3879	0.3814	-0.0057	***	-3.36
90	value oib_LB	83.1744	130.3619	51.3070	***	21.57
90	vol oib_LB	83.1462	131.2052	52.2049	***	21.81
90	value oib_EFF_TIME	88.2645	136.8289	52.6032	***	23.12
90	vol oib_EFF_TIME	88.3316	137.7512	53.4848	***	23.41

Panel C Third QFII quota release (April 3rd 2012)

Event window (days)	Measure	Before	After	Diff (after - before)		t-stat
5	Price Error	0.3938	0.4070	0.0149	***	6.56
5	value oib_LB	2.2995	2.3064	0.1048		0.33
5	vol oib_LB	2.2995	2.2955	0.0939		0.30
5	value oib_EFF_TIME	36.1225	27.3684	-8.6179	***	-6.10
5	vol oib_EFF_TIME	36.2903	27.1421	-9.0131	***	-6.40
10	Price Error	0.4016	0.3991	-0.0025		-1.54
10	value oib_LB	7.5673	9.0797	1.2114	**	2.40
10	vol oib_LB	7.5825	9.1230	1.2397	**	2.46
10	value oib_EFF_TIME	33.7891	14.2573	-19.8630	***	-18.12
10	vol oib_EFF_TIME	33.9726	14.2995	-20.0043	***	-18.26
15	Price Error	0.3975	0.3976	0.0000		-0.01
15	value oib_LB	18.2437	12.2719	-6.2783	***	-8.38
15	vol oib_LB	18.4410	12.3065	-6.4413	***	-8.48
15	value oib_EFF_TIME	39.3495	16.7629	-22.8620	***	-21.21
15	vol oib_EFF_TIME	39.6292	16.7726	-23.1326	***	-21.32
30	Price Error	0.3952	0.3990	0.0036	***	3.59
30	value oib_LB	33.2786	27.4882	-6.0868	***	-5.74
30	vol oib_LB	33.5443	27.5182	-6.3232	***	-5.91
30	value oib_EFF_TIME	49.3089	33.4167	-16.2983	***	-13.18
30	vol oib_EFF_TIME	49.7052	33.4446	-16.6681	***	-13.40
45	Price Error	0.3952	0.4039	0.0086	***	10.02
45	value oib_LB	46.3519	44.0337	-2.7795	**	-2.08
45	vol oib_LB	46.7723	44.1830	-3.0524	**	-2.27
45	value oib_EFF_TIME	60.4237	52.2398	-8.7782	***	-6.27
45	vol oib_EFF_TIME	60.9789	52.4605	-9.1140	***	-6.47
60	Price Error	0.3971	0.4059	0.0089	***	10.87
60	value oib_LB	57.4796	58.3757	0.8009		0.55
60	vol oib_LB	57.8298	58.5409	0.6131		0.42
60	value oib_EFF_TIME	66.4686	67.1410	0.5203		0.36
60	vol oib_EFF_TIME	66.8210	67.4386	0.4685		0.33
90	Price Error	0.4007	0.4103	0.0101	***	12.78
90	value oib_LB	78.4419	96.1197	18.0473	***	10.02
90	vol oib_LB	79.2263	96.6848	17.8409	***	9.83
90	value oib_EFF_TIME	84.5071	107.6685	23.6237	***	14.15
90	vol oib_EFF_TIME	85.2818	108.3215	23.5172	***	13.98

Figure 2. 1 Efficiency measures through years

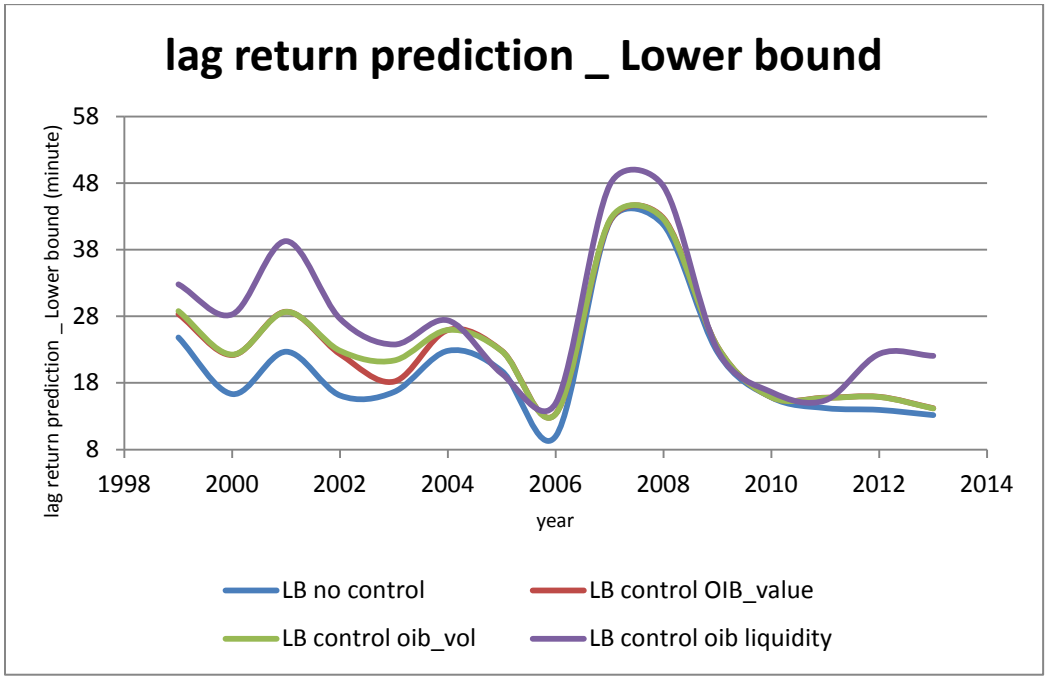
The figures plot the various price efficiency measures through years.

Panel A: Hasbrouck price Error (unit: %)

The figure plots Hasbrouck Price Error level through years.

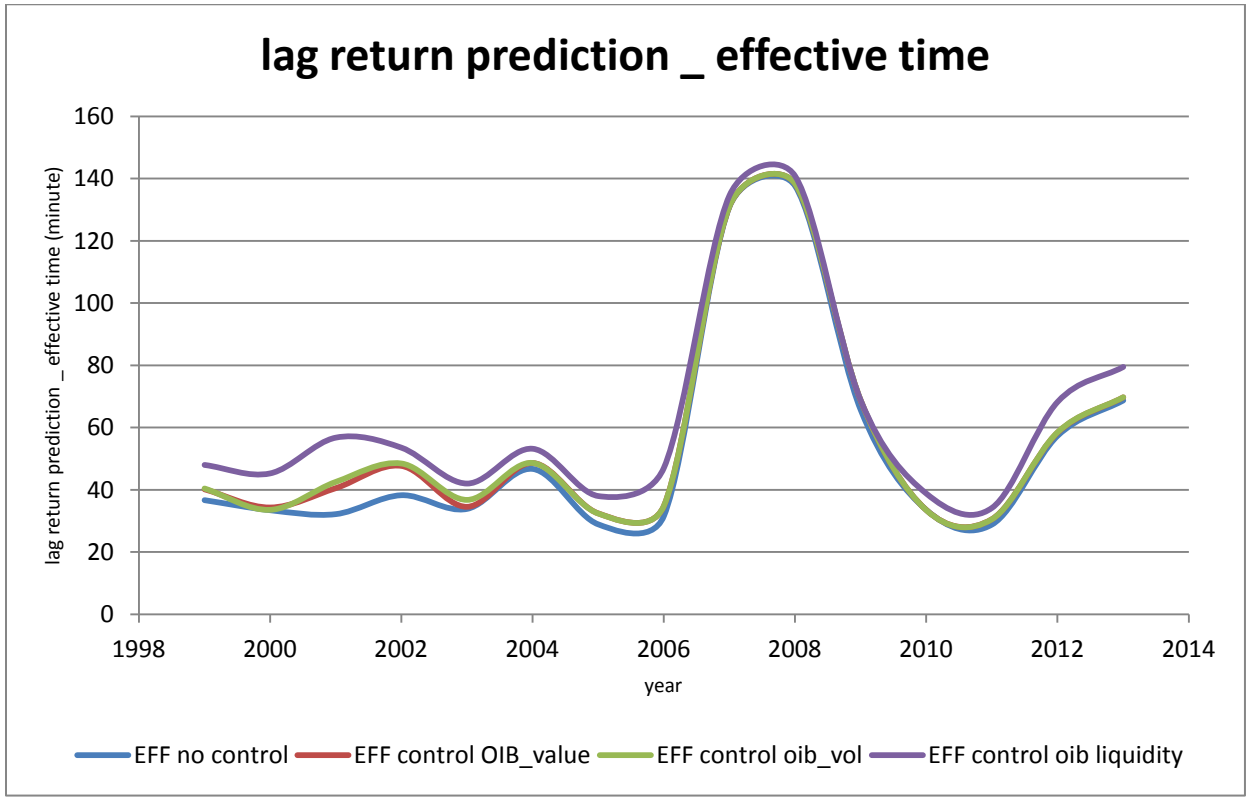
Panel B: Lower bound of lagged return prediction (unit: minute)

The figure plots lower bounds of lagged return prediction power on current return through years. The four lines are description of 4 models of the lag return prediction: regression models without control variable, with value order imbalance control, with volume order imbalance control and with both value order imbalance and effective spread respectively.



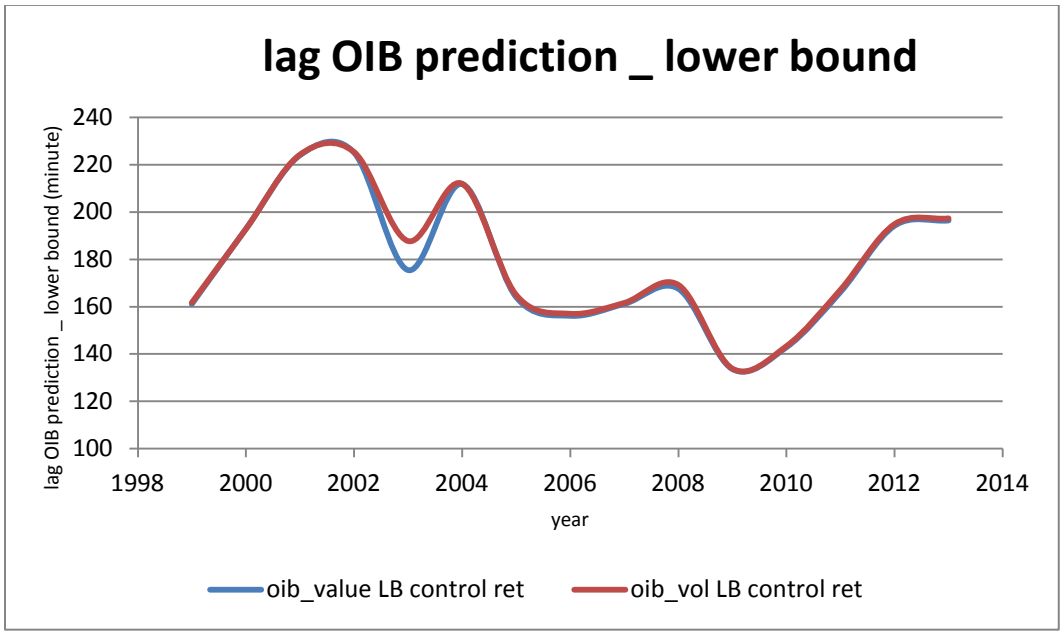
Panel C: Effective time of lagged return prediction (unit: minute)

The figure plots effective times of lagged return prediction power on current return through years. The four lines are description of 4 models of the lag return prediction: regression models without control variable, with value order imbalance control, with volume order imbalance control and with both value order imbalance and effective spread respectively.



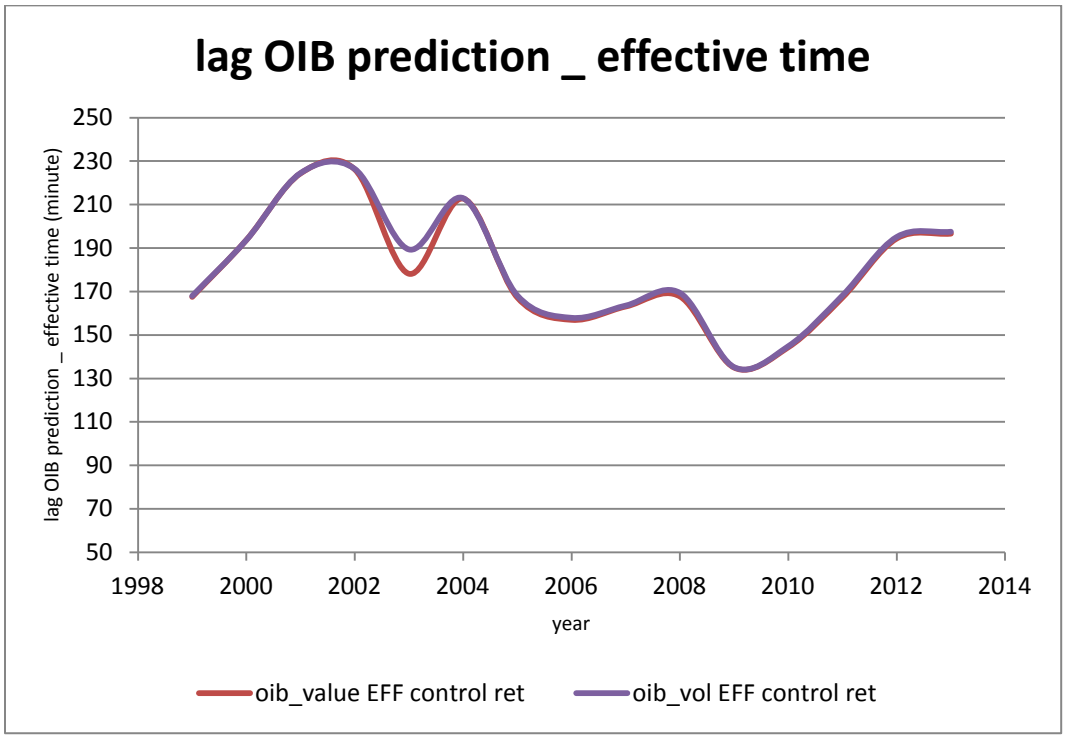
Panel D: Lower bound of lagged order imbalance prediction (unit: minute)

The figure plots lower bounds of lagged return prediction power on current return through years. The four lines are description of 2 models of the lagged value order imbalance and volume order imbalance prediction of current return with lagged returns, respectively.



Panel E: Effective time of lagged order imbalance prediction (unit: minute)

The figure plots effective times of lagged return prediction power on current return through years. The four lines are description of 2 models of the lagged value order imbalance and volume order imbalance prediction of current return with lagged returns, respectively.



REFERENCE

Agarwal, P., 2007. Institutional ownership and stock liquidity. Working Paper.

Agarwal, P., 2009. Institutional ownership, liquidity and liquidity risk. Ph.D. thesis, Cornell University.

Ahlgren, N., Sjo, B., Zhang, J., 2009. Panel cointegration of Chinese A and B shares. Applied Financial Economics 19, 1859–1871.

Arquette, G., Brown Jr., W., Burdekin, R., 2008. US ADR and Hong Kong H-share discounts of Shanghai-listed firms. Journal of Banking and Finance 32, 1916–1927.

Asquith, P., and L. Meulbroek. 1995. An empirical investigation of short interest. Working Paper.

Asquith, P., P.A. Pathak, and J. R. Ritter. 2005. Short interest, institutional ownership, and stock returns. Journal of Financial Economics 78:243–76.

Attig, N., W. Fong, Y. Gadhoum, L.H.P. Lang. 2006. Effects of large shareholding on information asymmetry and stock liquidity. Journal of Banking and Finance 30, 2875–2892.

Back, K., C. H. Cao, G. A. Willard. 2000. Imperfect competition among informed traders. Journal of Finance 55 (5), 2117-2155.

Back, K., C. H. Cao, G. A. Willard. 2000. Imperfect competition among informed traders. Journal of Finance 55 (5), 2117-2155.

Bailey, W. 1994. Risk and return on China's new stock markets: Some preliminary evidence. Pacific-Basin Finance Journal Volume 2, Issues 2–3, May 1994, Pages 243–260.

Ball, R., and P. Brown. 1968. An empirical evaluation of accounting income numbers. Journal of Accounting Research 6:159–78.

Beber, A., M. Pagano. 2013. Short-Selling Bans around the World: Evidence from the 2007–09 Crisis. Journal of Finance 68(1) 343–381.

Bekaert, G., and C. R. Harvey. 2002. Research in Emerging Markets Finance: Looking to the Future. Emerging Markets Review 3:429–48.

Beltratti, A., B. Bortolotti. 2006. The nontradable share reform in the Chinese stock market, working paper.

Benveniste, L. M., and P. A. Spindt. 1989. How investment bankers determine the offer price and allocation of new issues? Journal of Financial Economics 24, 343–361.

Benveniste, L. M., W. Y. Busaba, and W. J. Wilhelm. 2002. Information externalities and the role of underwriters in primary equity markets. Journal of Financial Intermediation 11, 61–86.

Benveniste, L.M., A.P. Ljungqvist, W.J. Wilhelm, X. Yu. 2003. Evidence of information spillovers in the production of investment banking services. Journal of Finance 58(2) 577–608.

Bernstein, P.L. 1987. Liquidity, Stock Markets, and Market Makers. Financial Management 16 58(2) 54-62.

Bhattacharya, U., H. Daouk, B. Jorgenson, and C. H. Kehr. 2000. When an Event Is Not an Event: The Curious Case of an Emerging Market. Journal of Financial Economics 55, 69–101.

Birtch, T.A., McGuinness, P.B., 2008. The 2001-2005 price convergence in the A- and H-shares of Chinese state- owned enterprises: a story of unprecedented economic, regulatory and political change. Journal of Financial Regulation and Compliance 16, 239–250.

Boehmer, E., C. M. Jones, and X. Zhang. 2008. Which shorts are informed? Journal of Finance 63:491–527.

Boehmea, R., G. Colak. 2012. Primary market characteristics and secondary market frictions of stocks. Journal of Financial Markets 15, 286–327.

Boehmer, and J. Wu. 2013. Short Selling and the Price Discovery Process. Review of Financial Studies 26:287–322.

Bris, A., W.N. Goetzmann, N. Zhu. 2007. Efficiency and the bear: short sales and markets around the world. Journal of Finance 62 (3), 1029–1079.

Brunnermeier, M. K., and L. H. Pedersen. 2005. Predatory trading. Journal of Finance 60:1825–63.

Burdekin, R.C.K., Redfern, L., 2009. Sentiment effects on Chinese share prices and savings deposits: the post-2003 experience. China Economic Review 20, 246–261.

Bushee, B., and T. Goodman. 2007. Which institutional investors trade based on private information about earnings and returns. Journal of Accounting Research 45, 289–321.

Bushee, B. J., H. G. Theodore. 2007. Which institutional investors trade based on private information about earnings and returns? Journal of Accounting Research 45 (2), 289-321.

Cai, C., McGuinness, P., Zhang, Q., 2011. The pricing dynamics of cross-listed securities: the case of Chinese A- and H-shares. Journal of Banking and Finance 35, 2123–2136.

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

Chan, K., A. Menkveld, and Z. Yang. 2007. The informativeness of domestic and foreign investors' stock trades: Evidence from the perfectly segmented Chinese market. Journal of Financial Markets 10, 391–415.

Chan K., A. J. Menkveld, Z. Yang. 2008. Information Asymmetry and Asset Prices: Evidence from the China Foreign Share Discount. The Journal of Finance 63:1, 159-196.

Chan, K.L., Kwok, K.H., 2005. Market segmentation and share price premium: evidence from Chinese stock markets. Journal of Emerging Market Finance 4, 43–61.

Chan, K., H.S. Tong, and S. Zhang. 2013. Trading Restriction, Tick Size and Price discovery: Evidence from a Natural Experiment in China, working paper.

Chaney, P. K., M. Faccio, D. Parsley. 2011. The quality of accounting information in politically connected firms. Journal of Accounting and Economics 51 (1), 58-76.

Chang, E.C., Y. Luo, J. Ren. 2013. Cross-listing and pricing efficiency: The informational and anchoring role played by the reference price. Journal of Banking and Finance 37:11, 4449-4464.

Chang, E.C. Y. Luo, J. Ren. 2014. Short-selling, margin-trading, and price efficiency: Evidence from the Chinese market. Journal of Banking and Finance 48, 411–424.

Chen, H., J. Chong, C. Lu, K. Wang. 2008. The effectiveness of regulatory policy changes on the volatility dynamics of Chinese stock markets. The Chinese Economy 41 (2), 5–23.

Chen, G.M., B.S. Lee, O. Rui. 2001. Foreign ownership restrictions and market segmentation in China's stock markets. The Journal of Financial Research 24, 133–155.

Chen, C.X., S.G. Rhee. 2010. Short sales and speed of price adjustment: evidence from the Hong Kong stock market. Journal of Banking and Finance 34 (2), 471–483.

Christophe, S. E., M. G. Ferri, and J. J. Angel. 2004. Short-selling prior to earnings announcements. Journal of Finance 59:1845–75.

Chordia, T., and B. Swaminathan. 2000. Trading volume and cross-autocorrelations in stock returns. Journal of Finance 55:913–35.

Chordia, T., R. Roll, and A. Subrahmanyam. 2005. Evidence on the speed of convergence to market efficiency. Journal of Financial Economics 76:271–92.

Chordia, T., R. Roll, and A. Subrahmanyam. 2008. Liquidity and market efficiency. Journal of Financial Economics 87:249–68.

Chung. D., K. Hrazdil. 2012. Speed of convergence to market efficiency: The role of ECNs. Journal of Empirical Finance 19: 702-720.

Chung, T., C. Hui, K. Li. 2013. Explaining share price disparity with parameter uncertainty: Evidence from Chinese A- and H-shares. Journal of Banking and Finance 37:3, 1073-1083.

Cumming, D., R. Dixon, W. Hou, E. Lee. 2013. Media coverage and foreign share discount puzzle in China. The European Journal of Finance 1-20.

Dechow, P.M., A. P. Hutton, L. Meulbroek, and R. G. Sloan. 2001. Short-sellers, fundamental analysis, and stock returns. Journal of Financial Economics 61:77–106.

Demsetz, H., 1968. The cost of transacting. Quarterly Journal of Economics 82 (1), 33-53.

Dennis, P., J. Weston. 2001. Who's informed? An analysis of stock ownership and informed trading. Working Paper.

Desai, H., K. Ramesh, S. R. Thiagarajan, and B. V. Balachandran. 2002. An investigation of the informational role of short interest in the NASDAQ market. Journal of Finance 57:2263–87.

Diamond, D.W., R.E. Verrecchia. 1987. Constraints on short-selling and asset price adjustment to private information. Journal of Financial Economics 18 (2), 277–311.

Diether, K. B., K. H. Lee, and I. M. Werner. 2008. Short-sale strategies and return predictability. Review of Financial Studies 22:575–607.

Domowitz, I., Glen, J., Madhavan, A., 1997. Market segmentation and stock price: Evidence from an emerging market. Journal of Finance 52, 1059–1085.

Doukas, J. A, L. Wang. 2013. Information asymmetry, price discovery, and the Chinese B-share discount puzzle. Pacific-Basin Finance Journal 21:1, 1116-1135.

Edmans, A. 2009. Blockholder Trading, Market Efficiency, and Managerial Myopia. The Journal of Finance 64(6): 2481–2513.

Errunza V. R, D. P. Miller. 2000. Market Segmentation and the Cost of the Capital in International Equity Markets. Journal of Financial and Quantitative Analysis, 35, pp 577-600.

Fama, E. F., and J. D. MacBeth. 1973. Risk, return and equilibrium: Empirical tests. Journal of Political Economy 71:607–36.

Fan P.H, T.J Wong. 2002. Corporate ownership structure and the informativeness of accounting earnings in East Asia. Journal of Accounting and Economics Volume 33, Issue 3, 401–425.

Fang, Z., X. Jiang. 2013. Effects of differences of opinions and short-sale constraints on the dual listed Chinese shares, China Finance Review International, Vol. 3 Iss: 1, pp.61 – 89.

Fernald, J., J.H. Rogers. 2002. Puzzles in the Chinese stock market. Review of Economics and Statistics 37 84 (3), 416–432.

Foerster, S. R., G. A. Karolyi. 1999. The Effects of Market Segmentation and Investor Recognition on Asset Prices: Evidence from Foreign Stocks Listing in the United States. The Journal of Finance, 54: 981–1013.

Foster, F. D., S. Viswanathan. 1996. Strategic trading when agents forecast the forecasts of others. Journal of Finance 51 (4), 1437-1478.

Fong, T., A. Wong, I. Yong. 2010. Share price disparity in Chinese Stock Markets. Journal of Financial Transformation 30, 23–31.

Foster, F. D., S. Viswanathan. 1996. Strategic trading when agents forecast the forecasts of others. Journal of Finance 51 (4), 1437-1478.

Geretto, E., R. Pauluzzo. 2012. Stock Exchange Markets in China: Structure and Main Problems. Transition Studies Review 19:1, 89-106.

Griffin, J, P. Kelly, F. Nardari. 2010. Do Market Efficiency Measures Yield Correct Inferences? A Comparison of Developed and Emerging Markets. Review of Financial Studies 23 (8): 3225-3277.

Goldstein, I., and A. Guembel. 2008. Manipulation and the allocational role of prices. Review of Economic Studies 75:133–64.

Guletekin, M. N., N. B. Guletekinand, A. Penati. 1989. Capital Controls and International Capital Market Segmentation: The Evidence from the Japanese and American Stock Markets. The Journal of Finance, 44: 849–869.

Guo, E., A. Keown. 2009. Privatization and non-tradable stock reform in China: The case of Valin Steel Tube and Wire Co., Ltd. . Global Finance Journal, 20(2), 191–208.

Hasbrouck, J., 1995. One security, many markets: Determining the contributions to price discovery. Journal of Finance 50, 1175–1199.

Hietala, P. T. 1989. Asset Pricing in Partially Segmented Markets: Evidence from the Finnish Market. The Journal of Finance, 44: 697–718.

Holden, C. W., A. Subrahmanyam. 1992. Long-lived private information and imperfect competition. Journal of Finance 47 (1), 247-270.

Hou, K., T.J. Moskowitz. 2005. Market frictions, price delay, and the cross-section of expected returns. Review of Financial Studies 18 (3), 981–1020.

Hou, W., E. Lee. 2012. Split Share Structure Reform, corporate governance, and the foreign share discount puzzle in China. The European Journal of Finance 1-25.

Huberman, G., G.W. Schwert. 1985. Information aggregation, inflation, and the pricing of indexed bonds. Journal of Political Economy 93, 92-114.

Johnson, S., La Porta, R., Lopez-de-Silanes, A., Shleifer. 2000. Tunneling. American Economic Review 90 (2), 22-27.

Jorion, P. and E. Schwartz. 1986. Integration vs. Segmentation in the Canadian Stock Market. The Journal of Finance, 41: 603–614.

Karolyi, G. A., L. Li, R. Liao. 2009. A (partial) resolution of the Chinese discount puzzle: The 2001 deregulation of the B-share market. Journal of Financial Economic Policy 1:1, 80-106.

Kyle, A. S., 1985. Continuous auctions and insider trading. Econometrica, 53 (6), 1315-1335.

La Porta, R La Porta, R., Lopez-de-Silanes, A., Shleifer. 1999. Corporate ownership around the world. Journal of Finance 54 (2), 471-517.

Lee, H. 2009. The Price Premium of China A-Shares over Hong Kong H-Shares: A Further Visit of the Liquidity Hypothesis. Asia-Pacific Journal of Financial Studies 38:5, 657-694.

Li, K., T. Wang, Y. Cheung, P. Jiang. 2011. Privatization and risk sharing: evidence from the split share structure reform in China. Review of Financial Studies 24, 2499–2525.

Liao, L., B. Liu, H. Wang. 2011. Information Discovery in Share Lock-ups: Evidence from the Split-Share Structure Reform in China. Financial Management 40 (4), 1001–1027.

Lo, A.W., A.C. MacKinlay. 1988. Stock market prices do not follow random walks: evidence from a simple specification test. Review of Financial Studies 1 (1): 41-66.

Lowry, M., G. Schwert. 2002. IPO market cycles: Bubbles or sequential learning? Journal of Finance 57, 1171–1200.

Lu, C., K. Wang, H. Chen, J. Chong. 2007. Integrating A- and B-Share Markets in China: The Effects of Regulatory Policy Changes on Market Efficiency. Review of Pacific Basin Financial Markets and Policies 10:03, 309-328.

Luo, Y., F. Fang, O. A. Esqueda. 2012. The overseas listing puzzle: Post-IPO performance of Chinese stocks and ADRs in the U.S. market. Journal of Multinational Financial Management 22:5, 193-211.

Ma, X., 1996. Capital controls, market segmentation and stock prices: evidence from the Chinese stock market. Pacific-Basin Finance Journal 4, 219–239.

Ma, J., P.L. Swan, F., Song. 2010. Price Discovery and Information in an Emerging Market: Evidence from China. Working Paper, Tsinghua University.

Marsh, I.W., R. Payne. 2012. Banning short sales and market quality: The UK's experience Journal of Banking and Finance 36(7), 1975–1986.

Mei, J., J. Scheinkman, W. Xiong. 2005. Speculative trading and stock prices: Evidence from Chinese AB share premia. Working paper.

Mendelson, H., T. I. Tunca. 2004. Strategic trading, liquidity, and information acquisition. Review of Financial Studies 17 (2), 295-337.

Miller, S., D. Li, L. Eden, and M. Hitt. 2008. Insider trading and the valuation of international strategic alliances in emerging stock markets. Journal of International Business Studies 39, 102–117.

Parrino, R., R. Sias, and L. Starks. 2003. Voting with their feet: Institutional ownership changes around forced CEO turnover. Journal of Financial Economics 68, 3–46.

Qi, D., W. Wu, H. Zhang. 2000. Shareholding structure and corporate performance of partially privatized firms: Evidence from listed Chinese companies. Pacific-Basin Finance Journal Volume 8, Issue 5, October 2000, Pages 587–610.

Rhee, S. G., J. Wang. 2009. Foreign institutional ownership and stock market liquidity: Evidence from Indonesia. Journal of Banking and Finance 33 (7), 1312-1324.

Rouwenhorst, K. G. 1998. International Momentum Strategies. Journal of Finance 53:267–84.

Rouwenhorst, K. G. 1999. Local Return Factors and Turnover in Emerging Stock Markets. Journal of Finance 54:1439–64.

Rubin, A., 2007. Ownership level, ownership concentration, and liquidity. Journal of Financial Markets 10, 219–248.

Saffi, P.A.C., K. Sigurdsson. 2011. Price efficiency and short selling. Review of Financial Studies 24 (3), 821–852.

Shenoy, C., Y. Zhang. 2007. Order imbalance and stock returns: Evidence from China. The Quarterly Review of Economics and Finance 47(5), 637–650.

Shleifer, A., R. W. Vishny. 1997. A survey of corporate governance. Journal of Finance 52 (2), 737-783.

Spiegel, M., A. Subrahmanyam. 1992. Informed speculation and hedging in a noncompetitive securities market. Review of Financial Studies 5 (2), 307-329.

Stoll, H. R., 2000. Friction. Journal of Finance 55 (4), 1479-1514.

Stulz, R., 1999. Globalization of equity markets and the cost of capital. Working Paper.

Subrahmanyam, A., 1991. Risk aversion, market liquidity, and price efficiency. Review of Financial Studies 4 (3), 417-441.

Sun, Q., W. Tong. 2000. The effect of market segmentation on stock prices: the China syndrome. Journal of Banking and Finance 24, 1875–1902.

Sun, Q., W. Tong. 2003. China share issue privatization: the extent of its success. Journal of Financial Economics 70 (2), 183-222.

Sun, Q., H.S. Tong and Y. Yan. 2009. Market liberalization within a country. Journal of Empirical Finance 16, 18–41.

Tian, G., G. Wan. 2004. Interaction among China-related stocks: evidence from a causality test with a new procedure. Applied Financial Economics 14:1, 67-72.

Tong, H.S., W. Yu. 2011. A corporate governance explanation of the A-B share discount in China. Journal of International Money and Finance 31 (2), 125-147.

Van der Hart, J., E. Slagter, and D. Van Dijk. 2003. Stock Selection Strategies in Emerging Markets. Journal of Empirical Finance 10:105–32.

Visaltanachoti, T., T. Yang 2010. Speed of convergence to market efficiency for NYSE-listed foreign stocks. Journal of Banking and Finance 34: 594-605.

Wang, S.S., L. Jiang. 2004. Location of trade, ownership restrictions, and market illiquidity: examining Chinese A- and H-shares. Journal of Banking and Finance 28, 1273–1297.

Wang, Q., T. Wong, L. Xia. 2008. State ownership, the institutional environment, and auditor choice: Evidence from China. Journal of Accounting and Economics 46 (1), 112-134.

Yung, C., G. Colak, W. Wang. 2008. Cycles in the IPO market. Journal of Financial Economics 89, 192–208.

Zhang, Y., R. Zhao. 2004. The valuation differential between class A and B shares: country risk in the Chinese stock market. Journal of International Financial Management and Accounting 15, 44–59.