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Three Essays on Chinese Stock Market

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Abstract

the thesis first investigates the regional effect on companies listing choice between two stock exchanges in China since dual listing is not allowed. Our major contribution is found that one unique feature of China's public listing is the regional effect, especially the location factor. Our model indicates that companies located in most provinces around Shenzhen, especially Guangdong province prefer to listing on Shenzhen Stock exchange (SZSE). And the same situation applies to companies listed on Shanghai Stock Exchange (SHSE).

Secondly, we test the effectiveness of price limits in Chinese stock market. The effectiveness of price limits as means to control excessive volatility has long been a controversial issue. The unique situation in the Shanghai stock exchange where price limits have been imposed twice in 1990's enables us to investigate the effectiveness of the mechanism. In this paper, we investigate the effects of price limits on the A-share index of Shanghai Stock Exchange. We have adopted a comprehensive approach which compares the excess kurtosis and the unconditional volatility in the three periods, in which the price limits is on in the first and third periods. Our analysis is carried out in the framework of cointegration and EGARCH models.

Finally, we try to identify the long term trend and co-integrations between A and B shares' system risk. One of our main results shows that there exists causal relationship between A shares in SHSE and in SZSE. However, although causal relationship also found in B-shares between two stock exchanges, the transmission direction is opposite to A-share's. The main reasons are the differences in market scale and sensitivity between A-share and B-share markets. This also reflects the two markets are segmented.

Chapter One: Introduction

During the last twenty years, China has undergone enormous economic change from a centrally planned economy to the current form of market economy and has deepened reforms in critical areas such as banking and financial system. Since 1980, china's gross domestic product (GDP) has grown nearly 9 percent every year outperforming any other country at any time in history for such a sustained period of growth. By 2003, the GDP has reached 1.414 trillion US dollars, which is equivalent to 1/9 of the GDP of the US. And if measured on a purchasing power parity (PPP) basis, China has become the second-largest economy in the world after the US.

China is commonly recognized as a manufacturing base for the world. After joining the World Trade Organization (WTO), the country gradually opens its market to foreign investors which means Chinese enterprises have to face the global competitions and operate under global standards. The development of a healthy capital market is crucial now for the sustainable economic growth in China in a globally competitive environment.

I Objective of this Study

China Capital market has several unique features, such as price limits mechanism which is used to control excessive stock price volatility, Segmented Chinese stock market, etc. The segmentation phenomenon can be analyzed from several aspects. Firstly, in China, many shares were controlled by the government even after listing and are therefore not traded in the market. Therefore, the same firm could issue shares listed in the stock exchange as free floating shares and shares that are not listed and not traded in the market as non traded shares (state shares and legal entity shares) at the same time. However, in 2005, the China Securities Regulatory Commission (CSRC) has changed the policy on non-tradable shares. The CSRC encouraged all mainland-listed companies to turn non-tradable in tradable shares and claimed that reform-compliant companies would be given priority to raise new capital. Secondly, from trading location aspects, in the early 1990s, mainland China has established two stock exchanges; one is located in Shenzhen where is near HongKong and called Shenzhen Stock Exchange (SZSE). The other one is located in Shanghai and called Shanghai Stock Exchange (SHSE). The two stock exchanges have very similar size and both are under the supervision of the same authority. However, Chinese companies can only list on one of the two stock exchanges in mainland China and cross listing between these two exchanges is not allowed. Then another character is foreign investors can only trade in foreign (B or H) shares and domestic investors only in A shares in China. This thesis attempts to investigate in these unique characteristics of China stock market in order to solve some puzzles about the market. First, we will give a brief outline of China Capital market. Then the study will try to analyze three distinct aspects of Chinese stock market.

In Chapter Two, a logistic regression is used to test a comprehensive panel data set of micro and macro information on China's publicly listed firms between 1995 and 2000 to see whether the model is an adequate representation of its behaviour. Our major contribution of this research is found that there is a regional effect on Chinese public listing companies' choice between stock exchanges which is the major difference from other countries.

Chapter Three has used the framework of co-integration and EGARCH models. It has explained the effects of price limits on the A-share index of Shanghai Stock Exchange and that of Shenzhen Stock Exchange. We have adopted a comprehensive approach which compares the excess kurtosis and the unconditional volatility in the three periods, in which the price limits is on in the first and third period. Our research indicates that there are evidence for possible delay in reaching equilibrium prices as a consequence of volatility reduction due to price limits.

In Chapter Four, the long term trend and co-integrations between A and B share's system risk has been investigated. The results showed that while the system risk of B-share market has increased from the lower international level to the higher A share market level, the downward trend in system risk of A-share market is quite obvious due to the much less political risk impact on share price, especially after 1997. the cointegration results indicate that the system risks between Shanghai A-share and Shenzhen A-share markets, the system risks between Shanghai B-share and Shenzhen B-share markets are cointegrated, respectively. This indicates that the two A-share markets and the two B-share markets are very closely related. However, the cointegration is rejected for the system risks between Shanghai A-share and B-share markets, and between Shenzhen A-share and B-share markets. Therefore, by some extent, China A-share and B-share markets are segmented. The thesis concludes in Chapter Five with a summary.

II A Brief introduction to the Chinese Capital Market

China's stock market has experienced rapid growth and development in the last 15 years, though the growth has been uneven and volatile. With the recent accession to the WTO, the Chinese stock market would become a great concern of the global investors, and would play a more important role in the world economy.

China's stock markets emerged in the 1980s following the introduction of China's economic reform programs. Before the reform, the whole financial system was dominated by the state-owned banks, and central planning agents. Investment was channeled either through direct grants from the state budgetary funds or from government allocated bank credits. In the 80's it became clear that most state-owned enterprises were in poor financial situation, and the planning system was no longer sustainable. While public listing in most developed countries either turn a privately-held company into a more widely-held public company, or transform a state owned enterprise (SOE) into a private-owned public company, the major goal of public listings in China was to change the rigid planning economy and to improve the efficiency and the governance of SOEs.

During the early stage, the Chinese central regulators established a quota system that each province can list a given number of SOEs and it was up to local leadership to decide which firms it would list. At the beginning, shares were sold internally to employees and local government staffs by force because most Chinese people did not understand the meaning of stocks and bonds. In the 1990s, the demands for secondary markets emerged. Therefore, in December, 1990 and soon after in July, 1991, Shanghai Stock Exchange (SHSE) and Shenzhen Stock Exchange (SZSE) were established, respectively.

Since 1992, because of the positive government policy for stock market in China and the price premium between issuing prices and secondary market first trading prices, the demand for stocks, especially for newly listed stocks has increased significantly. However, the number of newly listed companies was limited. For a fairer distribution of shares to the potential investors, a lottery system of IPO (initial public offering) was then used in both Shanghai and Shenzhen stock exchanges. This lottery system worked as follows. At first, the Security exchanges and the People's Bank of China announced several pre IPO companies and published their prospectus. Then investors can buy and submit the limited number of purchase applications for the company they are interested in on a pre-set date. After the date, a random drawing was held and only lucky winners have the right to buy the new IPOs. Attracted by the huge profits generated from IPOs which was due to limited free float and a policy of suppressing IPO prices (IPO price/earning ratios set to be below 15), investors did not really concern about which company they were buying. Later, the lottery system was revised. And the restrictions and limitations on application form purchases have been removed. However, each application must accompany the equivalent amount of deposit in a special account until the lottery winners were revealed.

2.1 Stock Issuing and Listing Process

Stock issuing and listing are two key processes of public listing. Before 2000, an SOE with intention to go public, it must seek permission from the local government or/ and its affiliated central government ministries, which receive an IPO quota from the CSRC (the China Securities Regulatory Commission, a China's SEC). Under this quota system, how many and which firms go public each year depend not only on the quality of the firms and macroeconomic conditions but also the availability and distribution of the quota. In 2000, the government decided to abandon the quota system and let the market determine which firms can go public.

In China, shares of a listed company can be divided into two broad categories: Non-tradable share (state shares & legal-person shares) and tradable shares. Non-tradable shares are issued to the founders of a company, business partners or employees. In China, the main purpose of issuing non-tradable shares is to keep the government's control of SOE while maximize IPO proceeds to solve the company's financial difficulty. State shares are held by central or local governments or by state-designated institutions (including SOEs). These shares are non-tradable shares. Legal person shares are held by domestic government controlled financial institutions, or by the foreign partners of a corporatized foreign joint venture. These shares are not listed which cannot be publicly traded. Individuals are prohibited from holding legal person shares. A 'legal person' is defined as a non-individual legal entity or institution. They are just a nominal distinction from state entities. Although non-tradable has secured governments control of SOEs, it creates several problems to the security market as well. Firstly, limited free float available for the market made the domestic stock market illiquid and volatile. Then the market manipulation and insider trading increased. Thirdly, the small amount of free float made public shareholders has limited influence on company's management. This made investors has less confidence in investing for long term and as a consequence, increased the volatility of china's domestic stock market.

Shares that can be trade on the stock exchanges are called tradable shares. These shares are mainly held by individuals, and they normally provide liquidity in the security market. Traded shares can also be divided into A shares, B shares, H shares and overseas listing shares.

A company could list its domestic investment shares (in the form of A-shares) or foreign investment shares (in the form of B-shares) in Shanghai or Shenzhen or its foreign investment shares on exchanges which have signed a Memorandum of Understanding with the CSRC or undertake a red-chip listing. The relevant laws and regulations governing stock listings are the *Administration of the Issuing and Trading of Shares Tentative Regulations, P.R.C. Company Law* and *P.R.C. Securities Law.*

<u>A Shares</u>

A -shares are different from other categories of domestic investment shares such as state-owned shares. A-shares are domestic investment shares issued by Chinese companies which are listed on the SHSE and SZSE. A-shares may only be subscribed by and traded among Chinese citizens and/or entities.

Under the *Administration of the Issuing and Trading of Shares Tentative Regulations* promulgated on April 22, 1993, before listing on the SHSE or SZSE, a shareholding company (also referred to as a joint stock limited company) must first be established. The procedure and requirements for establishing a shareholding company are set out in the *Company Law*. Note that the minimum amount of registered capital is *renminbi* 10 million which has to be paid up in cash at the time of filing application and supported by capital verification certificates.

A shareholding company must comply with the following criteria in order to apply for listing:

- A company should satisfy the following requirements when restructuring to a shareholding company: the Company have reported profits in the past 3 years and at the end of previous fiscal year, at least 30% of its total assets must be the net capital.
- When restructuring a SOE to a limited liability corporation, the Company must meet the following major criteria: firstly, 35% of the total issuing share must be purchased by issuer and the total value of shares hold by issues must be no less than RMB 30 million. Secondly, free float must be at least 25% of the total capital.
- After the private share placement, the Company can apply to go public on one of the stock exchanges in mainland China. Key additional criteria in addition to those above are the Company's post-IPO capital must be no less than RMB50 million and no illegal activity has been committed for the past three years.
- Then the Company needs to follow the 3 key steps to go public successfully:

a) Submission of the application and necessary documents which include past three years financial reports, registration file, prospectus and recommendations from stock exchange members and other files required by the CRSC.

b) List hearing by Stock exchange listing committee. Applications that have satisfied the listing requirements will get approval from Listing Committee within 20 days. Then a listing date will be determined.

C) Go public.

After these steps, the Company can start trading on the second market. When a company has listed stock on an exchange for one year or longer, it can re-issue shares follow the similar procedure.

B-Shares

Foreign investment shares may be listed as B-shares on the SHSE or SZSE. The term "B-shares", "domestically listed foreign investment shares" and "special *renminbi*-denominated shares" all refer to the same thing-ordinary shares of Chinese shareholding companies that are denominated in *renminbi* but traded in foreign currencies, such as U.S. dollars, on a Chinese securities exchange. B-shares can only be subscribed by and traded among foreign legal and natural persons and other entities, legal and natural persons from Hong Kong, Macau and Taiwan, and Chinese citizens who are resident abroad.

The regulatory framework surrounding the issue of B-shares was simplified by the State Council in December 1995 by the introduction of *Provisions* on *Listing of Foreign Investment Shares Inside China by a Shareholding Company* on December 25, 1995 and the *Provisions on Listing of Foreign Investment Shares Inside China by a Shareholding Company*: Implementing Rules on May 3, 1996. These provisions clarified the procedures involved in applying for approval to issue B-shares. They also set out the application procedures and approval requirements for companies seeking 1.0 issue B-shares in order to increase their share capital. The provisions contain important matters such as information disclosure, and the trading of B-shares by stock brokers and agents. The key contents of the provisions on B-Share listings include the following:

- The CSRC is responsible for the regulation and supervision of the issuing and trading of B-shares and related activities in relation to B-shares;
- In addition to the directors, supervisors and managers of a B-share company, other senior management personnel, including a shareholding company's chief financial officer, secretary and other executives specified in the company's articles of association, owe duties of good faith and diligence to the company;
- Chinese citizens residing outside mainland China may purchase B-shares;
- The derivative forms of B-shares, including warrants and depository receipts, may be circulated and traded outside China.

The B-Share listing implementing rules set out further detailed provisions governing the issue and trading of B-shares. They expand upon the application procedures set out in the B-share listing provisions to gain approval for the issuance of B-shares and list the documents to be submitted to the CSRC in support of an application. The key contents of the B-share listing implementing rules are as follows:

- An over-allotment option (commonly known as a "Greenshoe") may be granted by a Chinese shareholding company to the underwriters. With the approval of the CSRC, a company may set aside up to 15% of the total amount of the proposed B-share issue which constitutes the option. Such reserved shares will be considered as part of the issue.
- The distribution period for B-shares maynot exceed 90 days;
- The governing law of the underwriting agreement must be Chinese laws;

- Within 15 days after the closing date of the initial share distribution, the lead underwriter must submit to the CSRC a distribution report and a list of the 10 largest holders of its B-shares, and details of their holdings. The distribution report must contain details of tile distribution process;
- Domestic brokerage houses are required to report to the CSRC details of the number of B-shares held by them as a result of participating in the underwriting of a B-share issue;
- In addition to appointing Chinese appointing and auditing firms, B-share companies may also appoint foreign accounting and auditing firms that comply with the Chinese regulations to audit or review their financial statements;
- B-share companies must give prior notice to their auditors of dismissal or non-renewal of appointment and the auditors are entitled to present their views on any matter concerning the company's financial situation before the company's shareholders in the annual meeting. The *P.R.C. Securities Law* (Article 213) states that shares of Chinese companies designated for subscription and trading by foreign investors (B-shares and H-shares) are governed by measures separately formulated by the State Council.

B shares are subject to a strict annual quota system. Each year, the State council decides the amount of B-share quota in U.S. dollars for that year. For example, the quota was US$1 billion in 1993. The B-share listing provisions did not stipulate listing venue. In practice, the Shanghai Securities exchange attracted bigger and more reputable companies to list their shares.

Overseas? Listing of Foreign Shares

All foreign listings must be approved by the CSRC and the foreign stock exchange (and regulatory authority, such as the SEC in the case of a U.S listing). Foreign shares (such as H-shares) must be issued in registered form and denominated in *renminbi* even though they are traded in foreign currencies. Depository receipts issued over H-shares are also treated as foreign shares.

Before a Chinese company can undertake an overseas listing at a desired overseas exchange by means of a direct listing, the overseas exchange has to sign a Memorandum of Understanding (MoU) with the CSRC. The MoU deals with cross-border regulatory issues such as supervision, disclosure requirements and securities enforcement.

In addition to complying with the requirements prescribed by the stock exchange on which the shares are listed, a company seeking to list overseas must also comply with the *Articles of Association of Companies Seeking to Listing Outside the P.R. C. Prerequisite Clauses* issued by the Securities office of the Restructuring Commission and effective as of September 19,1994, *P. R. C. Company Law*, and *P.R.C. Securities Law*. Key contents of the Prerequisite Clauses include the following:

- State enterprises to be restructured into shareholding companies may have fewer than five promoters;
- The period between an overseas listing and a subsequent issue may be less than 12 months;
- A 45-day written notice is required to convene shareholders' meetings;
- A quorum of 50% of voting shares is required to convene a general meeting and shareholders must give a 20-day notice of their intention to attend a general meeting;
- The articles of association are binding not only on a company and its shareholders, directors, supervisors and general managers, but also on other senior officers including the chief financial officer and secretary to the board;
- Shares issued outside China may be in the form of warrants or other derivatives

subject to the approval of the State Council Securities Commission. An over-allotment option of up to 15% of the total issue may be granted by an issuer to the underwriters;

- Dividends on overseas foreign shares should be declared in *renminbi* and paid in foreign currency;
- The register of holders of foreign invested shares listed outside China may be kept abroad and maintained by an agent. Cooperation between Hong Kong and mainland stock market regulators started in 1993 when the issuance of H-shares on Hang Seng Stock Exchange was first proposed. By 1994 Hong Kong was able to update its legislation on listing requirements of PRC issuers. In November 1994, legislators added to Chapter 19 of Hong Kong Stock Exchange Ordinance a sub-clause known as Chapter 19a, which was solely devoted to PRC issuers. Once listed on the Hang Seng Stock Exchange, a PRC issuer is subject to all relevant Hong Kong laws and requirements, including the Hong Kong code on takeovers and mergers.

Red Chip Listing

Red-chip companies are those incorporated in Hong Kong and listed on the Hong Kong Stock Exchange but with controlling shareholders from mainland Chinese entities. In the early stage of development in Chinese stock markets, some companies had successfully bypassed the official listing channels and gotten listed either through a backdoor listing or by acquiring a Hong Kong "shell" company. After the CSRC was established, mainland and Hong Kong regulators started to cooperate and coordinate on red chip issues. Both sides agreed that before granting listing to a mainland Chinese company, each side would inform the other of the nature of the listing, company type and other related information. Nowadays red chip companies are generally diversified conglomerates which have grown rapidly by the injection of assets from their parent companies in mainland China. Red-chip companies include China Telecom, Beijing Enterprises Holdings, China Everbright, Shanghai Industrial Holdings, China Resources Enterprises and the "window-companies" or "International Trust and Investment Corporations (ITICs)" of provincial governments.

Until very recently, red-chip companies did not, strictly speaking, fall within the supervision of mainland Chinese authorities. Therefore, they were able to conduct restructuring and raise funds from overseas for new investments easily. In June 1997, the CSRC in conjunction with the State council introduced the *Notice on Further Strengthening the Administration of the Listing and Issuing of Shares Overseas* (also called the "Red Chip Notice"). The purpose of the Red Chip Notice was to protect domestic assets from being channelled overseas and from being sold off indirectly to discount. The Red Chip Notice targets both listed and unlisted companies registered outside mainland China.

The main content of the Red Chip Notice is as follows:

- If a foreign listed company is registered and controlled by Chinese shareholders and is undertaking a spin-off listing or additional issue f shares, it is subject to the supervision of the CSRC and the majority shareholder must report to the CSRC.
- Domestic shareholders that have held foreign and domestic assets for three years or more who seek to inject their assets to a red chip company may do so provided that prior consent is obtained from the local provincial government or relevant department of the State Council. Domestic assets held for less than three years may not be used in connection with foreign share issues unless there are special circumstances that the CSRC deems to be appropriate.
- Consent on restructuring and subsequent equity offerings must be obtained from the

provincial government or relevant State Council department and a report must be made to the CSRC for examination and final approval.

- Acquisition, share swap or other methods of injecting assets into a foreign Chinese holding company require similar relevant consent from the CSRC.

2.2 Offer Price

For offering price, China Securities Regulatory Commission (CSRC) did not use the auctioning method since it puts the offering prices out of the control of the regulater. Instead the government required to price IPO shares with net earnings per share multiplying by a fixed multiplier. The offer price is chosen months before the market trading starts, and there is no feedback mechanism through market demand that allows adjustments in offer price. Although the average Price/Earning ratios in the Chinese secondary market were over 30 most of the time, the multiplier was set as between 15 and 20 from 1992 to 1999. The specific multiplier is chosen by the issuer, but under a cap set by the regulator. There are two determinants of the offer price: the past three years' profits of the issuing company and the benchmarking P/E ratios suggested by those of the comparable listed companies.

*P (the offer price) = Averaged Profit * Given P/E ratio*

In 2001, government decided to let the demand and supply in the market decide the price of IPOs.

2.3 China Stock Exchanges

At present, there are two stock exchanges in operation in the mainland of China: the Shanghai Stock Exchange (SHSE) and the Shenzhen Stock Exchange (SZSE).

The Shanghai Securities Exchange, one of the two Chinese mainland securities exchanges, a non-profit membership institution and legal person, was founded on 26 November 1990, and opened its first trading day on 19 December, 1990. Over the past fifteen years, under the supervision of the CSRC, SHSE has developed into a sizable security market with a wide coverage. It trades A shares, B shares, investment fund shares, and treasury bonds. The trading unit for stocks is measured by the face value of the stocks, rather than by the number of shares. For example, one trading unit for stocks is 100RMB, called 'one hand'. Recently, SHSE developed new technology – computerized trading system –that is based on the principle of price priority and time priority in order to minimize paper-based operations. It has been working to supply an efficient trading environment for market participants and ensure normal operation of the securities market.

Shenzhen Stock Exchange (SZSE) is located about 30 miles north of Hong Kong and is also a non-profit, self-disciplined membership institution and legal entity. As Shenzhen is modelled on Hong Kong, SZSE is likewise modelled after the Hong Kong Stock Exchange (HKSE), especially in technical terms. SZSE has adopted a market trading system based on modern computerized and telecommunications technology, fully practiced electronically automated trading. Currently, the A share market in SZSE adopts T+1 settlement and the B share market uses T+3, which Shanghai Stock Exchange (SHSE) applies the same.

In 1999, the market capitalization of SHSE was 1458.05 billion RMB and the A share P/E ratio for the market reached 38.15%, while SZSE's were 1189.07 billion RMB and 37.56% respectively. Both exchanges follow the same security regulations issued by China Securities Regulatory Commission (CSRC). And requirement for membership in two stock exchanges are similar as well. Basically, to become a member, investors need have securities trading experience for at least two years and show profit during the period. In addition, they must pay membership seat fee of 0.6m RMB. Until 2000, SZSE has

0.12million memberships and SHSE has 0.14million. Generally, during the period 1995 to 1996, the total number of investors' account in SZSE is larger than SHSE's, which may imply that SZSE has more liquidity than SHSE. Major indices are the Shanghai Securities Exchange Index (SSEI), a weighted-average index of all listed shares on SHSE, and the China Index of all listed shares on both SHSE and SZSE.

On SHSE, the total cost is approximately 1.05% of the trade value, this includes a brokerage fee of 0.7% of the gross consideration (minimum RMB 5), a transfer fee of 0.1% of per value (minimum US$1). Stamp duty of 0.3% of the gross consideration, and a clearing fee of US $4 per execution for individuals and corporations US$8 for custodians. There is registration fee. The total cost on SZSE is 1%, a bit less than SHSE. However, although both stock exchanges used same national requirements for A shares listing, overall, Shenzhen is stricter than Shanghai. It requires companies publish financial statements twice a year and audited annual report within three months of period end. Because Shenzhen has a history of only 20 years, it has few sizeable industries. Most companies listed on SZSE are from industrial and commercial cities other than the Shanghai area. Ironically, though SHSE prides itself on being China's No.1 national stock exchange, many of its listed companies are based locally, in the Shanghai area. Shenzhen Stock Exchange is competing with Shanghai Stock Exchange to become the national stock exchange.

2.4 A- share indices

The two stock exchanges in mainland China, SHSE and SZSE established several market indices to provide a thorough measure of market trend. The Shanghai Stock Exchange index series includes the SHSE Composite index, the SHSE 180 index, the A-share index, the SHSE 50 index, the B-share index, the Bond index and the Fund index. The SHSE A-share index is based on all listed A shares at Shanghai Stock Exchange. The Base Day for it is December 19, 1990. The Base Period is the total market capitalization of all A shares of that day. The Base Value is 100. The index was launched on February 21, 1992. Similarly, the Shenzhen Stock Exchange indices include the SZSE Composite index, the SZSE Component index, the SZSE 100 index, the A share index, the B share index, the Bond index and the Fund index. Both SHSE and SZSE Indices are market capitalization weighted composite price indices. The formula is

Current index = current total market cap of constituents ÷ base market cap x base point

Since these indices are market weighted composite price indices, a large and widely held company will have a heavier influence on the stock market performance than a smaller company.

The thesis has outlined the basic information of China's Capital Market. The following Chapter will discuss the regional effect on companies listing choice between stock exchanges.

Chapter Two: Regional Effect on Companies? Listing Choice between Stock Exchanges

I Introduction

China's stock market has grown fast since establishing its two stock exchanges in 1990. The initial listings of public companies were politically driven. The main purpose was to improve the efficiency and the governance of SOEs. Indeed, the vast majority of China's publicly listed companies are former state-owned or state-controlled firms. China avoided privatizing state-owned enterprises (SOEs) and instead sought to reform them through piecemeal measures, such as by increasing managers' decision-making autonomy, introducing financial incentives, and bringing in contracts (or profit sharing) system. (Naughton, 1995; Shirley and Xu, 2001). However, since the ownerships of most SOEs were with local or central governments to whom the management had sole responsiblities; SOEs had suffered frequent administrative interferences, soft-budgeting, mismanagement and low efficiency problems. To transform state-controlled enterprises into market driven and independent modern corporations, the sole governmental ownership had to be changed. In the early 1990s the Chinese government began to shift the focus of SOE reform to privatization of small SOEs and the corporatization of larger ones (Cao, Qian and Weingast, 1999; Lin and Zhu, 2001).

Development of China's stock exchanges was further boosted after Deng Xiaoping's historical journey to Guangzhou and Shenzhen in 1992. However, before a company decides to go public, there are a lot decisions it has to face. For example, when a corporation needs to raise additional capital, it can either take on debt or sell partial ownership. If the corporation chooses to sell ownership to the public, it engages in an initial public offering (IPO). Corporations choose to go public instead of issuing debt securities for several reasons. The most common reason is that capital raised through an IPO does not have to be repaid, whereas debt securities such as bonds must be repaid with interest. Further, one of other decisions faced by firms is where its stock should be traded. Researchers have studied many aspects of the Chinese stock markets from different angles, including asset pricing in segmented Chinese markets (eg. Poon, Firth and Fung, 1998), the return and volatility link(eg., Su and Fleisher, 1999). However, Since dual listing is not allowed across the two mainland stock exchanges, Shanghai Stock Exchanges and Shenzhen Stock exchanges, it is surprising that there are virtually no systematic studies on the listing decision of China IPOs between them. The purpose of this paper is to identify the factors that influence companies' decision to list on either Shanghai or Shenzhen. The result of this research will leave profound implications to the further development of the two markets.

There are extensive literatures in IPO decisions between stock exchanges have been developed for Western firms. For instance, Ferrarrini(1998) indicates that factors like the provision of immediacy, price discovery, low price volatility, liquidity, transparency and transaction cost are important for investors and firms look for in deciding whether to trade or list. Reputation and quality also have contributed to making many regulators and/or exchanges reform their governance structure, trading systems and surveillance rules. (Di Noia, 1998).

Pirrong (1999) argues that many stock exchanges, especially within the European Union, are owned or controlled by financial intermediaries who are also the major buyers of the exchanges services. According to the author, when exchanges are not perfect substitutes, they may adopt inefficient rules that benefit members at the expense of customers and third parties. In 1998, Lee (1998) analyses the governance structure of exchanges and concludes that exchanges controllers—the trading intermediaries—have strong influence on the exchanges reform decisions.

Transaction cost is considered another possible reason. Foucault and Parlour (1999) suggest a framework for modeling IPO listing competition between two profit-maximizing exchanges. They demonstrates that trading costs is a key factor for firms to decide where to list. An important feature of this model is that firms' listing choices and listing requirements are endogenous. The main conclusion is that when exchanges with different trading costs, listing requirements and listing fees compete, they can co-exist.

Gehrig (2000) find that factors like market access costs and localization of information are particularly relevant in markets for assets priced on the basis of complex local information, like stocks and derivatives. Tesar and Werner (1995), and Hau (2001) explicitly introduce variables such as geographical distance and language barriers into asset pricing models. And Hau (2001) states that linguistic and cultural barriers, rather than geogrqphic distance per se, is key to the informational advantage identified in the data. Davis (1990) predicts that the optimal location theory of the firm and the economies of scale in financial services may lead to the emergence of a single global center in Europe, with smaller centers in each country.

Shy and Tarkka (2001) point out stock exchanges would benefit from alliances, whereas brokers would lose from alliances. Notably, mutual stock exchange agreements on access fees do not seem to be as detrimental as in other industries. This view is also supported by Ramos and von Thadden (2002) who compare stock exchange transaction costs and the impact of stock market integration. They find that transaction costs are likely to decrease as a result of stock market integration

Cowan, Carter, Dark, and Singh (1992) study the competition between NYSE and NASDAQ. They conclude that firms with unexpectedly high bid-ask spreads tend to list on the NYSE. Liquidity is viewed as an important factor in listing decisions. Macey and Kanda (1990) states that firms tend to select markets that are more likely to provide liquidity for their shares. Moreover, the concept of liquidity is closely linked to the concept of market efficiency. More liquid markets are generally more efficient. Regulation is also a crucial factor. Coffee(2001) argues that strong legal standards tend to attract listing rather than repel. The author supports his idea with evidence that exchanges with strong protection for minority shareholders have received comparatively listing.

In this paper, we use a panel of data includes all publicly listed companies in two stock exchanges in China (1995 to 2000) to investigate the regional effects on companies' decisions on where to list. We find that, overall, regional factors do significantly affect the companies' choice between the stock exchanges. The geographical factor we are aware of has greater impact on the decision than other macro factors. In our analysis, the inadequacy of legal infrastructure in some area rendering the analysis of more complicated. The special effort has been made to specially deal with this problem.

The organization of the paper is as follows. We provide an introduction to the development of the stock market and, in particular, the two stock exchanges in China in the next section. Section 3 discusses our model, describing the data, defining the variables and presents summary statistics. The main findings are reported in Section 4. The last section concludes.

II Public Listings in China

China's stock market has experienced rapid growth and development in the last 15 years. Before the reform, the whole financial system was laminated by the state-owned banks, and central planning agents. Investment was channeled either through direct grants from the state budgetary funds or from government allocated bank credits. In the 80's it became clear that most state-owned enterprises were in dire financial situation, and the planning system was no longer sustainable. In December 1990, the Shanghai Stock Exchange (SHSE) and the Shenzhen Stock Exchange were established. Since then, the two stock exchanges have been continuously updating their technology, improving services, and developing conditions that provide a foundation to expand the market. The number of listed companies reached 1,378 at the end of 2004, comparing to only 10 companies in the early 1990. Total market capitalization in 1992 was 104.8 billion RMB. However, this number was dramatically raised to 4,245 billion RMB by the end of 2004. And as a result of the economic restructuring of state-owned enterprises and the expansion of corporate privatization, the China equity market is expected to grow further. (Lee and Rui, 2000).

Upon the set-up of the stock exchanges, the stock issuance was determined by, the state planning committee, the state Economic System Reform Commission, the China securities regulatory commission (CSRC), and the people's bank of China, which stipulated the total number of new stocks to be listed on the exchanges. But more recently, the CSRC gradually became the sole organization that authorizes and supervises of stock listing and issuance. Currently, the Shanghai Stock Exchange and the Shenzhen Stock Exchange are under the direct administration of the CSRC. This change not only increases the stability and standardizes development of the Chinese stock market, but also protects the interests of investors.

Table 1: Development of the Chinese Stock Market

Year	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*
Panel A. Number of Listed Firms										
SHSE	8	29	105	171	188	293	383	438	486	574
SZSE	5	23	76	120	135	237	362	413	463	514
Total	13	52	181	291	323	530	745	851	949	1088
Panel B. Market Capitalization										
SHSE	2.9	71.5	218.8	259.7	252.6	547.8	921.8	1062.5	1458.0	2693.1
SZSE	8.0	49.0	133.5	109.1	94.9	436.5	831.1	888.1	1189.1	2116.0
Total	10.9	120.5	352.3	368.8	347.5	984.3	1752.9	1950.6	2647.1	4809.1
Panel C. The Composite Index of Chinese Stock Market										
SHSE	293.7	780.4	833.8	647.9	555.3	912.0	1194.1	1146.7	1366.9	2073.5
SZSE	110.4	241.2	238.3	140.7	113.3	312.9	381.3	343.9	402.2	635.7

Source: China Securities Regulatory Commission, China Securities and Futures Statistical, China Finance and Economic Publishing House, And CSRC's official website: http://www.csrc.gov.cn.

III Data Variables and Summary Statistics

In this section, detailed data and variables analysis will be given and summary statistics is provided as well.

3.1 Data Sample

There are 1088 newly listed companies during the period of 1995 to 2000 in our initial data set. However, missing values or invalid data entries reduce our sample to 764 firms. A majority of the firms deleted were lack pre-listing data. The main data source was purchased from a major financial information service company in China.

The time horizon for selected companies in our study is 1995 to 2000. Because listing decisions was made based on the information in previous year, companies' information we used is from 1994 to 1999. And reasons for choosing such a time horizon are as follows:

Table 2: Number of Newly Listed Stocks (1990-2001)

	1990	1991	1992	1993	1994	1995
ShangHai	7	0	29	50	39	1
GuangDong	1	4	22	32	29	11
Others	1	0	6	62	61	28
	1996	1997	1998	1999	2000	2001
ShangHai	11	9	12	4	9	7
GuangDong	18	18	10	4	15	11
Others	189	196	100	97	137	72

Data Source: www.cninfo.com.cn

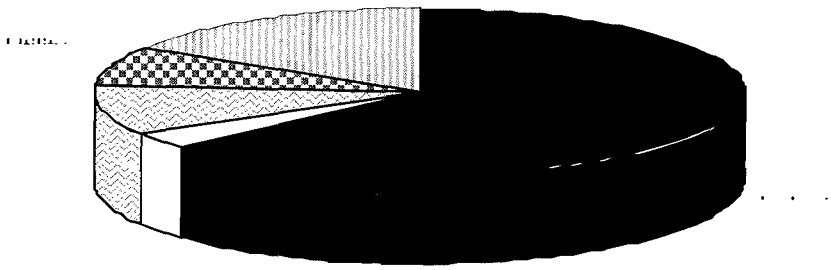
The main purpose of our research is to find whether there was any regional effect on companies' listing decisions. However, before 1995, because China stock markets experiment started from and localized in Shanghai and Guangdong provinces, number of newly listed IPOs in these two areas were larger than the sum of other 29 provinces'. (see table 2). In such a case that high concentration on only two provinces, it would simply cause bias conclusion if we include data before 1995. As shown in Table 2, the situation has changed in our sample period of 1995-2000, when Shanghai and Guangdong were no longer dominated public listings and companies from other provinces were listed in greater numbers and have shown some balanced distribution.

Secondly, a novel feature of our data set is that it contains pre-listing information. However, China first Company Laws and Provision Regulations were only issues in 1994 and not immediately strictly enforced. As a result, accounting information released before and after 1994 was usually not comparable if not adjusted appropriately. Restricting to post-1994 information will eradicate the non-comparable issue or avoid the adjustment hassle.

The main reason our research do not include data after 2000 is because the public listings activity in Shenzhen stock exchange was suspended from the end of 2000 as the Chinese government pondered merging its bourses into a single exchange in Shanghai and launch a Nasdaq-style second board in Shenzhen aimed at private and technology companies.

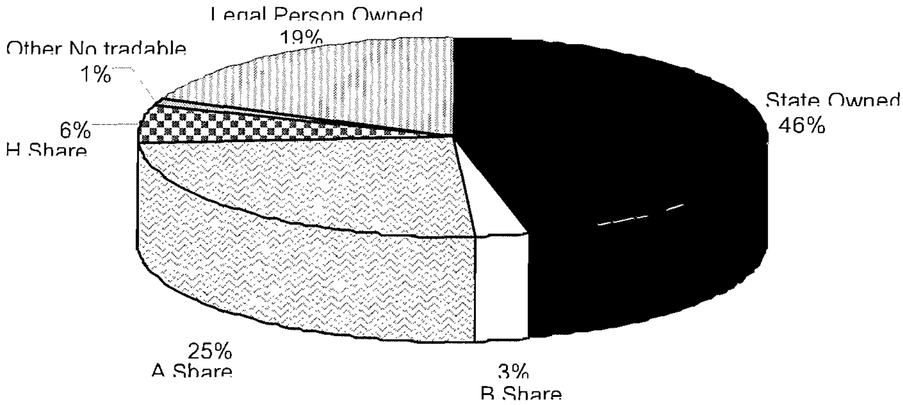
Listed companies in China are generally clustered in six sectors: industry, conglomerate, property, utility, commerce and finance. As Figure 1 shows that the industrial companies have the biggest proportion (63.1%) among other sectors. Conglomerate companies have 10.1% and finance companies are seldom listed. This structure is consistent with the structure of SOEs, the majority of which are also the industrial companies. Figure 2 indicates the capital structure of listed companies in China stock market. It implicates that by the end of 2001, most of the non tradable were state owned and legal person shares which took up 65% of total shares and left only 34% tradable shares (A, B and H shares) to public investors. This structure is believed to ensure that the companies are state-owned. In fact, state and local governments are the biggest owners of listed companies in China.

Figure 1: Industry Sectors



Source: Chinese Securities Regulatory Committee

Figure 2: Capital Structure 2001



Source: www.csrc.gov.cn

In this paper, the data set is free of survival bias that may cause problems in studying listing decisions. Although China's bankruptcy law was established in 1986, the government or banks always gave supports to SOEs that have financial difficulties in order to avoid bankruptcy. Therefore, no firm in our data set ceased operations or was de-listed after going public. Only in 2001 did we observe the first incidence of de-listing.

3.2 Variables

Variables are basic elements for a determinant model of Chinese public listings. In our analysis, we tried to follow the existing literature in choosing our dependent and explanatory variables. However, due to the fact that China stock market is very unique and much less developed than the western market, there are differences in variables in our model. For instance, Corwin and Harris (1998) find that transaction costs do affect listing decisions. Firms look for markets with smaller transaction costs. But, as described in section 2, the difference in transaction cost between the two stock exchanges in China is little since they use the same trading technologies. Therefore, we could not fit these factors in our model. Furthermore, some studies indicate that listing decisions may also be impacted by over-allotment options which are part of most initial public offering. The over-allotment option, which is also referred to as an green shoe provision, allows the underwriting syndicate to buy up to an additional 15% of the shares at the offering price if public demand for the shares exceeds expectations and the stock trades above its offering price. However, such option can rarely be found in China stock market which reflects the market is still immature and on its early stage of development.

To test the regional effect on public listing in China, we have selected a variety of company characteristics and regional factors as variables to cover both the microeconomic and macroeconomic aspects of the IPO decision process. Definitions of the explanatory variables to be used in our analysis are listed in Table 3.

Table 3. Definition of Explanatory Variables

Variable Name	Definition
Panal A. Company Factors	
ROE	Return on Equity, equal to a fiscal year's after-tax income divided by book value
ROE2	ROE squared
Leverage	Debt/asset ratio, a measure of company's leverage, calculated by dividing long-term debt by common shareholders' equity, usually using the data from the previous fiscal year.
Leverage2	Debt/asset ratio squared
Revgrow	Company revenue growth rate. A company's operating revenue gives an indication of a company's size and scale
LnMktC	Market capitalization. Calculated by multiplying the number of shares outstanding by the price per share. We use logarithm values of market capitalization.
Age	Firm's age before go to IPO
Industry	Categorical variable. Have 6 discrete values: industry, conglomerate, property, utility, commerce and finance
Ipo_time	Categorical variable. The year of listing: 1995, 1996, 1997, 19998, 1999, 2000
Panal B. Regional Factors	
COM_L	Regional dummy variable. The location of the listing company. The variable has 30 values ranging from Anhui to Zhejiang.*
RegGDP	Regional GDP at current price.
InvesComp	Dummy variable. '1' if the number of investors accounts in SZSE is greater than in SHSE, '0' otherwise.
COM_N	Total number of companies per region.
Political	The sum of scores of political factors that may affect listing decisions.

* *See Appendix A for the complete list of China's provinces, automomous regions and municipalities.*

In general, companies' public listing decisions are firstly based on its own distinctive. Companies with different characteristics choose to list on different exchanges. Aggarwal and Angel (1997) indicate that small and risky firms prefer to listing on a high service market. This argument implies that a company's size matters for listing decisions on stock exchanges. In our model, we use market capitalization as a measure to classify a company's size and risks. Also, a company's revenue indicates its size and risk. Revenue is the total payment for goods and services that are credited to an income statement over a particular time period. Profit is a critical valuation base for stocks in a mature capital market. It shows how well a company performs on the market. Here, we use Return on Equity (ROE) as a general indication of the company's efficiency. In other words, how much profit it is able to generate given the resources provided by its stockholders. Investors usually look for companies with returns on equity that are high and growing. We also examine debt to equity ratio, the degree to which a company is utilizing borrowed money. After 1984, since many SOEs no longer received direct financial support from the government as before, they accumulated very high levels of debt in the form of bank loans. Companies that are highly leveraged may be at risk of bankruptcy if they are unable to make payments on their debt, they may also be unable to find new lenders in the future. Therefore, to reduce their debt level, public listing is more attractive for these highly leveraged companies. A company with a higher debt-to-equity ratio can offer greater returns to shareholders but be riskier. Public recognition has become more important to companies in China since market competition gradually becomes a reality. Listing on a major exchange increases a company's public recognition and reduces the future costs of capital. Considering the fact that the order the company is, the more public attention they get when go to IPO, we treat firm's age as an explanatory variable in our model. In addition, Industry classification might be a consideration in the public listing decision as well.

Public listing process in China is complex due to the strong influence of the government. To fully understand public listing decisions in China, we include macroeconomic measures in our investigation: company location, regional GDP, comparison between investors account number in SZSE and in SHSE, total number of companies per region and political score.

Our main objective is to examine whether the regional factors have impact on listing decisions between two stock exchanges in China. Then regional dummy variable should be included in our model. The region dummy has thirty values ranging from Anhui to Zhejiang. Chongqing municipality is grouped together with Sichuan province since it was a part of Sichuan prior to 1997. Schwartz (1995) argues that higher liquidity increases the utility of market participants. Firms tend to choose highly liquid market to list their stocks. And the market liquidity is covered by the variable investors' accounts numbers since the market with more investors may let listing companies cheaply raise capital and build their reputation. In China, government seems to have too much influence on the market. It keeps a tight control on the issuance of IPOs. And, due to the inadequate regulations in financial area in China and the Chinese culture which emphasizes on personal relationships ('GuanXi') rather than obeying legal procedures, politics might play some role in listing decisions and not surprisingly, should be included in our model. We followed the method used by Jiang (2002), which reflect the ruling structure of China, to summarize our political score: 5 points to CPC Standing Committee members, 4 points to Political Bureau members of vice premiers of State Councils, 3 points to ministers of the State Planning Commission, ministers of the Economic Trade Committee, the Ministry of Foreign Economics and Trade, presidents of the People's bank of China and the chairman of CSRC, 2 points to CPC central committee members or vice chairmen of the National People Congress, and 1 point to other economic related ministers or vice chairmen of the Chinese People Political Council Committee. The final regional political score is the sum of points produced above. Furthermore, regional economic development factors, like total number of firms per region and real GDP per region are included in our analysis since they might have impact on listing decisions as well.

Table 4. Descriptive Statistics of Variables

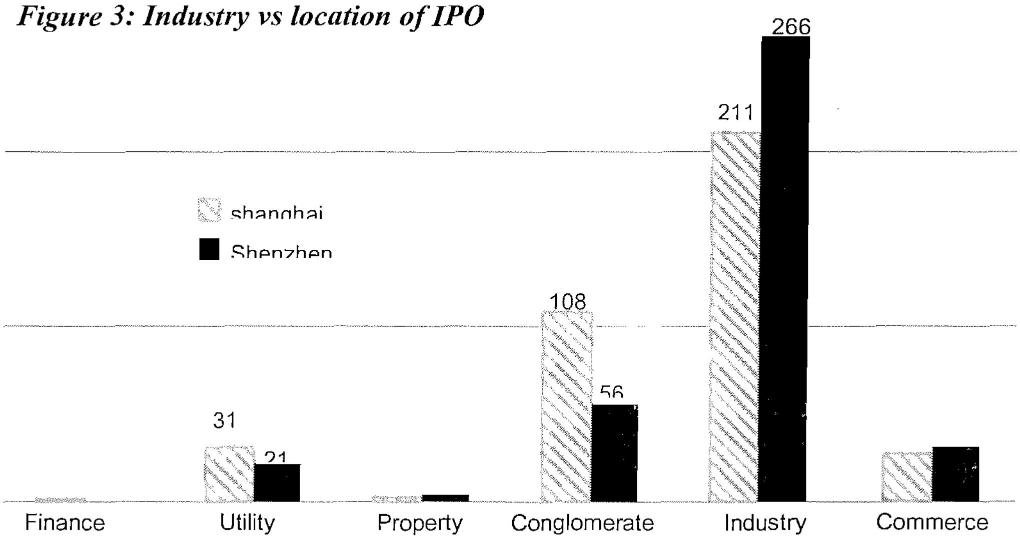
Variable	Mean	Std Dev	Minimum	Maximum
Panal A: Shanghai Stock Exchange				
ROE	18.658	10.291	0.800	98.350
ROE2	4.537	6.678	0.010	96.730
Leverage	47.677	17.505	3.580	96.180
Leverage2	25.787	16.214	0.130	92.510
Revgrow	27.241	81.083	-96.300	864.100
Age	8.063	3.618	3.000	45.000
RegGDP	3766.090	2248.653	91.200	8464.300
Com_NO	112988.703	66175.408	1388.000	273067.000
MKTCaptial*	404.397	595.238	18.000	7845.860
Panal B: Shenzhen Stock Exchange				
ROE	16.287	8.962	0.000	75.480
ROE2	3.454	4.961	0.000	56.970
Leverage	44.941	17.089	1.840	86.060
Leverage2	23.109	15.118	0.030	74.060
Revgrow	15.662	43.783	-93.280	243.000
Age	8.601	4.267	4.000	46.000
RegGDP	4221.834	2507.544	91.200	8464.300
Com_NO	123908.690	75767.890	1388.000	273067.000
MKTCaptial*	328.770	315.813	13.000	2040.000

Note: For comparison puposes, we used a common sample period (1994-1999) to compute the descriptive statistics
** Here we use the absolute value of market capitalization of company, not the Logarithm value we will use in our model*
Source: data software from SZSE, www.csrc.gov.cn, www.google.com,

We report the descriptive statistics for public listing decisions in Table 4. The results show that company's characteristics differ significantly across two stock exchanges. The mean market value in SHSE (404.4) is much higher than that in SZSE (328.8). Similarly, companies in SHSE have significantly greater mean return on equity ratio and mean debt-to-equity ratio. Not surprisingly, the revenue growth rates of listed companies in SZSE are only about half of those of firms in SHSE. However, regional

GDPs in SZSE are quite large, compared to those in SHSE, with 4221.8 to 3766.1. It seems that companies located in wealthier region tend to list on SZSE although their operation performances are weaker than firms in SHSE. From figure 3, it can be seen that most listing companies in both stock exchanges are in industry sector. It also shows that SHSE has more utility and conglomerate companies than SZSE while more industry companies in SZSE.

Figure 3: Industry vs location of IPO



Source: Security Statistical Yearbook of China.

Public listing decisions in China not only depend on the company's performance, but also on regional element and politics factors. To quantify the regional effects on public listings, a more comprehensive model should be used.

IV Methodology and Results

The problem why some companies listed in SZSE and others listed in SHSE has a binary response. Therefore, the logistic regression model which is the standard approach for studying binary responses, will be used in our study. Although probit regression model and discriminate analysis also have been used to analyze binary responses data, in our case, they all have limitations. Probit regression model involves a lot complex calculation and there is no natural interpretation for its parameters. And as Halperin and Blackwelder (1971) argued, logistic regression yields more accurate estimates when the assumptions of discriminate analysis are violated. Binomial (or binary) logistic regression is a form of regression which is used when the dependent is a dichotomy and the independents are of any type. The form of the model is

$$\Pr ob\{Y=1|X\}=\prod X=\frac{1}{1+e^{-\alpha-\beta x_i}}=\frac{e^{\alpha+\beta x_i}}{1+e^{\alpha+\beta x_i}}$$

Where

α = ***intercept parameters;***

β = vector of slope parameters;

X_i = vector of explanatory variables.

Logistic regression does not apply as many restrictive assumptions as other regression methods:

1. Logistic regression does not assume a linear relationship between the dependents and the independents. And the dependent variable need not be normally distributed and be homoscedastic for each level of the independents
2. Normally distributed error terms are not assumed
3. Logistic regression does not require that the independents be interval and unbounded.

Also, logistic regression model produces clearer and simpler interpretable parameters than other methods. The logit can be converted easily into an odds ratio simply by using the exponential function (raising the natural log e to the b_1 power). For instance, if the logit b_1 is 2.303, then its log odds ratio is $e^{2.303} = 10$. And it indicates that when the independent variable increases one unit, the odds that the dependent = 1 increase by a factor of 10, when other variables are controlled.

In our model, the dependent variable Y is binary: 1 indicating the company listed on Shenzhen Stock Exchange (SZSE) and '0' indicating the company listed on Shanghai Stock Exchange (SHSE). Our first step is to examine the company specific factors' effects on IPO decisions. The explanatory variables included in this 'basic' model are: 'ROE', 'ROE Square', 'Leverage', 'Leverage Square', 'Revgrow', 'LnMktC', 'Age', 'Industry' and 'Ipo-time'. (Detailed descriptions see Section 3). We use logarithm values of market capitalization instead of the absolute values because its outputs have more meaningful interpretations. Furthermore, both 'Industry' and 'ipo-time' are categorical variables. 'Industry' has six discrete values (industry, conglomerate, property, utility, commerce and finance) while 'ipo-time' has six as well (1995, 1996, 1997, 1998, 1999, 2000). We used SPSS software (version 12) to estimate the model. The results are reported in Table 5.

As the "Sig." of the "Model" row of the 'Omnibus Tests of Model Coefficients' table is less than the significant level 0.05, it implicates that the model is well fitting the data. This is also supported by the results in the following 'Hosmer and Lemeshow Test' table. It shows that the H-L goodness-of-fit test statistic is greater than 0.05 (0.839). We failed to reject the null hypothesis that there is no difference between the observed and model-predicted values of the dependent, implying that the model's estimates fit the data at an acceptable level. In addition, Harrell and Lee (1984) have argued that a regression model is considered as reliable when the number of predictors is less than m/10, where m represents the effective sample size. Therefore, in our case, model with over 76 free parameters will not be considered.(76 = effective sample size of 760 divided by 10). Our 'basic' model's 'df' is only 17, which is much smaller than 76. Furthermore, note from the 'classification table' that overall 61.2% of the participants were predicted correctly. The covariate variables were better at helping us predict what kind of companies would list on SZSE (66.1% correct) than at what firms would listed on SHSE (56.1% correct).

The last table listed the parameter estimates of individual variables, such as their degree of freedom (df), coefficient (B), standard error of estimated parameters (S.E.), the Wald-x^2 test statistics (Wald) and the odds ratio estimates of individual variables (Exp(B)). The explanatory variables that significantly contribute to the model at 5 percent level are: LnMkt, overall industry classification and overall ipo_time. ROE and Revgrow are significantly different from zero at a 10% level. Also the 'sig' values of listing years '1997', '1998' and '1999' imply that their coefficients do differ from 1995 significantly at the 5% level. However, in the sector classification (industry), no value is significantly different from 'utility' at a 5% level. B indicates the coefficient of the variables. The negative B (eg, - 0.343 for 'Conglomerate') means that the group (listed in SZSE) tends to have less conglomerate companies than utility firms. Estimated odds ratio for 'Property' is 2.123, which means that the odds of property companies listing in Shenzhen Stock Exchange are about 2.1 times that of utility companies. And the odds ratio of a conglomerate company to utility company is only 0.71. This evidence shows that less industrial companies have more chance to be listed in Shenzhen, especially property companies, and this is consistent with the fact that Shenzhen is a short history and lack of industrial city where however, is the cradle of China real estate market. Moreover, the estimates of variable 'LnMkt' imply that larger companies tend to list on Shanghai stock exchange.

Table 5 Estimates of Basic Model

Omnibus Tests of Model Coefficients

	Chi-square	df	Sig.
Step	66.017	17	0.000
Block	66.017	17	0.000
Model	66.017	17	0.000

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	4.201	8	0.839

Classification Table

Observed	Predicted		Percentage Correct
	shanghai	Shenzhen	
shanghai	206	161	56.10
Shenzhen	126	249	66.10
Overall Percentage			**61.20**

The cut value is .500

Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp(B)
ROE	-0.040	0.021	3.528	1	0.060	0.961
ROE2	0.034	0.033	1.077	1	0.299	1.034
Leverage	-0.005	0.022	0.059	1	0.808	0.995
Leverage2	0.008	0.025	0.112	1	0.737	1.008
Revgrow	-0.002	0.001	3.020	1	0.082	0.998
LnMkt	-0.262	0.097	7.268	1	0.007	0.770
Industry *			18.255	5	0.003	
Finance	-20.270	28127.437	0.000	1	0.999	0.000
Commerce	0.307	0.413	0.551	1	0.458	1.359
Property	0.753	0.836	0.810	1	0.368	2.123
Conglomerate	-0.343	0.343	1.001	1	0.317	0.710
Industrial	0.491	0.309	2.534	1	0.111	1.634
Age	0.027	0.023	1.444	1	0.229	1.028
ipo_time **			14.119	5	0.015	
1996	-0.886	0.550	2.596	1	0.107	0.412
1997	-0.175	0.302	0.339	1	0.561	0.839
1998	0.479	0.272	3.093	1	0.079	1.615
1999	0.238	0.296	0.646	1	0.422	1.269
2000	0.368	0.913	1.622	1	0.203	1.445
Constant	1.476	0.913	2.611	1	0.106	4.374

Note: Variable(s) entered on step 1: ROE, ROE2, Leverage, Leverage2, Revgrow,

LnMkt, industry, Age, ipo_time.

*: For variable-'industry', we use 'Utility' as the reference category and other values will compare to It: Finance vs Utility; Commerce vs Utility; Property vs Utility; Conglomerate vs Utility; Industrial vs Utility. The reference value is chosen by convenience without preference.

**: For variable-'ipo_time', the reference category is 1995 and other values will compare to it: 1996 to 1995; 1997 to 1995; 1998 to 1995; 1999 to 1995; 2000 to 1995. Again, The reference value is chosen by Convenience without particular preference.

Many studies indicate that geographic pattern does sometimes have impact on companies' decision about where their stock should be traded. Inland China is considerably big and has only two stock exchanges which are all located alongside the coastland. A company's listing decision may partly depend on other listed companies performance in the stock exchange, especially when it is located far away from the exchanges. This suggests that the regional dummy variable may be a good predictor in the public listing decision. Then our 'regional' model is:

$$\log it\ (sz\_se) = f\ (ROE,\ ROE2,\ leverage,\ leverage2,\ Revgrow,\ LnMkt,\ industry,\ Age,\ Ipo\_time,\ COM\_L)$$

It includes all micro variables from the previous 'basic' model and the regional dummy variable—'COM_L'. The reference category for 'COM_L' is 'Xinjiang' and again this choice is made simply because of the convenience with no particular preference. Table 6 shows the parameter estimates of the 'Regional' model. The results in both 'Omnibus Tests of Model Coefficients' table and 'Hosmer and Lemeshow Test' table presents that the model fits the data very well. 'Variables in the Equation' table exhibits that the company characteristic variables: Return on Equity (ROE), Company Size (LnMkt), Industry dummy variable and listing time(ipo_time) still have strong influence on the listing decision of choosing exchanges. Moreover, the regional variable is very significant overall in this model as well. The listing odds ratios of most provinces around Shenzhen, especially Guangdong province, have more favorable odds relative to provinces far from they city. Furthermore, the overall correct percentage in this model has largely increased from 61.2% (the 'Basic' Model) to 70.62%. (see 'Classification Table'), which implies the model has been significantly improved by adding location dummy variable. This also supported by the results showed in Figure 4. Receiver Operating Characteristic (ROC) curve used to evaluate the accuracy of any method of predicting dichotomous outcome. It graphically represents the trade-off between false positive (x-axis) and false negative rates (y-axis) for every possible cut off. The further the curve lays above the reference line, the more accurate the test. In Figure 4, both models ROC curve are above the reference line and the 'Regional' model lies further above than the 'basic' model. This means that the model with regional dummy variables is more accurate.

Table 6. Estimates of Regional Model

Omnibus Tests of Model Coefficients

	Chi-square	df	Sig.
Step	200.815	46	0.000
Block	200.815	46	0.000
Model	200.815	46	0.000

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	5.926	8	0.656

Classification Table

Observed	Predicted		Percentage Correct
	Shanghai	Shenzhen	
Shanghai	253	114	68.94
Shenzhen	104	271	72.27
Overall Percentage			70.62
The cut value is .500			

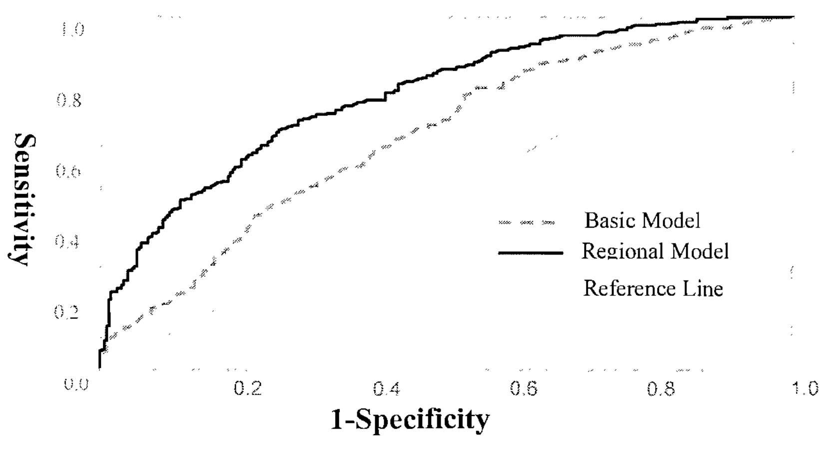
Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp(B)
ROE	-0.044	0.024	3.311	1	0.069	0.957
ROE2	0.046	0.037	1.603	1	0.205	1.048
Leverage	-0.023	0.025	0.823	1	0.364	0.978
Leverage2	0.029	0.028	1.087	1	0.297	1.030
Revgrow	-0.002	0.002	1.536	1	0.215	0.998
LnMkt	-0.270	0.113	5.694	1	0.017	0.763
industry*			15.883	5	0.007	
Finance	-19.328	25378.681	0.000	1	0.999	0.000
Commerce	0.327	0.483	0.460	1	0.498	1.387
Property	0.650	0.992	0.430	1	0.512	1.916
Conglomerate	-0.338	0.388	0.759	1	0.384	0.713
Industrial	0.543	0.358	2.300	1	0.129	1.721
Age	0.040	0.026	2.350	1	0.125	1.041
ipo_time**			20.124	5	0.001	
1996	1.295	0.573	5.109	1	0.024	3.652
1997	2.050	0.585	12.281	1	0.000	7.768
1998	1.771	0.616	8.264	1	0.004	5.878
1999	1.976	0.622	10.079	1	0.001	7.211
2000	1.421	0.616	5.314	1	0.021	4.140
COM_L***			74.938	29	0.000	
Beijing	0.773	0.635	1.484	1	0.223	2.167
Shanghai	-20.141	7180.360	0.000	1	0.998	0.000
Tianjin	0.761	0.830	0.841	1	0.359	2.140
Hebei	1.452	0.710	4.175	1	0.041	4.271

Shanxi	1.338	0.774	2.989	1	0.084	3.811
Neimenggu	-0.006	0.785	0.000	1	0.994	0.995
Liaoning	1.099	0.636	2.990	1	0.084	3.002
Jilin	1.075	0.712	2.284	1	0.131	2.931
Heilongjiang	0.218	0.704	0.096	1	0.757	1.243
Jiangsu	0.328	0.635	0.267	1	0.606	1.388
Zhejiang	-0.699	0.707	0.978	1	0.323	0.497
Anhui	1.547	0.721	4.605	1	0.032	4.696
Fujian	1.079	0.684	2.487	1	0.115	2.942
Jiangxi	0.791	0.793	0.996	1	0.318	2.206
Shandong	0.954	0.635	2.257	1	0.133	2.597
Henan	0.722	0.723	0.999	1	0.318	2.059
Hubei	0.884	0.636	1.931	1	0.165	2.420
Hunan	2.208	0.713	9.599	1	0.002	9.095
Guangdong	3.192	0.712	20.114	1	0.000	24.326
Guangxi	2.085	0.825	6.388	1	0.011	8.042
Hainan	0.565	0.807	0.490	1	0.484	1.759
Sichuan	1.681	0.649	6.698	1	0.010	5.369
Guizhou	0.734	0.913	0.646	1	0.422	2.083
Yunnan	0.418	0.781	0.287	1	0.592	1.519
Tibet	-0.073	1.048	0.005	1	0.945	0.930
Shannxi	0.151	0.775	0.038	1	0.845	1.163
Gansu	0.821	0.795	1.068	1	0.301	2.273
Qinghai	-0.251	1.018	0.061	1	0.805	0.778
Ningxia	1.217	0.909	1.794	1	0.180	3.378
Constant	-0.729	1.243	0.344	1	0.558	0.482

Note: Variable(s) entered on step 1: ROE, ROE2, Leverage, Leverage2, Revgrow, LnMkt,
industry, Age, ipo_time, COM_L.
* For variable-'industry', we use 'Utility' as the reference category
** For variable-'ipo_time', the reference category is 1995
*** For variable - ' COM_L', the reference category is 'Xinjiang'
all the reference value is chosen by convenience, without particular preference.

Figure 4: ROC Curve



Now, we would like to discuss how important the geography factor is. Is it significant enough to change the listing destination of a company? To answer this question, we may move companies located near Shanghai to Guangdong province where Shenzhen Stock Exchange located, and compare the difference between the probabilities to list on Shenzhen Stock Exchange. By using the 'Regional' model we previously derived, related results are shown in Table 7.

The table implies that the regional dummy variable is important enough to change companies' choice on two stock exchanges. If we choose 0.5 as the cutoff probability to classify listed on SHSE and listed on SZSE companies, the model predicts that among the total 37 Zhejiang listed companies that none had more than 50% predicted probability to be listed on SZSE, 27 would have a greater than 50% chance of being listed on SZSE after they are moved to Gongdong province. Even for those under 50%, their probabilities of choosing SZSE for listing dramaticly increase after the location swap as well.

Table 7: Regional Effect Analysis 1: Move companies near Shanghai to Guangdong

	P_Before	P_After		P_Before	P_After
1	0.105	0.474	20	0.050	0.312
2	0.140	0.556	21	0.092	0.466
3	0.243	0.736	22	0.187	0.656
4	0.343	0.780	23	0.161	0.594
5	0.325	0.789	24	0.270	0.485
6	0.299	0.758	25	0.113	0.487
7	0.373	0.677	26	0.388	0.808
8	0.136	0.533	27	0.284	0.748
9	0.231	0.691	28	0.208	0.641
10	0.153	0.600	29	0.158	0.603
11	0.125	0.516	30	0.246	0.719
12	0.158	0.550	31	0.217	0.702
13	0.266	0.714	32	0.370	0.802
14	0.152	0.543	33	0.194	0.646
15	0.163	0.587	34	0.175	0.621
16	0.170	0.642	35	0.076	0.377
17	0.050	0.293	36	0.135	0.567
18	0.055	0.334	37	0.121	0.523
19	0.067	0.390			

From the obverse prospective, it is also interesting to examine the change in listing choice probability were an listed company from Xinjiang, Tibet or Qinghai where are all far away from both exchanges, to have applied from Guangdong. The results in table 8 show that before the location change, all listed companies located in these three regions have quite low probabilities to list on SZSE. However, like the previous regional effect test, the probabilities have risen significantly. Only 2 out of 17 listed companies in Xinjiang, 1 out of 7 in Qinghai and 1 out of 7 in Tibet's predicted probabilities may be below 0.5.

Table 8: Regional Effect Analysis 2:
Move companies far away from both exchanges to Guangdong

	P_Before	P_After		P_Before	P_After
XinJiang			**QingHai**		
1	0.049	0.231	1	0.078	0.394
2	0.079	0.326	2	0.274	0.709
3	0.160	0.503	3	0.279	0.709
4	0.194	0.550	4	0.318	0.745
5	0.201	0.554	5	0.330	0.775
6	0.205	0.572	6	0.340	0.759
7	0.243	0.620	7	0.380	0.801
8	0.252	0.632			
9	0.254	0.652	**Tibet**		
10	0.279	0.657	1	0.098	0.424
11	0.335	0.717	2	0.199	0.593
12	0.335	0.711	3	0.218	0.577
13	0.342	0.746	4	0.222	0.588
14	0.355	0.744	5	0.264	0.652
15	0.383	0.745	6	0.451	0.821
16	0.425	0.797	7	0.548	0.861
17	0.438	0.798			
18	0.471	0.818			

In the above analysis, we found that company's size and other factors such as return on equity ratio, company's sector classification and listing time are strong determinant factors of listing company's choice between stock exchanges. We also discovered the regional effect in the listing decision is significant, in other word, which a company's decision on where to list is heavily depends on its location. However, we may wonder whether this regional effect may be explained by other regional and macro variables or it is just a pure geographic cause. To answer this question, some selected provincial macroeconomic variables are included in the following model—namely 'fundamental' model. The regional effect variables included in this model are regional GDP (RegGDP), regional company number (COM_NO), the comparison of regional investors' account number between the two exchanges (InvestComp), political score (Political). (detailed variable analysis see section 3). Since the model is for distinguishing regional effects, the regional dummy (COM_L) will be excluded. The complete model is then

$$\log it\ (sz\_se) = f\ (ROE,\ ROE2,\ leverage,\ leverage2,\ Revgrow,\ LnMkt,\ industry,\ Age,\ Ipo\_time,\ RegGDP,\ COM\_NO,\ InvestComp,\ Political)$$

Table 9 displays the estimated parameters of this 'fundamental' model. Although the table shows that the model fits data very well (Sig = 0.741 > 0.05), the overall correct ratio in 'Classification' table is only 66% which is slightly lower than the previous 'regional' model's (70.6%). This result implies that the 'fundamental' model's performance is not as good as the model with only the regional dummy variable. Moreover, from the 'Variable in the Equation' table, we may conclude that regional variables: regional GDP and regional investor account number have significant influence on the model. And the negative B – -0.975 for 'InvestComp' means that companies located in the region with more opening accounts in SZSE prefer listing on it as well. This is consistent with other studies' conclusion that companies tend to list on where more investors know about them in order to cheaply raise their capital and build their reputations. However, the results also show that the political factor is not as important as we assumed in the listing decision model. This means that although politics, especially 'GuanXi' play some major role in many business areas in China, it has minor impact on companies' listing choice between the two stock exchanges.

Table 9. Estimates of Fundamental Model

Omnibus Tests of Model Coefficients

	Chi-square	df	Sig.
Step	115.767	21	0.000
Block	115.767	21	0.000
Model	115.767	21	0.000

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	5.150	8	0.741

Classification Table

Observed	Predicted		Percentage Correct
	Shanghai	Shenzhen	
Shanghai	238	129	64.850
Shenzhen	123	252	67.200
Overall Percentage			66.038

The cut value is .500

Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp(B)
ROE	-0.039	0.022	3.101	1	0.078	0.962
ROE2	0.035	0.033	1.068	1	0.301	1.035
Leverage	-0.017	0.023	0.576	1	0.448	0.983
Leverage2	0.022	0.026	0.717	1	0.397	1.022
Revgrow	-0.002	0.002	2.288	1	0.130	0.998
LnMkt	-0.283	0.103	7.561	1	0.006	0.754
industry*			17.436	5	0.004	
Finance	-19.803	28132.305	0.000	1	0.999	0.000
Commerce	0.423	0.432	0.960	1	0.327	1.527
Property	0.618	0.867	0.508	1	0.476	1.854
Conglomerate	-0.279	0.355	0.619	1	0.431	0.756
Industrial	0.560	0.320	3.059	1	0.080	1.750
Age	0.023	0.024	0.909	1	0.340	1.023
ipo_time**			17.311	5	0.004	
1996	0.870	0.523	2.770	1	0.096	2.387
1997	1.610	0.534	9.082	1	0.003	5.001
1998	1.385	0.564	6.036	1	0.014	3.993
1999	1.544	0.568	7.392	1	0.007	4.681
2000	1.132	0.565	4.011	1	0.045	3.101
RegGDP	0.000	0.000	3.735	1	0.053	1.000
InvesComp***	-0.975	0.167	34.219	1	0.000	0.377
Political	-0.004	0.010	0.124	1	0.725	0.996
Com_NO	0.000	0.000	1.106	1	0.293	1.000
Constant	0.909	1.021	0.792	1	0.373	2.481

Note: Variable(s) entered on step 1: ROE, ROE2, Leverage, Leverage2, Revgrow, LnMkt, industry, Age, ipo_time, RegGDP, InvesComp, Political, Com_NO.

* For variable-'industry', we use 'Utility' as the reference category

** For variable-'ipo_time', the reference category is 1995

*** For variable - 'InvestComp', the reference category is more investors in Shenzhen

all the reference value is choosen by convenience,without particular preference.

Since the regional effect variables could be independent of regional dummy variable, it is possible that the geographic factor might not be fully explained by other regional elements. Basically, if the two groups of variables are independent, the performance of 'fundamental' model would be advanced by adding regional dummy variable. On the other hand, the significance of regional dummy will be decreased if there are substitution effects between the two groups of variables, which imply that the regional dummy might be explained by other regional effect variables. To verify if regional effect can be explained by regional economic variables, we formulate the final version of determinant model by adding regional dummy variable (COM_L) into the 'fundamental' model. The model's formula is:

$$\log it\ (sz\_se) = f\ (ROE,\ ROE2,\ leverage,\ leverage2,\ Revgrow,\ LnMkt,\ industry,\ Age,\ Ipo\_time,\ RegGDP,\ COM\_NO,\ InvestComp,\ Political,\ COM\_L)$$

From the results shown in table 10, we can see that when the cut value is 0.5, overall 71.83% of the participants were predicted correctly which is much greater than the 'fundamental' model's 66%. In addition, the regional dummy variable (COM_L) is still significant overall, and the 'Sig' of its class values do not change dramatically. And the political variable has greater influence on the model after combining with the location variable. (0.061 to 0.725). However, the regional investor accounts number effect does not as significant as before at the 5% level. This may be caused by the correlation between the regional dummy variable and regional accounts number. Therefore, the importance of comparison in accounts number between stock exchanges diminishes substantially as geography factor getting into the determinant model. In addition, figure 5 displays the ROC curve of all four models we produced in this study, the regional model and final model are very close to each other. We may conclude that the location variable's impact on the listing decision could not be dramatically diminished by the regional effect factors, although they are not significantly independent predictors.

Table 10. Estimates of Final Model

Omnibus Tests of Model Coefficients

	Chi-square	df	Sig.
Step	210.112	48	0.000
Block	210.112	48	0.000
Model	210.112	48	0.000

Classification Table

Observed	Predicted		Percentage Correct
	Shanghai	Shenzhen	
Shanghai	256	111	69.755
Shenzhen	98	277	73.867
Overall Percentage			71.833

The cut value is .500

Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp(B)
ROE	-0.043	0.024	3.187136328	1.000	0.074	0.958
ROE2	0.045	0.037	1.511672625	1.000	0.219	1.047
Leverage	-0.025	0.025	0.981000155	1.000	0.322	0.975
Leverage2	0.032	0.028	1.240814405	1.000	0.265	1.032
Revgrow	-0.002	0.002	1.558008646	1.000	0.212	0.998
LnMkt	-0.247	0.116	4.580259483	1.000	0.032	0.781
industry*			15.45900643	5.000	0.009	
Finance	-19.392	25438.530	5.81137E-07	1.000	0.999	0.000
Commerce	0.303	0.484	0.393607251	1.000	0.530	1.354
Property	0.611	0.994	0.378051041	1.000	0.539	1.843
Conglomerate	-0.348	0.389	0.798484626	1.000	0.372	0.706
Industrial	0.535	0.359	2.219510201	1.000	0.136	1.708
Age	0.039	0.026	2.23026116	1.000	0.135	1.040
COM_L***			57.20980212	29.000	0.001	
Beijing	-7.200	4.291	2.816162542	1.000	0.093	0.001
Shanghai	-29.140	7122.366	1.67386E-05	1.000	0.997	0.000
Tianjin	-3.378	1.974	2.92818587	1.000	0.087	0.034
Hebei	0.668	1.095	0.371537103	1.000	0.542	1.950
Shanxi	1.536	1.412	1.183629239	1.000	0.277	4.645
Neimenggu	1.439	1.099	1.712738355	1.000	0.191	4.215
Liaoning	1.818	0.743	5.993191298	1.000	0.014	6.162
Jilin	0.184	1.155	0.025474927	1.000	0.873	1.202
Heilongjiang	-3.046	1.875	2.639972496	1.000	0.104	0.048
Jiangsu	-4.750	2.775	2.929557655	1.000	0.087	0.009
Zhejiang	-1.074	0.735	2.130936142	1.000	0.144	0.342
Anhui	-0.359	1.186	0.091759802	1.000	0.762	0.698

Fujian	1.690	1.459	1.341940775	1.000	0.247	5.418
Jiangxi	0.252	1.254	0.040438875	1.000	0.841	1.287
Shandong	-6.792	3.638	3.485773451	1.000	0.062	0.001
Henan	0.703	0.724	0.943815993	1.000	0.331	2.020
Hubei	-3.174	2.361	1.808143937	1.000	0.179	0.042
Hunan	-1.083	1.577	0.471961646	1.000	0.492	0.338
Guangdong	-2.728	2.747	0.986078236	1.000	0.321	0.065
Guangxi	2.463	0.849	8.419737095	1.000	0.004	11.741
Hainan	2.192	1.944	1.271166794	1.000	0.260	8.954
Sichuan	-3.118	2.203	2.003622686	1.000	0.157	0.044
Guizhou	-3.050	1.864	2.676797682	1.000	0.102	0.047
Yunnan	3.657	1.898	3.711973793	1.000	0.054	38.729
Tibet	1.636	1.792	0.833267167	1.000	0.361	5.134
Shannxi	1.791	1.943	0.849243471	1.000	0.357	5.995
Gansu	-0.265	0.987	0.072140965	1.000	0.788	0.767
Qinghai	0.116	1.038	0.01247157	1.000	0.911	1.123
Ningxia	2.516	1.859	1.830828998	1.000	0.176	12.373
ipo_time**			22.38214542	5.000	0.000	
1996	1.315	0.572	5.279768027	1.000	0.022	3.726
1997	2.137	0.586	13.28274391	1.000	0.000	8.478
1998	1.780	0.616	8.346667613	1.000	0.004	5.932
1999	2.044	0.623	10.76790229	1.000	0.001	7.721
2000	1.427	0.617	5.354867255	1.000	0.021	4.165
InvesComp(1)	-1.245	0.897	1.924641092	1.000	0.165	0.288
Political	0.361	0.193	3.521469573	1.000	0.061	1.435
Constant	-7.529	4.482	2.822256856	1.000	0.093	0.001

Note: Variable(s) entered on step 1: ROE, ROE2, Leverage, Leverage2, Revgrow, LnMkt, industry, Age, RegGDP, ipo_time, COM_L, InvesComp, Political.

* For variable-'industry', we use 'Utility' as the reference category

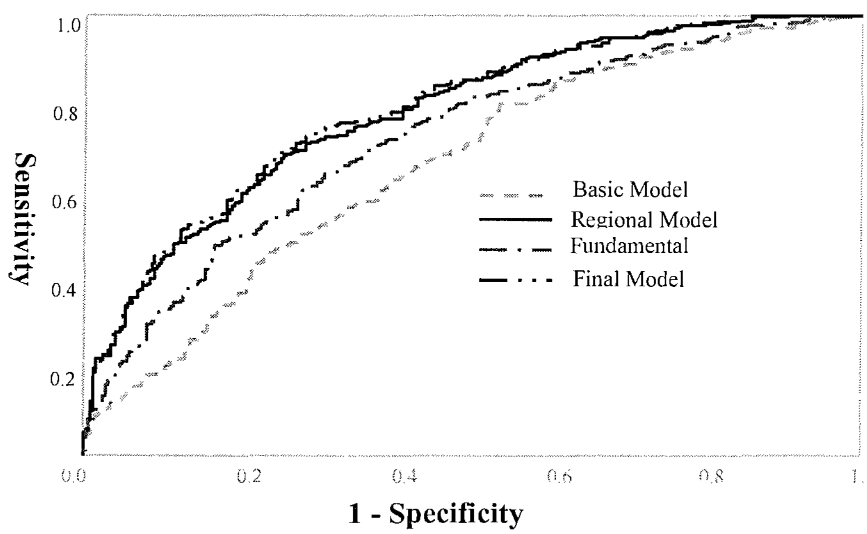
** For variable-'ipo_time', the reference category is 1995

*** For variable - ' COM_L', the reference category is 'Xinjiang'

**** For variable - 'InvestComp', the reference category is more investors in Shenzhen

all the reference value is choosen by convenience,without particular preference.

Figure 5: ROC Curve



All in all, variables like return on equity, company size, company's location, company's sector classification and political factors have significant impact on the listing decisions on stock exchanges. And the company's location factor may not be fully explained by the regional effect variables like regional GDP, account number comparison and regional listed company number.

V Conclusion

China's stock market has experienced great development after establishing two stock exchanges in 1990s. Its main goal was to reform state controlled companies. While dual listing is not allowed in China, companies have to choose on which stock exchange they prefer before going public. Our research is to find out determinants of the listing decisions by using quantitative method.

In this paper, a logistic regression is used to test a comprehensive panel data set of micro and macro information on China's publicly listed firms between 1995 and 2000 to see whether the model is an adequate representation of its behavior. We found that larger IPO intend to list on the Shanghai Stock Exchange and companies located in wealthier region tend to list on Shenzhen Stock Exchange although their operation performances are weaker than firms in Shanghai Stock Exchange. We tried to follow the existing literature in choosing variables. However, since the Chinese stock market is quite unique and much less developed than the western market, there are some differences in variables in our models. Variables are categorized into two sections; one is microeconomic variables, such as ROE, industry, age etc. This is mainly because in general, companies' public listing decisions are firstly based on its own features. The second variables section is macroeconomic variables, such as regional factor, regional GDP, etc. It is mainly because our main purpose of the research was to find out if there are any regional effects on the Chinese companies IPO decisions. In this paper, we built three key models: Basic Model, Regional Model and Final Model. The basic model only included microeconomic variables, such as ROE, industry etc. The Regional model added the regional dummy variable into the previous basic model. By adding this location dummy variables, we wanted to see if the model has improved and more importantly, if the regional factors has any significant effect on companies IPO choices. And in order to deepen our research, we made the Final model which includes all the macro and micro-economic variables, ROE, regional dummy variables, regional GDP, etc. The idea was to see whether those regional factors, like regional GDP, political factor, investors' amount etc could fully explain the regional location dummy variables.

One of this paper's finding suggests that among company's characteristics, return on equity ratio (ROE), industry classification and listing time are all significantly affect the listing decisions on stock exchanges.

We also find that one unique feature of China's public listing is the regional effect, especially the location factor. The model indicates that companies located in most provinces around Shenzhen, especially Guangdong province prefer to listing on SZSE. And the same situation applies to companies listed on SHSE. To further get convince of the importance of regional dummy variables in companies listing decisions, we used the regional model to examine the change in listing choice probability by move an listed company from Xinjiang, Tibet or Qinghai where are all far away from both exchanges to Guangdong where is quite near Shenzhen Stock exchange. And the results show significant probability increases of listing on SZSE after the movement. This indicates that the regional factor is an important factor in companies listing decisions. In addition, to test this phenomenon from a more macroeconomic point of view, we have sought various provincial macroeconomic variables. And we found although some regional factors, like regional GDP and comparison of regional investors account number, do have significant effect on listing choice between stock exchanges, they can not fully explain the regional dummy variables. Furthermore, although it always argues that Chinese government have too much control on the market; we found that the political factor seems quite weak in companies' decisions between stock exchanges.

Our major contribution of this paper is found that there is a regional effect on Chinese public listing companies' choice between stock exchanges which is the major difference from other countries. Although the some regional economic factor, like regional GDP, can explain the location factor, the regional dummy variable is still very important for companies listing decisions and cannot fully explained by macro economic factors. There is immense opportunity for further expansion of this research. It is recommended that a predictive model of listing decisions could be built based on company specific variables and other broader economic variables. Variables in the predictive model will differ from those in our determinant models, for example, the year dummy variables have to be excluded since their coefficients are unknown out of sample years.

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Appendix A: MAINLAND CHINA扴 PROVINCES, AUTONOMOUS REGINES AND MUNICIPALITIES

In lexicon order: Anhui, Beijing, Chongqing, Fujian, Gansu, Guangdong, Guangxi, Guizhou, Hainan, Hebei, Heilongjiang, Henan. Hubei, Hunan, Inner Mongolia, Jiangsu, Jiangxi, Jilin, Liaoning, Ningxia, Qinghai, Shaanxi, Shandong, Shanghai, Shanxi, Sichuan, Tianjin, Tibet, Xinjiang, Yunan, Zhejiang

Note:

1. A municipality is a city that directly subordinates to the central government and hence is administratively equivalent to provinces.
2. Chongqing municipality was established in 1997 and was within Sichuan Province before.

Chapter Three: Effectiveness of Price Limits:

Evidence from Shanghai and Shenzhen Stock Market

I Introduction

As part of major reform of the Chinese economy, the Shanghai Stock Exchange (SHSE) was set by the Chinese government on November 26, 1990 and started trading on December 19, 1990. Shortly afterwards, the Shenzhen Stock Exchange (SZSE) was also set and started trading in July 1991. The main activities of SHSE & SZSE have been trading spot values of shares (not including derivatives) of listed companies, the majority of which have been state-owned companies. Initially, the primary aim of SHSE & SZSE was to raise badly needed funds for the state-owned companies, most of which were in a dire financial situation. The shares have been denominated in Chinese yuan (RMB), and are subsequently called A-shares after the launch in February 1992 of B-shares denominated in US dollars, aiming for foreign investors alone.

In the past sixteen years, SHSE & SZSE witnessed a rapid expansion. For instance, the number of listed companies in SHSE had risen from 8 in 1990 to 1212 in September, 2002, and the total capitalisation had risen from a mere 3.1 billion yuan initially, equivalent to 0.18% of the total GDP, to 4.55 trillion yuan in December 2002, amount to 53.79% of the GDP. This massive expansion in a relatively short period of time has incurred abnormally high market volatility. At the offset, the China Securities Regulatory Committee (CSRC), the state governing body, decided to impose an upper limit of +1% and a lower limit of -5% on the daily movement of individual A-share prices, intending to control excessive market volatility. These restrictions were lifted after only a year and half as part of government's effort to jump-start the whole-scale economic reform in China[1]. On May 2, 1992, the +1% daily limit was removed by the CSRC, and so was the -5% daily limit on May 22, 1992.

In the next four and half years after the removal of price limits, trading of A-shares in SHSE & SZSE remained volatile. After a turbulent period of chaotic trading which saw the A-share index increased by 242% in 1996(!) in SHSE, a 10% symmetric daily price limits on all stocks were re-introduced by CSRC on December 13, 1996. This restriction was considered necessary at the time to combat the uncontrolled volatility culminated in late 1996. The price limits have remained in place in SHSE & SZSE ever since.

Price limits mechanism has been employed to control excessive stock price volatility in stock market, but its effectiveness has not been unambiguous, at least theoretically, and it has often been a focus of discussion. Advocates of price limits believe that the mechanism can reduce stock price volatility as, firstly, price limits set a ceiling and a floor, which restrict and hence control the price movement within trading day. Secondly, price limits provide a cool-off period for panic traders to reassess their strategies and, finally, price limits counters over-reaction (see e.g. Ma *et al* (1989)). Critics of price limits, however, argue that they may have adverse effects on stock markets. The restrictions on large daily movement may hamper immediate price corrections and hence cause volatility to increase in the subsequent days (volatility spillover hypothesis), and prevent stock prices from fully reaching their equilibrium level (delayed price discovery hypothesis). Also, the interrupts of trading caused by price limits are hardly welcome (trading interference hypothesis) as the shares become less liquid when they hit the limits and the trading would be heavier on the following

[1] The tour to the southern China by Mr. Deng Xiaoping, the then paramount leader of China, during Jan. 18 to Feb. 21, 1992 has been considered the start of the whole-scale economic reform in China.

days. Ironically, share price may accelerate as it gets closer to the limits (magnet effect hypothesis) (see e.g. Roll (1989), Fama (1989)). It is clear that the lack of theoretical consensus on price limits has prompted the need of empirical research to shed light on the issue. Evidence has recently been found support both sides of the argument (see, *inter alia*, Lee and Chung (1996), Su and Fleisher (1998, 1999) and Cho *et al* (2000)).

In this paper, we provide an empirical analysis to examine the effectiveness of the price limits adopted by SHSE and SZSE in an effort to control excessive volatility in A-share trading. Instead of investigating the effects of price limits on individual shares, we analyse the effects of price limits on the A-share indices and, hence, the market volatility. We are particularly looking for, firstly, evidence for possible delay in reaching equilibrium prices as a consequence of volatility reduction due to price limits; secondly, whether the reduction in volatility by price limits has long-term effects. We use the daily data of A-share index from December 19, 1990 to November 12, 2002 for SHSE and July 1, 1991 to November 12, 2002 (SZSE started later than SHSE).

Our approach differs from most of previous studies in the following respects. Firstly, most previous studies have focused on modelling volatility of individual share returns using ARCH-type models, from which relevant conclusions are drawn. In doing so, efforts have been made to improve the efficiency of estimation and inference, for instance, by dealing with the truncation caused by price limits (see Miller (1989), Wei (2002)). In contrast, our focus is on the market level looking at the change of volatility of the indices in the three periods, in which the restrictions are on and off. It has been noted that high excess kurtosis is often related to the magnitude and number of outliers (see e.g. Franses & Ghijsels (1999)). When price movement is restricted by prices limits, the price is truncated when it hits the price limits, and this leads to high excess kurtosis. This fact has been used in the literature as alternative measure for the effectiveness of the price limits (see e.g. Ma *et al* (1989)). The unique situation in SHSE and SZSE where price limits have been imposed twice enables us to directly compare excess kurtosis in the three periods and reveal important implications to the effectiveness of the price limits mechanism. Secondly, we ascertain if the reduction in volatility has incurred delay for market to reach equilibrium prices. We focus on the difference between the closing price and the next day opening price. We use cointegration analysis to ascertain if there is delay in reaching equilibrium when individual share prices reached restrictions. We compare the closing level of the indices with the next-day opening levels using a cointegration framework in the three periods when price limits were on and off. In normal situation, the closing level and the next-day opening level should be close only subject to random variation. However, if the price limits caused delay for the A-shares Index to reach equilibrium, this should be picked up by noticeable discrepancy between the two time series. Finally, in modelling volatility in SHSE and SZSE, our aim is to assess the change of unconditional volatility in the three periods caused by the price limits. To this end, we employ an EGARCH(1,1) model with GED errors. This model has become popular since the introduction by Nelson (1991). The findings from this model, together with those in the analysis of excess kurtosis, provide us with evidence on the effectiveness of the price limits.

The structure of the paper is as follows. In the next section we investigate if the price limits adopted in SHSE and SZSE caused delay for market to reach equilibrium using a cointegration analysis. We then compare the results in the three time periods to assess the effects of the price limits. The analysis is on both SHSE and SZSE which is followed by a comparison. In Section III, we develop an analysis to assess the long term effects of price limits on market volatility using an EGARCH model.

II A Cointegration Analysis of Effects of Price Limits

The following analysis is using the A-shares Indices of SHSE and SZSE which are market value-weighted average of all listed A-shares in the two stock exchanges, respectively. The indices are frequently adjusted to filter out the influence from merges, spin-offs, ex-dividends, ex-bonus and ex-rights *etc.*, such that it only reflects the actual stock price changes. In this paper, we choose the sample from December 19, 1990 to November 12, 2002, excluding weekends and public holidays for SHSE, and from July 1, 1991 to November 12, 2002 for SZSE.

In SHSE and SZSE the price limits on A-share are set on daily increment of individual shares. On any given trading day price changes are not allowed to exceed +1% up or -5% down on the closing prices of previous trading days. When an individual share hits the boundary, trading would still be allowed to continue as long as the deal is settled within the limits. This no doubt has effects on slowing down trading and reducing trading volume. On the other hand, this may keep investors in the waiting list, which may well last to next trading day if the queue is not cleared within the day. As a result, we often observe noticeable gaps between the opening prices and the previous closing prices. Moreover, in SHSE, for instance, among the 354 observations on daily return in the first period, 295 observations are positive showing increases during the trading days and on 239 occasions, the opening prices are noticeably higher than the closing prices of previous trading days which all ended up high. Although the individual shares that hit the up limit on these trading days may have different effects on the index, the overall results seem to indicate that the price limits delay the trading and cause abnormal surge in the opening prices of following trading days. We, therefore, analyse the overall effects of price limits on the indices by looking at the relationship between the opening price and the lagged closing price. If there is a statistically significant constant in the regression between closing prices and the next opening prices, we take this as evidence for delay in reaching equilibrium prices as a result of price limits

The daily return of A-share index is defined as $r_t = \log P_{ct} - \log P_{ot}$, where $\log P_{ct}$ and $\log P_{ot}$ denote the natural logarithm of daily closing and opening prices, respectively. This definition focuses on the intra-day price moments which are essential for our analysis as the price limits are on the changes within a trading day[2]. This definition also enables us to investigate trading delay and volatility spillover by analysing gaps between closing prices and the following opening prices.

2.1 Summary of statistics for SHSE & SZSE

A summary of descriptive statistics of daily return r_t on A-share indices of SHSE & SZSE is presented in Table 1 & Table 2 in three periods where the price limits were on and off. The first period when the price limits were in effect was set as Period I from the beginning to May 22nd, 1992. It is worth noting that the +1% upper limit was removed on May 2nd, 1992, but the -5% lower limit was removed only on May 22nd. However, before the removal of the limits the market was very low and the upper limit was hardly in use at all. Therefore, we chose May 22nd, 1992 as the terminal date for Period I when the price limits applied. We set Period II as from May 23rd, 1992 to December 12th, 1996 when the price limits were lifted, and Period III as from December 13th, 1996 to November 12th, 2002 when the sample terminates, in which a 10% price limits was imposed.

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[2] Alternative definitions are available in the literature, *e.g.* it may be defined as the difference of two consecutive closing prices $\log P_{ct} - \log P_{c,t-1}$. However, this kind of definition may not help our investigation as it includes unobservable information accumulated overnight.

We summarise some useful statistics of A-share index of SHSE in the following table:

Table 1: Descriptive statistics of r_t of SHSE in three periods

	Mean	S.D.	Skewness	E.Kurtosis	Max	Min	Range
Period I	-0.119e-2	0.00499	2.699	17.289	0.0401	-0.0204	0.0605
Period II	0.131e-2	0.0310	0.591	7.397	0.1880	-0.2052	0.3932
Period III	-0.281e-3	0.0156	0.131	6.834	0.1094	-0.0919	0.2013

Note: Max = $\log high_t - \log close_{t-1}$ and Min = $\log low_t - \log close_{t-1}$.

Under the restriction of price limits, the first period by far the has smallest standard deviation and, consequently, the smallest Max and the biggest Min values. The standard error in the first period is only a bit more than 15% of that in the second period. This indicates some effects of the price limits in reducing volatility in the first period. The relatively large positive skewness of 2.699 in the same period shows a long tail on the positive side of the distribution, which indicate that the asymmetric price limits ($+1\%$ and -5%) are more restrictive on positive side of the distribution. In this period, the daily return has the largest excess kurtosis, more than double of those in the second and third periods. These statistics, as we argument in the following, have major implications to the effectiveness of the asymmetric price limits.

The structure of SZSE A-index is not entirely the same as that of SHSE due to historical reasons. A SZSE composite index was launched on Aril 4th, 1991 about 4 months later than that of SHSE. On Oct. 4th an A-share and B-share indices were launched in SZSE, with the composite index still being compiled as an index of overall market performance. In calculating summary statistics for A-share index for SZSE in the three periods, we use the data of composite index for Period I. The relevance of this lies in the fact that the composite index did not include the B-shares which were launched on Oct. 4th, 1992. As Oct. 4th is within the second period and due to the difference in composition of composite and A-share indices, it is difficult to combine the two indices and produce meaningful summary statistics in Period II. We therefore chose Oct. 4th, 1992, instead of May 23rd, 1992, as the start date of Period II. The Period III of SZSE A-share index has the same starting date but terminates on Dec. 31st, 2001 due to a major structure change in SZSE. The summary statistics of r_t in the three periods are given in the following table:

Table 2: Descriptive statistics of r_t of SZSE in three periods

	Mean	S.D.	Skewness	E.Kurtosis	Max	Min	Range
Period I	0.646e-2	0.0374	1.0689	10.304	0.192	-0.187	0.371
Period II	0.037e-2	0.0305	1.269	11.611	0.295	-0.142	0.337
Period III	7.820e-6	0.0175	0.0263	7.170	0.132	-0.095	0.227

The statistics for Period I and Period II are very similar. In contrast to those in Table 1, these statistics do not seem to suggest any noticeable difference between the two periods and, hence, indicate that the price limits had limited effects on the SZSE index. One explanation to this is that SZSE started about 6 months later that SHSE when SHSE had established its dominant role. Though SHSE and SZSE were similar in size and capitalisation at the time, the trading in SZSE was much quieter than that in SHSE in the first year. For instance, on May 22nd, 1992 when the price limits were lifted, the total trading volume in SHSE was RMB 189.67 millions in sharp contrast to RMB 4.75 millions on the same day in SZSE.

We can see that our results for SZSE are a lot weaker than those of SHSE, especially for Period I. Apart from the trade volume being much less in SZSE than in SHSE, the data problem is also partially responsible for them. Firstly, SZSE index data we used had smaller sample size because SZSE index started later that SHSE; then the SZSE A-share index only started in Oct. 1992 only two months before Period I ended. The sample we used from April 1991 is the composite index of SZSE. Although it could be used as a proxy, the components of the composite index are different from A-share index. Therefore we believe SZSE data was weaker and we decided not to use for volatility analysis.

2.2 A cointegration analysis for SHSE

We first plot $\log P_{ct}$ and $\log P_{ot}$ for the three periods in Figure 1. The movements of $\log P_{ct}$ and $\log P_{ot}$ are similar within the periods but very different across the three periods. They are almost monotonically increasing functions in the first period, but have more variations in the second and third periods. The following table gives the unit root tests of the two time series.

Table 3: Unit root tests for $\log P_{ct}$, $\log P_{ot}$ in the three periods

	Period I			Period II			Period III		
	DF	ADF(1)	ADF(2)	DF	ADF(1)	ADF(2)	DF	ADF(1)	ADF(5)
$\log P_{ot}$	3.782	3.286	2.713	-0.2037	-0.1997	-0.2074	0.2022	0.2120	0.2376
$\log P_{ct}$	3.802	3.244	2.774	-0.2584	-0.2611	-0.2829	0.3330	0.3321	0.3341

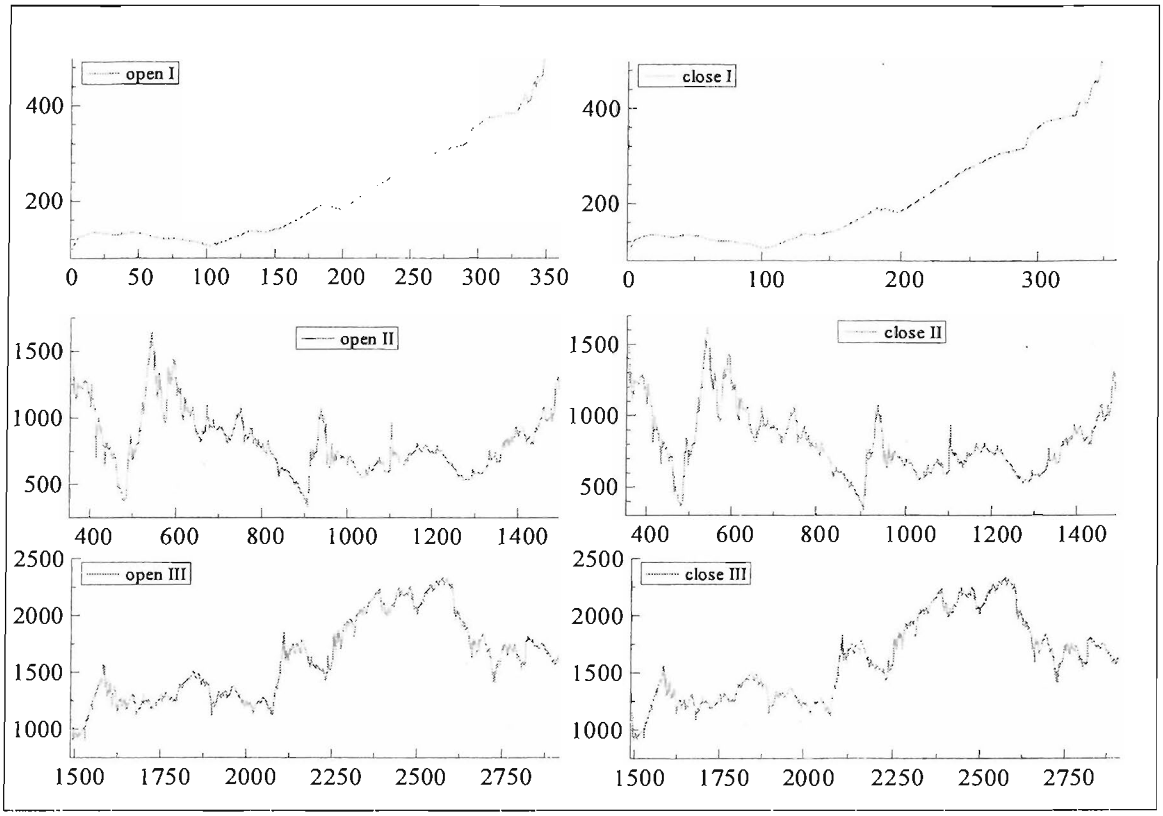

Figure 1: $\log P_{ct}$ **and** $\log P_{ot}$ **in the three periods for SHSE**

The unit root hypotheses for $\log P_{ct}$ and $\log P_{ot}$ are supported by the data in all three periods. We then analyse the relationship between $\log P_{ot}$ and $\log P_{c,t-1}$ by testing if they are actually cointegrated with or without a constant in the three periods. The test is carried out on the following model:

$$\log P_{ot} = \alpha + \beta \log P_{c,t-1} + \varepsilon_t \quad (1)$$

and the results are reported in Table 4 and Table 5.

Table 4: Cointegration analysis for $\log P_{ot}$ and $\log P_{c,t-1}$ in the three periods (SHSE)

	Period I			**Period II**			**Period III**		
	Coeff	**SD**	**t-value**	**Coeff**	**SD**	**t-value**	**Coeff**	**SD**	**t-value**
$\hat{\alpha}$	-0.073	0.023	**-3.19**	0.0072	0.0178	**0.409**	-0.0123	0.0072	**-1.72**
$\hat{\beta}$	1.015	0.0043	236.0	0.999	0.0026	375.0	1.0017	0.0009	1015
	R^2	**DW**	***F***	R^2	**DW**	***F***	R^2	**DW**	***F***
	0.993	1.89	**	0.992	1.86	**	0.999	1.62	**
ARCH 1-1	P-value: 0.9551			P-value: [0.000]**			P-value: [0.000]**		

Note: "**" and "*" denote significance at 1% level and 5% level, respectively.

The results in Table 4 clearly suggest that variables $\log P_{ot}$ and $\log P_{c,t-1}$ are cointegrated in all three periods provided the regression residuals are stationary, which is confirmed in the following Table 5, in which the Dicky-Fuller tests reject the unit root hypothesis in the residuals.

Table 5: Unit root tests on residuals $\hat{\varepsilon}_t$ for SHSE

	Period I			**Period II**			**Period III**		
	DF	**ADF(1)**	**ADF(2)**	**DF**	**ADF(1)**	**ADF(2)**	**DF**	**ADF(1)**	**ADF(2)**
$\hat{\varepsilon}_t$	-17.96**	-12.08**	-2.264*	-31.42**	-21.95**	-18.76**	-36.81**	-28.22**	-23.87**

Note: "**" and "*" denote significance at 1% level and 5% level, respectively.

We notice from Table 4 that Model (1) exhibits ARCH effects in Period II and Period III. We therefore re-estimate Model (1) for these two periods using GARCH(1,1) procedure, and the results are reported in Table 6.

Table 6: **Cointegration analysis for $\log P_{ot}$ and $\log P_{c,t-1}$ in periods II & III using GARCH**

	Period II			**Period III**		
	Coeff	**SD**	**t-value**	**Coeff**	**SD**	**t-value**
$\hat{\alpha}$	0.0374	0.01184	**0.606**	0.0009	0.0041	**0.141**
$\hat{\beta}$	0.994	0.00178	109	0.999	0.0005	1086

These results are only marginally different from those in Table 5 as far as the *t*-values of the constants are concerned. Estimation residuals are plotted in the following Figure 2.

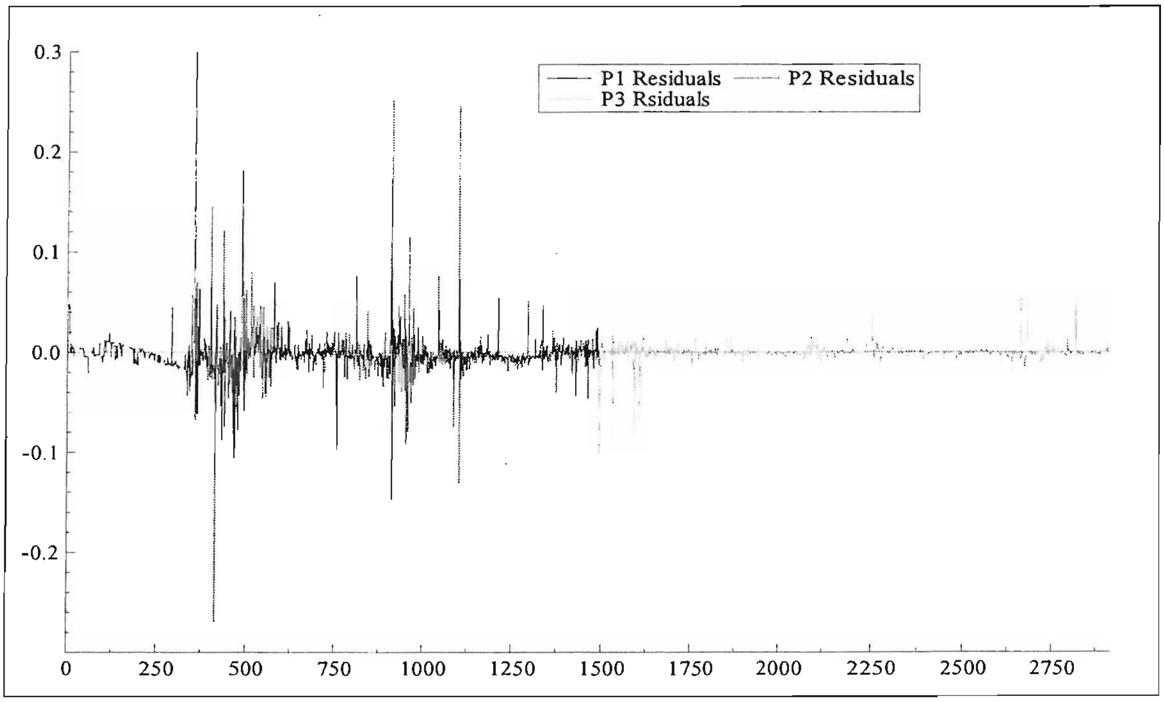

Figure 2: Residuals in the three periods for SHSE

Before we draw final conclusions on our findings, we test the hypothesis that the cointegrating vector of $\log P_{ot}$ and $\log P_{c,t-1}$ is [1, -1] for all three periods. The hypothesis is accepted for all periods. We illustrate the testing procedure for Period I below. We are following the test procedure outlined on p610 - p611 of Hamilton (1994).

Period I:

1. From Table 5, we calculate $t = (1.015 - 1)/0.0043 = 3.488$;
2. Calculate $s^2 = (T-2)^{-1}\sum_{t=1}^{T}\hat{\varepsilon}_t = 0.5583/354 = 0.00157$;
3. A second-order AR fit for residuals $\hat{\varepsilon}_t = 0.0446\hat{\varepsilon}_{t-1} + 0.0763\hat{\varepsilon}_{t-2} + \hat{e}_t$; and $\hat{\sigma}_1 = (353-2)^{-1}\sum \hat{e}_t = 0.00156$
4. $\hat{\lambda} = (0.00156)^{1/2}/(1-0.0446-0.0763) = 0.0455$;
5. Testing statistic for cointegrating vector [1, -1] is

$t \cdot (s/\hat{\lambda}) = (3.488)(0.00157)/(0.0455) = 0.12$

Since 0.12 is above the 5% critical value of -1.96 for standard normal. We accept the null hypothesis of the cointegrating vector for Period I is [1, -1].

We therefore impose the restriction of [1, -1] on Model (1) and re-estimate coefficient α:

Table 7: Re-estimation of α with cointegration restriction for SHSE

	Period I			**Period II**			**Period III**		
	Coeff	**SD**	***t-Prob***	**Coeff**	**SD**	***t-Prob***	**Coeff**	**SD**	***t-Prob***
α	0.0062	0.0026	**1.9%***	0.0011	0.0008	17.6%	0.0004	-0.0003	7.9%

We now draw our remarks from the above analysis:

1. $\log P_{ot}$ and $\log P_{c,t-1}$ are cointegrated in all three periods in SHSE with cointegrating vector [1, -1];

2. Only in Period I there is a significant constant at 5% level. This confirms that the price limits do have overall effects on the A-share index in Period I. In fact, the estimates in Table 7 implies:

$$\hat{\log} p_{ot} = 0.0062 + \log p_{c,t-1}$$

Hence

$$\hat{p}_{ot} / p_{c,t-1} = \exp(0.0062) \approx 1.0062$$

Therefore, on average the opening price increased by 0.62% over the previous-day closing price.

3. Period III has insignificant constant implying that the ±10% limits have no overall effect on the index, and the differences between the opening prices and the previous-day closing prices are mainly due to random disturbs.

2.3 A cointegration analysis for SZSE

We now apply the analysis developed in the previous section to SZSE A-share index. The results in Table 7 confirm that variables $\log P_{ot}$ and $\log P_{ct}$ are unit root processes. We then move on to estimate the regression model (1) of cointegration for SZSE in the three periods.

Table 7: Unit root tests for $\log P_{ot}$ and $\log P_{ct}$ in the three periods for SZSE

	Period I[§]			Period II			Period III		
	DF	ADF(1)	ADF(2)	DF	ADF(1)	ADF(2)	DF	ADF(1)	ADF(5)
$\log P_{ot}$	1.626	1.345	1.286	-0.5186	-0.4980	-0.6326	-1.876	-1.737	-1.649
$\log P_{ct}$	1.626	1.345	1.286	-0.5563	-0.5833	-0.7318	-1.690	-1.702	-1.670

? The statistics in the first Period are almost identical reflecting the fact that trading was very thin in this period and the index had very little movement.

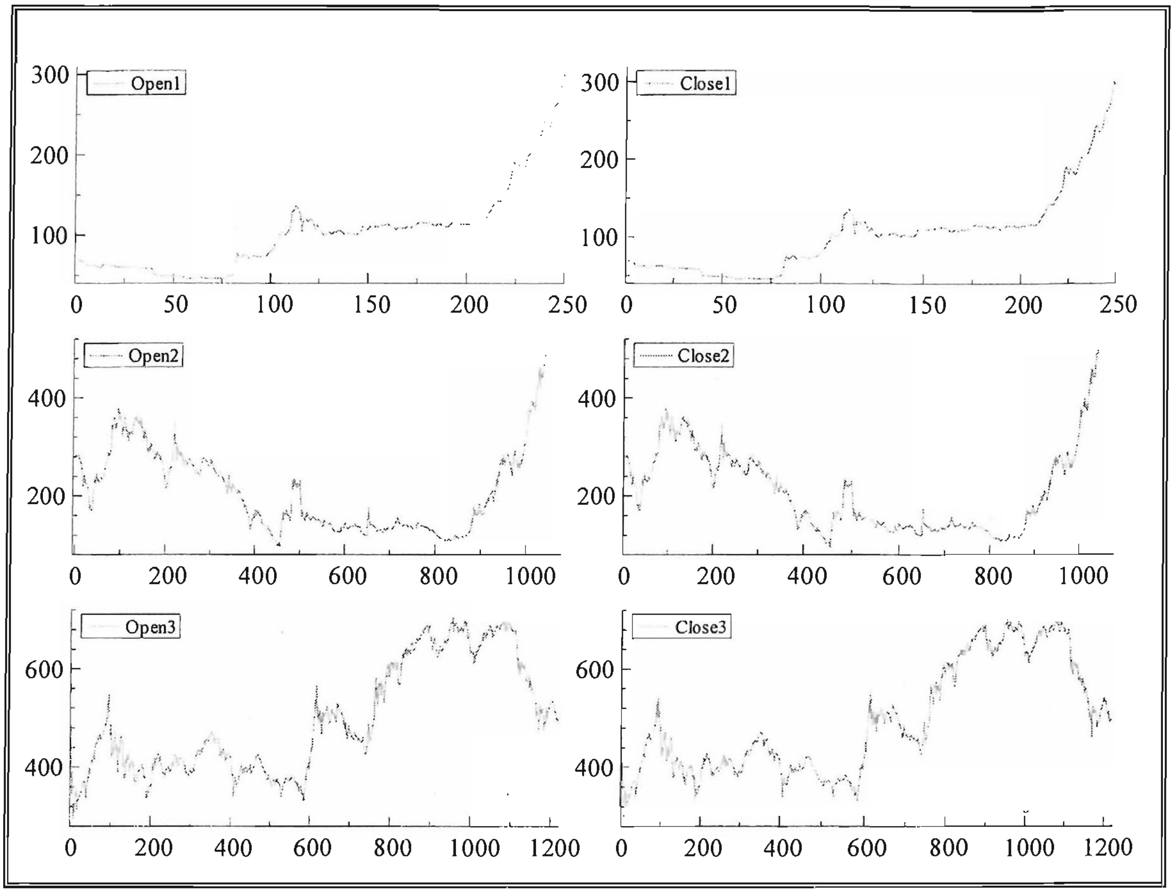

Figure 3: $\log P_{ct}$ **and** $\log P_{ot}$ **in the three periods for SZSE**

Table 8: Cointegration analysis for $\log P_{ot}$ **and** $\log P_{c,t-1}$ **in the three periods for SZSE**

	Period I			**Period II**			**Period III**		
	Coeff	**SD**	**t-value**	**Coeff**	**SD**	**t-value**	**Coeff**	**SD**	**t-value**
$\hat{\alpha}$	-0.0316	0.0224	-1.41	0.0025	0.0054	0.463	-0.0113	0.0076	-1.48
$\hat{\beta}$	1.0082	0.0049	205	0.9995	0.0010	976.0	1.0018	0.0012	811
	R^2	**DW**	***F***	R^2	**DW**	***F***	R^2	**DW**	***F***
	0.994	1.82	**	0.999	1.73	**	0.998	1.35	**
ARCH 1-1	P-value: [0.0000]**			P-value: [0.0185]*			P-value: [0.000]**		

Note: "**" and "*" denote significance at 1% level and 5% level, respectively.

Table 8 presents the results of cointegration analysis of $\log P_{ot}$ and $\log P_{c,t-1}$ in the three periods for SZSE. We notice two differences between these results and those in Table 4. Firstly, none of the estimates for constant α appears significant; Secondly, Period I exhibits ARCH effect while Period II only significant for ARCH effect at 5%. We therefore re-estimate the cointegration model for SZSE in all three periods using an ARCH framework. The results are reported below.

Table 9: Cointegration analysis for $\log P_{ot}$ and $\log P_{c,t-1}$ in the three periods for SZSE with ARCH

	Period I			Period II			Period III		
	Coeff	SD	t-value	Coeff	SD	t-value	Coeff	SD	t-value
$\hat{\alpha}$	-0.0294	0.0085	-3.31	0.0031	0.0062	0.511	-0.0017	0.0025	-0.601
$\hat{\beta}$	1.0067	0.0020	470	0.9994	0.0011	851.0	1.00036	0.0004	2362

Table 10: Unit root tests on residuals $\hat{\varepsilon}_t$ for SZSE

	Period I			Period II			Period III		
	DF	ADF(1)	ADF(2)	DF	ADF(1)	ADF(2)	DF	ADF(1)	ADF(2)
$\hat{\varepsilon}_t$	-14.36**	-10.45**	-8.164**	-32.11**	-22.56**	-21.34**	-31.84**	-24.19**	-20.68**

Note: "**" and "*" denote significance at 1% level and 5% level, respectively.

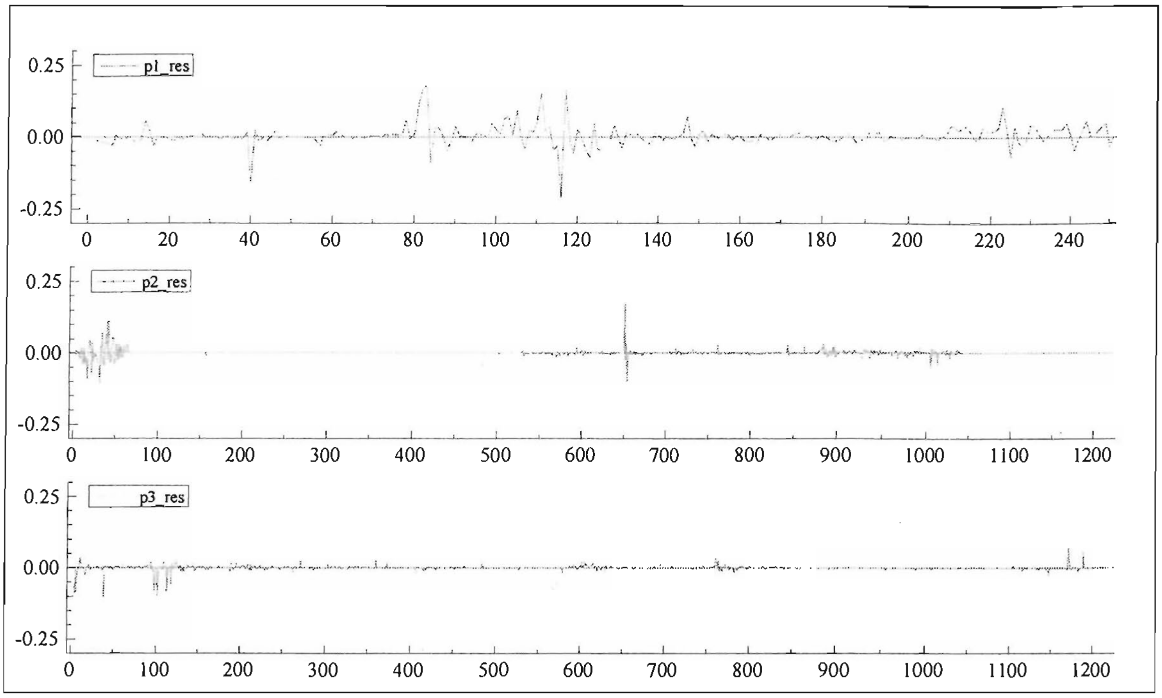

Figure 4: Residuals in the three periods for SZSE

The above Table 9 and Table 10 summarise our findings on cointegration relation between $\log P_{ot}$ and $\log P_{c,t-1}$ when ARCH has been taken into consideration. The constant term α is only significant in the first period which is consistent with our previous findings in SHSE. All unit root test on the regression residuals are rejected which again confirms the relevance of the cointegration relations in the three periods.

Further tests on the hypothesis of [1, -1] on cointegrating vectors are accepted (procedure outlined above). We therefore impose the restriction on the three periods and re-estimate the cointegration model. The results are reported below.

Table 11: Re-estimation of α with cointegration restriction for SHSE

	Period I			**Period II**			**Period III**		
	Coeff	**SD**	***t-Prob***	**Coeff**	**SD**	***t-Prob***	**Coeff**	**SD**	***t-Prob***
α	0.0057	0.0023	**1.4%***	0.00008	0.0004	82.6%	0.000053	0.0003	84.6%

Similar to our findings in SHSE, we now draw our remarks from the above analysis:

4. $\log P_{ot}$ and $\log P_{c,t-1}$ are cointegrated in all three periods in SZSE with cointegrating vector [1, -1];

5. Only in Period I there is a significant constant at 5% level. This confirms that the price limits do have overall effects on the A-share index in Period I. The estimates in Table 7 implies:

$$\hat{\log} p_{ot} = 0.0057 + \log p_{c,t-1}$$

Hence

$$\hat{p}_{ot} / p_{c,t-1} = \exp(0.0057) \approx 1.0057$$

Therefore, on average the opening price increased by 0.57% over the previous-day closing price, which is comparable with that in SHSE

6. Period III has insignificant constant implying that the ±10% limits have no overall effect on the index, and the differences between the opening prices and the previous-day closing prices are mainly due to random disturbs.

2.3 Remarks

The above analysis has been carried out on the level of the A-share indices of SHSE and SZSE. The purpose of the analysis is to ascertain if the price limits imposed in Periods I & III have overall effects on the level of the indices. Our findings confirm that in Period I the overall effects might have delayed the overall price to reach equilibrium as the opening index levels of SHSE and SZSE are found to be about 0.62% and 0.57% above the previous-day closing levels. However, the re-imposition of the price limits in Period III does not seem to have the overall effects on the A-share indices in either market. Our next task is to investigate if the price limits imposed in Period I and III have any overall effects on the volatilities of the indices in SHSE and SZSE. We discuss this in the next section

III An EGARCH Model for Long-term Effects of Price Limits

There have been empirical studies using ARCH-type models in analysing volatility processes in Chinese financial markets. Su (1998) discussed the effects of price limits in a framework of risk analysis on the return of Chinese stock market. A GARCH(1,1) model was employed and a dummy variable was specified in the volatility process to assess the impact of the removal of price limits in May 1992. Su has found that the removal was followed by higher volatility in SHSE. However, Su did not discuss the effects of the asymmetric price limits in the first period and the effects of the reinforcement of price limits and its consequential impacts on price level in December 1996.

Similar to the approach used in the previous section, we adopt the approach such that the volatility in the three periods is analyses simultaneously in the same EGARCH model to ascertain if there is any difference in the price limits' effects on the indices in the three periods. As seen above that the overall effects of the price level seem to be similar in the two markets (only slightly weaker in SZSE), our following analysis on volatility will concentrate on SHSE. All our calculation has been carried out using PcGive 10.

3.1 Model Specification

The following are our main considerations of model specification. Firstly, as the main purpose of this paper is to assess whether the mechanism of price limits has its effects, but not to quantify these effects, it suffices to specify three dummy variables representing the three periods from December 1990 to November 2002, respectively, and they are defined as follows:

$$D1 = \begin{cases} 1 & Dec.19,90 - May\,21,92 \\ 0 & otherwise \end{cases} \qquad D2 = \begin{cases} 1 & May\,22,92 - Dec\,12,96 \\ 0 & otherwise \end{cases}$$

$$D3 = \begin{cases} 1 & Dec\,13,96 - Nov\,12,02 \\ 0 & otherwise \end{cases}$$

These dummy variables will be used in both the mean and variance processes.

There is need to investigate asymmetric behaviour in the Shanghai return series. The contributing causes include the fact that the price limits was asymmetric in the period from December 19, 1990 to May 21, 1992 with upper limit +1% and lower limit -5%. Clearly, unexpected upsurge in price level in the period was considered by the government as the major danger of price instability. An EGARCH (Nelson 1991) model is a natural specification for the return series to capture the asymmetry.

Since the opening in December 1990, the SHSE has witnessed drastic changes in almost every aspect and its process towards maturity has also been noticeable. Nevertheless, there still have been many issues with "Chinese characteristics" need to be analysed with care. For instance, it has been reported (SHSE 2002 report) that there were 33,269,300 A-share investors, but among them only 158,700 institutional investors – a mere 0.48% in participant ratio that is very low (comparing with e.g. 5% in Taiwan). With more than 99% of investors are individual investors, whose primary aim is to maximise the short-term gains, the SHSE is bound to be excessively sensitive to new information and susceptible to even tiny disturbances. This often generated frantic trading activities upon the arrival of news, while information about long-term fundamentals of companies might be neglected. This phenomenon has been related to the theory of "information avalanche" in which untreated information could accumulate to cause major market crash. This is considered as one of the contributing factors to the Asian financial crisis in 1998 (See Lee 1998). We therefore follow Lamoureux and Lastrapes 's approach (1990), using daily trading volume V_t as the proxy for information arrivals. Variable V_t is serially correlated with high correlation. The estimated coefficients of an AR(1) for V_t are given in the following table:

Table 12: Basic statistics of $V_t = \rho V_{t-1} + \varepsilon_t$

	Coefficient ρ	**Std. Error**	***t*-value**	***t*-prob**
V_{t-1}	0.9823	0.0033	295.0	0.0000
Constant	0.3699	0.0699	5.290	0.0000

But the unit root hypothesis is rejected:

Table 13: ADF Tests for unit root of V_t

No. lags	**Coefficient**	***t*-adf**	***t*-prob**
2	0.9851	-4.567^{**}	0.000
1	0.9829	-5.147^{**}	0.000
0	0.9809	-5.746^{**}	0.000

Note: ** indicates significant at 1% level.

Although the inclusion of $\log V_t$ improves the specification of the EGARCH model, we are aware of the fact that volatility, lagged volatility and volume could be correlated, therefore the inclusion of the lagged volume variables in the volatility equation might render volatility coefficients insignificant (see e.g Lamoureux and Lastrapes (1990)).

The above considerations lead to the following EGARCH(p,q) model:

$$r_t = \delta_1 D1 + \delta_2 D2 + \delta_3 D3 + \varepsilon_t \qquad (1)$$

where

$$\varepsilon_t = \sqrt{h_t} v_t \qquad (2)$$

and the conditional variance h_t:

$$\log h_t = \alpha_0 + \gamma_1 D2 + \gamma_2 D3 + \gamma_3 \log V_t + \sum_{i=1}^{q} \alpha_i \left\{ \theta_1 \varepsilon_{t-i} + \theta_2 \left(|\varepsilon_{t-i}| - \mathrm{E}|\varepsilon_t| \right) \right\} + \sum_{i=1}^{p} \beta_i \log h_{t-i}$$

(3)

where $\log V_t$ is the logarithms of daily trading volume V_t and $\alpha_1 = 1$ by default in PeGive 10. The error term v_t is independently distributed following a *generalised error distribution* (GED) defined as

$$f(z) = \frac{\nu \exp\left(\frac{1}{2} |z/\lambda|^{\nu} \right)}{\lambda 2^{1+1/\nu} \Gamma(1/\nu)}, \qquad -\infty < z < \infty \quad \nu > 0$$

where $\Gamma(\cdot)$ is the gamma function, and $\lambda^2 = 2^{-2/\nu}\Gamma(1/\nu)/\Gamma(3/\nu)$. The advantage of GED lies in its flexibility and it includes many important distributions as special cases. For instance, it coincides with the standard normal distribution when $\nu = 2$. In this case, $\mathrm{E}(|\varepsilon_t|) = (2/\pi)^{1/2}$. When $\nu < 2$, the GED has thicker tails than the standard normal[3].

The mean equation (1) includes all three dummy variables, but no constant term. This specification is adopted as the return series r_t is expected to have zero mean, and the alternative specification of including a constant term and two dummy variables in (1)

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[3] There have been attempts in the literature to employ the so-called *generalised t-distribution* that encompasses

GED (see e.g. McDonald and Newey, 1988, and Watanabe, 2000).

is less straightforward. On the other hand, only two dummy variables D1 and D2 are included in the volatility process to avoid collinearity, which will result if dummy variable D3 were also included.

The presence of asymmetry in the conditional volatility process is captured by parameters θ_1 and θ_2 as $\sum_{i=1}^{q}\alpha_i\left\{\theta_1\varepsilon_{t-i}+\theta_2\left(|\varepsilon_{t-i}|-\mathrm{E}|\varepsilon_t|\right)\right\}$ becomes:

$$\sum_{i=1}^{q}\alpha_i\left\{(\theta_1+\theta_2)\varepsilon_{t-i}-\theta_2\mathrm{E}\varepsilon_t\right\} \quad \varepsilon_{t-i}>0$$

$$\sum_{i=1}^{q}\alpha_i\left\{(\theta_1-\theta_2)\varepsilon_{t-i}+\theta_2\mathrm{E}\varepsilon_t\right\} \quad \varepsilon_{t-i}<0$$

A small and insignificant value of θ_1 is therefore considered as an indication of absence of asymmetric effects.

3.2 Estimation results

Two models, EGARCH(2,2) and EGARCH(1,1) with GED errors, have been estimated and the results are reported in Table 14 and Table 15

Table 14: Estimation of EGARCH(2,2) model

		Coefficient	Std. Error	*t*-value	*t*-prob
Mean	δ_1 (D1)	8.16323 e-005	3.837 e-005	2.13	0.033
	δ_2 (D2)	-1.21175 e-003	0.0004340	-2.79	0.005
	δ_3 (D3)	-9.28303 e-005	0.0002273	-0.408	0.683
Volatility	γ_1 (D2)	0.412621	0.1669	2.47	0.013
	γ_2 (D3)	-0.287850	0.1678	-1.72	0.086
	γ_3 ($\log V_t$)	0.167945	0.01616	10.4	0.000
	α_0	-5.88331	0.4018	-14.6	0.000
	α_2	0.707639	0.1417	4.99	0.000
	θ_1 (ε_{t-1})	-0.0663538	0.02487	-2.67	0.008
	θ_2 ($\|\varepsilon_{t-1}\|$)	0.539588	0.04034	13.4	0.000
	β_1	0.0256419	0.09796	0.262	0.794
	β_2	0.695429	0.08743	7.95	0.000
	GED $\log(v/2)$	-0.744980	0.02812	-26.5	0.000
Statistics	AIC: -5.82367322		Log-likelihood	8498.09189	

Table 15: Estimation of EGARCH(1,1) model

		Coefficient	Std. Error	*t*-value	*t*-prob
Mean	δ_1 (D1)	8.23064 e-005	3.886 e-005	2.12	0.034
	δ_2 (D2)	-1.17326 e-003	0.0004438	-2.64	0.008
	δ_3 (D3)	-8.51921 e-005	0.0002281	-0.374	0.709
Volatility	γ_1 (D2)	0.311579	0.08139	3.83	0.000
	γ_2 (D3)	5.89560 e-003	0.08505	0.0693	0.945
	γ_3 ($\log V_t$)	0.0646904	0.009381	6.90	0.000
	α_0	-2.62870	0.2306	-11.4	0.000
	θ_1 (ε_{t-1})	-0.0460903	0.02166	-2.13	0.033
	θ_2 ($\|\varepsilon_{t-1}\|$)	0.483944	0.03337	14.5	0.000
	β_1	0.863492	0.01243	69.4	0.000
	GED $\log(v/2)$	-0.746554	0.02735	-27.3	0.000
Statistics	AIC: -5.81745703		Log-likelihood	8487.03489	

In both models, logged trading volume as a proxy of information arrivals plays a significant role in volatility process. Alternative proxy using lagged values of $\log V_t$ fails to produce significant coefficients. The more general form of EGARCH(2,2) has a small gain in both log-likelihood value and AIC. However, the insignificant value of β_1 renders EGARCH(2,2) less convincing. The EGARCH(1,1) model has lost a bit in AIC, but it is more coherent, and its more parsimonious for makes it a better model. The negative value of θ_1 in Table 6 (though relatively small and only marginally significant) represents some asymmetric effects in the volatility process, and the significant negative value -0.746554 of $\log(\nu/2)$ indicates $\nu < 2$, hence thicker tails in the error distribution.

The means of the daily return series in the three periods are represented by the coefficients of the three dummy variables in the mean process:

Table 16: Estimated mean of EGARCH(1,1) model

	I	II	III
Const	8.23064 e-005	-1.17326 e-003	-8.51921 e-005
t-value	2.12**	-2.64**	-0.374

Though the coefficients of D1 and D2 are significant (but not for D3), all the estimated values are so small that we could safely assume the zero mean for the daily return series.

In an EGARCH model, coefficient α_0 represents the logarithms of unconditional volatility η_0 [4]. Combining α_0 with the dummy variables, the unconditional volatility η_0 in the three periods is given as follows:

[4] Nelson (1991) allowed unconditional volatility to be a function of time, $\alpha_t = \alpha_0 + \log(1+\rho N_t)$, where

Table 17: Estimated unconditional volatility of EGARCH(1,1) model

	I	II	III
η_0	$\exp(-2.6287) = 0.072172$	$\exp(-2.3171) = 0.098557$	$\exp(-2.6228) = 0.072599$
t-value	-11.4**	3.83**	0.0693

The unconditional volatility in the second period increased by more than a third as a result of lifting the price limits. But this increase did not persist into the third period, in which η_0 returned to the same level as that in the first period. This seems to indicate that although there was a short-term surge in volatility after the lift of price limits, the return volatility appeared to regress to an equilibrium level without being subject to external force as the re-imposition of price limits did not seem to have long-term effects on either mean or volatility.

Table 18: Estimation of the final EGARCH(1,1) model

		Coefficient	Std. Error	t-value	t-prob
Volatility	γ_1 (D2)	0.306041	0.05916	5.17	0.000
	γ_2 ($\log V_t$)	0.0659151	0.01281	5.15	0.000
	α_0	-2.63823	0.4811	-5.48	0.000
	θ_1 (ε_{t-1})	-0.0408448	0.02338	-1.75	0.081
	θ_2 ($\lvert \varepsilon_{t-1} \rvert$)	0.482811	0.04346	11.1	0.000
	β_1	0.864505	0.02362	36.6	0.000
	GED $\log(v/2)$	-0.777424	0.03332	-23.3	0.000
Statistics	AIC: -5.8157757		Log-likelihood	8480.58519	

The final model is reached by setting deleting all dummy variables and D3 in the mean and volatility processes, respectively. The estimates are given above:

The final EGARCH(1,1) model is further tested for its specification and the validity of the subsequent inferences. The following table contains some key testing statistics of the estimation residuals:

N_t denotes the number of nontrading days between dates $t-1$ and t.

Table 19: Tests on estimation residuals

Normality test	$\chi^2(2) = 7158.2$ [0.0000]**
Excess kurtosis	21.431
ARCH 1-4	F(4,2899)= 0.095224 [0.9840]
Portmanteau (20)	$\chi^2(20) = 34.244$ [0.0245]*

Normality is still rejected which is not unexpected given many large residuals. There is marginal autocorrelation in residuals. But no significant ARCH effects are found though there is still significant excess kurtosis in the residuals. The findings are confirmed by the following diagrams:

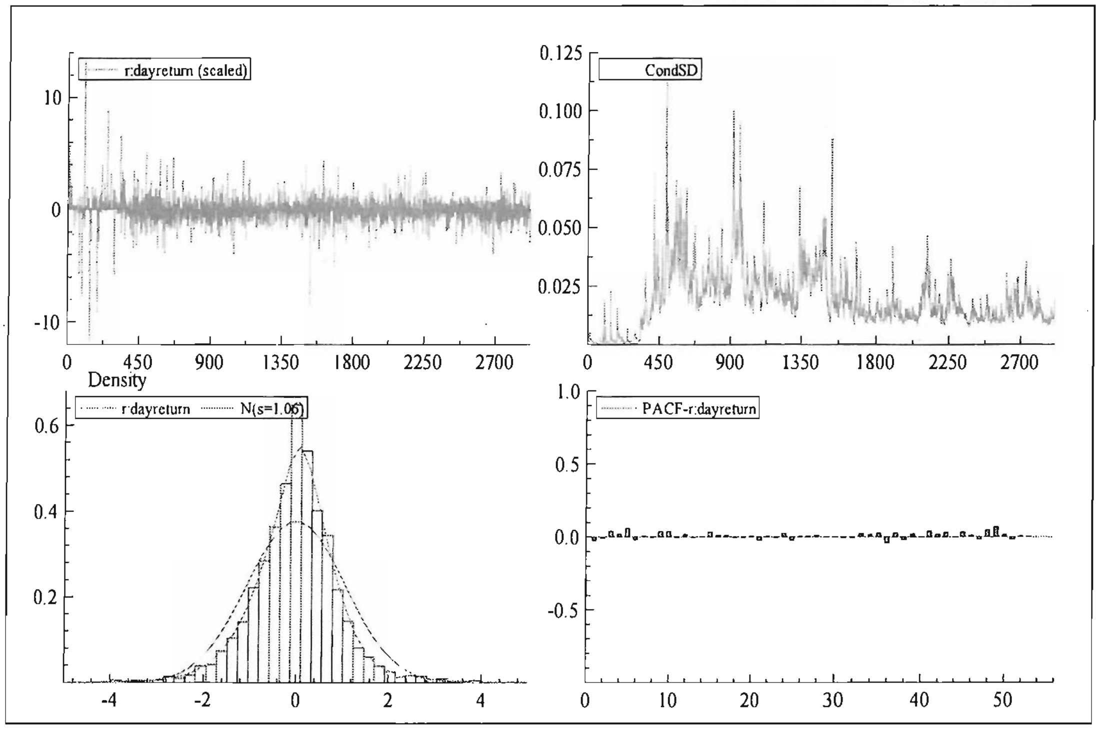

Figure 5: Scaled residuals

Using the estimation of the final model in Table 13, we can calculate the unconditional volatilities for the here periods:

Table 20: Estimated unconditional volatility of the final EGARCH(1,1) model

	I, III	II
η_0	$\exp(-2.63823) = 0.07149$	$\exp(-2.33219) = 0.09708$
t-value	-5.48**	5.17**

The unconditional volatility in the second period when there's no price limits is 35% higher than those of the first and third periods. But this increase in volatility has not become incontrollable. From the model, the unconditional volatility returns to the level of period I, with almost no external restrictions as the role of the 10% price limits re-imposed in this period proves insignificant. This provides further evidence that the equilibrium reached in the second period when restriction is lifted becomes more stable in the third period .

The model stability and parameter consistence are further checked by recursive estimation. Parameters α_0 , δ_1 , δ_2 and β_1 are estimated recursively and depicted between the band of 2 standard errors in the following graphs. These graphs show that there is no noticeable structure change in the model.

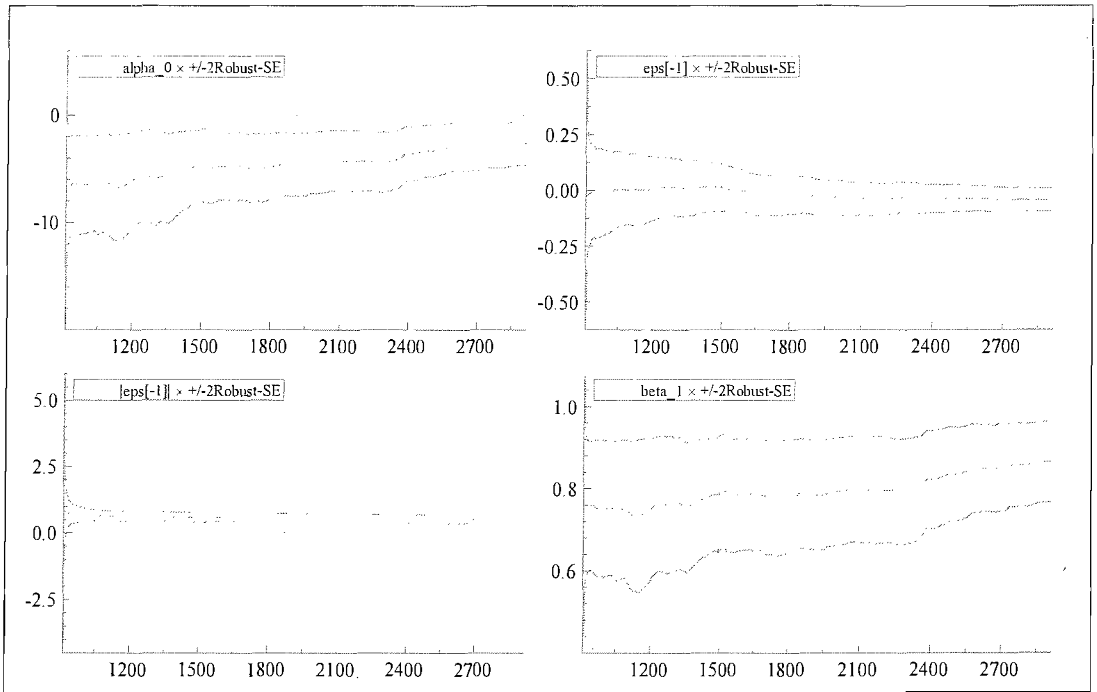

Figure 6: Scaled residuals

IV Conclusion

The effectiveness of price limits as means to control excessive volatility has long been a controversial issue. The unique situation in the Shanghai stock exchange where price limits have been imposed twice in 1990's enables us to investigate the effectiveness of the mechanism. In this paper, we investigate the effects of price limits on the A-share index of Shanghai Stock Exchange. We have adopted a comprehensive approach which compares the excess kurtosis and the unconditional volatility in the three periods, in which the price limits is on in the first and third periods. Our analysis is carried out in the framework of cointegration and EGARCH models.

Our results show that in the first period (Dec. 90 – May 92) when +1% and -5% limits is imposed, excessive volatility is partially controlled. However, the high values of skewness and excess kurtosis in this period indicate distortion and disequilibrium in the return distribution. In the second period up to Dec. 1996 when the price limits is lifted, volatility increases noticeably accompanied with considerable reduction in skewness and excess kurtosis. These findings show that the distortion in distribution is greatly reduced and a new equilibrium is reached in the second period. Finally, we have found that in the third period up to November 2002, when a ±10% price limits is in place, skewness and excess kurtosis remain the same as those in the second period. The effectiveness of 10% limit in this period has not been supported by empirical evidence. The EGARCH model shows that the restriction in the third period has insignificant effects. The unconditional volatilities are the same in the first and third period after an increase in the second period. From these evidence we argue that the equilibrium reached in the second period in the absence of price limits become more stable in the third period where the nominal price limits has insignificant effect. However, although our analysis shows that with in our framework of co-integration analysis on level and EGARCH analysis on volatility, the 10% price limits does not have overall effect on the indices. But this could mean a number of things: a) the price limits did have effect on individual stocks but no on index; b) the 10% limits were not strict enough to have effect; c) this period also partially coincided with the Asian financial crisis. Therefore, our results may not be extended to imply that it's time to lift the price limits again. In fact, the turbulence the Chinese stock market has just experienced in the past month might provide evidence to support otherwise.

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Chapter Four: Long Term Trend of Segmented Market抯 System Risk

I Introduction

There are several unique features in Chinese equity market and segmentation is one of the most prominent. The distinct Chinese segmented stock markets could be analyzed from several aspects. First of all, in China, many shares are still controlled by the government even after listing and are therefore not traded in the market. Therefore, the same firm could issue shares listed in the stock exchanges as free floating shares and shares that are not listed and not traded in the market as non-traded shares (state shares and legal entity shares) at the same time. Secondly, from trading location aspects, Chinese companies can only list on one of the two stock exchanges in mainland China and cross listing between these two exchanges is not allowed. Thirdly and the most important character is foreign investors can only trade in foreign (B or H) shares and domestic investors only in A shares in China. My whole thesis is concentrating on the segmentation of Chinese stock market and the previous two chapters have tried to solve these questions: 1) how would companies decide where to list, Shanghai vs Shenzhen? 2) How would these two markets perform differently? In particular, does the "price limits" have the same effects on both markets? This Chapter is focusing on the questions on segmented Chinese A and B share markets.

Since the early of 1990s, the rapid growth of China's economy and stock markets has attracted a lot of foreign capital. The Chinese stock markets opened to international investors in 1992. The issue of the B (foreign) share of Shanghai Vacuum Electron on the Shanghai Stock Exchange on February 21, 1992 was quickly followed by the B share of China Southern Glass on February 28, 1992, which was the first B share listed on the Shenzhen Stock Exchange. Since then, in China a local firm may issue shares which can be traded by domestic investors (A-Shares), shares denominated in foreign currencies and reserved for foreign investors (B-Shares), and shares of companies listed or cross-listed overseas (e.g. H shares, for those listed in Hong Kong). In addition, like many developing countries, China set up legal restrictions on the foreign ownership of domestic equity in order to maintain the control over local firms, especially those state owned companies that are of strategic and national importance.

In China, not every company can issue B shares. Only firms that get permission from the authorities are allowed to issue B shares. At the end of 2005, there are 1360 Chinese firms listing A shares and 109 firms listing B shares on either the Shanghai or Shenzhen stock exchanges. In the B-share market, most investors are institutional investors. On the contrary, in the A-share market the percentage of individual investors is much higher than that in the B-share market.

Many western researchers have done extensively researches in many aspects, such as reasons for segmenting stock markets, the impact of market segmentation on stock price, price volatility. It is commonly believed that the differentiation in tax policy is the main reason for market segmentation. Neumark, Hauser, Tonsini (1991) found out overseas market reflects quicker for domestic stock price changes than domestic market. In addition, Mei, Scheinkman and Xiong (2005) discovered that finding a 421.8% premium for A shares over B shares, regardless of equal property rights on dividends by comparing the performance of A and B shares for 75 companies for the period 1993 – 2001. Mookerjee and Yu (1999) report violations of the efficient market hypothesis. They find both autocorrelation and seasonality in returns. However, an important issue that has not been adequately investigated in the literature is that the characteristics of segmented China stock market's system risk. The purpose of this study is to identify the long term trend and co-integrations between A and B shares' system risks. In this paper, we use a panel of data includes 100 A Share listing companies and all B share listing companies in two stock exchanges in China (1993 to 2001) to investigate the issue. Co-integration test and Granger causality test methods were used. We find that, while the downward trend in system risk of A-share market is quite obvious due to the much less political risk impact on share price, the system risk of B-share market has increased, especially after 1997. In addition, our Granger causality result shows that in terms of system risk, there exists causal relationship between A-shares in SHSE and in SZSE. However, although causal relationship also found in B-shares between two stock exchanges, the transmission direction is opposite to A-share's. The main reasons are the differences in market scale and sensitivity between A-share and B-share markets. This also reflects the two markets are segmented.

The organization of the paper is as follows. We describe the unique characters of China stock markets in Section 2. Section 3 discusses our model, describing the data, defining the variables and presents summary statistics. Section 4 presents the results while section 5 concludes the paper.

II Market Segmentation

In most emerging markets, like the Finnish, Swiss, Singapore markets, stock market segmentation between domestic and foreign investors is not uncommon. A major reason for this arrangement is to attract foreign funds without risking the loss of ownership control. In all these markets, domestic investors can hold and trade both the domestic shares (restricted shares) and the foreign shares (unrestricted shares), while foreigners are restricted to own only unrestricted shares. However, while the segmentation in those markets are only partial, the Chinese stock markets for the A shares and B shares are completely segmented between 1992 and 2001. In China, B shares can be owned only by foreign investors while A shares can be owned only by Chinese citizens. International accounting standards (IAS) are used to prepare accounting reports for the B-share holders. And Chinese Accounting Standards (CAS) are used to prepare accounting reports for the A-share holders. In addition, B shares companies are audited by more professional and expensive international CPA firms, while the financial statements of A share companies are audited by less developed Chinese CPA firms.

After 2001, Segmentation was gradually relaxed as the government approved domestic Chinese investors can trade B shares and qualified foreign institutional investors (QFII) can invest in A shares. However, even though Chinese investors are able to trade both classes of shares, we still think the A and B share markets are segmented. The main reasons are: firstly, Both short selling of A and B shares are not allowed in China's stock market; secondly, an investor, who wants to trade B shares, has to open an individual bank account that is only used for trading B shares and foreign exchange in such an account must be transferred from foreign banks. Thirdly, the domestic investors cannot freely buy foreign exchanges by using RMB.

Another unique character of Chinese stock markets is that in contrast to other emerging markets, domestic A-shares are sold at a premium relative to foreign shares due to the rigidly segmented A and B share markets. Some researchers argued that the lack of investment alternatives is a possible reason for this A share price premium. Fernald and Rogers (1998) concluded that the premium is consistent with the simple asset pricing model and a difference in expected returns by domestic and foreign investors. They explained that due to the limited alternative investments available in China, domestic investors may accept a lower required rate of return than foreigners, and therefore, are willing to pay a higher price. In addition, they also suggested that the volatility of the A-share market is several times higher than that of the B-share market which indicated that the domestic A-share market is heavily influenced by the sentiment or irrational behaviour of retail investors.

On the contrary, some researchers, such as Bailey (1994) argued that price discovery and information diffusion between domestic and foreign investors are relevant. Chui and Kwok (1998) investigate the cross-autocorrelation of A and B share returns. They find that returns on B shares lead returns on A shares, which may reflect an information advantage of foreign investors.

Chakravarty, Sarkar and Wu (1998), and Bergstrom and Tang (2001) argue that the A share price premium is caused by segmentation and information differences, and present empirical support for the segmentation hypothesis. Stulz and Wasserfallen (1995) and Domowitz et al. (1997). They argue that due to the deadweight cost, the demand for domestic shares by foreign investors is less price elastic than the demand by domestic investors. Domestic entrepreneurs like to limit foreign ownership restrictions so that they can maximize firm values through price discrimination against foreign investors. As a result, there are equity premiums for foreign shares.

In addition, we would expect price discovery to force the share prices of the same firm to converge, so that the A and B share prices of the same firm are cointegrated. Sjoo and Zhang (2000) find that it is difficult to reject the hypothesis of no cointegration between A and B share prices using formal tests of cointegration. They also find that the direction of information diffusion is determined by the choice of stock exchanges.

III Data

3.1 System Risk

The capital asset pricing model (CAPM) states that the expected return on an asset is related to its risk measured by beta, b:

$$R_j = a_j + b_j R_M + \varepsilon_j \qquad (1)$$

Where R_j is the expected return on asset j given its beta and R_M is the market risk premium, the expected return on the market minus the risk-free rate. In addition, beta b is the asset's sensitivity to returns on the market portfolio, equal to $Cov(R_j, R_M)/\sigma_M^2$.

Modern investment analysis categorizes the traditional sources of risk causing variability in returns into two general types: non systematic risk, those that is unique to a particular security and is associated with such factors as business and financial risk as well as liquidity risk. And systematic risk, those that are caused by macroeconomic variables, such as market risk or interest rate risk. Therefore, we must consider these two categories of total risk.

An investor can construct a diversified portfolio and eliminate part of the total risk, the diversifiable or non systematic risk. However, the systematic risk is non-diversifiable. Virtually all securities have some systematic risk, whether bonds or stocks, because systematic risk directly encompasses interest rate, market, and inflation risks. This systematic risk, measured by the standard deviation of returns of the market portfolio, can change over time with changes in the macroeconomic variables that affect the valuation of all risky assets.

We assume the total risk could be represented by both systematic risk and non-systematic risk, using the following equivalent:

$$\sigma_j^2 = \beta_j^2 \sigma_M^2 + \sigma_\varepsilon^2 \qquad (2)$$

Where σ_j^2 is the total risk and $\beta_j^2\ \sigma_M^2$ is the systematic risk, while σ_ε^2 represents the unsystematic risk. Therefore, we get the ratio θ of systematic risk to total risk:

$$\theta = \frac{\beta_j^2 \sigma_M^2}{\sigma_j^2} = \frac{\rho_{jM}\sigma_j\sigma_M}{\sigma_M^2} \cdot \frac{\sigma_M^2}{\sigma_j^2} = \rho_{jM}^2 \qquad (3)$$

And then the ratio of unsystematic risk to the total risk is

$$1-\theta = 1-\rho_{jM}^2 \qquad (4)$$

Many researchers tried to use above models to solve the puzzles in the stock markets. Donghui Shi (1996) has pointed out that the average ratio of systematic risk to total risk in China stock market during 1993 to 1996 was 81.37%, which was much higher than most developed countries average 10% to 30% level. Then he concluded that because the weight of systematic risk to total risk is quite high, therefore, the risk of portfolio could not be diversified well and remains high. However, there is a drawback of his research. He used average data to analyze the issue, which cause lots of information being ignored. Instead, in our paper, we used time series data to analyze the trend of systematic risks between SHSE and SZSE.

3.2 The calculation of ρ_{Mt}^2

In order to test co-integration between system risks of A share and B share markets, this paper has developed the following regression by using variables: the rate of return for each sample data and the rate of return of Shanghai A-share index:

$$R_{jt} = a_{jt} + b_{jt}R_{Mt} + \varepsilon_{jt} \qquad 〔1〕$$

Where: $R_{jt} = LnP_{jt} - LnP_{jt-1}$

$R_{Mt} = LnI_t - LnI_{t-1}$

P_{jt}: share price of stock j in day t;

I_t: index value in day t

R_{jt}: the rate of return for stock j in day t

R_{Mt}: the rate of return for index in day t

ε_{jt}: the random error term

By using the monthly results derived from (1), We could get the square of correlation coefficient ρ^2_{jMt} in month t between each sample share and index value. After obtaining ρ^2_{jMt} value, the monthly average value of ratio in system risks to total risks for each data set could be calculated, which

$$\rho^2_{Mt} = \frac{1}{J}\sum_{j=1}^{J}\rho^2_{jMt} \qquad (2)$$

here J is the number of shares, therefore we could get N's ρ^2_{Mt} 。

In this paper, the data set is selected as follows:

(1) A-share sample: we randomly selected 100 A Share listing companies from both SHSE and SZSE, Shanghai A-share index and Shenzhen A-share index

(2) B-share sample: all B share listing companies in two stock exchanges in China. Shanghai B-share index and Shenzhen B- share index

The main data source was purchased from a major financial information service company in China.

The time horizon for selected companies in our study is from 1st January, 1993 to January, 2001 which total N is 97 months. However, we used data set until 31th August, 2001 in our calculation. The reason for choosing such a time horizon is because after Feb. 2001, the major change of government policy on stock markets has impacts on the basic characteristics of data. Then we do not include any data after Feb. 2001 in this paper.

IV Model and Hypothesis

4.1 Cointegration

Cointegration theory is the innovation in theoretical econometrics that has created the most interest among economists in the last decade. It is an econometric technique for testing the correlation between non-stationary time series variables. If two or more series are themselves non-stationary, but a linear combination of them is stationary, then the series are said to be cointegrated. Before the 1980s many economists proceeded as if stationarity could be achieved by simply removing deterministic components (e.g. drifts and trends) from the data. However, stationary series should at least have constant unconditional mean and variance over time, a condition which hardly appears to be satisfied in economics, even after removing those deterministic terms. Those problem were showed by Granger and Newbold (1974) and Nelson and Plosser (1982) as a dangerous approach, that could produce nonsense or spurious correlation.

Engle and Granger (1987) were the first to formalize the idea of integrated variables sharing an equilibrium relation which turned out to be either stationary or have a lower degree of integration than the original series. They denoted this property by cointegration, signifying co-movements among trending variables which could be exploited to test for the existence of equilibrium relationships within a fully dynamic specification framework. In this sense, the basic concept of cointegration applies in a variety of economic models including the relationships between capital and output, real wages and labor productivity, nominal exchange rates and relative prices, consumption and disposable income, long and short-term interest rates, money velocity and interest rates, price of shares and dividends, production and sales, ect. Consequently, we have the first hypothesis:

H_1: if there is a statistically significant connection between the system risk of A share and B share market in China, each roughly following a random walk, we deem they are cointegrated. Therefore, the two markets are not segmented. However, if the cointegration between the system risks of two markets does not exist, then the markets are segmented.

The first step in determining the existence of a long-run stable relationship between variables is to check for stationarity. In this paper, we use standard Augmented Dickey-Fuller (ADF) unit root tests. Then, the Engle-Granger test is used for testing whether the system risks of A share and B share markets are cointegrated. .

4.1.1 Unit Root Tests (ADF tests)

A series is called stationary if its mean and variance are constant and its covariance is independent of time. On the other hand, if a series is expressed as a first order autoregressive or AR (1) process:

$$x_t = \theta x_{t-1} + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

With θ=1, it is said to be integrated of order one, denoted $I(1)$ and is nonstationary with a unit root, usually referred to as a random walk. The most commonly used tests for a unit root test is Augmented Dickey-Fuller (ADF) test. (Levin and Lin,1992; Im, Pesaran and Shin, 1997; Maddala and Wu 1999). The ADF unit root test is based on the model

$$\Delta x_t = b x_{t-1} + \sum_{l=1}^{k} \alpha_l \Delta x_{t-l} + \varepsilon_t \qquad (3)$$

The null hypothesis is b = 0 and the alternative hypothesis is b < 0. If we can reject the null hypothesis at a given significance level, we can conclude that x_t is stationary. Otherwise, x_t is non-stationary. The number of lags k are selected under the Akaike information criterion (AIC).

4.1.2 Engle ? Granger Test

If all series are $I(1)$ and follow unit roots, they are examined then to determine whether they are cointegrated. In general, linear combinations of $I(1)$ variables will also be $I(1)$, but if they happen to be $I(0)$, the variables are said to be cointegrated, and there exists a representation of an error correction model (ECM) among the cointegrated variables (Engle and Granger, 1987). More than one method of conducting cointegration test are existed. In this paper, we used the Engle – Granger test for cointegration which is to run a static regression after first having verified that Y_t and X_t both are I(1)

$$X_t = bY_t + s_t \qquad (4)$$

where Y_t is one- or higher-dimensional. The asymptotic distribution of b is not standard, but the test suggested by Engle and Granger was to estimate $\hat{b}$ by OLS and the test for unit roots in

$$\hat{s}_t = X_t - \hat{b}Y_t$$

Note that since the unit root tests test the null hypothesis of a unit root, most cointegration tests test the null of no cointegration. We will test whether the residual s_t is stationary by using ADF test. If s_t is stationary, Y_t and X_t are cointegrated; otherwise, Y_t and X_t are not cointegrated

4.2 Granger causality

Engle and Granger (1987), show that if two series are individually I(1), and cointegrated, a causal relationship will exist in at least one direction. The definition of Granger causality is that it is a technique for determining whether one time series is useful in forecasting another. Given two series X and Y, usually better through a series of F-tests on lagged valued of X and with lagged values of Y (Granger, 1987),

$$\sigma^2\left(Y_t \middle| Y_{t-k}, \forall k>0\right) > \sigma^2\left(Y_t \middle| (Y_{t-k}, X_{t-k}), \forall k>0\right)$$

X is said to Granger cause Y (X→Y), if it can be shown, that those X values helps in the prediction of future values of Y. A two-way causation occurs frequently; series x Granger causes series y and series y Granger causes series x. Using Granger causality tests, we can analyze our second hypothesis:

> H_2: if one or more of the system risk time series is Granger cause other time series, then the Chinese stock market is not segmented from the system risks aspect. Otherwise, we can say that the markets are segmented and the Granger cause relationships could not be determined.

This causality test could be presented as follows:

$$Y_t = \sum_{j=1}^{k} (\theta_j Y_{t-j} + \beta_j X_{t-j}) + \varepsilon_t \qquad (5)$$

$$X_t = \sum_{j=1}^{k} (\lambda_j X_{t-j} + \alpha_j Y_{t-j}) + \mu_t \qquad (6)$$

Where ε_t and μ_t are zero-mean, serially uncorrelated, random disturbances and the correspondent null hypothesis are:

$$H_{0x} : \beta_j = 0 \quad j = 1, 2, \cdots k \qquad (7)$$

$$H_{0y} : \alpha_j = 0 \quad j = 1, 2, \cdots k \qquad (8)$$

The number of lags k are determined by the Akaike information criterion (AIC). And the results have four situations:

One way Granger cause	X→Y :	if reject H_{0x} , but accept H_{0y} ;
One way Granger cause	Y→X :	if reject H_{0y} , but accept H_{0x} ;
Two way Granger cause	X↔Y:	if reject H_{0x} , and also reject H_{0y} ;
Independency	X⊥Y :	if accept H_{0x}, and also accept H_{0y}。

V Results and Interpretation

5.1 Description Analysis

Until Aug. 2001, the percentage of system risk to total risk of china A-share markets (include both Shanghai A-share and Shenzhen A-share market) was higher than most developed countries. The average value of system risk ratio in Shanghai A-share market was 51%, while the percentage was around 48% in Shenzhen. From yearly result shown in Figure 1, we can see that the percentage of A share market system risk to total risk has largely decreased which was mainly because of the more standardized Chinese stock market.

Figure 1: A share market system risk yearly result (1993 ? 2000)

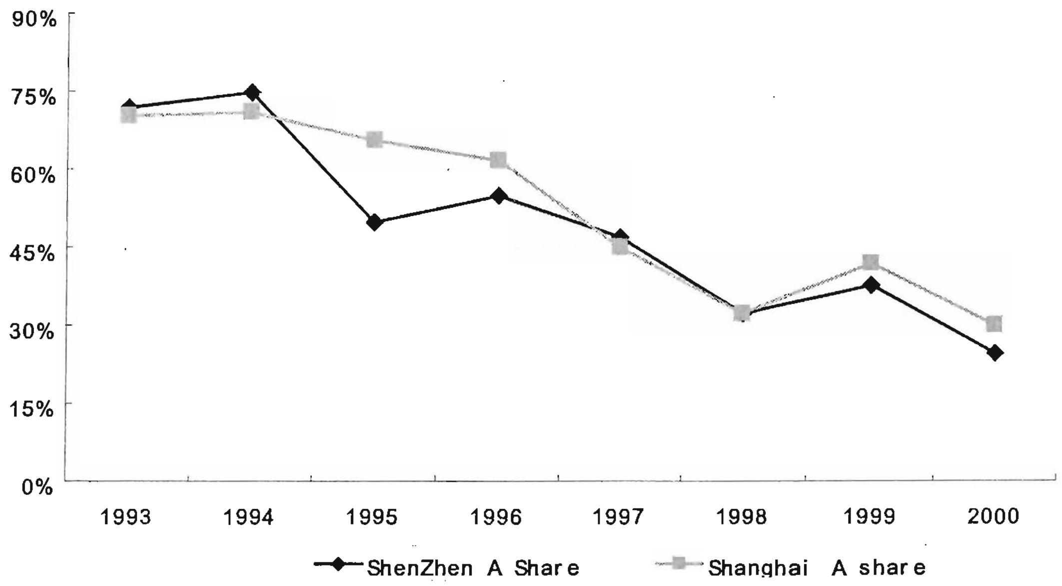
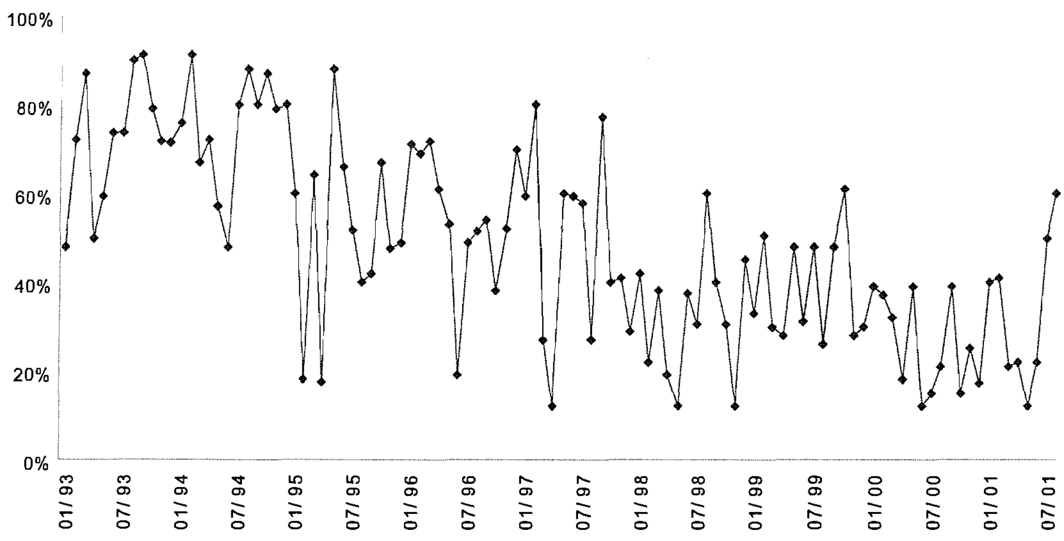


Figure 2: Shanghai A share market system risk monthly result (1993 ? 2001)

Figure 3: Shenzhen A share market system risk monthly result (1993 ? 2001)



The development of Chinese stock market might be reflected from the following aspects: firstly, investors become more rational than previously. Before, most domestic investors treated investing as gambling. Now, instead, they start to analyze the real value of companies before investing, Secondly, more institutional investors entered into the market which not only increased the stock markets' size and liquidity but also helped standardizing the market. Thirdly, the stronger government's role has also helped the development of Chinese stock markets.

The results of A-share markets' ratio of system risk to total risk are shown in Figure 2 and 3. It can be seen that the system risk of both A-share markets always reached the lowest point in April every year, comparing to other months each year. The main reason for this is that domestic investors start to realize the importance of analyzing and value companies' performance in investing. Therefore, since the annual reports, which mostly come out in April each year, are the most useful and accurate companies' information sources, and investments in the stock market are more rational than other months, system risks then reached the lowest point every year. This evidence also reflects the development of Chinese stock market.

The results of B-share markets' ratio of system risk to total risk are shown in Figure 4 and 5. It can be seen that the system risk of B-share market has significantly changed since the second half of 1996. The system risk of Shanghai B share market was quite low before Dec, 1996 which average value was only 22.93%, while Shenzhen B-share market (before Jun. 1996) average system risk value was 13.42%. These values were quite near to the 10% to 30% ratio from the developed countries, such as USA, UK, and Canada. However, the system risk of Shanghai B-share market has greatly increased to average value of 41.16% after Dec, 1996. Similarly, after Jun. 1996, the average value of system risk in Shenzhen B-share market rise to 43.95%. At the same period, the system risk average values of A-share markets are quite close to the B-share markets values. (Average value for Shanghai A-share market was 38.04%; and the average value for Shenzhen A-share market was 36.52%)

There are several reasons for the significant change of system risks of B-share markets after 1997. First of all, the weaknesses of B-share markets started to show, which include the small market size, weak liquidity, much lower rate of return than A-share markets. Until the end of 2000, the total market capitalization of B share markets is only 3.2% of A-share markets. This small market size directly causes the weak market liquidity. In addition, the limited information flaw and bad performance of most B-share listed companies also prevent foreign investors from investing in B-share market. Secondly, before 1997, the major players of B-share market were foreign institution investors who used to invest in the value of listed companies for a long term. Therefore, the system risk of B-share market in China was quite close to the international markets during that period. However, since more and more domestic investors invested in the B-share markets after 1997, the system risk began to increase to the A-share markets level. Thirdly, the appearance and developed substitute stock markets for domestic companies to raise capitals overseas, such as Hong Kong stock market and US stock market, has weakened B-share markets position. Finally, the east-south Asia financial crisis in 1997 caused a large amount of foreign capitals leave to the more stable European and North American markets.

Figure 4: Shanghai B share market system risk monthly result (1993 ? 2001)

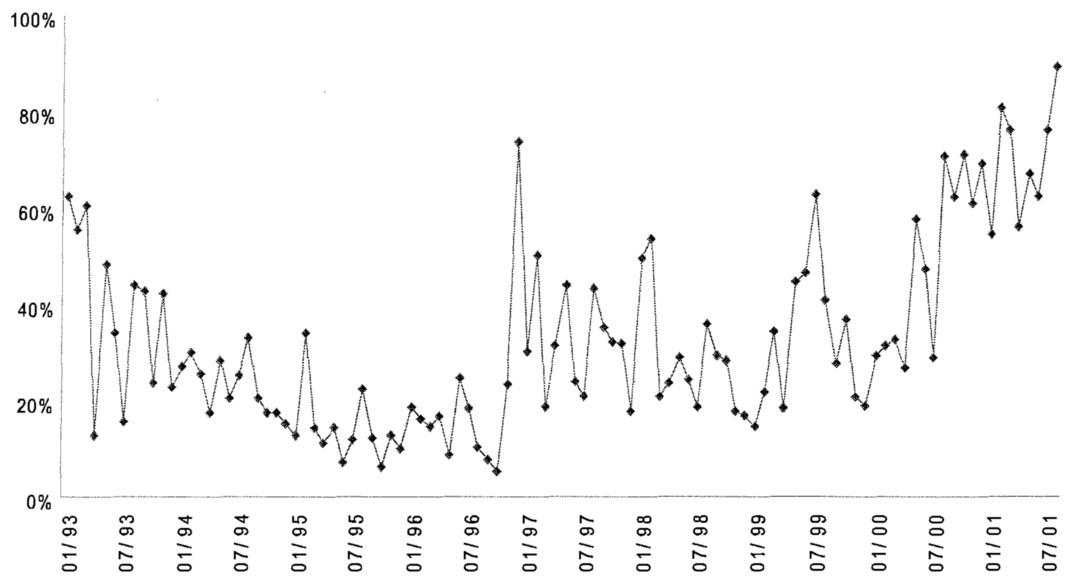
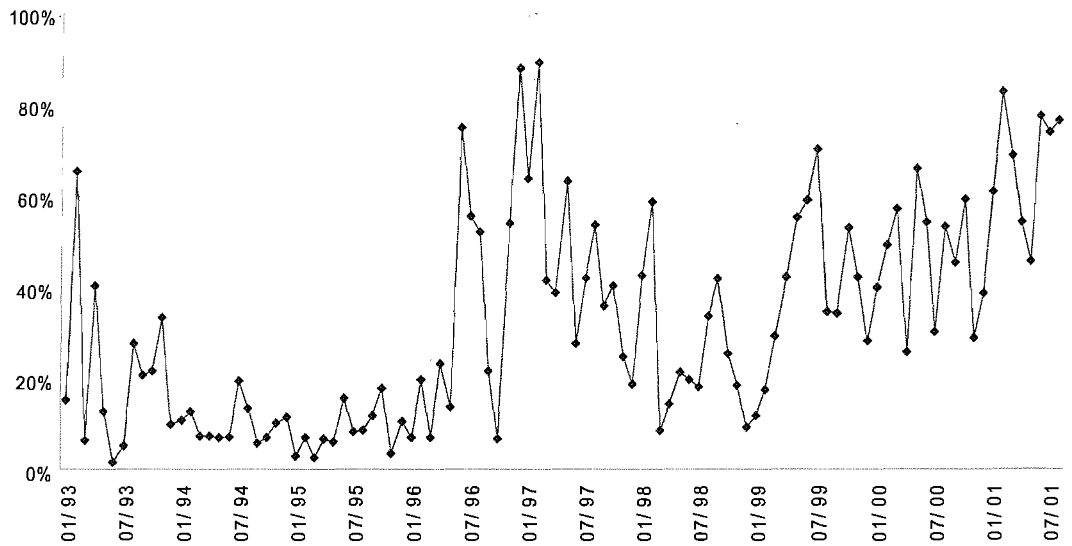


Figure 5: Shenzhen B share market system risk monthly result (1993 ? 2001)



5.2 Cointegration test results (test for hypothesis 1)

The first step is to check for stationarity by using standard Augmented Dickey-Fuller (ADF) unit root tests.

Table 1: Unit Root Test Results

x_t	a_t	b_t	c_t	d_t	Δa_t	Δb_t	Δc_t	Δd_t
ADF Test	-1.086	-0.915	0.732	-0.590	-6.205	-8.506	-5.289	-8.464
DW Test	2.017	1.997	1.947	2.029	2.019	1.999	1.939	2.037
R^2	0.240	0.336	0.316	0.162	0.718	0.769	0.760	0.679
Number of lags	5	4	6	3	4	3	5	2
1% Critical	-2.587	-2.587	-2.587	-2.587	-2.587	-2.587	-2.587	-2.587
5% Critical	-1.943	-1.943	-1.943	-1.943	-1.943	-1.943	-1.943	-1.943

In table 1, a_t、b_t、c_t、d_t represent the system risk ratio of Shanghai A-share market, Shenzhen A-share market, Shanghai B-share market and Shenzhen B-share market, respectively. Δa_t、Δb_t、Δc_t、Δd_t are their correspondent one unit change value. The results indicate that in no case we can reject the null hypothesis that a_t、b_t、c_t、d_t contain a unit root at the 5 percent level. However, the null of a unit root in Δa_t、Δb_t、Δc_t、Δd_t can be rejected at the 1 percent level. Therefore, the four time series a_t、b_t、c_t、d_t are non-stationary, while their one unit change values are stationary.

We firstly test for cointegration between system risks of Shanghai A-share and Shenzhen A-share markets by using Engle-Granger test. The following regression equivalent was obtained:

$$a_t = 1.0116 b_t$$

t value is 41.208, R^2=0.594 , DW=1.398

The results for testing whether the residual s_t is stationary by using ADF test are as following:

$$\Delta s_t = -0.462 s_{t-1} - 0.349 \Delta s_{t-1} - 0.127 \Delta s_{t-2} - 0.075 \Delta s_{t-3} - 0.113 \Delta s_{t-4}$$

ADF value is -3.179 , $R^2 = 0.418$, $DW = 1.952$

Then the null hypothesis of a unit root in the residual s_t is rejected (-1.943) at the 5 percent level. Therefore, we conclude that the system risks of Shanghai A-share market and Shenzhen A share market are cointegrated.

Similarly, we also test the cointegration between the system risks of Shanghai B-share and Shenzhen B-share markets, Shanghai A-share and Shanghai B-share markets, Shenzhen A-share and Shenzhen B-share markets, respectively.

For Shanghai B-share and Shenzhen B-share markets, the regression model is:

$$c_t = 0.873 d_t$$

t-value = 20.717 , R^2=0.261 , DW=1.044

and the ADF test result for s_t is

$$\Delta s_t = -0.201 s_{t-1} - 0.379 \Delta s_{t-1} - 0.219 \Delta s_{t-2} - 0.057 \Delta s_{t-3} - 0.081 \Delta s_{t-4}$$

ADF value = -2.302 , $R^2 = 0.284$, $DW = 2.056$

Therefore, the system risks of Shanghai B-share market and Shenzhen B-share market are cointegrated as the null of a unit root in s_t is rejected at 5 percent level (-1.943).

Then the cointegration test result for Shanghai A-share and B-share markets are:

$$a_t = 1.093 c_t$$

t value = 11.911 , R^2=0.215 , DW=0.294

in addition,

$$\Delta s_t = -0.063 s_{t-1} - 0.471 \Delta s_{t-1} - 0.219 \Delta s_{t-2} - 0.130 \Delta s_{t-3}$$

ADF value = -1.231 , $R^2 = 0.237$, $DW = 2.014$

And the conclusion is that there is no cointegration between the system risk of Shanghai A share and B-share markets.

Finally, we concluded that the system risks between Shenzhen A-share and B-share markets are not cointegrated according to the following cointegration results:

$$b_t = 0.891 d_t$$

t value is 9.029 , R^2=0.287 , DW=0.427

$$\Delta s_t = -0.084 s_{t-1} - 0.547 \Delta s_{t-1} - 0.231 \Delta s_{t-2} - 0.328 \Delta s_{t-3} - 0.229 \Delta s_{t-4} - 0.159 \Delta s_{t-5}$$

ADF value = -1.457 , $R^2 = 0.349$, $DW = 2.074$

Table 2: Co-integration Test Result

	Shanghai A Share	Shenzhen B Share
Shenzhen A Share	Co-integrated	Non co-integrated
Shanghai B Share	Non co-integrated	Co-integrated

To sum up, it shows in the table 2 that cointegration is accepted for the system risks between Shanghai A-share and Shenzhen A-share markets, the system risks between Shanghai B-share and Shenzhen B-share markets. This indicates that the two A-share markets and the two B-share markets are very closely related. However, the cointegration is rejected for the system risks between Shanghai A-share and B-share markets, and between Shenzhen A-share and B-share markets. Therefore, by some extent, China A-share and B-share markets are segmented

5.3 Granger causality test results (test for hypothesis 2)

Table 3: Granger causality Test Result

	H_0	Lags	F value	P value	Result
a_t to b_t	b_t does not Granger Cause a_t	1	0.413	0.522	$a_t \rightarrow b_t$
	a_t does not Granger Cause b_t		10.069	0.002	
c_t to d_t	d_t does not Granger Cause c_t	2	4.609	0.012	$d_t \rightarrow c_t$
	c_t does not Granger Cause d_t		0.008	0.992	
a_t to c_t	c_t does not Granger Cause a_t	1	7.099	0.009	$a_t \leftrightarrow c_t$
	a_t does not Granger Cause c_t		6.816	0.010	
b_t to d_t	d_t does not Granger Cause b_t	2	4.375	0.015	$b_t \leftrightarrow d_t$
	b_t does not Granger Cause d_t		3.913	0.023	

Our Granger – causality results show that the system risk of Shanghai A-share market Granger-cause the Shenzhen A-share market. However, the Shenzhen A-share market's system risk does not Granger-cause the Shanghai A-share market. In other words, the Granger causality runs one-way from Shanghai A-share market to Shenzhen A-share market and not the other way. This result is intuitive and consistent with the observed reality since shanghai A-share market is bigger than Shenzhen A-share market in terms of market size, the number of listed companies and market capital. Table 3 also shows that the system risk of Shenzhen B-share market Granger-cause the Shanghai B-share market, but not the other way. Therefore, we can conclude that in some extent, there exists market segmentation between Chinese A-share and B-share markets. However, since the results also indicates that the Granger causality runs two-way between either Shanghai A-share market and Shanghai B-share market, or Shenzhen A-share and B-share markets. This two way Granger causality makes us difficult to say whether the stock markets are segmented.

VI Conclusion

There are several unique features in Chinese equity market and segmentation is one of the most prominent. In China, foreign investors can only trade in foreign (B or H) shares and domestic investors only in A shares. This paper is to identify the long term trend and co-integrations between A and B shares' system risks by using Co-integration test and Granger causality test methods. In this paper, we use a panel of data includes 100 A Share listing companies and all B share listing companies in two stock exchanges in China (1993 to 2001) to investigate the issue.

Our results showed that while the system risk of B-share market has increased from the lower international level to the higher A share market level, the downward trend in system risk of A-share market is quite obvious due to the much less political risk impact on share price, especially after 1997. the cointegration results indicate that the system risks between Shanghai A-share and Shenzhen A-share markets, the system risks between Shanghai B-share and Shenzhen B-share markets are cointegrated, respectively. This indicates that the two A-share markets and the two B-share markets are very closely related. However, the cointegration is rejected for the system risks between Shanghai A-share and B-share markets, and between Shenzhen A-share and B-share markets. Therefore, by some extent, China A-share and B-share markets are segmented.

In addition, our Granger causality result shows that in terms of system risk, there exists causal relationship between A-shares in SHSE and in SZSE. However, although causal relationship also found in B-shares between two stock exchanges, the transmission direction is opposite to A-share's. The main reasons are the differences in market scale and sensitivity between A-share and B-share markets. This also reflects the two markets are segmented.

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Chapter Five: Conclusion and Summary

The thesis has investigated market segmentation phenomenon in China capital market. The first part of this thesis uses a panel of data includes all publicly listed companies in two stock exchanges in China (1995 to 2000) to investigate the regional effects on companies' decisions on where to list. We find that, overall, regional factors do significantly affect the companies' choice between the stock exchanges. The geographical factor we are aware of has greater impact on the decision than other macro factors. In our analysis, the inadequacy of legal infrastructure in some area rendering the analysis of more complicated. The special effort has been made to specially deal with this problem.

The second part of thesis analysis the effectiveness of price limits by using evidence from Shanghai and Shenzhen stock market. The effectiveness of price limits as means to control excessive volatility has long been a controversial issue. The unique situation in the Chinese stock exchanges (Shanghai and Shenzhen) where price limits have been imposed twice and lifted once in the 1990's enables us to investigate the effectiveness of the mechanism empirically by comparing returns and volatility changes in the three periods. Our results show that in the first period (Dec. 90 – May 92) when +1% and -5% limits are imposed, excessive volatility is partially controlled, but delay is incurred in reaching equilibrium price and distortion appears in the return distribution. In the second period up to December 1996 when the price limits are lifted, volatility increases noticeably accompanied with considerable reduction in skewness and excess kurtosis, indicating less distortion in return distribution and an equilibrium being reached. Finally, in the third period up to November 2002, when ±10% price limits are in place, we find that skewness and excess kurtosis remain the same as those in the second period, both being considerable lower than those in the first period. The effectiveness of the ±10% limits in this period has not been supported by empirical evidence. We have adopted a cointegration analysis to assess the effects of price limits. An EGARCH model shows that the restriction in the third period has insignificant effects. The unconditional volatilities are the same in the first and third periods after an increase in the second period. From this evidence we argue that the equilibrium reached in the second period in the absence of price limits becomes more stable in the third period where the nominal price limits has insignificant effects.

The third part of thesis investigates the long term trend and co-integrations between A and B shares' system risks. This issue has not been adequately investigated in the literature, In this paper, Co-integration test and Granger causality test methods were used. Our results show that, while the downward trend in system risk of A-share market is quite obvious due to the much less political risk impact on the share price, the system risk of B-share market has increased, especially after 1997. In addition, our Granger causality result shows that in terms of system risk, there exists causal relationship between A-shares in SHSE and in SZSE. However, although causal relationship also found in B-shares between two stock exchanges, the transmission direction is opposite to A-share's. The main reasons are the differences in market scale and sensitivity between A-share and B-share markets. From this evidence we argue that the two markets are segmented.