HURST EXPONENT AND THE PRICING OF CROSS-LISTED SHARES: EMPIRICAL EVIDENCE FROM CHINA'S STOCK MARKET

A Thesis

Presented to the Faculty of the Graduate School

of Cornell University

In Partial Fulfillment of the Requirements for the Degree of

Master of Science

by

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August, 2012

ABSTRACT

By the end of 2010, there are 85 firms are listed in both China's A- and B-share stock markets. With the identical issuing companies, trading rules, voting rights and dividends policies, B shares have been selling at a discount relative to A-share counterparts, which is considered as a puzzle over years.

This thesis characterizes three major factors responsible to the price differences between A- and B-share markets: market friction, greater fool factor, and Hurst exponent (market efficiency) factor. More specifically, the results show that in Chinese stock markets institutional investors help to stabilize the stock prices; the results also indicate that time series standard Brownian motion are not responsible for the price differences.

BIOGRAPHICAL SKETCH

Di Wu was born on September 17, 1987 in Xinjiang, China. He is the only son of the family.

He matriculated into Purdue University, in West Lafayette, Indiana majoring in applied economics. He graduated from Purdue University with the highest distinction and received his Bachelor of Science degree in 2010.

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ACKNOWLEDGMENTS

First, I would like to express my deepest sense of gratitude to my thesis committee chair, my advisor, Professor Calum G. Turvey. Many thanks for his constructive guidance, inspiration, and unreserved help throughout this study.

I would also like to thank my committee member, Professor Vicki L. Bogan for her excellent advice and motivations throughout this thesis.

I am also thankful to my classmates Xiaolin Cui, Lin Sun and Dr. Paitoon Wongsasutthikul for their help and valuable advice.

Finally, I would like to dedicate this thesis to my parents, Yueming Wu and Qiaolin Duan.

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CHAPTER ONE

INTRODUCTION

What determines asset prices? The standard theory in financial economics, the Efficient Market Hypothesis (EMH), argues prices are always consistent with the 'fundamentals'; and equilibrium prices are passively achieved by the market, because an efficient market should 'fully reflect all available information' (Fama, 1991). However, one question arose when scholars attempted to shed some lights on how securities are traded in the market, that is whether the equilibrium price consistent with the 'fundamentals' would be achieved by the market? China's stock markets have experienced tremendous growth and development since the two stock exchanges—Shanghai Stock Exchange (SSE) and Shenzhen Stock Exchange (SZSE) were founded in 1990, forming what is referred to as the A-share market. Two years later, in 1992, Chinese securities markets opened a door to foreign investors and created the B-share market in both Shanghai and Shenzhen. Initially, domestic investors only traded in the A-share market while foreign investors traded in B-share market. After reforms were implemented in 2001, domestic Chinese retail investors have been allowed to trade in B-share market. With the identical issuing companies, trading rules, voting rights and dividends policies as A shares, it has been observed that B shares have historically sold at discount relative to their A-share counterparts. However, according to The Law of One Price, if two assets have the same payoffs (in every state of nature), then given the weak form of efficient markets, they must trade at the same price. Thus, the price disequilibrium between A- and B-share markets is considered as a puzzle and has

attracted the interest of numerous researchers (Sun and Tong 1999, Chakravarty, Sarkar and Wu 1998, Chui and Kwok 2001).

Some existing studies have offered the possible explanations to the price disequilibrium between A- and B-share markets. For example, the demand and supply theory[1] suggest that B-share price discount is due to the limited demand from foreign investors. Also, since B shares have more substitutes B-share investors are facing a more elastic demand curve than A-share investors. Hence, any softening of supply will result in B shares trading at lower prices. However, unless the demand for A-shares becomes more elastic as supply increases (which is entirely possible in a behavioral driven market) for such an argument to hold in general, one would likely observe positive and negative oscillations as shares are released or withheld from markets. Other studies argue that the large price discount of B shares is due to market segmentation and information asymmetry[2]. Particularly, foreign investors have limited information about Chinese capital markets but they actually receive news faster than domestic investors due to information barriers in China. While much of economics abstracts from the mechanic of trading, microstructure theory focuses on how specific trading mechanisms affect the price formation process (O'Hara 1995, Madhavan 2000). Demsetz (1968) was one of the first economists to analyze how the behavior of traders affects the formation of prices. Demsetz argued that while a trader willing to wait might trade at the single price envisioned in the Walrasian auctioneer framework, a trader not wanting to wait could pay a price for immediacy, i.e. liquidity. This results

[1] See Bailey 1999; Sun and Tong 1999.
[2] See Chakravarty et al. 1998; Gao 2001; Chui and Kwok 2001.

in two equilibrium prices. Moreover, since the size of the price concession needed to trade immediately depends on the number of traders, the structure of the market could affect the cost of immediacy and thus the market-clearing price. In addition, the greater fool theory also concerns about the behavior of traders. It refers to those who buy an investment based on the premise they will be able to sell it at the profit to a "greater fool". Many investors subscribe to this theory, but don't know they are engaging in it. In an ironic twist, they become the "greater fool," and are left holding the bag when the investment falls and they either can't find a buyer or they have to sell at a loss. In this contingent behavior, people's actions are based on the way they expect others to act. To the extent that people act in this way and that "greater-fool" speculating influences prices in financial markets. As a result, the mispricing has persisted and the financial markets serve as a source of economic disturbances rather than as mere transmitters.

The purpose of this thesis is to consider a particular setting where an identical security (e.g. identical issuing companies) is traded in multiple markets, and to study why an identical underlying share are not guaranteed to be traded at the same price in A- and B- share markets. In this thesis, we aim to answer these following questions. First of all, we need to describe the price disequilibrium and analyze the causes focusing on the ownership structure of China's stock markets to test whether the ownership structure along with the demand factors significantly impact the price differences between A- and B-share markets. Specifically, we are more interested in the individual-institutional structure and tradable-nontradable structure. Are individual

investors considered to be more irrational and less informed? As for capital control, do more shares tradable mean that more shares add liquidity to the market? And will a higher proportion of non-tradable shares in the market limit the liquidity and lead to mispricing of the stocks? Second, because of poorly educated investors and banned short-selling environment in China's stock market we further exam the greater fool theory to study the price disequilibrium. The greater fool theory holds that markets behave according to the psychological whim of investors who enter the market en masse with each new investor believing that there is one more foolish than he to drive the price even higher. A market such as this would be entirely consistent with a demand model market, with demand becoming over more inelastic as supply shortages create angst amongst newly accredited investors. Finally, from the market efficiency point of view, this thesis focuses on the fractional Brownian motion. Can the Hurst exponent distribution explain the price disequilibrium? We utilize the 8-year quarterly panel data from 2003 to 2010 over the 85 cross-listing stocks in A- and B-share markets to investigate the causes of the price disequilibrium. Here, we assume geometric Brownian motion as the null test of efficient markets. The alternative hypothesis is a fractional Brownian motion, which we believe has behavioral characteristics that cause extraordinary excursions from time to time which are viewed as being inefficient, chaotic, bubbled, contagious and so on (see Mandelbrot and Hudson 2004; Kahneman 2011; Akerlof and Shiller 2009). For the most part research has found only weak evidence that stocks or futures are persistently fractal (Turvey 2007) largely because one way or another market corrects themselves. In other words it is perhaps more unusual not to observe periodic flirtations with fractional

characteristics within sub-samples of stock returns, and this is entirely consistent with efficient markets so long as the entirety of the time series is consistent with a gBm. But if indeed fractional processes persist over the long run, then something other than efficient markets is at play.

The rest of the thesis is organized as follows. Chapter Two gives a survey of China's stock market. The review of the literatures that related to the possible causes of disequilibrium, greater fool theory and fractional Brownian motion is provided in Chapter Three. Chapter Four summarizes the data and sample selection. The econometrics methodology and the empirical results will be reported and interpreted in Chapter Five. Chapter Six concludes the paper with a summary of results and discussion of implications.

CHAPTER TWO

CHINA'S STOCK MARKET

China's experience with its securities markets extends back to 1891 when foreign brokers founded the 'Shanghai Share brokers' Association', which was headquartered in Shanghai as China's first stock exchange. In 1904 the Association applied for registration in Hong Kong and it was renamed as the 'Shanghai Stock Exchange'. By the 1930s, Shanghai had emerged as the financial center of the Far East, where both the Chinese and foreign investors could trade stocks, debentures, government bonds, and futures; the Shanghai Stock Exchange grew to be the largest domestic securities exchange with 140 listed companies. The operation of Shanghai Stock Exchange paused in 1941 because of the World War II, and re-opened in 1946, but closed again since 1949 when the Communist revolution took place (Lavelle, 2004).

Beginning in the late 1980s, enterprise reforms took place during China's gradual transition to a market economy; many state-owned companies and collective enterprises issued shares to their employees in order to save on wage expenses. Local governments in China started experimenting with selling shares of collectively owned enterprises directly to private individuals in order to raise equity capital. Private property rights were reintroduced in the sphere of share holdings by law for the first time since its abolition in China in 1949, when the Chinese Communist Party introduced socialism in China. However, under the spirit of the socialist ideology and centrally planned economy, the policies were designed to improve the performance of

state-owned firms rather than outright transfer of their ownership to the private sector. Two over-the-counter markets were launched; one was in Shanghai in 1984 and the other was in Shenzhen in 1986, with only a handful of shares trading in these informal exchanges. Nevertheless, funding raised in this way proved to be vastly insufficient for the state-owned companies in their process of transferring from a planned to a market based institutions, so in the late 1990s and early 1991s, two stock exchanges, created respectively by the Shanghai municipal government and the Shenzhen municipal government, were established, with the central government's formal approval.

The milestone in the development of China's stock market is the establishment of the Shanghai Stock Exchange and the Shenzhen Stock Exchange in the early 1990s. Prior to the 90s, the Chinese government had done some experiments in Shanghai and Shenzhen by setting up Over-The-Counter (OTC) markets where only small-scale trading of treasury securities and shares were processed, and the security prices on the OTC markets were determined by negotiation between buyers and sellers. By the end of 2006, there were a total of 1434 listed firms, and the total market capitalization is $1402.75 billion in both stock exchanges, and among them, Shanghai Stock Exchange accounts for $1123.70 billion.

There are many publications about China's stock market from which we can find detailed insights about the evolution of China's stock market. Green (2003) and Walter and Howie (2003) have provided a detailed information of the history of

China's equity market and state-owned enterprises reform from mid 1980s to early 2000s, right before the ownership structure reformation of China's stock market. The Chinese listed firms differ from the listed firms in other developed or emerging stock markets because approximately two-thirds of non-tradable shares issued by the listed firms were ultimately controlled by the state, while only the one-third of shares can be traded in the stock market. Although Chinese authorities arranged to make one-third of shareholdings of the listed state-owned enterprises available to private investors, state-owned enterprises could hardly improve their performance and corporate governance without changing control rights of the listed firms (Groves et al. 1994; Gao 1996; Cao et al. 1999; Allen et al. 2005).

There is no doubt that two-thirds ownership of non-tradable shares by the state has restrained the performance of the Chinese listed state-owned enterprises. Also, it has become a critical barrier to the development progress of China's stock market. From the early 2000s, the Chinese authorities have made several attempts to deal with the problem of non-tradable shares on several occasions. The first batch of four state-owned companies convert their non-tradable shares into tradable shares by compensating the existing shareholders in various ways such as bonus shares, cash, and options on April 29, 2005. This pilot program, launched by China Securities Regulatory Commission (CSRC), allowed the tradable shareholders to bargain over the transfer of non-tradable shares. In June 2005, the CSRC initiated a second pilot program involving 42 companies worth 10% of overall stock market value. On August 19, 2005, this second program was successfully accomplished. Besides the non-

tradable share barrier, China's stock market has been making progress step-by-step to break down some other barriers. On February 19, 2001, the CSRC announced that Chinese residents would be allowed to own B shares, which are shares of mainland companies and traded in both the Shanghai and Shenzhen stock exchanges and denominated in US dollars (Shanghai stock exchange) and HK dollars (Shenzhen stock exchange). In addition, the CSRC and the People's Bank of China (PBOC) introduced the QFII (Qualified Foreign Institutional Investor) program as a provision for foreign capital to access China's financial markets in November 2002. Chinese authorities established QDII (Qualified Domestic Institutional Investors) on April 13, 2006, which is a scheme under which selected government--authorized domestic institutional investors are allowed to invest in overseas capital markets under the foreign exchange control system in China. This facility is restricted to investment in the capital market of Hong Kong only. These policies are partially responsible for the "price discount puzzle", for example, part of B share discount declined after February 19, 2001. QFII and QDII are with limited application by institutional investors, a thorough integration of three sub-markets, as yet, remains incomplete (Neftici et al., 2007; http://www.csrc.gov.cn).

Chronology of the historical events of the China's stock market

1891	Shanghai Stock Exchange founded to broker foreign stocks
1905	Shanghai People's Exchange founded in Hong Kong
1914	Shanghai Stock Commercial Association founded: China's first formal stock trading association; Northern Government issues "Stock Exchange Law"
12/1/1990	Shenzhen begins "trial operations" without formal approval and with only one stock trading
12/19/1990	Shanghai Stock Exchange begins operations. PBOC announces that all public stock issues and listings can only be done on the Shanghai and Shenzhen exchanges: opens the primary market again
7/3/1991	Shenzhen Stock Exchange is formally approved and opened after seven months of "trial operation"
10/7/1992	Brilliance China Automotive lists on the NYSE, raising US$80 million. This was China's first ever overseas IPO
10/25/1992	CSRC established; shortly after announces nine candidates companies for Hong Kong listing, known as the "First Batch"
7/29/1993	Tsingdao Beer completes the first SEHK IPO by a Chinese company, raising US$115 million
12/29/1993	National People's Congress passes the Company Law
7/1/1994	Zhu Rongji signs Company Law into effect permitting Shandong Huaneng (HNP later) to proceed with its NYSE listing, the first direct listing of a Chinese company on the NYSE
8/10/1994	First direct listing of a Chinese company on the NYSE, Shandong Huaneng Power Generation, raising US$333 million
7/1/1997	Hong Kong returns to Chinese sovereignty
12/29/1997	National People's Congress at last passes Securities Law
7/1/1999	Securities Law goes into effect; CSRC begins preparing regional offices that would give it a national presence for first time
10/27/1999	Sale of state shares through inclusion in public offerings announced
3/14/2000	The CSRC approves listing and trading of leftover rights offering shares beginning in April. A start to getting rid of residual "non-tradable" shares
3/17/2000	To comply with the Securities Law, CSRC releases regulations defining the new review method for listing applications, and eliminates old quota and administrative pricing mechanisms
2/19/2001	Domestic investors permitted to buy B shares
11/5/2000	The CSRC and the People's Bank of China (PBOC) introduced the QFII (Qualified Foreign Institutional Investor) program as a provision for foreign capital to access China's financial markets.
4/13/2006	The CSRC and the People's Bank of China (PBOC) introduced the QDII (Qualified Domestic Institutional Investors), which allows selected government authorized domestic institutional investors to invest in overseas capital markets under the foreign exchange control system.

Figure 1 Chronology of the historical events of the China's stock market

2.1 Overview of China's stock markets

Market segmentation is one of the most dominating features for China's stock market as discussed in the previously. Chinese listed firms have two classes of shares outstanding: shares which are traded domestically in mainland China, including A-share and B-share; and shares listed in overseas markets, such as H-share, N-share, S-share and T-share, representing shares issued in Hong Kong, the U.S, Singapore, and Japan markets. Segmentation further exists within the domestic shares—A shares are traded by domestic investors while B shares are denominated in foreign currencies and traded by foreign investors. Plus, another unparalleled feature of ownership structures in China's stock market is its tradable and non-tradable shares. Non-tradable shares typically owned the state.

Table 1 China's Stock Market Overview

Panel A: Shanghai Exchange

	2007		2008		2009		2010	
	A share	B share	A share	B share	A share	B share	A share	B share
No. of Listings	884	54	860	54	854	54	850	54
Issued Volume(billion)	21,810	130	16,536	124	15,289	121	14,058	115
Market Value(billion)	178,000	1,007	183,800	855	96,875	377	268,497	1,342
Trading Volume(billion)	25,812	152	33,477	203	16,207	104	23,931	394
Deals Traded(million)	1,653	8	2,133	10	1,273	6	1,599	19
Trading Value(billion)	303,216	1,096	345,443	1,069	179,762	668	301,960	3,474
Tradable Volume(billion)	15,901	130	11,455	124	4,795	121	3,284	115
Tradable Market Value(billion)	141,330	1,007	113,950	855	31,929	377	63,191	1,342
Individual Investors(accounts)	75,555,733	-	69,108,156	-	60,883,646[3]	1,453,400	54,468,593	1,422,000
Institutional Investors(accounts)	307,508	-	290,514	-	262,770	11,885	250,615	3,030
Total Accounts	75,863,241	-	69,398,670	-	61,146,416	1,465,285	54,719,208	1,425,030

Panel B: Shenzhen Exchange

No. of Listings	455	54	454	55	455	55	464	55
Issued Volume(million)	292,888	14,995	270,110	14,916	230,362	13,846	210,445	12,817
Market Value(million)	3,984,450	95,675	1,742,156	42,329	4,544,363	121,155	1,498,071	79,551
Trading Volume(million)	1,385,000	25,517	651,628	11,426	1,093,697	32,584	538,756	17,695
Deals Traded	918,307,700	8,189,763	527,046,338	4,412,890	741,164,554	12,077,341	243,983,287	4,877,318
Trading Value(million)	13,834,451	102,872	6,949,071	55,472	13,663,734	231,094	2,890,045	68,029
Tradable Volume(million)	206,616	14,794	161,652	14,702	124,909	13,549	100,343	11,879
Tradable Market Value(million)	2,770,379	94,733	981,711	41,820	2,351,229	119,623	707,373	77,795
Individual Investors(accounts)	74,668,041	-	68,169,084	-	59,865,636	926,700	53,244,974	899,900
Institutional Investors(accounts)	267,548	-	250,044	-	223,358	11,500	203,487	10,400
Total Accounts	74,935,589	-	68,419,128	-	60,088,994	938,200	53,448,461	910,300

Panel C: Total Chinese Stock Market

No. of Listings	1,339	108	1,314	109	1,309	109	1,314	109
Issued Volume(billion)	22,103	145	16,807	138	15,520	135	14,268	128
Market Value(billion)	181,984	1,103	185,542	898	101,420	498	269,995	1,421
Trading Volume(billion)	27,197	178	34,128	214	17,301	137	24,470	412
Deals Traded(million)	2,572	16	2,660	14	2,014	18	1,843	23
Trading Value(billion)	317,050	1,199	352,392	1,124	193,426	899	304,850	3,542
Tradable Volume(billion)	16,108	145	11,617	138	4,920	135	3,384	127
Tradable Market Value(billion)	144,101	1,102	114,931	897	34,281	496	63,898	1,419
Individual Investors(accounts)	150,223,774	-	137,277,240	-	120,749,282	2,380,100	107,713,567	2,321,900
Institutional Investors(accounts)	575,056	-	540,558	-	486,128	23,385	454,102	13,430
Total Accounts	150,798,830	-	137,817,798	-	121,235,410	2,403,485	108,167,669	2,335,330

[3] The numbers of individual and institutional accounts are decreasing over time because of macroeconomics conditions. During economic hardship people may withdraw their accounts from the stock markets.

Table 1 gives an overview of China's stock market. There are currently 1,339 stocks listed in A-share market and 108 stocks listed in B-share market. And there are 85 companies listed in both A-share and B-share markets. A shares are quoted in Chinese RMB, while B shares are quoted in foreign currencies (B Shares listed in Shanghai Stock Exchange are listed in US dollars and B Shares in Shenzhen Stock Exchange are listed in Hong Kong dollars). A-share market is open to Chinese domestic retail and institutional investors, while B-share market is open to foreign investors and Chinese domestic retail investors, not including domestic institutional investors. Except those difference mentioned above, the B shares and A-share counterparts are identical—they have the same voting rights, dividends and trading rules.

The market information in Table 1 from "factbooks" 2007 to 2010 is published on Shanghai Stock Exchange website and Shenzhen Stock Exchange website. It reports two pairs of shares: A shares & B shares and shares listed in SSE & shares listed in SZSE. From Table 1, we can easily conclude that A-share market is much larger than B-share market in different ways in terms of number of listings, trading volume, market capitalization and total number of participants. There are about 10 times more companies listed in A-share market than B-share market. And the market value of A-share market is about 100 times of the market value of B-share market. The ratio of trading volume in A-share market over B-share market is about 150, and the ratio of tradable volume in A-share market over B-share market is about 100. The difference between the two ratios is because about 80% of shares in A-share market are tradable shares; while almost all the shares in B-share market are tradable. The huge

differences existing between the two markets in issued volume, market value, and trading volume further also suggest that A-share market is much bigger than B-share market.

Figure 2 Market Values of A-Share Market and B-Share Market

Figure 2 presents a comparison of market values between A-share market and B-share market. Market value in the graph is calculated by stock price multiplies the numbers of shares outstanding. From the graph, we can see that A-share market value is approximately 4 to 5 times the B-share market value. However, it also shows the great co-movement with A- and B-share market value.

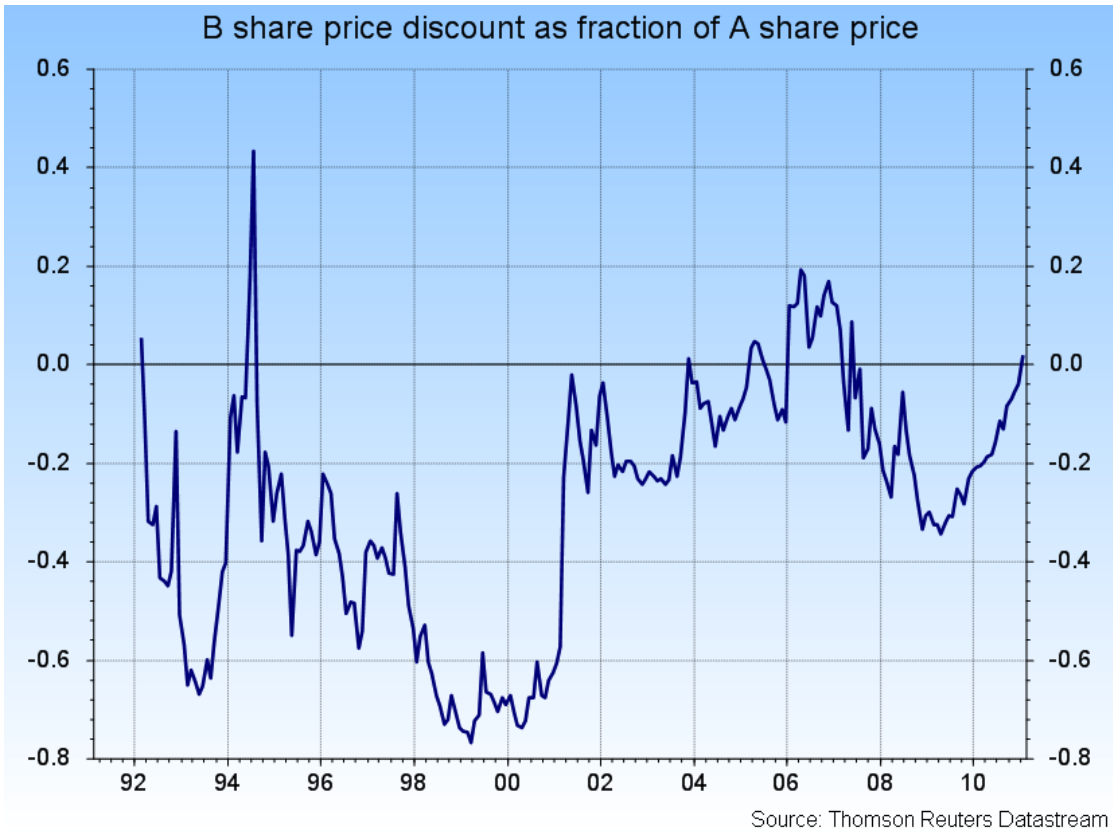

Figure 3 B-Share Price Discount as Percentage of A-Share Price

The B-share discount as a percentage of A-share price is calculated by using equation $(price_B - price_A)/ price_A$ (Domowitz et al. 1997). Figure 3 shows how the B-share discount was changing from 1992 to 2011. The numbers in the graph is below 0 in most years, meaning B shares have been selling at a discount compared to A-share counterparts. Particularly, as mentioned in the previous chapter, prior to the market reform (year of 2001), B shares were sold 60% below their A-share counterpart prices. After the reform, B-share price discount decreased close to 20% below their A-share counterpart prices. The graph also shows that the price difference changes over time, which indicates time variance is related to B-share discount.

2.2 The features of China's stock market

China's stock market remains a hybrid with planned and market-oriented components. It differs from other conventional stock markets by its particular rules. In general, a stock market consists of the stock exchange, listed firms and shareholders, and the foundation of the framework is an entity of private property with legal protection. It is hard to believe that in a country with a relatively short experience with the private ownership such as China, the securities and stock exchange can really exist and play a role as the established conventional stock exchange. On the other hand, the key role of the stock market should play is to mobilize and allocate capital resources in a market economy. The major motivation for the development of China's stock market was to mobilize private funds to finance state-owned enterprises, as well as to improve the performance of state-owned enterprises through public participation. An efficient securities market should have the capacity to assign the capital to the most productive sector. However, the Chinese stock market clearly favors state-owned enterprises without any consideration of their performance.

Incorporation and listing of state-owned enterprises through IPOs is not an activity which is unique to China. Berkman, et al. (2002) showed that the median offering of IPOs was only 35% of a firm's equity capital based on a worldwide sample of 384 state-owned enterprises' share-issue during 1977-1997. In most cases, especially in developed stock markets, the common shares issued by companies give the particular

rights to their owners, primarily the right to vote at shareholders' meetings, to receive companies' profits in the form of dividends and to sell the shares in the secondary markets. The owners of common shares enjoy these rights and are treated equally under most circumstances. In contrast, China has artificially created three categories of individual, legal person and state shares that have the equal rights by legislation.

Individual shares are the only sort of shares that can be listed and publicly traded in the stock exchange markets. Legal person shares are created through the injection of assets from legal person entities, which include enterprises, institutions or authorized social groups. State shares are owned ultimately by the State Council. Legal person and state shares which accounted for two-thirds of the total outstanding shares of listed firms were declared non-tradable. This situation has changed dramatically since the reform in 2005. The owners of individual shares can be recognized by retail investors or employees of a company who have invested their own wealth in the company. State shares are issued to authorized government organs acting on behalf of the state in return injection of assets such as buildings, equipment, and land-use rights. The State-owned Assets Supervision and Administration Commission of the State Council (SASAC) and local state asset management bureau currently mange the state shares. A distinct feature of ownership structures of the Chinese listed firms is that holders of non-tradable shares have exactly the same voting rights as the holders of tradable shares. Non-tradable shares cannot be traded publicly even though the company is publicly listed. Typically these shares belong to the state or to domestic financial institutions which are ultimately owned by the central or local governments. In other words, individual tradable shareholders tolerate the market risk while non-tradable

shareholders do not. A company may issue legal person shares to non-state investors who contribute non-state assets and these shares become standard legal person shares.

The listed firms have different market prices in each market, arbitrage among five markets is nearly forbidden. For example, for firms issuing both A and B shares, although B shares has been traded at a large price discount relative to A share, there is no arbitrage mechanism to short A shares and buy B shares due to the restrictions of short selling and the restrictions on foreign exchange currency that the Chinese citizens can only purchase very limited amount of foreign currency. On the other hand, no conventional stock market exists in China for the transfer of legal person and state shares. Legal person shares used to be transferred through management buy-out and the shares were usually priced below net asset value. The undervaluation scandals such as management buy-out, the unfairness revealed information, illegal sources of funding, and lack of transparency are due to share mispricing (Slovin, Sushka, and Bendeck, 1991). Consequently, management buy-outs have been almost stopped since 2004 by the Chinese authorities. State shares were transferred only among state entities at negotiable prices before non-tradable state-owned shares reform. Additionally, individual owners pay higher price for their shares than non-tradable shareholders because prior to the IPO the price is close to net asset value when the non-tradable shareholders launched their shareholdings. As a result, they pay far less than the IPO price and individual owners have to suffer this discrimination in terms of pricing. By the end of 2002, only 6% of listed companies had non-tradable shares accounting for less than 40% of total equity capital, while only 0.4% of listed

companies had no non-tradable shares at all (Walter and Howie 2003; Green 2004; Chen and Chen 2007).

CHAPTER THREE

LITERATURE REVIEW

3.1 Price disequilibrium

Studies have been done to analyze the possible explanations of the price disequilibrium. For example, Bailey (1994) studies and documents the behavior of B-share returns since the market was established. He focuses on the relationship between B-share returns and international stock index returns and finds that B shares have considerable diversification value. For his later study on international asset pricing, especially the Chinese stock markets disequilibrium, he explains the large price premium by the concepts focusing on foreign investor's demand and supply of shares (Bailey 1999). Some other studies demonstrate that the price difference between Chinese A shares and matching B shares is correlated with many different factors for example, investors' attitudes toward risk and the correlations between B shares and foreign shares; demand elasticity differences, liquidity and speculation; market segmentation and information asymmetry (Ma 1996; Sun and Tong 1999; Chakravarty, Sarkar and Wu 1998; Gao 2001). Specifically, Chui and Kwok (2001) find empirical evidence showing that the information flow is actually from B-share market to A-share market, meaning foreign investors receive news faster than domestic investors due to information barriers in China. To support and extend Sun and Tong's (1999) concept centering on the demand elasticity difference, Yang (2005) proves that the number and trading volume of Chinese firms traded in the U.S. are also

related to the large price premium in A-share market than B-share market. In other words, the shares listed in the U.S. stock markets are another substitute for B shares.

1) Liquidity Hypothesis

From the point of view of liquidity hypothesis, the price difference between A shares and the matching B shares can be explained by the differential liquidity levels between the two markets. According to the existing studies, A-share market is more liquid than B-share market, which drives B-share prices lower than A-share prices to compensate for illiquidity. The differential liquidity levels may explain the time-series and cross-sectional variation of the price difference (Bailey 19994). Sun and Tong (1999) find a positive relationship between the trading volume ratio (B shares over A shares) and the B-share discount, which suggests that relatively less trading activity in B-share market than A-share market drives the price gap larger.

2) Information Asymmetry and Market Segmentation

Researchers under this topic mainly test which market has more information over the other. Chakravarty, Sarkar and Wu (1998) argue that the discount in B-share market is due to foreign investors' lack of information relative to domestic investors. They argue that difficulties of gaining information are due to language barriers, different accounting standards and lack of knowledge about the local economy. They develop a model focusing on information asymmetry and market segmentation, and derive a pricing equation for A shares and B shares. The results show that information asymmetry explains a significant portion of the cross-sectional variation of the B-share

discounts. However, Chui and Kwok (2001) argue and prove with empirical evidence that the information flow is from B share market to A share market, which is right opposite of what Chakravarty, Sarkar and Wu (1998) found. They argue that the returns on B shares should lead the returns on A shares, and this pattern of information flow is due to the segmentation in the China's capital markets and China's information barriers.

3) Differential Demand

According to the differential demand argument, researchers mainly focus on the share supply (shares outstanding) and demand elasticity (substitutes for A shares and B shares), and their influence on the stock prices. Under differential demand hypothesis, the demand elasticity of domestic investors is relatively lower than that of foreign investors. As a result, A-share investors would like to pay a higher price for the same stocks than B-share investors. Sun and Tong (1999) argue that the China's B-share discount phenomenon is due to foreign investors facing a more elastic demand curve than Chinese domestic investors. They state that B shares have more substitutes than A shares, which makes the demand curve of B shares more elastic. The result shows that when more H shares and red chips listed in Hong Kong (which they believe are the substitutes of B shares), the B-share discount becomes larger. In my thesis, as an empirical proxy for relative demand of share, I use the ratio of number of shareholders in A-share market to B-share market. And as a possible proxy for relative share supply, I use the ratio of number of shares outstanding in A-share market to B-share market. Theoretically, the price premium of A shares over B shares should be

negatively related with share supply ratio and positively related with share demand ratio according to demand-supply equations.

4) Differential Risk

For the differential risk argument, researchers study the differential risk aversions of A shareholders and B shareholders. The hypothesis argues that Chinese domestic investors are highly speculative, which drives the A-share price much higher than B-share price. Ma (1996) documents that "cross-sectional differences between prices of A shares and B shares are correlated with investors' attitudes toward risk and correlations between B shares and foreign shares".

5) Institutional vs. Retail Investor

Sias (1996) states that, from an academic point of view, institutional investors are more likely attracted by less-risky stocks because of several reasons: (1) many institutional investors are governed by more strict rules, thus they are more cautious and conservative when picking their stocks, (2) greater institutional ownership may gather more information, and (3) institutional investors tend to be more rational than individual investors. Gompers and Metrick (1999) argue that "investors would prefer liquid assets over illiquid ones and would be willing to give up some amount of expected future cash flows to buy more liquidity, especially institutional investors". Except for facing a stricter legal environment and being more sensitive to liquidity and transaction cost, the reason why institutional investors are so different is that they have better knowledge about historical return patterns and risk control. Some studies

provide empirical evidence on the stabilizing impact of institutions. Institutions buy shares from individuals in response to positive cash-flow news. And when stock price goes up without any positive news, institutions sell shares to individuals. Individual investors display "attention-based" buying behavior on days with high trading activities. In contrast, institutional investors do not show this buying behavior. If institutional herds all react to the same news, it will help with the adjustment of stock prices to new information faster and thus make the stock market more efficient. In other words, institutional investors may stabilize stock prices and help the stock prices move towards their fundamental values. Thus, the more shares held by institutional investors, the more the stock prices reflect the firms' true values (Cohen 2002; Barber and Odean 2003; Bohl and Brzeszczynski 2005). However, a number of studies state that institutional investors have negative herding effect on stock markets. For instant, Gabaix, Gopikrishnan, Plerou and Stanley (2006) present a theory of excess stock market volatility, in which market movements are due to large institutional trading in relatively illiquid markets. And such trades generate significant extreme values in returns and volume.

6) Tradable and Non-tradable Shares

Tradable shares mean the free float in the market; and non-tradable shares are the restricted shares that cannot be traded in the stock exchanges. In order to ensure government's control of state-owned firms, non-tradable shares were created and took up about 20% of China's stock markets. Chen and Xiong (2002) find that the non-tradable state-owned shares and legal-person shares in China have an average

illiquidity discount of about 70% to 80% when they are traded over the counter. Beltratti and Bortolotti (2006) show that the tradable shares investors are typically minority shareholders with little power to affect management decisions. Also, the limited free float available due to the existence of non-tradable shares makes the stock markets illiquid, volatile and speculative. Thus, by changing the tradable and non-tradable structure (unlocking non-tradable shares and increasing tradable shares) the market would expect better liquidity given the substantial increase in the free float. The increase in the percentage of tradable shares will put downward pressure on the market, which will pull the A-share prices close to B-share prices.

3.2 Greater fool theory

In general, the greater fool theory is the belief that one buys a security in the financial markets not because you believe that it is worth the price, but rather because you believe that you will be able to sell it to someone else at an even higher price. The intuition of the greater fool theory originated from the Keynesian beauty contest. Keynes (1936) describes the action of rational agents in a market using an analogy based on a fictional newspaper contest, in which entrants are asked to choose a set of six faces from photographs of women that are the "most beautiful". Those who picked the most popular face are then eligible for a prize. A naïve strategy would be to choose the six faces that, in the opinion of the entrant, are the most beautiful. A more sophisticated contest entrant, wishing to maximize the chances of winning a prize, would think about what the majority perception of beauty is, and then make a selection

based on some inference from their knowledge of public perceptions. This can be carried one step further to take into account the fact that other entrants would each have their own opinion of what public perceptions are. Thus the strategy can be extended to the next order, and the next, and so on, at each level attempting to predict the eventual outcome of the process based on the reasoning of other rational agents. "

It is not a case of choosing those faces that, to the best of one's judgment, are really the prettiest, nor even those that average opinion genuinely thinks the prettiest. We have reached the third degree where we devote our intelligences to anticipating what average opinion expects the average opinion to be. And there are some, I believe, who practice the fourth, fifth and higher degrees." (Keynes, 1936)[4]. Keynes believes that similar behavior was at work within the stock market. This would have people pricing shares not based on what they think their fundamental value is, but rather on what they think everyone else thinks their value is, or what everybody else would predict the average assessment of value to be.

Keynes's insight opens a brand new window for us to observe the financial market. Traditionally, many financial researchers hold a view that the price of an asset should be equal to the current expectations of its future pay-offs by a representative agent. Some assets pricing literatures[5] suggest that a lot of investors on average can be represented by a uniform agent that holds a certain belief and preference. By assuming the existence of representative agent, one can claim that the current expectation of the future pay-offs in the market should be in line with the representative agent's current

[4] The General Theory of Employment , Interest and Money, Page 140
[5] For example, Mconstatinides and Duffie 1996; Brav et al. 2002

expectation of the future pay-offs based on the martingale process. By applying the rationale in the assets pricing world, the calculation of asset prices not only requires the understanding of investors' beliefs about future cash flows, but investors' beliefs about other investors' beliefs, and higher order beliefs as well. At the basis of the beauty contest, the greater fool theory states that it does no matter if the price paid for an asset is higher than the fundamental value, as long as the greater fool is willing to pay a higher price. The anticipation of other greater fools' move is a typical higher order belief. Sun and Tong (1999) conclude that "the higher of the A-share market volatility relative to the B-share market volatility the larger B-share discount will be". This means that Chinese domestic investors' excessive speculative activities on A shares seem to be related to the A-share price premium, which in turn suggests a self-fulfilling prophecy.

3.3 Fractional Brownian motion

Fractional Brownian motion (fBm) is simply an extension of the well-known Brownian motion to the fractal dimensions. It was first introduced by Kolmogorov in 1940 when it was called *Wiener Helix*. Later, Mandelbrot and Van Ness gave the process its name *fractional Brownian motion* (Mandelbrot and Van Ness 1968; Campbell and Abhyankar 1978; Mandelbrot 1982). Different methods and techniques used to generate fBm have been documented in (Doukhan, Oppenheim et al. 2003). More recently, the generation of fBm using a wavelet-based approach has started to gain popularity due to its faster computational speed as compared to other simulation

methods (Pipiras 2004). However, the implementation requires the generation of fractional ARIMA sequences with a suitable scaling parameter.

It was Mandelbrot who coined the parameter *H* Hurst exponent after the name of a British hydrologist Harold Edwin Hurst, who studied the yearly water run-offs in the Nile River basin (Biagini, Hu et al. 2008). In his study, Hurst discovered that the values of successive yearly run-offs show a certain level of dependency. This phenomenon could not be modeled using a process with independent increments so he developed a method that eventually became known today as the Hurst rescaled range analysis. A fBm with Hurst exponent *H* belonging to (0,1) is a continuous and centered Gaussian process with covariance. Each successive run-off could be thought of as the increment of a fBm characterized by a certain value of the Hurst exponent (Hurst 1951; Bassingthwaighte and Raymond 1994).

A fBm starts from zero almost surely, has stationary increments, and is self-affine (Mandelbrot 1982). Hurst exponent, ranging from 0 to 1, emerges as a parameter that describes the degree of factuality in any stochastic processes. For $H = 0.5$, the fBm becomes a standard Brownian motion where the increments are independent. If $H < 0.5$, the increments are negatively correlated resulting in a mean-reversion or ergodic process. When $H > 0.5$, they are positively correlated and lead to a long-memory process (Bassingthwaighte and Raymond 1994; Carmona and Coutin 1998; Alvarez-Ramirez, Cisneros et al. 2002; Turvey 2007; Biagini, Hu et al. 2008).

The standard fBm *B(H)* has the following properties:

1. $B(H)(0) = 0$ and $E\,[B(H)(t)] = 0$ for all $t \geq 0$.

2. *B(H)* has stationary increments.

3. *B(H)* has continuous trajectories.

4. *B(H)* is a Gaussian process.

In this paper, we will use the scaled variance ratio technique from (Cannon, Percival et al. 1997; Turvey 2007) that is quite distinct but consistent with *R/S* analyses (Hurst 1951; Mandelbrot and Van Ness 1968) to estimate the Hurst exponent of a fBm generated from an AR(q) process:

$$\frac{E[Y(t+k)-Y(t)]^2}{E[Y(t+1)-Y(t)]^2} = \frac{\sigma_k^2}{\sigma_1^2} = (k)^{2H} \qquad (1)$$

which defines a power rule that can be used to estimate the value of *H*.

Some existing studies have tried to test the problem that whether a market has or does not have long memory. The main findings from these studies are that the deviations from efficiency are associated with the degrees of development. Actually, they found the Hurst exponent bigger than 0.5 for emerging capital markets (Beben et al. 2001; Matteo et al. 2003). Cajueiro and Tabak (2003) use the Hurst exponent to test whether emerging markets are becoming more efficient over time. They suggest that developed capital markets are very efficient in terms of speed of information. However, in

emerging capital markets investors react to new information slowly. They find that Hurst exponents vary over time due to changes in the dynamics of the underlying return time series. This is not explained either by time-varying short-range dependencies nor time-varying volatility as the Hurst exponents are time-varying even after adjusting for short-range dependency and time-varying volatility. Furthermore, Eom et al. (2008) use Hurst exponent as the measurement of the degree of efficiency. They suggest that the Hurst exponent represents a measurement which has information values useful for the prediction of future price changes. Furthermore, we also found that the Hurst exponent is useful as standards that can distinguish emerging capital markets from mature capital markets.

3.4 Calculate the Hurst exponent

For the Hurst exponent calculation, we use the method developed from Turvey (2007). First, in our sample total observation of price for each stock are approximately 2500 (daily stock price from 2001 to 2010). Then we get one and fifty days lagged prices for each stock.

Second, we compute the percentage change in prices for each of $ln x(i+k) - ln x(i)$, allowing for overlapping prices (k=1 and 50). Lo and Mackinlay (1999) argue that whether sub-series should be contiguous or overlapping. Ellis (2006) claims that overlapping subseries are clearly preferred for R/S analysis. There is no reason to

expect that the preference would be different for the calculation of scaled variance ratios (Turvey 2007).

Third, calculate the variance, $VAR[lnx(t+k) - lnx(t)]$, for each k

Fourth, the rations of the form

$$\frac{\sigma_k^2}{\sigma_1^2} = \frac{VAR[lnx(t+k) - lnx(t)]}{VAR[lnx(t+1) - lnx(t)]}, k = 50 \qquad (2)$$

Fifth, in order to estimate the value for *H*, we use the following regression

$$ln\left(\frac{\sigma_k^2}{\sigma_1^2}\right) = \delta_0 + \delta_1 ln(k) + \delta_t \qquad (3)$$

with $H_0: \delta_0 = 0$. Then from Eq.(1) and (3), we have the value

$$H = \frac{\delta_1}{2} = \frac{\frac{ln\left(\frac{\sigma_k^2}{\sigma_1^2}\right)}{ln(k)}}{2} \qquad (4)$$

CHAPTER FOUR

DATA AND SAMPLE SELECTION

By the end of 2010, there were 1339 firms listed in the A-share market and 108 firms listed in the B-share market. Meanwhile, 85 firms are listed in both A- and B-share markets. To analyze the price differences between the two markets and its possible factors, we only include firms that have listed in both A- and B-share markets into our data sample. Therefore, we use quarterly data of those 85 stocks from December 2001 to December 2010 to perform a panel data analysis[6]. We choose 2001 as the start year because after the reform in 2001 domestic retail investors have been able to invest in the B-share market, which was seen as a turning point of the markets. The ownership structure related variables [7] are retrieved from Resset Database, Bloomberg, Datastream and Shanghai Stock Exchange and Shenzhen Stock Exchange websites. The greater fool related variables[8] are collected from "Monthly Registered Stock Accounts" retrieved from CSD&C, "China Securities Depository and Clearing Corporation"[9]. Since the public available information of the CSD&C only starts from January 2003, our data series is limited to start from the same time. The ending date is December 2010. Therefore, a total of 32 quarters' observations have been utilized in our analysis.

[6] All 85 companies list in Appendix A and Appendix B
[7] Ownership structure related variables are volatility ratio, turnover ratio, number of shares outstanding, tradable shares percentage, number of shareholder, institutional holdings
[8] Greater fool related variables are newly registered retail and institutional investor stock accounts
[9] www.chinaclear.cn

Descriptive Statistics

Table 2 Summary Statistics

Panel A: Control Variables(means)

Year	Price difference (%)	Volatility ratio	Volume ratio	Number of shares outstanding	Tradable shares percentage	Number of shareholders (logarithm)	Institutional holdings (logarithm)
2001	7.9034	0.6872	5.5855	2.4395	0.473	0.542	-1.9591
2002	8.8067	0.8489	22.9456	2.5045	0.483	0.5244	-1.6397
2003	8.656	1.0819	35.6129	2.5099	0.488	0.4681	-0.6086
2004	8.8979	1.091	38.0213	2.5797	0.497	0.4373	-1.8224
2005	9.2796	1.1065	53.624	2.5955	0.507	0.5929	-3.1239
2006	7.2204	1.1323	35.681	2.6738	0.773	0.6384	0.8775
2007	6.6028	1.1185	36.2833	2.8032	0.953	0.4929	1.8856
2008	7.3898	1.1503	72.8994	2.8861	0.975	0.5768	1.8252
2009	8.4539	1.228	74.2746	3.0182	0.981	0.6785	0.9466
Mean	8.1345	1.0494	41.6586	2.6678	0.681	0.5501	-0.4021

Panel B: Hurst Exponent

	Mean	Max	Min	Median
A-share Market	0.3623	0.5350	0.0823	0.3790
B-share Market	0.5456	0.6112	0.5058	0.5415

Panel C: Newly Opened Accounts

Year	New retail accounts	New institutional accounts
2003	736,163	8,460
2004	853,618	7,299
2005	438,076	5,262
2006	1,505,086	13,749
2007	18,700,000	58,818
2008	7,195,270	27,516
2009	8,563,236	33,467
Mean	5,427,349.86	22,081.57

Table 2 Panel A present the means for each control variable used in our regression model. From the second column of Panel A, we can see that the A-share price

premium is about 8% of the B-share price. The volatility of the A-share market is a little bit higher than that of the B-share market. The ratio of turnover rate changed tremendously from year to year, but the A-share market is much more liquid than the B-share market. The number of shares outstanding in the A-share market is about 2.5 times the number of shares outstanding in the B-share market. Tradable shares in the markets increased greatly since 2005 when the reform[10] started. After taking the logarithm of the number of shareholders, the numbers are above zero, which indicates that the number of shareholders in A-share market is more than that in B-share market. And after taking the logarithm of institutional shareholdings, the mean of 10 years institutional holdings are higher in B-share market than that in A-share market. Table 2 Panel B reports the summary statistics for the A- and B-share markets Hurst exponent. The mean of the A-share market Hurst exponent is 0.3623 and the mean of the B-share market is 0.5456. According to Turvey (2007), approximate upper and lower 90% confidence intervals for scaled variance ratio with N=2500, k=50 is (0.4550, 0.5449). This means if a value of H between 0.4550 and 0.5449 there is 90% confidence that the time series follows a gBm. Hence, in our cases, the B-share market Hurst exponent slightly deviates from the 90% confidence interval indicating B-share time series does not follow a gBm. A-share market Hurst exponent is much lower than the lower bound of 90% confidence interval indicating A-share market time series does not follow a gBm either. However, based on Turvey (2007) 95% confidence interval for scaled variance ratio, the upper and lower bounds are 0.5539 and 0.4461,

[10] As mentioned in the previous section, in 2005, the China Securities Regulatory Commission initiated the reform to transform non-tradable shares into tradable shares. The percentage of non-tradable shares is from 65% in 2005 to today's 20%, which actually increased the shares supply and liquidity of the whole markets. The change can be seen from Table 1 that the percentage of tradable shares over shares outstanding has increased from 2007 to 2010 in A-share market.

respectively. Thus, B-share market Hurst exponent falls into the 95% confidence interval meaning there is 95% confidence that B-share time series follows a gBm. On the other hand, A-share market Hurst exponent is still outside of the 95% confidence interval indicating there is evidence that A-share market time series does not follow a gBm. If we use the Hurst exponent as the measurement of market efficiency, then we can tell the B-share market is much more efficient than the A-share market since the B-share market Hurst is closer to 0.5. In addition, the B-share market tends to be persistent while the A-share market is mean reverting[11]. Table 2 Panel C presents the total number of newly opened accounts for each year. In general, newly opened accounts in China's stock markets can be divided into retail and institutional accounts. As we can see from Panel C, the numbers of newly opened retail and institutional accounts fluctuate over time.

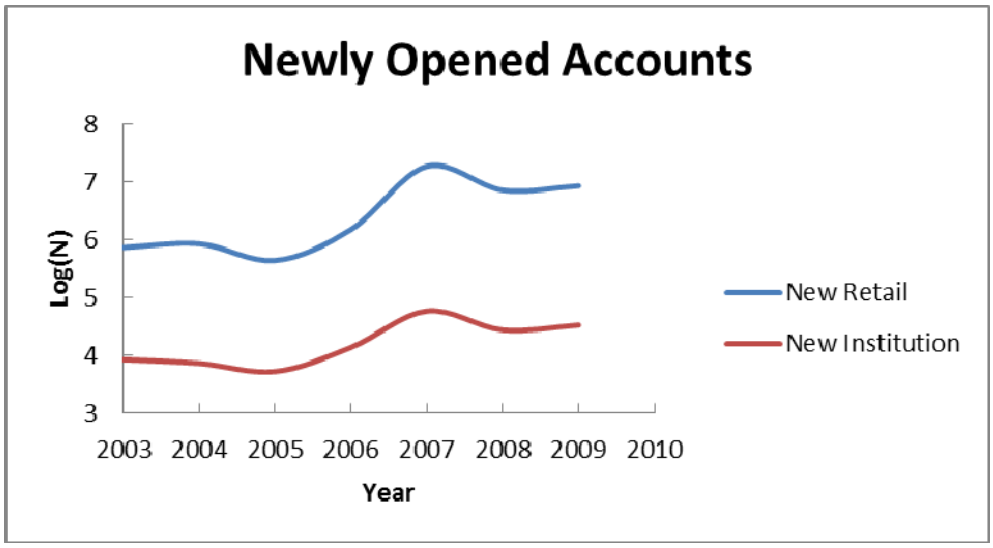

Figure 4 Newly Opened Accounts

[11] Mean reversion, in general terms, is that a stock's price tends to move to the average price over time. When the current market price is above the average price, the market price is expected to fall. In other words, deviations from the average price are expected to revert to the average.

Figure 4 visualizes the fluctuation of the number of newly opened accounts. We take the logarithm of the number of newly opened accounts for each year. As we can see, new retail and institutional accounts fluctuations are parallel. From 2005 to 2007, there is a significant growth in the number of the accounts for both retail and institutional accounts. For the period of 2003 to 2005 and 2007 to 2008, newly opened accounts decrease. The fluctuation is consistent with the business cycle. People tend to enter the stock market during periods of relatively rapid economic growth.

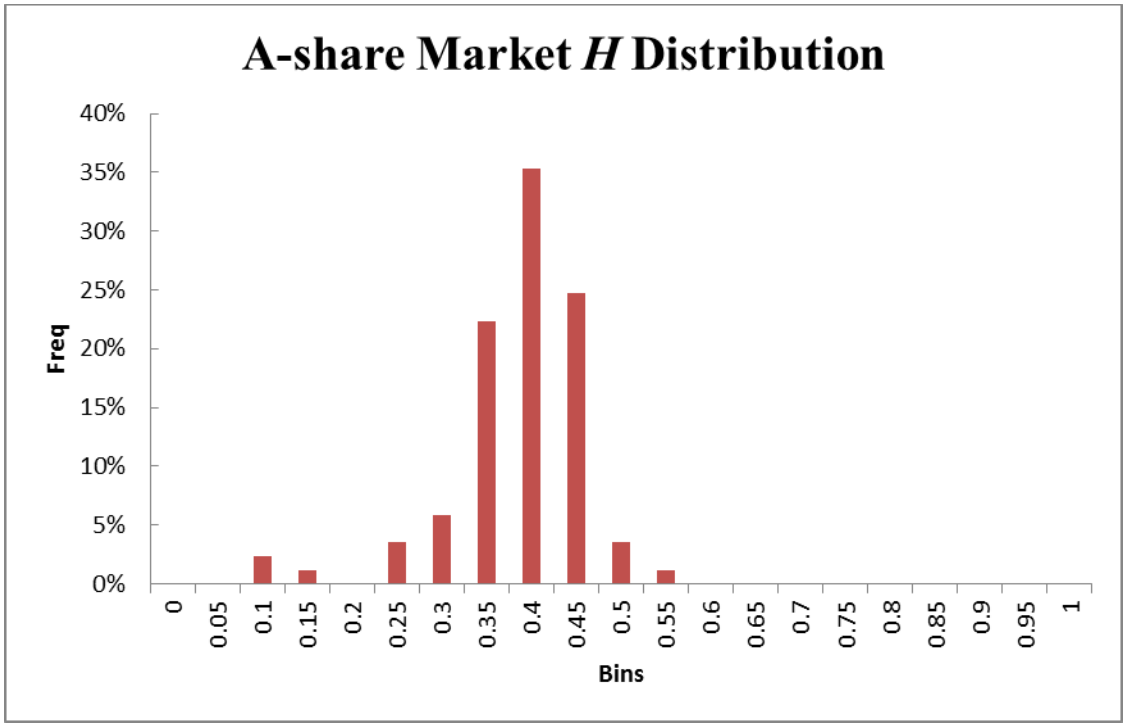

Figure 5 A-Share Market Hurst Exponent Distribution

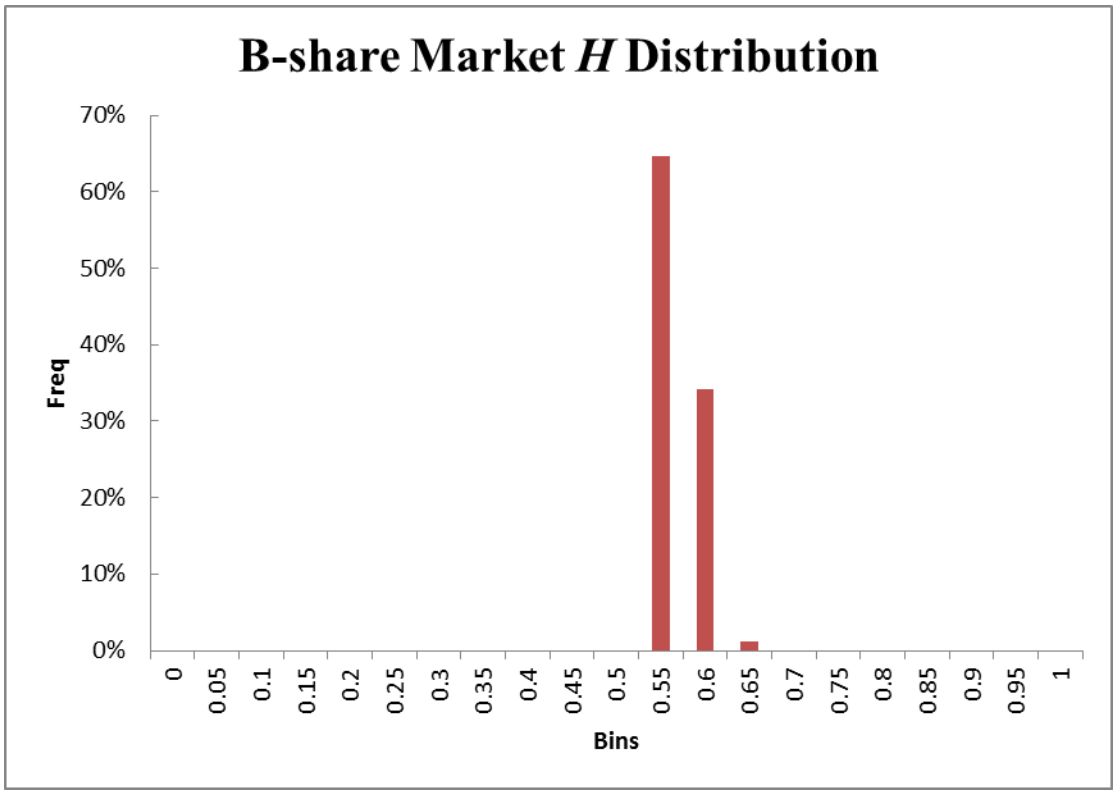

Figure 6 B-Share Market Hurst Exponent Distribution

Figure 5 and 6 are histograms for the A- and B-share market Hurst exponents. Based on the discussion above, the range of *H* is from zero to one. Thus, we create bins with a 0.05 interval from 0 to 1[12]. Then, we calculate the frequency for each bin. Figure 2 shows the A-share market *H* distribution. Approximately 64% of the Hurst exponents fall into the range of 0.4 and 0.5. About 25% falls into (0.35, 0.4]. However, Figure 3 shows a very different distribution from Figure 2. Over 65% of the B-share market Hurst exponents are in the range of 0.5 and 0.55. 34% falls into (0.55, 0.6]. B-share market Hurst exponents are more centralized close to 0.5, while A-share market Hurst exponents are distributed widely.

[12] The raw Hurst exponent for A- and B-share market are reported in Appendix A

CHAPTER FIVE

ECONOMETRIC ANALYSIS AND RESULTS

The panel data set enables us to establish a causal relationship between price differences and possible factors over time and across firms. Also, the panel nature of the data set allows us to control for idiosyncratic variation that could influence the price differences between the A- and B-share markets. Also, panel data methods can improve the precision of estimates of model dynamics in short time-series (e.g., Hsiao, 1986). In addition to increasing degrees of freedom and generally reducing the collinearity among explanatory variables, fixed effects panel model has been established in this thesis.

Based on the previous discussion of the determinates of the price disequilibrium, I perform a panel data analysis, which was also used by Domowitz et al. (1997), and Sun and Tong (1999). My regression model is as follows:

$$
\begin{aligned}
pricediff_{i,t} = {} & a_i \\
& + \nu_{1i} Habin(1)_{i,t} + \nu_{2i} Habin(2)_{i,t} + \cdots + \nu_{10i} Habin(10)_{i,t} \\
& + \tau_{1i} Hbbin(1)_{i,t} + \tau_{2i} Hbbin(2)_{i,t} + \cdots + \tau_{10i} Hbbin(10)_{i,t} \\
& + \beta_1 volatility_{i,t} + \beta_2 volume_{i,t} + \beta_3 nosh_{i,t} + \beta_4 pcttradable_{i,t} \\
& + \beta_5 lnoshholder_{i,t} + \beta_6 lnoinstitution_{i,t} + \theta_1 retailpctchange_{i,t} \\
& + \theta_2 institutionpctchange_{i,t} + \gamma_1 exchange_1 + \eta_i industry_{i,t} \\
& + \mu_1 year_{i,t} + \varepsilon_{i,t}
\end{aligned}
$$

Where $Habin(k)_{i,t}$ $(k = 1,2,\ldots,10)$ is the number of A share market Hurst exponent that fall into interval $bin(k)$ for stock *i* at time *t*. $Hbbin(k)_{i,t}$ $(k = 1,2,\ldots,10)$ is the number of B share market Hurst exponent that fall into interval $bin(k)$ for stock *i* at

time *t*. $bin(k)$ $(k = 1,2,\ldots,10)$ is the interval ((*k-1)/10, k/10*][13]. $priceadiff_{i,t}$ is A,B share price differences divided by B-share price; $volatility_{i,t}$ is the ratio of volatility (in A-share market over that in B-share market); $volume_{i,t}$ is the ratio of volume; $nosh_{i,t}$ is number of shares outstanding; $pcttradable_{i,t}$ is ratio of percentage of tradable shares; $lnoshholder_{i,t}$ is ratio of number of shareholders (in logarithm); $lnoinstitution_{i,t}$ is ratio of institutional holdings (in logarithm); $retailpctchange_{i,t}$ is the percentage change of newly registered retail accounts (in logarithm) from time *t-1* to time *t*; $institutotnpctchange_{i,t}$ is the percentage change of newly registered institutional accounts (in logarithm) from time *t-1* to time *t*; $exchange_1$, $industry_{i,t}$, $year_{i,t}$, are dummy variables representing stock exchange, industry category, individual firm and year

5.1 Description of variables

The dependent variable in the model is $priceadiff$, which is the A and B share price differences defined as ($price_A$ - $price_B$)/ $price_B$, where $price_A$ and $price_B$ are quarterly-end prices of A and B shares. A shares are all traded in Chinese Yuan (RMB). B shares listed in Shanghai Stock Exchange are traded in U.S. dollars (USD), while those listed in Shenzhen Stock Exchange are traded in Hong Kong dollars (HKD). To unify the prices and calculate $priceadiff$, all the prices are converted into USD by using quarterly-end exchange rates. Most of the time A shares are more expensive than their counterparts in the B share market; as a result, $priceadiff$ are

[13] The interval excludes *"(k-1)/10"* and includes*" k/10"*.

almost all positive in the sample data.

There are six numerical independent variables all in the form of ratios (A-share market over B-share market). *pcttradable* the percentage of tradable shares and *lnoinstitution* institutional holdings are the two major variables represent the two ownership structures that may cause the price difference between A shares and matching B shares. *nosh* number of shares outstanding and *lnoshholder* number of shareholders capture the differential demand factors. Other two indicates the market general features— *volatility* market volatility and *turnover* turnover rate (daily average volume).

1) Test ownership structure influences

pcttradable and *lnoinstitution* are the two main variables in the model, representing two classes of ownership structures in China's stock markets. Those variables are to test the hypothesis about the influence of ownership structures in China's stock markets on the price disequilibrium. *pcttradable* is the ratio of percentage of tradable shares in A-share market over tradable shares in B-share market. Tradable shares are shares that can be traded in the stock exchanges and are the real share supply in the market. Non-tradable shares are shares that held by the Chinese government or organizations that are backed by the government and cannot be traded in the stock exchanges. And most of the non-tradable shares are represented by state-owned shares or legal-person shares. Non-tradable shares are an unparalleled feature of the ownership structure of Chinese listed companies (Beltratti and

Bortolotti, 2006). The existence of non-tradable shares extremely limits free float available and makes the markets illiquid, volatile and speculative. The more shares are not tradable, the less the free float will be available in the market, and the higher stock prices will be.

Another possible factor of ownership structure on the price difference is *lnoInstitution*, which represents the relative institutional holdings (number of shares owned by institutional investors) between A shares and B shares. As a very important group of investors, institutional investors are considered to be more informed and experienced, and thus help to stabilize asset prices as suggested by most of academic literature. However, there is a number of studies show that institutional investors are associated with more volatile stocks. "Herding and positive feedback trading are the two main arguments put forward for the destabilizing impact on stock prices induced by institutional investors." (Bohl and Brzeszczynski, 2006) To test the relationship between institutional ownership and the price difference, the null hypothesis is that there is no relationship between the ratio of relative institutional holdings and the A-share premium. If institutional investors help with stock price stability, *lnoInstitution* (ratio of institutional holdings) will be negatively related to *prceadiff* (A-share premium) because the more shares held by institutional investors the closer the stock price will come toward its fundamental value and the smaller the price gap will be. If institutional investors are associated with disability of the market, the estimate will be positive indicating that institutions prefer risker stocks and drive the price difference between the two markets larger. When checking the assumptions

of the model, the residuals pattern of the institutional shares ratio is mostly scattered on the left hand side in the graphs, indicating a different residuals variance. Therefore, I use natural logarithm of this variable. The adjusted R square of the multi-regression is greatly improved after the transformation.

2) Test the differential demand argument

lnoshholder and *nosh* represent the share demand and share supply in the markets respectively. *nosh* is the ratio of the number of shares outstanding in A-share market over B-share market, which represents the relative share supply in the two markets. In Sun and Tong (1999), they use shares outstanding as the supply of the market to test whether the demand curve is downward sloping. And they get a negative sign in the result, which demonstrates that when the supply of A shares increases relative to the supply of B shares, price pressure would push A-share prices to drop relative to B-share prices. With the same expectation as Sun and Tong (1999), I expect that *nosh* (number of shares outstanding) will be negatively related with *pricediff* (A-share price premium). *lnoshholder* is the ratio of number of shareholders in A-share market to that of B-share market. I use this variable as share demand in the model. Merton (1987) suggests that an increase in a firm's investor base increases the firm's value. Amihud, Mendelson and Uno (1999) find that a reduction in the minimum trading unit increases a firm's base of individual investors, and significantly increases stock liquidity and price. Further, the stock price appreciation drives an increase in the number of shareholders in return. To sum up, as a factor of share demand, the more investors in the market, the higher the prices will be. Thus, with the same expectation,

the relationship between *lnoshholder* (number of shareholders) and *prtsdiff* (A-share premium) should be positive. I use natural logarithm of this variable because of left-scattered residual pattern. The adjusted R square of the multi-regression is greatly improved after the transformation.

3) Test general factors

The model also includes some general variables— *volatility* and *turnover*, which are the ratio of volatility and turnover rate in the two market and representing relative speculative activities and liquidity levels. Sun and Tong (1999) test those two factors and find that they are significantly influence the price difference between the two markets. *volatility* is included in the model to test the speculative argument. It is calculated by the volatility of A shares divided by the volatility of B shares. Volatility is used to quantify the risk of the financial instrument over the specified time period. At the same time, the ratio of volatility is a way to capture the relative speculative activities of investors in the two markets: the excess of volatility of A shares over B shares can be explained by the relative excess of speculative activities. If A-share market is more speculative than B-share market, the relationship between *volatility* (ratio of volatility) and *prtsdiff* (A-share price premium) should be positive. *turnover* is the ratio of turnover rate (A shares over B shares). Volume rate is a liquidity variable. In Sun and Tong (1999), instead of using turnover rate as the liquidity proxy they use trading volume. As a ratio, *Volume* in the model is the indicator of relative liquidity levels between A- and B-share markets. If the B-share discount is due to lack of liquidity of B-share market, the *Volume* should be positively

related to *prcadiff* (A-share premium).

4) Firm, industry, stock exchange and time effects

Except for six numerical variables, there are four dummy variables in the model. *exchange* represents the stock exchanges. The reason that why I include this variable in the model is that the firms that listed in the two markets are quite different from each other. Specifically, the companies that listed in SSE are large-capital firms who have over 4 trillion capital stocks. On the contrary, the companies that listed in SZSE are usually much smaller with a capitalization of less than 1 trillion. *industry* shows different industry categories and there are 7 types of industries associated in the data sample. Information Technology Industry, Manufacturing, Production & Supply of Power, Gas & Water, Real Estate, Social Services, Transportation & Storage, and Wholesale And Retail Trades. And *year* is the time factor in the model, which is from 2001 and 2010. I include this variable in the model because as showed in Figure 1-1, the price difference changes over time, which indicates time variance exists in the sample.

5) Test greater fool factors

The explanatory variable will include the greater fool factors—*retailpctchange* and *institutionpctchange* the percentage change of newly registered retail and institutional investor stock accounts respectively from time *t-1* to time *t*. As mentioned in the literature review session, we utilize these two variables as

the proxies of the supply of greater fools. The more supply of greater fools, the higher chance to find one and sell the stocks and hence the higher prices.

6) Test Hurst exponent

Based on the previous discussion of the calculation of Hurst exponent, we create the bins (consecutive, non-overlapping intervals) for the value of *H* for both A share market and B share market. For each market, since the range of *H* is from zero to one so we divide the raw *H* into deciles so that each part represents 1/10 of the total number of *H*. We then count the number of *H*s within each bin and record that number as our independent variable. Total number of *H* is 85. We use the bins instead of the raw value of *H* because the bins show the distribution of the continuous variable *H* and it will yield a clear result for each interval we interested. Given the feature and relationship between Hurst exponent and fBm, it helps us locate the relationship between a specific range of Hurst exponent and the price differences between A share and B share. In our regression, $Habin(k)$ $(k = 1,2,\dots,10)$ represents the number of A share market *H*s fall into the interval ((*k-1)/10, k/10*]. $Hbbin(k)$ $(k = 1,2,\dots,10)$ represents the number of B share market *H*s fall into the interval ((*k-1)/10, k/10*).

5.2 Results

1) Regression results

Table 3 Regression Results

	Coef.	Std. Err.	T-Statistic
A_bin_0.1	1.4195*	0.8577	1.65
A_bin_0.2	0.2324	0.8385	0.28
A_bin_0.3	0.5891	0.8164	0.72
A_bin_0.4	-0.2063	0.8109	-0.26
A_bin_0.5	-0.0007	0.8786	0.00
A_bin_0.6	1.6057**	0.7720	2.09
B_bin_0.5	-1.4824	0.8924	-1.42
B_bin_0.6	-2.4317***	0.9274	-2.70
B_bin_0.7	-2.7646***	0.8584	-3.23
Volatility ratio	1.2473	0.8178	1.53
Volume ratio	0.0026 *	0.0016	1.70
# of shares outstating ratio	0.0276	0.1162	0.24
Percentage of tradable shares ratio	-0.3161	1.0307	-0.31
# of shareholders ratio	-1.9053***	0.2039	-9.35
Institutional holdings ratio	-0.0709***	0.0391	-1.82
Retail accounts quarterly change	0.1691**	0.0852	-2.12
Institutional accounts quarterly change	-4.9099 **	2.4596	-2.00
Year	YES		
Industry	YES		
Exchange	YES		
Observation	555		
Adj R2	0.8980		

* Significant at the 10% level.
** Significant at the 5% level.
***Significant at the 1% level.

(a) Ownership structure factors

For the ownership structure variables, the ratio of percentage of tradable shares in A-share market to B-share market does not have a significant relationship with the price differences. However, our hypothesis is that the more shares tradable in A-share market over B-share market, the more the share supply will be in A-share market

relative to B-share market, and the lower the A-share prices will be relative to B-share prices. From the empirical results, we do not get a significant negative relationship between the ratio of tradable shares and A-share price premium. Another important factor of ownership structure is the institutional shares. From Table 3, the ratio of institutional shares of A-share market over B-share market is negatively related to the price differences (significant at the 1% level). In other words, the more institutional investors relatively in A-share market over B-share market, the smaller the A-share premium will be. And it is consistent with the hypothesis that institutional investors help to narrow the price difference. For the general variables, the ratio of volatility of A shares to B shares, which represents the relative speculative activities between A-share and B-share markets is not significantly related to the price differences. This result does not support the speculation argument by Sun and Tong (1999)—the excessive speculative activities in A-share market than B-share market is one of the factors that enlarge the price difference between the two markets. The ratio of trading volume of A shares to B shares representing the relative liquidity of the two markets is significantly (at 10% level) related to the price differences. For the possible factors for share supply and share demand, the ratio of number of shareholders in A-share market over B-share market—has a negative sign in the regression results in Table 3, which is also unexpected and inconsistent with the hypothesis. As a variable of share demand, the more number of shareholders in A-share market relative to B-share market, the lower the A-share price premium should be. Our results are consistent with the hypothesis. The ratio of number of shareholders between A-share market and B-share market increases, the ratio of the shares demand between the two markets increases.

Thus, it will draw the A-share price down and decrease the price differences between A- and B-share markets.

(b) Hurst exponent

We regress the price differences between A- and B-share markets on the A- and B-share market Hurst exponent. Instead of the raw Hurst exponent, we use the frequency bins. From Table 3, the Hurst exponent is not correlated to the price differences if *H* closes or equals to 0.5, as expected. Based on what we discussed above, *H* closes or equals to 0.5 indicates a standard Brownian motion. Thus, they shouldn't impact the price differences. However, as one can see, for A-share market, the Hurst exponent in the range of (0.5, 0.6] tends to have a positive relationship with the price differences (significant at the 1% level). Basically, in the range of 0.5 and 0.6, if the stochastic process of the price in A-share market become a long-memory process, then it will increase the A price premium or the price differences between A- and B-share market. Likewise, in B-share market, if *H* closes or equals to 0.5, the Hurst exponent does not affect the price differences. Plus, the Hurst exponent in the range of (0.5, 0.6] or (0.6, 0.7] is more likely to have a negative impact on the price differences between A- and B-share market (significant at the 1% level). Particularly, the B-share market becomes more persistent, and the price differences between A- and B-share market decrease.

(c) Greater fool factors

From Table 3, the percentage change of retail investors loads positively and significantly (significant at 5% level) against the price differences between the A- and

B-share markets. This is consistent with the Greater Fool Theory. More retail investors join in the market, higher the chance a greater fool could be found and higher the price spread between the A- and B-share markets. One explanation could be that more retail participants would increase the total turnover of the exchanges, hence, increasing the short-term volatility in the markets. The percentage change of institutional investors loads negatively and significantly (significant at 5% level) against the price differences. This is indicating the institutional investors are not qualified as greater fools. The risk taking capacity of institutional investors is far more than that of retail investors. So, that is why we see many institutional investors purchasing falling stocks or holding stocks even in the phase of a bear market[14]. Institutional investors have their own talented research teams which conduct a thorough stock research before investing. Thus, their investment behavior would basically help to correct the mispricing of the A- and B-share markets. Hence, more institutional participants join in the market would not decrease the price differences between A- and B-share markets.

[14] A market condition in which the prices of securities are falling, and widespread pessimism causes the negative sentiment to be self-sustaining.

2) Model Comparison

Table 4 reports the comparison among the four models: the final model in our thesis, model without Hurst exponent's variables, model without greater fool variables, and model without market friction variables. From the comparison table we can find that the final model has the highest adjusted R^2 0.8980 indicating the highest significance among the models. Also, Mallow's C statistic[15] has been reported. The final model has the lowest Mallows' C statistic which confirms that this model is the most significant model among the four models.

[15] Mallows' C statistic (C_p) addresses the issue of overfitting. $C_p = \frac{SSE_p}{s^2} - N + 2P$, where SSE_p the error sum of squares, P is the number of regressors, S^2 is the residual mean square, N is the sample size.

Table 4 Model Comparison

	Final model	Model w/o Hurst	Model w/o Greater fool	Model w/o Ownership
A_bin_0.1	1.4195*	-	1.5447*	-0.1967
	(0.8577)		(0.7486)	(0.3495)
A_bin_0.2	0.2324	-	0.4313	0.6788
	(0.8385)		(0.7172)	(0.3592)
A_bin_0.3	0.5891	-	0.8139	1.9143
	(0.8164)		(0.6867)	(1.2156)
A_bin_0.4	-0.2063	-	0.1726	0.5088
	(0.8109)		(0.6928)	(0.3805)
A_bin_0.5	-0.0007	-	0.5059	0.2107
	(0.8786)		(0.7763)	(0.3368)
A_bin_0.6	1.6057**	-	1.8603**	2.0662***
	(0.7720)		(0.6876)	(0.3501)
B_bin_0.5	-1.4824	-	-0.9033	0.3709
	(0.8924)		(0.7389)	(0.3339)
B_bin_0.6	-2.4317***	-	-2.1088***	-0.5779
	(0.9274)		(0.7543)	(0.3583)
B_bin_0.7	-2.7646***	-	-2.4193***	-1.0233***
	(0.8584)		(0.7054)	(0.3656)
Volatility ratio	1.2473	0.6217	0.7398	-
	(0.8178)	(0.8359)	(0.7512)	
Volume ratio	0.0026*	0.0037**	0.0022	-
	(0.0016)	(0.0017)	(0.0015)	
# of shares outstating ratio	0.0276	0.0972	-0.0212	-
	(0.1162)	(0.1116)	(0.1044)	
Percentage of tradable shares ratio	-0.3161	-1.2711	0.1725	-
	(1.0307)	(1.0497)	(0.9254)	
# of shareholders ratio	-1.9053***	-1.7223***	-2.0297***	-
	(0.2039)	(0.1916)	(0.1824)	
Institutional holdings ratio	-0.0709***	-0.1168***	-0.0797**	-
	(0.0391)	(0.0411)	(0.0365)	
Retail accounts quarterly change	0.1691**	1.9397	-	1.3454
	(0.0852)	(3.0817)		(1.5157)
Institutional accounts quarterly change	-4.9099 **	-3.7506	-	-1.2199
	(2.4596)	(2.7069)		(1.4998)
Year	YES	YES	YES	YES
Industry	YES	YES	YES	YES
Exchange	YES	YES	YES	YES
Observation	555	555	555	555
Adj R2	0.8980	0.8734	0.8878	0.8311
Mallows' C Statistic	1116.4	1310.8	1249.5	1541.5

* Significant at the 10% level.
** Significant at the 5% level.
***Significant at the 1% level.

CHAPTER SIX

CONCLUSION

This study characterizes three major factors responsible to the price differences between A- and B-share markets: market friction, greater fool factor, and Hurst exponent (market efficiency) factor. We test whether these factors are empirically valid and statistically significant. The objective of this study has been fulfilled with a satisfactory result. First, the empirical tests find that the supply of greater fools is a force that drives the price differences between A- and B-share markets. Second, the overview of China's stock markets shows that there is always a tremendous price gap between China's A- and B-share markets and B shares have been traded at discount relative to matching A shares. By building up the regression model, the A-share premium can be explained by the ownership structure differences between the two markets. Specifically, the results show that in Chinese stock markets, institutional investors help to stabilize prices. As the number of institutional holdings in the A-share market rises relative to B-share market, the price difference between the two markets decreases. It indicates that institutional investors help in narrowing down the price gap between A shares and B shares and it may due to their advantage in knowledge, experience, information over individual investors. The ratio of number of shares outstanding negatively related with A-share premium, as expected. Third, from the market efficacy point of view, the results are exactly consistent with the hypothesis. At Hurst exponent H=0.5, the coefficient is not statistically significant. In other word, if the prices are driven by a standard Brownian motion then they are not

responsible for the price differences between A- and B-share markets. However, if the Hurst exponent greater than 0.5 indicating the prices are persistent, then it will be responsible for the price differences. Some further improvement could be done on this study. First, we could further incorporate more psychology implements on how to explain between the Hurst exponent and the price differences. Second, a wider range of testing periods could be included if data in the earlier time has been revealed.

Given the results of this study, the Chinese government could consider the following policies: invite more institutional investors into the markets; increase the number of shareholders and approve more retail investor stock accounts registrations. In the long run the Chinese government would merge A-share and B-share markets, since QFII27—the new tool for foreign investors to invest in Chinese stock market was created. The above policies may drive the A-share price down and decrease the price difference between A-share and B-share markets, and thus make the future mergence smooth and successful.

APPENDIX A: 85 CROSS-LISTING SHARES HURST EXPONENT IN CHINA'S A-SHARE AND B-SHARE MARKETS

A-share Code	A-share Hurst	B-share Code	B-share Hurst
000002 CH Equity	0.531734	200002 CH Equity	0.524785
000011 CH Equity	0.535534	200011 CH Equity	0.567514
000012 CH Equity	0.518727	200012 CH Equity	0.547993
000016 CH Equity	0.496460	200016 CH Equity	0.518048
000017 CH Equity	0.523561	200017 CH Equity	0.597942
000018 CH Equity	0.493296	200018 CH Equity	0.554237
000019 CH Equity	0.485491	200019 CH Equity	0.546495
000020 CH Equity	0.525809	200020 CH Equity	0.593472
000022 CH Equity	0.485083	200022 CH Equity	0.520063
000024 CH Equity	0.512994	200024 CH Equity	0.536536
000025 CH Equity	0.511612	200025 CH Equity	0.585192
000026 CH Equity	0.517513	200026 CH Equity	0.551894
000028 CH Equity	0.482400	200028 CH Equity	0.542744
000029 CH Equity	0.539391	200029 CH Equity	0.528275
000030 CH Equity	0.539391	200030 CH Equity	0.611241
000037 CH Equity	0.508288	200037 CH Equity	0.555687
000039 CH Equity	0.507127	200039 CH Equity	0.557745
000045 CH Equity	0.490081	200045 CH Equity	0.528825
000055 CH Equity	0.466607	200055 CH Equity	0.505848
000056 CH Equity	0.492837	200056 CH Equity	0.534888
000058 CH Equity	0.530297	200058 CH Equity	0.534818
000413 CH Equity	0.484888	200413 CH Equity	0.543423
000418 CH Equity	0.526013	200418 CH Equity	0.541543
000429 CH Equity	0.487303	200429 CH Equity	0.521521
000488 CH Equity	0.494671	200488 CH Equity	0.540337
000505 CH Equity	0.518427	200505 CH Equity	0.555367
000513 CH Equity	0.516505	200513 CH Equity	0.552141
000521 CH Equity	0.516661	200521 CH Equity	0.536649
000530 CH Equity	0.478799	200530 CH Equity	0.528159
000539 CH Equity	0.511962	200539 CH Equity	0.516359
000541 CH Equity	0.495071	200541 CH Equity	0.524923
000550 CH Equity	0.494620	200550 CH Equity	0.546749
000553 CH Equity	0.511092	200553 CH Equity	0.538709
000570 CH Equity	0.537471	200570 CH Equity	0.556897
000581 CH Equity	0.529848	200581 CH Equity	0.550055
000596 CH Equity	0.499719	200596 CH Equity	0.581812
000613 CH Equity	0.561882	200613 CH Equity	0.594163
000625 CH Equity	0.540101	200625 CH Equity	0.570986
000725 CH Equity	0.524998	200725 CH Equity	0.556411
000726 CH Equity	0.521677	200726 CH Equity	0.535143
000761 CH Equity	0.512012	200761 CH Equity	0.555068

000869 CH Equity	0.484435	200869 CH Equity	0.535266
600054 CH Equity	0.487170	900942 CH Equity	0.531678
600190 CH Equity	0.491596	900952 CH Equity	0.535736
600221 CH Equity	0.505693	900945 CH Equity	0.524372
600272 CH Equity	0.432913	900943 CH Equity	0.538875
600295 CH Equity	0.500556	900936 CH Equity	0.540658
600320 CH Equity	0.491997	900947 CH Equity	0.544165
600555 CH Equity	0.217980	900955 CH Equity	0.533109
600602 CH Equity	0.497222	900901 CH Equity	0.529464
600604 CH Equity	0.529907	900902 CH Equity	0.565974
600610 CH Equity	0.516098	900906 CH Equity	0.572715
600611 CH Equity	0.527476	900903 CH Equity	0.548287
600612 CH Equity	0.489286	900905 CH Equity	0.559811
600613 CH Equity	0.483976	900904 CH Equity	0.548409
600614 CH Equity	0.513611	900907 CH Equity	0.576298
600617 CH Equity	0.486111	900913 CH Equity	0.563497
600618 CH Equity	0.482013	900908 CH Equity	0.537668
600619 CH Equity	0.434846	900910 CH Equity	0.515382
600623 CH Equity	0.517677	900909 CH Equity	0.542126
600639 CH Equity	0.479684	900911 CH Equity	0.526131
600648 CH Equity	0.467026	900912 CH Equity	0.517767
600650 CH Equity	0.466777	900914 CH Equity	0.521028
600663 CH Equity	0.488528	900932 CH Equity	0.535976
600679 CH Equity	0.523368	900916 CH Equity	0.550941
600680 CH Equity	0.472737	900930 CH Equity	0.531627
600689 CH Equity	0.471753	900922 CH Equity	0.538226
600695 CH Equity	0.485757	900919 CH Equity	0.548084
600698 CH Equity	0.553239	900946 CH Equity	0.559895
600726 CH Equity	0.512447	900937 CH Equity	0.547855
600751 CH Equity	0.556355	900938 CH Equity	0.586708
600754 CH Equity	0.474558	900934 CH Equity	0.524987
600776 CH Equity	0.490666	900941 CH Equity	0.515746
600801 CH Equity	0.508486	900933 CH Equity	0.581152
600818 CH Equity	0.509548	900915 CH Equity	0.527424
600819 CH Equity	0.508584	900918 CH Equity	0.534283
600822 CH Equity	0.454957	900927 CH Equity	0.526507
600827 CH Equity	0.500021	900923 CH Equity	0.517024
600835 CH Equity	0.522104	900925 CH Equity	0.534636
600841 CH Equity	0.454021	900920 CH Equity	0.530621
600843 CH Equity	0.466789	900924 CH Equity	0.539435
600844 CH Equity	0.532910	900921 CH Equity	0.587280
600845 CH Equity	0.468026	900926 CH Equity	0.541766
600848 CH Equity	0.532135	900928 CH Equity	0.559490
600851 CH Equity	0.531402	900917 CH Equity	0.554107

APPENDIX B: OVERVIEW OF 85 CROSS-LISTING STOCKS

A-share Code	B-share Code	Industry	Date	Full Shares	Tradable Shares	Listed in HK market
C000002	200002	Real Estate	2001-12-31	121,755,136	121,755,136	N
C000002	200002	Real Estate	2010-12-31	1,314,955,468	1,314,955,468	N
C000011	200011	Real Estate	2001-12-31	61,459,312	61,459,312	N
C000011	200011	Real Estate	2010-12-31	67,605,243	67,605,243	N
C000012	200012	Metal, Nonmetal	2001-12-31	299,052,546	299,052,546	N
C000012	200012	Metal, Nonmetal	2010-12-31	762,583,992	762,583,992	N
C000016	200016	Electronic	2001-12-31	202,837,902	202,837,902	N
C000016	200016	Electronic	2010-12-31	405,675,804	405,675,804	N
C000017	200017	Machinery, Equipment, Instrument	2001-12-31	178,620,649	178,620,649	N
C000017	200017	Machinery, Equipment, Instrument	2010-12-31	248,362,982	248,362,982	N
C000018	200018	Textile, Clothing, Fur	2001-12-31	69,421,903	69,421,903	N
C000018	200018	Textile, Clothing, Fur	2010-12-31	69,421,903	69,421,903	N
C000019	200019	Food And Beverage	2001-12-31	26,136,000	26,136,000	N
C000019	200019	Food And Beverage	2010-12-31	26,136,000	26,136,000	N
C000020	200020	Information Technology Industry	2001-12-31	101,995,836	101,995,836	N
C000020	200020	Information Technology Industry	2010-12-31	101,995,836	101,995,836	N
C000022	200022	Transportation, Storage	2001-12-31	106,447,000	106,447,000	N
C000022	200022	Transportation, Storage	2010-12-31	179,611,983	179,611,983	N
C000024	200024	Transportation, Storage	2001-12-31	136,221,800	136,221,800	N
C000024	200024	Real Estate	2010-12-31	141,633,850	141,633,850	N
C000025	200025	Wholesale And Retail Trades	2001-12-31	26,400,000	26,400,000	N
C000025	200025	Wholesale And Retail Trades	2010-12-31	26,400,000	26,400,000	N
C000026	200026	Machinery, Equipment, Instrument	2001-12-31	58,320,000	58,320,000	N
C000026	200026	Machinery, Equipment, Instrument	2010-12-31	58,320,000	58,320,000	N
C000028	200028	Wholesale And Retail Trades	2001-12-31	54,885,600	54,885,600	N
C000028	200028	Wholesale And Retail Trades	2010-12-31	54,885,600	54,885,600	N
C000029	200029	Real Estate	2001-12-31	120,000,000	120,000,000	N
C000029	200029	Real Estate	2010-12-31	120,000,000	120,000,000	N
C000030	200030	2001-12-31	39,600,000	39,600,000	N	
C000030	200030	Papermaking, Printing	2010-12-31	39,600,000	39,600,000	N
C000037	200037	Production & Supply Of Power, Gas & Water	2001-12-31	108,565,928	108,565,928	N
C000037	200037	Production & Supply Of Power, Gas & Water	2010-12-31	263,854,446	263,854,446	N
C000039	200039	Metal, Nonmetal	2001-12-31	142,403,801	142,403,801	N
C000039	200039	Metal, Nonmetal	2010-12-31	1,430,478,709	1,430,478,709	N
C000045	200045	Textile, Clothing, Fur	2001-12-31	33,000,000	33,000,000	N
C000045	200045	Textile, Clothing, Fur	2010-12-31	49,500,000	49,500,000	N
C000055	200055	Metal, Nonmetal	2001-12-31	145,368,000	145,368,000	N
C000055	200055	Metal, Nonmetal	2010-12-31	223,967,460	223,967,460	N
C000056	200056	Wholesale And Retail Trades	2001-12-31	72,000,000	72,000,000	N
C000056	200056	Wholesale And Retail Trades	2010-12-31	101,688,192	101,688,192	N
C000058	200058	Electronic	2001-12-31	228,041,727	228,041,727	N
C000058	200058	Electronic	2010-12-31	246,461,318	246,461,318	N

C000413	200413	Electronic	2001-12-31	100,000,000	100,000,000	N
C000413	200413	Electronic	2010-12-31	100,000,000	100,000,000	N
C000418	200418	Machinery, Equipment, Instrument	2001-12-31	127,357,248	127,357,248	N
C000418	200418	Machinery, Equipment, Instrument	2010-12-31	160,184,158	160,184,158	N
C000429	200429	Transportation, Storage	2001-12-31	303,750,000	303,750,000	N
C000429	200429	Transportation, Storage	2010-12-31	348,750,000	348,750,000	N
C000488	200488	Papermaking, Printing	2001-12-31	206,480,550	206,480,550	N
C000488	200488	Papermaking, Printing	2010-12-31	557,497,485	557,497,485	Y
C000505	200505	Real Estate	2001-12-31	57,500,000	57,500,000	N
C000505	200505	Real Estate	2010-12-31	64,975,000	64,975,000	N
C000513	200513	Medicine, Biologic Products	2001-12-31	122,306,984	122,306,984	N
C000513	200513	Medicine, Biologic Products	2010-12-31	111,993,354	111,993,354	N
C000521	200521	Machinery, Equipment, Instrument	2001-12-31	113,100,000	113,100,000	N
C000521	200521	Machinery, Equipment, Instrument	2010-12-31	113,100,000	113,100,000	N
C000530	200530	Machinery, Equipment, Instrument	2001-12-31	115,000,000	115,000,000	N
C000530	200530	Machinery, Equipment, Instrument	2010-12-31	115,000,000	115,000,000	N
C000539	200539	Production & Supply Of Power, Gas & Water	2001-12-31	665,340,000	665,340,000	N
C000539	200539	Production & Supply Of Power, Gas & Water	2010-12-31	665,326,500	665,326,500	N
C000541	200541	Machinery, Equipment, Instrument	2001-12-31	82,500,000	82,500,000	N
C000541	200541	Machinery, Equipment, Instrument	2010-12-31	225,225,000	225,225,000	N
C000550	200550	Machinery, Equipment, Instrument	2001-12-31	344,000,000	344,000,000	N
C000550	200550	Machinery, Equipment, Instrument	2010-12-31	344,000,000	344,000,000	N
C000553	200553	Petroleum, Chemical, Rubber, Plastic	2001-12-31	115,000,000	115,000,000	N
C600602	900901	Electronic	2010-12-31	293,370,465	293,370,465	N
C600604	900902	Machinery, Equipment, Instrument	2001-12-31	232,925,000	232,925,000	N
C600604	900902	Machinery, Equipment, Instrument	2010-12-31	232,925,000	232,925,000	N
C600611	900903	Social Services	2001-12-31	202,800,000	202,800,000	N
C600611	900903	Social Services	2010-12-31	533,871,000	533,871,000	N
C600613	900904	Transmitting, Culture Industry	2001-12-31	45,626,375	45,626,375	N
C600613	900904	Social Services	2010-12-31	45,626,375	45,626,375	N
C600612	900905	2001-12-31	120,051,360	120,051,360	N	
C600612	900905	Wholesale And Retail Trades	2010-12-31	132,056,496	132,056,496	N
C600610	900906	Machinery, Equipment, Instrument	2001-12-31	120,120,000	120,120,000	N
C600610	900906	Machinery, Equipment, Instrument	2010-12-31	120,120,000	120,120,000	N
C600614	900907	Petroleum, Chemical, Rubber, Plastic	2001-12-31	41,745,000	41,745,000	N
C600822	900927	Wholesale And Retail Trades	2001-12-31	66,550,000	66,550,000	N
C600822	900927	Wholesale And Retail Trades	2010-12-31	99,825,006	99,825,006	N

C600848	900928	Machinery, Equipment, Instrument	2001-12-31	107,145,500	107,145,500	N
C600848	900928	Machinery, Equipment, Instrument	2010-12-31	107,145,500	107,145,500	N
C600680	900930	Information Technology Industry	2001-12-31	124,800,000	124,800,000	N
C600680	900930	Information Technology Industry	2010-12-31	124,800,000	124,800,000	N
C600663	900932	Real Estate	2001-12-31	509,600,000	509,600,000	N
C600663	900932	Real Estate	2010-12-31	509,600,000	509,600,000	N
C600801	900933	Metal, Nonmetal	2001-12-31	164,000,000	164,000,000	N
C600801	900933	Metal, Nonmetal	2010-12-31	78,238,700	78,238,700	N
C600754	900934	Social Services	2001-12-31	156,000,000	156,000,000	N
C600754	900934	Social Services	2010-12-31	156,000,000	156,000,000	N
C600295	900936	Textile, Clothing, Fur	2001-12-31	210,000,000	210,000,000	N
C600295	900936	Textile, Clothing, Fur	2010-12-31	420,000,000	420,000,000	N
C600726	900937	Production & Supply Of Power, Gas & Water	2001-12-31	432,000,000	432,000,000	N
C600726	900937	Production & Supply Of Power, Gas & Water	2010-12-31	432,000,002	432,000,002	N
C600751	900938	Transportation, Storage	2001-12-31	180,000,000	180,000,000	N
C600751	900938	Transportation, Storage	2010-12-31	180,000,000	180,000,000	N
C600776	900941	Information Technology Industry	2001-12-31	150,000,000	150,000,000	N
C600776	900941	Information Technology Industry	2010-12-31	300,000,000	300,000,000	N
C600054	900942	Social Services	2001-12-31	104,000,000	104,000,000	N
C600054	900942	Social Services	2010-12-31	156,000,000	156,000,000	N
C600272	900943	Textile, Clothing, Fur	2001-12-31	80,000,000	80,000,000	N
C600272	900943	Integrated	2010-12-31	80,000,000	80,000,000	N
C600221	900945	Transportation, Storage	2001-12-31	76,680,000	76,680,000	N
C600221	900945	Transportation, Storage	2010-12-31	184,723,201	184,723,201	N
C600698	900946	Machinery, Equipment, Instrument	2001-12-31	230,000,000	230,000,000	N
C600698	900946	Machinery, Equipment, Instrument	2010-12-31	230,000,000	230,000,000	N
C600320	900947	Machinery, Equipment, Instrument	2001-12-31	110,000,000	110,000,000	N
C600320	900947	Machinery, Equipment, Instrument	2010-12-31	858,000,000	858,000,000	N
C600190	900952	Transportation, Storage	2001-12-31	166,500,000	166,500,000	N
C600190	900952	Transportation, Storage	2010-12-31	222,806,970	222,806,970	N
C600555	900955	Textile, Clothing, Fur	2001-12-31	110,000,000	110,000,000	N
C600555	900955	Social Services	2010-12-31	330,000,000	330,000,000	N

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