# Taming the Dragon: The Modernization of the Chinese Equity Markets and its Effects on IPO Underpricing

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**ABSTRACT**

The extreme underpricing of Chinese Initial Public Offerings in the early days of the Chinese equity markets was reduced by several reforms instituted by the Chinese government from around 2000 to 2002. These reforms reduced 1-day returns on IPOs from 295% to 72%. The reforms reduced IPO underpricing by decreasing the inequality between IPO supply and demand. These reforms, while announced between 2000 and 2002, likely took until around 2004 to take full effect. In addition to inequality between supply and demand, other factors such as information asymmetry and government/quality signaling contributed to underpricing both before and after the reforms.

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## I. Introduction

The People's Republic of China (PRC), commonly known as "Mainland China" or just "China," has, in the past thirty years, experienced one of the fastest, largest, and most transformative industrializations in human history. China's incredible transformation began in 1979, with the "Reform and Opening Up" initiated by communist leader Deng Xiaoping, following which China's economy began to expand at an unprecedented pace. China's phenomenal economic growth over the past few decades and the accompanying gains in political power, aside from lifting hundreds of millions out of poverty and improving the quality of life for many of China's people, have catapulted China and its economy to "superpower" status, its political and economic clout challenged by only the United States and perhaps the European Union.

As China's economy has continued to grow and become more open to foreign trade and commerce, China's role in the global economy has continued to expand, and, along with it, the importance to foreign countries and businesses of understanding how China's economy is structured and how it functions. While China's economy is immense, multifaceted, and constantly evolving, and it could take years of study to fully grasp its inner workings, one part of the economy that plays an extremely important role in its functioning is China's equity (or stock) market. China's stock markets were formed only twenty-one years ago, in 1990 (Mok and Hui, 1998), but in the short time since their formation, they have become some of the most attractive and heavily examined markets in the financial world.

China's equity markets are located on two exchanges, the larger one in Shanghai, known as the Shanghai Stock Exchange (SSE), and the smaller one in Shenzhen, known as the Shenzhen Stock Exchange (SZSE). Both stock exchanges have exploded since their formation in

1990; the Shanghai Stock Exchange now has over 800 companies listed with a market capitalization (total value of the shares of all companies traded) of US$ 2.8 trillion. The Shenzhen Stock Exchange now has over 1,000 companies listed with a market capitalization of around US$ 1.2 trillion ("Monthly Statistics", 2010). In addition to the massive size of the markets themselves, China's stock markets are also drawing an unprecedented level of investor participation. China's markets "involve more investors than any other market in the world," with around "124 million brokerage accounts" (Xie, 2010). At times, the markets have also been some of the world's fastest growing. In a two-year time span from 2005 to 2007, the market capitalization of China's stock markets jumped from 3 trillion yuan (or Renminbi, both names of the currency of China) to 21 trillion yuan, a jump of 700% ("Explosive Growth", 2007). While this extraordinarily rapid pace of growth has since cooled, enthusiasm for the Chinese equity markets remains stronger than ever, and the markets will likely remain a popular area of study for years to come.

Within the many interesting aspects of the Chinese equity markets, this study focuses on Initial Public Offerings (IPOs), the process by which a stock is first listed on either the Shenzhen or the Shanghai Stock Exchange. An IPO is the name given to the first set of shares or equity (i.e. part ownership in the company) issued by a company to the public. After the IPO occurs, the company will be officially "listed" on one of the exchanges. Given the importance of IPOs to the functioning of the global capital markets, much research in the past has been done on the pricing, performance, and effects of IPOs. One phenomenon that has been consistently recorded and documented across IPO markets globally has been the phenomenon of IPO underpricing. IPO underpricing is essentially defined as "a large positive gain of a new issue immediately after flotation" (Chi and Padgett, 2005), and it has been noted in numerous markets around the globe

throughout various time periods, to the point that it is considered "one of the 10 puzzles of financial research" (Brealey and Myers, 1991). Previous studies on IPO underpricing in various markets have found underpricing of a few percent among 38 US Investment Banks (Muscarella and Vetsuypens, 1989), while other studies have found underpricing of 48% in the U.S. over specific time periods (Ritter, 1984). In Asia specifically, underpricing of 149.3% has been recorded in Malaysia (Hanley and Ritter, 1992), and underpricing has been found in numerous other Asian markets (Mok and Hui, 1998).

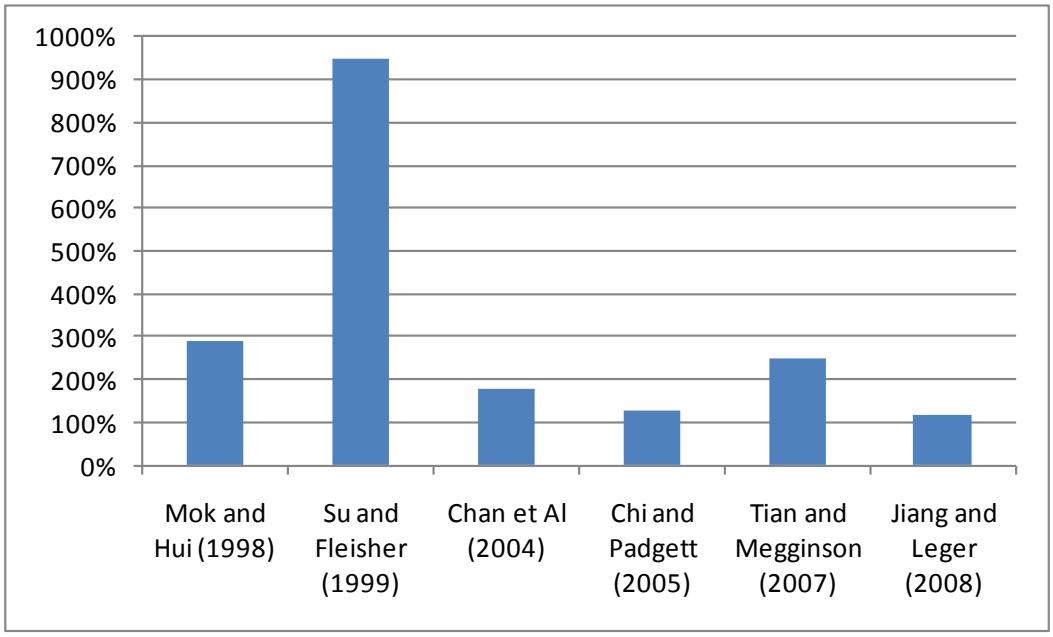
In addition to these studies on general underpricing, several previous studies, which will be discussed shortly, have specifically documented severe IPO underpricing in the Chinese markets. This underpricing rivals some of the most severe underpricing ever recorded anywhere in the world, and previous studies have postulated that this extraordinary underpricing is caused by a number of "Chinese characteristics" that differentiate Chinese equity and stock markets from markets anywhere else in the world. While previous studies have done an excellent job of measuring underpricing in Chinese markets and exploring the different "Chinese characteristics" that contribute to this underpricing, the main shortcoming of these studies is that they are, for the most part, relatively static studies. They fail to really take into account many of the major changes that have occurred in the structure and functioning of China's equity markets since their formation in 1990. My study contributes to the previous literature by studying how certain key changes in China's equity markets affected the severity and causes of IPO underpricing. In particular, I look at the effects of two major changes that occurred in an "era of reform" that occurred between 2000 and 2002. These reforms, which will be discussed in detail later, had the general effect of making the stock markets more "open," i.e. taking some of the control of the markets from the government and giving it to private companies and investors. In general, my

study suggests that these liberalizing reforms, which make China's equity markets more similar to American markets and other, freer markets, had the effect of lowering Chinese IPO underpricing, bringing it more in line with the level of underpricing that routinely occurs in developed markets worldwide.

## II. Literature Review and Theoretical Framework

Although the studies noted above show that underpricing is a global phenomenon, arguably the most severe underpricing in the world has been recorded in China in the past two decades since the 1990 formation of China's stock markets. In the past 20 years, there have been several studies that have examined the underpricing phenomenon in Chinese markets, recording an average degree of underpricing that exceeds what has been recorded in almost any other market. Mok and Hui (1998) performed the first significant analysis of underpricing in Chinese IPO markets, finding average underpricing of 289% among A-shares (domestically-trades shares) traded on the Shanghai stock exchange from 1992-1994. Su and Fleisher (1999) found that IPO underpricing in the early years of the Chinese stock exchanges reached to as high as 948.59%. Slightly later studies, such as the Chan et al. study (2004) and the Chi and Padgett study (2005) find a slightly lower, yet still extraordinarily high, level of underpricing, with average underpricing finds of 178% and 129.16%, respectively. In addition, the most recent studies, including the Tian and Megginson study (2007) and the Jiang and Leger study (2008), found underpricing of 247% and 117.48%, respectively. All of these studies show a general range of underpricing somewhere between 100% and 300% ranging from the formation of the Chinese stock exchanges in 1990 all the way up to the early 2000s, where most of the datasets used by these studies end. Figure 1 provides an overview of the degree of underpricing measured in each study.

*Figure 1: Chinese IPO Underpricing as Measured in Previous Studies*




Although the findings of these studies regarding the basis for such severe underpricing are certainly not uniform, the authors do agree on a certain number of "Chinese Characteristics" that set apart Chinese equity markets from equity markets elsewhere in the world; these "Chinese Characteristics" play important roles in Chinese IPO underpricing. The first of these characteristics is the segmentation of the equity market into "A-shares" and "B-shares." A-shares are traded in Yuan (Renminbi), the local currency of China, and are only available to domestic investors. B-shares, on the other hand, are issued in U.S. dollars and are only available for foreign investment (Mok and Hui, 1998). There have been some efforts to make A- shares available to certain foreign institutional investors (Wan, 2009), as well as efforts to allow domestic Chinese to buy B-shares ("China Stocks", 2010), but the bifurcation into A-shares and B-shares remains an important and influential characteristic of the Chinese equity markets. A second "Chinese Characteristic" that may play a role in IPO underpricing is high equity retention by the Chinese government. In fact, at the end of 2000, only about 35.7% of total shares were

tradable in the open market, with the rest being retained by the state (Chi and Padgett, 2005). A third characteristic involves the manner in which companies are selected for IPOs. In a mechanism that is unique to the Chinese market, an annual quota for new shares to be issued each year is actually set by the China Securities Regulatory Commission (CSRC) (Chi and Padgett, 2005). The manner in which this quota is determined has changed over the years and is one of the factors contributing to my research, which will be discussed shortly. A fourth characteristic deals with the manner in which IPO shares are distributed to potential investors. Rather than being carried out solely by investment banks, IPO shares in China are distributed via a lottery system, with random selection occurring to determine which investors are allocated IPO shares (Chi and Padgett, 2005). The manner in which the lottery has functioned has also changed over the years and is another factor contributing to my report. Finally, it is worth noting that the Chinese government is by far the largest issuer of IPOs in China, constituting between 66-88% of issuances (Tian and Megginson, 2007).

While the authors of these several studies do not reach a consensus on the exact factors behind China's severe IPO underpricing, the factors that they propose can be sorted into three broad groups: inequality between IPO supply/demand, information asymmetry, and quality signaling to investors. Inequality between IPO supply/demand is probably one of the most compelling proposed reasons for severe IPO underpricing, and such inequality is exacerbated by the "Chinese Characteristics" of a yearly IPO quota and an IPO lottery allocation system. The fact that the CSRC places a yearly quota on the number of IPOs that can be issued means that there is generally overwhelming demand for the small number of IPOs that are issued per year. On top of this, the lottery system means that only a small number of investors who want to buy IPO shares will actually be allocated the shares. Both of these factors contribute to a large

number of investors being left out, unable to obtain shares in many IPOs in which they wish to take part (Chi and Padgett, 2005). Because demand for IPOs exceeds supply by such a great deal, this causes the stock price to balloon upward in the first few days after flotation as those investors who were left out of the initial allocation try their best to get a share of the IPO as soon as possible. Mok and Hui (1998) detected a large amount of share turnover during the first five days after a share is floated, which supports the idea that this process is indeed occurring, as "flippers" quickly buy and sell shares of the IPO in the attempt to make a quick profit. As in any form of speculation, this process of "flipping" exacerbates the problem even further and contributes to the severe underpricing.

The second factor that contributes to IPO underpricing in China is information asymmetry between the IPO issuer (generally the Chinese government) and the IPO investors. Essentially, because the government/issuer has so much more information about the company than the investors (and full disclosure is not as required or enforced as in America or Europe), the investors must be compensated for taking on the additional risk that comes with investing in a company about which not everything is known. Because information asymmetry may be somewhat difficult to measure, several of the studies use proxy variables for asymmetry, such as the percentage of the share issuance that is retained by the government (Chi and Padgett, 2005).

A third factor that contributes to Chinese IPO underpricing is the government/quality signaling hypothesis. Essentially, this theory holds that by underpricing an IPO, issuers are sending positive signals about the quality of the issuing firm. This occurs because investors reason that only firms of good quality and solid financial standing could afford the increased costs that come with underpricing an IPO, the largest of which is the opportunity cost of all of the money left on the table that the firm could have raised if they had priced the IPO higher. On

the other hand, firms of poor quality or questionable financial standing could not afford to leave money on the table and thus would try to price the IPO higher and avoid underpricing (Chi and Padgett, 2005).

While the previous studies have done an excellent job of identifying the existence of severe underpricing in Chinese IPO markets, as well as beginning to distill some of the key possible causes behind this underpricing, there are a few shortcomings of these studies when it comes to attempting to fully and accurately analyze the Chinese IPO markets. The first of these shortcomings is that many of the studies are simply not up to date. Most of the studies do not cover data extending further than the year 2001, and the most up-to-date study only goes up to 2004. This leaves a gap of 7 years since the last data has been included in a study of any sort. The second shortcoming, which occurs primarily as a result of the first, is the fact that few of the studies deal with any of the systemic changes that have occurred in the Chinese IPO markets since the year 2000. There have been several of these major changes that could potentially have enormous effects on the IPO markets, but of the studies that cover Chinese IPO markets, only the Jiang and Leger (2008) study looks at the effects of a particular regulatory change.

Given these shortcomings, my study makes a significant and distinct contribution to the existing IPO literature by providing an updated IPO underpricing study that focuses on the effects of two major systemic changes that occurred in the early 2000s. The first of these major changes occurred in 2001 with the abolition of the quota system, which set a limit to the number of companies that could issue IPOs in a given year. Under the quota system, the quota number would be announced each year by the CSRC, and all of the government ministries, provinces, and municipalities had to compete for the allocation of issuances, which they would, in turn, distribute to companies that they believed should go public (Tian and Megginson, 2007). In

essence, the government controlled the entire process that determined what companies would go public and when, with little input from the private sector. Obviously, this system was inefficient in many ways and may have contributed to the disparity between IPO supply and demand. However, in 2001, an authorization system was put in place of the previous quota system. Under this system, the investment banks participate much more directly in determining which companies go public and when; however, the CSRC must still "authorize" or approve any company recommended by the banks to go public (Tian and Megginson, 2007). It is reasonable to estimate that greater input of the investment banks in the IPO process would take greater account of investor demand, thereby reducing the disparity between supply and demand, which would in turn reduce underpricing.

The second major change occurred in 2002 with the alteration of the lottery mechanism that allocates IPO shares to potential investors. Prior to the change that occurred in May of 2002, the probability of winning the lottery had simply depended on the money spent on the subscription. However, in May 2002, the lottery mechanism was altered to allocate shares based on the "market value of investors' tradable shareholdings" (Jiang and Leger, 2008). Essentially, the more the existing shareholding held by an investor, the higher the probability of that investor winning the lottery. According to Jiang and Leger (2008), this change in regulation had a mixed reception from the financial community. While some claimed the reform "was beneficial to small investors" and helped the "stability of the market," others claimed that it had a "failure to motivate institutional investors" (Jiang and Leger, 2008). Jiang and Leger provided a rather compelling explanation for why such a reform may actually have helped to reduced underpricing. They claim that, prior to the reform, when one's chance of winning depended on the money spent on the subscription, in order to have a shot at winning an investor would have to put in a

large amount on the subscription. This money would then be tied up for a gap that could last up to several months, and they would lose out on the chance to use these funds for other purposes, such as purchasing stocks in the secondary markets. Essentially, investors would only put in a subscription for IPO shares if "they are convinced that the opportunity cost will be paid off" (Jiang and Leger, 2008). This led to many investors who would otherwise have put in an order for shares waiting to purchase shares in the secondary market, causing a sharp rise in the price during the first few days of aftermarket trading. On the other hand, once the reform was put in place, investors no longer had to lock up significant funds just for a chance at getting a piece of the IPO; in essence, attempting to subscribe to the IPO simply became less risky. Thus, investors who were truly interested in the IPO could place bids for shares rather than waiting to buy in the aftermarket. Ideally, this would give issuers a better idea of the demand for their IPO shares and reduce underpricing (Jiang and Leger, 2008).

My study analyzes IPO performance on either side of these "breaks," using two different methodologies. In the first methodology, I define the "era of reform" as occurring from 2000 to 2002, the time period during which the two major market reforms were being considered and implemented. I then analyze IPO underpricing for Shanghai A-share IPOs during three periods: 1993-2009, the "overall" period consisting of data from before, after, and during the reforms; 1993-1999, the period before the "era of reform," and 2003-2009, the period after the era of reform. In each of these periods, I first measure the mean and median magnitude of IPO underpricing. I then utilize a series of regressions to determine the effects of different factors (each falling into the three categories discussed previously – inequality between supply and demand, information asymmetry, and government/quality signaling) on IPO underpricing in each period. A second, more complex methodology uses a likelihood model to take an "agnostic"

view towards these breaks, using the data itself to determine when exactly the break occurred, perhaps even matching it up with one of the two key changes to imply that that change actually played a more significant role in influencing underpricing in the Chinese IPO markets.

The goal of my analysis of IPO performance on either side of the "era of reform" is twofold. The first goal is simply to see whether or not there was a significant change in IPO underpricing when looking at underpricing before and after the break. Measuring this goal is accomplished by using similar methods for underpricing measurement that were used in previous studies, adjusted to measure equities issued on either side of this "era of reform." The second goal is to see how much of a role each of the three proposed contributing factors to underpricing (inequality between supply/demand, information asymmetry, government and quality signaling) play in the underpricing of Chinese equities before and after the break, and whether the break causes any significant change in the relative importance of these three factors. For example, I hope to find out whether information asymmetry plays a similar role in underpricing on both sides of the break or whether government reforms made it more or less significant in terms of its contribution to underpricing. I hope to make a similar discovery regarding each of the three factors.

It is clear from looking at the two major changes that occurred during this "era of reform" that the underpricing factor most affected by these reforms is the inequality between supply and demand. Both the first reform, which deals with the elimination of the quota system, and the second reform, which changes the lottery system by which investors are allocated IPO shares, should theoretically cause supply and demand to match up much more effectively. Thus, as far as my first goal of whether there will be a significant change after the "era of reform," it seems

reasonable to expect that, with more accurate measures of supply and demand, IPO underpricing should decrease after the break.

As far as goal two is concerned, it seems obvious that the first factor, inequality between supply and demand, should decrease in contribution to underpricing after the break because most of the reforms implemented during the "era of reform" deal with resolving the inequality between supply and demand. However, it should definitely not be ruled out that these reforms might have affected the other factors in less obvious ways. For example, it is certainly conceivable that many investors could see any act of liberalization in the markets as a sign that the government is becoming less involved and that companies are becoming more and more transparent. Thus, there may certainly be some effects on the information asymmetry factor as well. Theoretically, one could predict that the liberalizing of the markets reduces the information asymmetry between buyer and seller, thus reducing underpricing because investors don't have to be compensated as much for an IPO with less information asymmetry. Such liberalizing effects might also extend to the government/quality signaling hypothesis. With the process of IPO pricing and distribution more liberalized, one could argue that investors would have more information on the quality of companies, requiring less signaling by the company or the government. This would also cause the government/quality signaling factor to become less significant after the break. One could imagine a number of possible secondary effects in addition to the examples provided, affecting all three major factors; this makes it difficult to make an exact prediction regarding the relative significance of each of the three factors before and after the break. Yet it is clear that the theory predicts a decrease in underpricing after the break, with each of the three factors declining in significance, at least in absolute terms.

## III. Data and Underpricing Calculations

The original data consisted of all 868 A-share IPOs listed on the Shanghai Stock Exchange (SSE) from its inception to the present day. However, because of a lack of specific data for a number of the IPOs, the original sample was reduced to a smaller sample of 422 A-share IPOs. The IPOs for which the data is missing do not appear to be grouped in a similar industry; thus, the existing sample is probably not biased by the missing data. As in previous studies of Chinese IPOs, I looked specifically at the Shanghai Stock Exchange rather than the Shenzhen Stock Exchange or both exchanges together. The justification that Mok and Hui (1998) use in their looking only at the Shanghai Stock Exchange is that Shanghai, rather than Shenzhen, is the financial hub of China and that the Shanghai Stock Exchange, at the time of their study, had a market capitalization over twice as large as the Shenzhen Stock Exchange. Presently, this distinction still applies to the two markets, as the Shanghai Stock Exchange had a market capitalization in October 2010 of USD $2.8 trillion compared to the Shenzhen Stock Exchange's market capitalization of around USD $1.2 trillion ("Monthly Statistics", 2010). Additionally, I decided based on previous studies of Chinese equities to just focus on A-shares rather than A-shares and B-shares. Chi and Padgett (2005) claim that looking only at A-shares is common practice in studies of the Chinese equity markets because the A-share market is much larger and more liquid than the B-share market.

Underpricing data serves as the dependent variable in the study and was calculated in a relatively simple manner, using a similar method to that used by Mok and Hui (1998). To calculate underpricing, Mok and Hui use a "raw price relative" to calculate underpricing of an individual IPO; they then find the mean of all the raw price relatives to get the "average price relative." They then adjust each of the price relatives to changes in the market over that same

time period to determine the "market-adjusted price relative" and finally average these relatives to determine the "market-adjusted average price relative." My measures differ from Mok and Hui in that I looked at each of these statistics over 1-day, 5-day, 10-day, and 20-day periods, while Mok and Hui only looked at these statistics for one day. One key consideration to keep in mind for all of the following calculations is that, for the initial offering price of the IPO, the split-adjusted price, rather than the original price, must be used. This is because all of the price series data provided by Datastream has been automatically adjusted for splits, so using the original rather than the split-adjusted price leads to inaccurate results.

The price relative for an individual equity is very simple to calculate; it is simply the percent change of the closing price after a given period of time over the original IPO offering price. Thus, the 1-day price relative would be calculated as follows:

$$PR1 = \frac{P_1}{P_0}$$

In this equation, $P_1$ is the closing price of the individual equity after the first day of trading, and $P_0$ is the initial offering price of the IPO. Similarly, the 5-day price relative for an individual equity would be:

$$PR5 = \frac{P_5}{P_0}$$

Similar terminology would be used to calculate the 10-day and 20-day price relatives.

In order to calculate average price relatives, I simply took the arithmetic mean of the price relatives for each of the individual stocks. So, for example, the 1-day average price relative would be calculated as:

$$APR1 = \frac{1}{n}\sum_{i=1}^{n}\frac{P_{i1}}{P_{i0}}$$

Where *n* is the total number of IPOs, and *i* represents an individual IPO. The 5-day average price relative looks very similar:

$$APR1 = \frac{1}{n}\sum_{i=1}^{n}\frac{P_{i5}}{P_{i0}}$$

Calculating the market-adjusted underpricing was somewhat trickier than calculating the simple underpricing. In order to calculate market-adjusted underpricing, I downloaded the daily closing prices for the Shanghai Stock Exchange (SSE) Composite Index from Datastream to use as a benchmark off of which to measure market-adjusted underpricing. For each day from the formation of the Shanghai Stock Exchange to present day, I calculated change in price for 1, 5, 10, and 20 days forward. I then matched this data with the dates of each of the 422 IPOs in the dataset, which allowed me to see the change in the SSE Composite Index for 1, 5, 10, and 20 days after each IPO. The market-adjusted price relative was then created simply by subtracting the change in the SSE Composite Index over a 1, 5, 10, or 20 day time period from the change in an individual IPO price over that same time period. For example, the 1-day market-adjusted price relative for a single IPO was calculated as:

$$MPR1 = \left(\frac{P_1}{P_0} - \frac{P_{m1}}{P_{m0}}\right)$$

The market-adjusted price relatives for 5, 10, and 20 days were calculated in the same manner.

Finally, the market-adjusted average price relative was calculated by averaging together the MPRs for each of the 422 IPOs. Thus, the 1-day market-adjusted average price relative was calculated as follows:

$$MAPR1 = \frac{1}{n}\sum_{i=1}^{n} MPR_{i1}$$

The independent variables in the study consist of a number of IPO-specific and company-specific factors for each of the 422 companies included in the study. This data is used in the regressions to determine which factors contributed the most to underpricing.

The independent variables for which data was collected are as follows:

- GAP : measures the time gap between the IPO issue date and the first day of trading
- LOGSIZE: measures log base 10 of the IPO funds raised (number of shares times the offer price) in Renminbi
- EPS: measures an equity's earnings per share in 1st year after offering
- TECH: similar to Chi and Padgett, a dummy for if a company is in a high tech industry, 1 if the industry is high tech and 0 if it is not
- FLOAT: measures the percentage of the equity that is floated, which proxies for government retention of the stock

The actual equities comprising the Shanghai Stock Exchange, the price series data from the first day of trading to present day for each of these equities, and the data for the FLOAT variable were downloaded from the program Datastream. The International Securities Identification Numbers (ISINs) of each of these equities were then recorded, allowing for easier

identification by other software or programs. [1] Data on IPO pricing, date, LOGSIZE, EPS, and TECH were then downloaded by Bloomberg using ISINs, tickers, and manual entry. Both the original and split-adjusted IPO prices were included. Data on the GAP variable was obtained from the SDC Global program.

After the data was collected, it was divided into three groups for purposes of studying IPO underpricing before and after the era of reform. The "overall" group simply consists of data for all 422 IPOs included in the study. The "pre-reform" group consists of data for the 142 IPOs that occurred before the year 2000. The "post-reform" group consists of data for the 136 IPOs that occurred after the year 2002. Table 1 provides a summary of the data collected for the "overall," "pre-reform," and "post-reform" groups:

*Table 1: Summary Statistics*

| | | Adj Day 1 Underpricing | GAP | LOGSIZE | EPS | FLOAT |
|---|---|---|---|---|---|---|
| | **MEAN** | **175.38%** | 29.29 | 8.53 | 0.13 | 68.03% |
| **Entire Sample** | **MEDIAN** | **102.23%** | 21.50 | 8.51 | 0.13 | 63.00% |
| | **MAX** | **7324.53%** | 470.00 | 10.70 | 0.99 | 100.00% |
| | **MIN** | **-53.67%** | 0.00 | 7.31 | -2.06 | 6.00% |
| | **MEAN** | **294.76%** | 39.11 | 8.30 | 0.15 | 53.42% |
| **Pre-Reform** | **MEDIAN** | **107.36%** | 26.00 | 8.29 | 0.15 | 44.00% |
| **(Pre-2000)** | **MAX** | **7324.53%** | 470.00 | 9.60 | 0.70 | 100.00% |
| | **MIN** | **-53.67%** | 2.00 | 7.31 | -0.21 | 6.00% |
| | **MEAN** | **72.22%** | 20.24 | 8.72 | 0.11 | 80.23% |
| **Post-Reform** | **MEDIAN** | **62.05%** | 20.00 | 8.56 | 0.13 | 100.00% |
| **(Post-2002)** | **MAX** | **326.93%** | 33.00 | 10.70 | 0.90 | 100.00% |
| | **MIN** | **-7.37%** | 5.00 | 8.18 | -2.06 | 19.00% |

Because TECH is a binary variable measuring whether or not a company is in a high tech industry, it was not included in the above summary tables. However, the distribution of high tech

[1] An International Securities Identification Numbers (ISIN) is a unique identification numbers for any security traded anywhere throughout the world. An ISIN consists of a country identifier and an alphanumeric ID code within that country.

firms in each of the groups is balanced. A total of 92 high tech firms were included in the data, with 26 firms in the pre-reform group and 32 firms in the post-reform group.

The results show average underpricing in the "overall" group of around 175%, well within the range of all of the previous studies discussed earlier that pegged underpricing at somewhere between 100% and 300%. However, because previous studies looked principally at what I consider the "pre-reform period," a better comparison might be to look at average pre-reform underpricing. The results show average pre-reform underpricing of 295%, which is generally near the high end of the range found by previous studies. The underpricing results for the "pre-reform" and "post-reform" show a significant drop in underpricing after the break, from around 295% before the break all the way to around 72% after the break. The underpricing data for each of the three groups clearly reinforces my hypothesis that the changes that occurred during China's "era of reform" from 2000-2002 reduced the effects of the unique "Chinese Characteristics" that contributed to severe underpricing before the reforms were put in place.

Because the market adjusted data for the most part does not differ significantly from the non-market adjusted data, only the market adjusted underpricing data was included in Table 1. Both the market adjusted data and the non-market adjusted data show a significant decrease in underpricing after the break. Refer to Appendix 1 for a comparison among average Day 1 underpricing with market adjusted data and Non-market adjusted data.

## IV. Empirical Specification / Methodology

The primary empirical tests performed in my study were regressions of IPO underpricing on each of the five dependent variables measured: GAP, LOGSIZE, EPS, TECH, and FLOAT. Each of these five variables is grouped into one of three "factor groups" that have been

determined by past studies to affect Chinese IPO underpricing: (1) Inequality between supply and demand, (2) Information Asymmetry, and (3) Government/quality signaling.

My hypotheses for the directions of the signs on the three independent variables studied are as follows: For the inequality between supply/demand factor group, I expect the sign on GAP to be positive. I expect this result because the old quota and lottery methods of allocating IPO shares, which caused a large discrepancy in the supply of and demand for IPOs, also necessitated a long time lag between the time that investors committed to the IPO and the actual allocation of shares. After the reforms of these two mechanisms in the 2000-2002 period, I expect that the allocation system would more closely resemble other global markets, which generally feature much smaller time lags. Thus, a smaller time lag would be indicative of a reduction in the discrepancy in supply and demand, leading in turn to less underpricing as fewer investors felt the need to buy up the IPO immediately after issuance.

In the information asymmetry factor group, I expect the sign on the LOGSIZE variable to be negative, keeping in mind that LOGSIZE measures the base 10 log of the total amount of funds raised by the IPO. Thus, I expect that the smaller an IPO's size, the greater the underpricing of that IPO. This is because investors likely know less about smaller companies and must be compensated for the risk they are taking on due to this lack of information. I expect the sign on TECH to be positive as well, as high-tech companies are generally more difficult for investors to understand, especially in the developing, convoluted Chinese markets. Because of this difficulty, investors would need to be compensated through underpricing for buying IPOs in a riskier industry rather than other, safer industries. On the other hand, I expect the sign on the FLOAT variable to be negative. A higher flotation percentage implies a smaller percentage of the IPO that is retained by the government. The lower the percentage that is retained by the

government, the lower amount of information asymmetry expected by investors, leading to a lower degree of underpricing. Thus, a higher float would imply lower asymmetry and less underpricing.

Finally, for the government/quality signaling hypothesis, I expect the sign on EPS to be positive. This is because the government/quality signaling hypothesis predicts that higher quality companies will underprice their IPOs in order to signal to investors that they are of high quality; the reasoning involved is that only high quality companies can afford the loss in funds that comes along with underpricing (as underpricing prevents firms from raising maximum capital). Because EPS (to some extent) signals quality, I expect it to be positively correlated with IPO underpricing. The table below summarizes my expectations for the independent variables in the study:

*Table 2: Expected Signs of Independent Variables*

| Factor Group | Variable | Expected Sign |
|---|---|---|
| Ineqaulity Between Supply/Demand | GAP | Positive (+) |
| | LOGSIZE | Negative (-) |
| Information Asymmetry | FLOAT | Negative (-) |
| | TECH | Positive (+) |
| Government/Quality Signaling | EPS | Positive (+) |

With Mean 1-day underpricing as the dependent variable and the three variables above as independent variables, I ran twelve regressions using Stata, each with a different variation of underpricing as the dependent variable, measured with and without heteroskedasticity-robust standard errors. The six dependent variables included were: (1) Non-adjusted overall underpricing, (2) Adjusted overall underpricing, (3) Non-adjusted pre-2000 underpricing, (4) Adjusted pre-2000 underpricing, (5) Non-adjusted post-2002 underpricing, and (6) Adjusted

post-2002 underpricing. Each of these measured with and without an assumption of heteroskedasticity made for twelve regressions.

The general form for the basic regressions without the coefficients is below (with epsilon defined as the error term):

$$Underpricing = \alpha + \beta_1 EPS + \beta_2 LOGSIZE + \beta_3 TECH + \beta_4 FLOAT + \beta_5 GAP + \varepsilon$$

All twelve of the aforementioned regressions were calculated using Stata. Table 3 below is a summary table of the regression results, including the regression coefficients, standard errors, and t-statistics.

*Table 3: Summary and Significance of Regression Coefficients*

| Dependent Variable | Independent Var | Coefficient | Standard Error | T Value | P>t |
|---|---|---|---|---|---|
| | GAP | 0.0350083 | 0.006496 | 5.39 | 0 |
| | TECH | -0.7475199 | 0.5626851 | -1.33 | 0.185 |
| **Overall Adj Underpricing** | FLOAT | 1.693774 | 0.7687306 | 2.2 | 0.028 |
| | EPS | 0.4907455 | 1.053704 | 0.47 | 0.642 |
| | LOGSIZE | -3.945547 | 0.5641518 | -6.99 | 0 |
| | Constant | 33.33681 | 4.75297 | 7.01 | 0 |
| | GAP | 0.0350083 | 0.0100259 | 3.49 | 0.001 |
| | TECH | -0.7475199 | 0.4098373 | -1.82 | 0.069 |
| **Overall Adj Underpricing** | FLOAT | 1.693774 | 1.201177 | 1.41 | 0.159 |
| **(Robust Standard Errors)** | EPS | 0.4907455 | 0.5977971 | 0.82 | 0.412 |
| | LOGSIZE | -3.945547 | 1.553274 | -2.54 | 0.011 |
| | Constant | 33.33681 | 12.92699 | 2.58 | 0.01 |
| | GAP | 0.0371474 | 0.0106386 | 3.49 | 0.001 |
| | TECH | -0.2878768 | 1.61513 | -0.18 | 0.859 |
| **Pre-Reform Adj Underpricing** | FLOAT | 6.604001 | 2.19374 | 3.01 | 0.003 |
| | EPS | 2.363428 | 5.051909 | 0.47 | 0.641 |
| | LOGSIZE | -11.68448 | 1.738892 | -6.72 | 0 |
| | Constant | 94.61037 | 14.29056 | 6.62 | 0 |
| | GAP | 0.0371474 | 0.0056764 | 6.54 | 0 |
| | TECH | -0.2878768 | 0.8183128 | -0.35 | 0.726 |
| **Pre-Reform Adj Underpricing** | FLOAT | 6.604001 | 3.513983 | 1.88 | 0.062 |
| **(Robust Standard Errors)** | EPS | 2.363428 | 4.121409 | 0.57 | 0.567 |
| | LOGSIZE | -11.68448 | 4.000057 | -2.92 | 0.004 |
| | Constant | 94.61037 | 32.15056 | 2.94 | 0.004 |
| | GAP | -0.0162865 | 0.0106231 | -1.53 | 0.128 |
| | TECH | 0.0527335 | 0.1058671 | 0.5 | 0.619 |
| **Post-Reform Adj Underpricing** | FLOAT | -0.6070983 | 0.1622151 | -3.74 | 0 |
| | EPS | 0.2398577 | 0.1604546 | 1.49 | 0.137 |
| | LOGSIZE | -0.3717734 | 0.1052985 | -3.53 | 0.001 |
| | Constant | 4.742031 | 1.068913 | 4.44 | 0 |
| | GAP | -0.0162865 | 0.0116501 | -1.4 | 0.165 |
| | TECH | 0.0527335 | 0.0843367 | 0.63 | 0.533 |
| **Post-Reform Adj Underpricing** | FLOAT | -0.6070983 | 0.2143024 | -2.83 | 0.005 |
| **(Robust Standard Errors)** | EPS | 0.2398577 | 0.1465244 | 1.64 | 0.104 |
| | LOGSIZE | -0.3717734 | 0.0978203 | -3.8 | 0 |
| | Constant | 4.742031 | 1.144401 | 4.14 | 0 |

Additionally, the Table 3 is provided in a larger form in Appendix 1[2].

The results presented in Table 3 above suggest a number of important economic and statistical considerations regarding the absolute and relative contribution of each of the independent variables to IPO underpricing in the overall, pre-reform, and post-reform group. Starting with EPS, the variable that represents the government/quality signaling hypothesis, it can be seen that the magnitude of the coefficient drops from around 2.4 in the pre-reform group

[2] Because the coefficients were very similar for both adjusted and non-adjusted underpricing, Table 3 only provides the coefficients for adjusted underpricing. See Appendix 1 for the coefficients for non-adjusted underpricing.

to around 0.24 in the post-reform group. This means that a $1.00 increase in earnings per share would increase underpricing by 240% in the pre-reform group but would only increase underpricing by 24% in the post-reform group. Recall that the mean magnitude of day-1 underpricing dropped from around 295% in the pre-reform group to 72% in the post-reform group, so some drop in the EPS coefficient certainly makes sense.

Statistically, the EPS coefficients are not significant at the 10% level or better for any of the coefficients in the overall, pre-reform, or post-reform groups. This lack of statistical significance suggests that there is not a very strong correlation between a company's earnings per share and the underpricing of its IPO. Because EPS is the one variable in this study that represents the government/quality signaling hypothesis, this calls into question the assumption that Chinese companies will deliberately underprice IPOs in order to signal to investors that they are high quality companies. Alternatively, it is possible that lower quality companies as well as higher quality companies are both trying to signal to investors that they are of high quality. Lower quality companies may use underpricing as a means to try to "trick" investors into believing that they are of higher quality than they truly are. In order for this to be possible, the opportunity cost of underpricing an IPO in terms of the capital left on the table must be deemed by lower quality companies less significant than the potential increase in interested investors that could be attained by "faking" high quality.

The variables LOGSIZE, TECH, and FLOAT represent the information asymmetry factor. As with EPS, the magnitude of LOGSIZE drops from the pre-reform to the post-reform groups. In the pre-reform group, the LOGSIZE coefficient is around -11.7, while in the post-reform group, it is around -0.4. Recall that the LOGSIZE variable measures not simply the IPO size itself, but rather base 10 log of total funds raised by the IPO in RMB. Thus, the coefficients in

both the pre-reform and post-reform groups suggest that the larger the IPO size, the smaller the magnitude of the underpricing. This finding reinforces my hypothesis, which predicts that investors will generally be able to find less information on smaller firms than they can find on larger, more established firms. Investing in firms without as much available information constitutes an additional risk, for which investors must be compensated by IPO underpricing. As with EPS, the magnitude of the LOGSIZE coefficient dropped from the pre-reform to the post reform. However, unlike EPS, the LOGSIZE coefficients in the basic regressions for the overall, pre-reform, and post-reform are statistically significant to the 1% level. This suggests that an increase in size has a clear decreasing effect on underpricing, no matter if the IPO was issued before, after, or during the break.

The magnitude of the TECH coefficient drops in absolute value as well as switches signs when moving from the pre-reform to post-reform era, changing from around -0.29 in the pre-reform group to around 0.05 in the post-reform group. Recall that TECH is a dummy variable with a value of 1 if the company is in a high tech industry and a value of 0 if the company is not in a high tech industry. Thus, the coefficients imply that in the pre-reform era, a company belonging to a high tech industry experienced average underpricing of 29 percentage points less than a company not belonging to a high tech industry. However, in the post reform era, a company belonging to a high tech industry experienced an increase in underpricing of 5 percentage points compared to a company not belonging to a high tech industry. Interestingly, the coefficient for the overall group actually had a magnitude of -0.75, which is higher in absolute value than the coefficients for either of the two sub-groups. Statistically, none of the TECH coefficients for any of the regressions were significant at the 1% or 5% level. The sign switch that occurs between the pre-reform and the post-reform group, as well as the lack of

statistical significance for any of the TECH coefficients, suggests that a company's status as a high tech company had little impact on the underpricing of that company's IPO, regardless of the time period in which the IPO occurred. My initial hypothesis for the TECH variable expected a positive relationship between a company having "high-tech" status and IPO underpricing because high tech companies are generally more difficult for investors to understand. Because of this, the information asymmetry hypothesis would claim that investors should be compensated for this lack of information. One possible explanation for why the results did not conform to this hypothesis could be that high-tech companies, recognizing that their businesses might be more difficult for investors to understand, are proactive in releasing information to investors above and beyond what is required by the government. Such information would have the effect of leveling the playing field in terms of information asymmetry, thus making a company's "high-tech" status a non-issue.

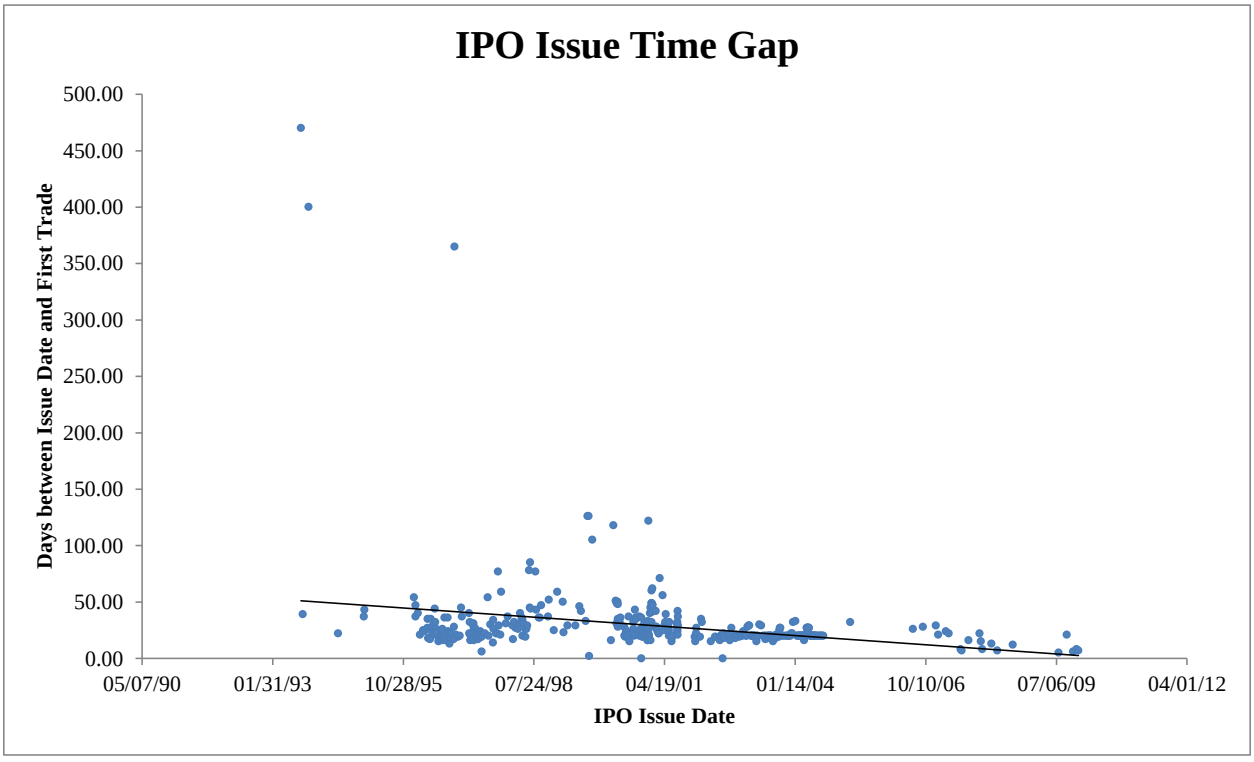
The magnitude of the FLOAT coefficient drops from a value of around 6.6 in the pre-reform era to a value of -0.61 in the post reform era. These coefficients suggest that in the pre-reform era, a 10 percentage point increase in the percentage of the equity floated is associated with an increase underpricing by 66 percentage points. However, in the post-reform era, a 10 percentage point increase in the percentage of equity floated would actually decrease underpricing by 6.1 percentage points. The FLOAT coefficient for the overall group is 1.7 suggesting that a 10 percentage point increase in percentage of equity floated would be associated with a 17 percentage point increase in underpricing. Statistically, the standard regressions for the overall group, pre-reform, and post-reform groups were all significant at either the 1% or the 5% level.

Like the coefficients on the TECH variable, the coefficients on FLOAT were also quite different from what I expected. I expected the coefficients on FLOAT to be negative because a higher percentage of FLOAT implied a lower percentage of equity retained by the Chinese government. A lower percentage of equity retained by the government would imply less information being withheld from investors, less information asymmetry, and a lower degree of underpricing. While the coefficients for the post-reform group were indeed negatively signed, the coefficients for the overall and pre-reform groups were actually positively signed. One possible explanation for this might be that in the pre-reform era, corruption within both the government at large and the IPO allocation and distribution system was so ingrained that government retention of equity could have been taken as a negative signal of the quality of the firm. According to the quality/signaling hypothesis, firms of higher quality are generally underpriced to indicate their high quality to investors. Thus, a higher float percentage (meaning lower equity retention by the government) could have very plausibly resulted in a higher degree rather than a lower degree of underpricing. The reasoning would be that firms with less equity held by the government had likely been able to survive and operate effectively "on their own," without government help, meaning they were higher quality firms and thus should elicit a higher degree of underpricing. This would be a case of the government/quality signaling hypothesis "overpowering" the information asymmetry hypothesis and causing the sign to be positive rather than negative.

Finally, GAP serves as the lone variable representing the inequality between supply/demand hypothesis. Arguably, both the GAP variable and the inequality between supply/demand hypothesis are the factors most affected by the government reforms instituted between 2000 and 2002. Both of the reforms discussed previously, one of which eliminates the quota system and the other of which alters the IPO lottery system, were specifically designed to

create a better match between IPO supply and demand. As discussed earlier, the IPO time gap is directly tied to the IPO allocation system, so I expected both of the reforms to cause a significant reduction in the GAP variable. As Figure 2 shows, this reduction in time GAP is clearly visible when each of the GAP data points is plotted over time:

*Figure 2: Time Gap between IPO Issue Date and First Day of Trading*




Returning to the regression, the coefficients on GAP for both the overall and pre-reform groups were positive, with coefficients of 0.035 and 0.037, respectively. This means that a one day increase in the time gap between the IPO issuance date and the first day of trading is associated with a 3.7 percentage point increase in underpricing for the overall group and a 3.5 percentage point increase in underpricing for the pre-reform group. This finding is in line with my hypothesis for the GAP variable, which posited that a larger time gap is associated with a higher degree of inequality between supply and demand, leading to higher underpricing. In

contrast, the GAP coefficient for the post-reform group was -0.016, meaning that a one-day increase in the gap between IPO issuance and the first day of trading would be associated with a 1.6 percentage point decrease in underpricing for the post-reform group. Statistically, it is worth noting that the GAP coefficients for the overall and pre-reform groups are significant at the 1% level, while the GAP coefficient for the post-reform group is not significant at the 10% level or better. This finding suggests that IPO allocation reforms from 2000 to 2002 made GAP a less significant indicator of IPO underpricing. Under the old lottery and quota systems, GAP was likely an accurate proxy for inequality between supply and demand, which made it an effective predictor of IPO underpricing. However, with the implementation of the reforms that greatly reduced this supply/demand disparity, the average GAP became much smaller and less indicative of any inequality between supply and demand. Generally, the findings with regard to the GAP variable suggest that the reforms were effective in their aim of reducing the problem of supply/demand inequality.

With the regressions completed and the coefficients on each of the independent variables measured for the overall, pre-reform, and post-reform groups, the next step was to test whether specifying the era of reform from 2000-2002 as a "break" in the data was a valid assumption. There are two methods that I utilized to test whether the gap from 2000-2002 was a valid break and whether the regression functions for the pre-2000 and post-2002 data were statistically different. The first method, known as the Chow test, is widely known as the most rigorous method to test for a break in a dataset. Essentially, the Chow test allows that "the null hypothesis of no break can be tested using a binary variable interaction regression," such as the example provided in Stock and Watson's *Introduction to Econometrics* (2007):

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + \delta_1 X_{t-1} + \gamma_0 D_t(\tau) + \gamma_1 [D_t(\tau) \times Y_{t-1}] + \gamma_2 [D_t(\tau) \times X_{t-1}] + u_t$$

The test essentially tests whether the corresponding coefficients of the pre-2000 and post-2002 data sets are the same; for example, it tests the EPS coefficients against each other, the FLOAT coefficients against each other, and so on. The test can be achieved through Stata simply by pooling the data together and performing a series of cumulative hypothesis tests on each of the coefficients to yield an F-statistic showing whether or not the corresponding coefficients in each of the datasets are the same.[3] For example, the pooled regression used to obtain the coefficients for each variable and allow them to be tested against each other, using adjusted underpricing data, is as follows (with epsilon defined as the error term):

$$AdjUnderpricing = \alpha + \beta_1 EPSPre + \beta_2 LOGSIZEPre + \beta_3 TECHPre + \beta_4 FLOATPre + \beta_5 GAPPre + \beta_6 EPSPost + \beta_7 LOGSIZEPost + \beta_8 TECHPost + \beta_9 FLOATPre + \beta_{10} GAPPost + \beta_{11} Post2002 + \varepsilon$$

Once the regression was performed, the corresponding coefficients for each variable before and after the break were cumulatively tested against each other for significance. For example, $\beta_1$ was tested against $\beta_6$, $\beta_2$ tested against $\beta_7$, and so on. The results of the tests were accumulated together, along with a test of the Post2002 time dummy variable, to produce a single F-statistic.

The results of the Chow test for both the adjusted and non-adjusted data are summarized below in Table 4:

*Table 4: Chow Tests for Adjusted and Non-Adjusted Data*

| | **F-Statistic** | **Prob > F** |
|---|---|---|
| **Non-Adjusted** | 10.76 | 0.00 |
| **Adjusted** | 10.76 | 0.00 |

[3] For an overview of how to perform the Chow test using Stata, refer to http://www.stata.com/support/faqs/stat/chow3.html

The F-statistic for both the non-adjusted and adjusted data was 10.76. This implies that for both the adjusted and non-adjusted data, the probability that there was no difference in the coefficients was less than 1%. Thus, the Chow test suggests that the era of reform from 2000-2002 is a valid break point in the data.

Although the Chow test confirms my suspicion that a break in the data occurred in the period from 2000 to 2002, the Chow test does not provide a specific, exact date for the break in the data. Finding such a date is a useful exercise for several reasons. First, the knowledge of an exact date can suggest that one of the several "key reforms" to the Chinese IPO and equity markets discussed previously had more of an effect on IPO underpricing than the other reforms. Secondly, it might imply something about the manner in which the markets reacted to the announcement and implementation of these reforms. For example, if the exact break occurs very close to the year 2000, it suggests that the markets anticipated the coming reforms, which was enough to have an immediate impact on IPO underpricing. On the other hand, if the exact break occurs near the end of 2002, it suggests that the reforms did not take effect immediately and that it took some extra time for the markets to adjust to the reforms.

To determine an exact date for the break, I decided to implement a model that allows me to remain "agnostic" to when the break occurred. Essentially, the model examines the data and provides a date for the break that is implied by the data itself. To perform the "agnostic" test, I use a Marcos-Ricci model that implements a likelihood function and allows for breaks in the coefficients of the regression model. The model looks at the coefficients of the OLS regressors in my regression model and uses the likelihood function to determine when it is most likely that a break occurred. In addition to looking for a break in the coefficient, the model also looks for a break in volatility, as the break caused by the key reforms may have had effects on volatility in

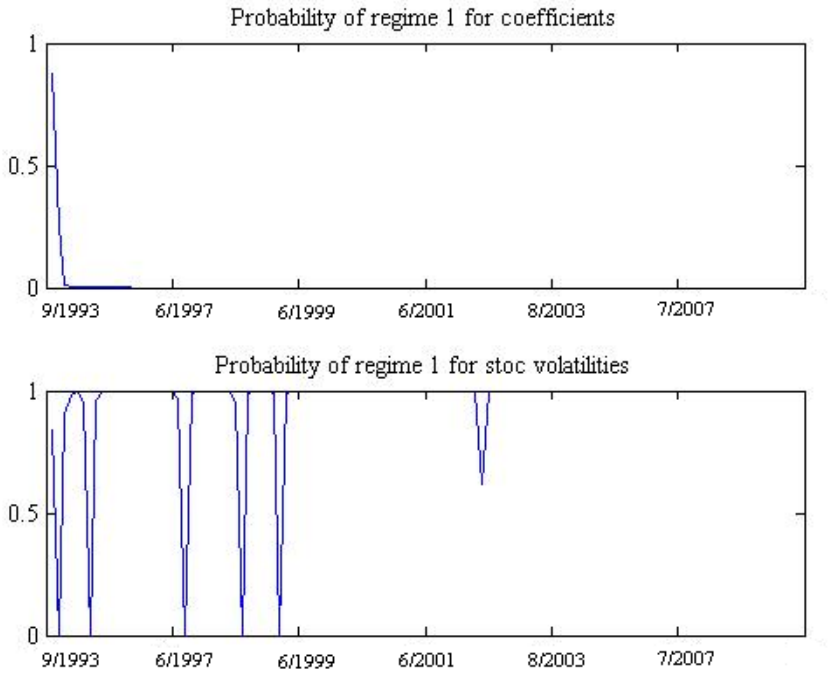
the IPO markets as well. A basic model of one regressor and the corresponding volatility measure would appear as follows:

$$Y_t = B_i X_t + c + \delta_j \varepsilon_t$$

The above "agnostic" likelihood model was implemented using a program in Matlab, which tested the model iteratively in order to find the most likely time period for the break.

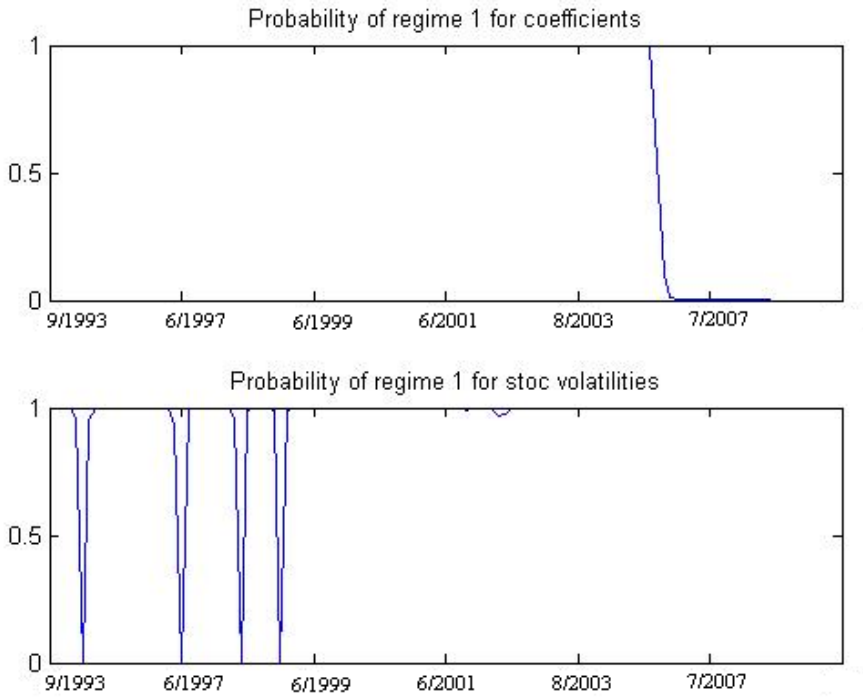
The initial results of this test were somewhat disappointing; they specified that the most likely point for a "break" in the data was at the very beginning of the time series, either in 1993 or 1994. Such a break is clearly a long way away from the expected break point of somewhere in 2000, 2001, or 2002. Figure 3 below shows the predicted break and volatilities of the original model:

*Figure 3: Projected Break and Volatilities of Original Agnostic Model*



After re-examining the data, I realized that the data was probably being distorted by the presence of a few outliers in 1993, at the beginning of the time series. In the entire final data set, only four out of the 422 IPOs studied occurred in 1993. These four IPOs contained some of the highest degrees of underpricing and the longest IPO issue time gaps out of all the IPOs. Both the underpricing and GAP variables were high enough on a few of these four IPOs that when contrasted with the rest of the data, one could plausibly perceive a "break" occurring at the beginning of 1994. Because of the possibility of this distortion, I removed the outliers and ran the model a second time. Figure 4 shows the projected break and volatilities implied by the data with the outliers removed:

*Figure 4: Projected Break and Volatilities with Outliers Removed*




Once the outliers were removed, the model implied that the most likely date for the break was around June 2004. While this still does not fall within my original range of 2000-2002, it is much

closer to that range than the original model, and it may suggest certain conclusions about the manner in which the Chinese government reforms of 2000-2002 took effect. The fact that the likelihood model produced a "most likely" break date of June 2004 implies that it may have taken two or three years for the reforms of 2000-2002 to take full effect in the markets. There are many possible reasons for why there would have been a lag time between the announced reforms and the actual "break" in the data, especially given that the way in which the Chinese government implements reforms such as these remains ambiguous. For instance, perhaps the government chose to gradually implement these reforms, only introducing them to small industry groups or a small number of provinces at any specific time, so that there was actually a significant gap between the announced time of the reforms and full implementation. Alternatively, perhaps corrupt government officials at the regional or local levels continued to allocate IPOs to some extent as before, and it may have taken some time for the central government to ensure total compliance with the reforms. An interesting area for further study might be to examine a number of different economic reforms, both in China and globally, to try and find what causes this lag time between announcement and when the reforms actually take effect.

Additionally, the volatilities implied by the data both with and without the outliers appear to spike several times from 1993 to 1999 and then level off for the rest of the data. This observation reflects the often sporadic and risky nature of emerging and developing markets, where the possibilities for high returns are usually accompanied by high risks. The model shows that the reforms implemented from 2000 to 2002, in addition to reducing underpricing, also helped to reduce the volatility in the Chinese markets. Such a reduction in volatility should be

considered natural for any market as it evolves from an "emerging" or "developing" market into a more established, developed, and mature market.

## V. Conclusion

The underpricing data collected in the overall, pre-2000, and post-2002 groups suggests a significant degree of underpricing in the Chinese IPO markets since their formation in 1990. The mean overall underpricing of around 175% is consistent with previous studies on Chinese IPOs and is much higher than underpricing generally found in more established markets. The data also suggests a significant drop in underpricing after the "era of reform" from 2000 to 2002, during which China instituted a number of market reforms intended to modernize the Chinese IPO and equity markets. The drop in underpricing shown by the data suggests that the reforms instituted during this time caused a decrease in IPO underpricing as they created a market atmosphere reminiscent of more established markets across the globe. The Chow test and the modified regression with time series dummy reinforced the validity of using the "era of reform" as a break in the data.

The regression coefficients on the dependent variables for the overall, pre-reform, and post-reform groups suggest that the government / quality signaling hypothesis and the information asymmetry hypothesis have both contributed and continue to contribute to IPO underpricing in China. The sign switch on the FLOAT variable implies that perhaps information asymmetry has become a relatively more important factor after the era of reform, as loss of government control over IPOs reduced the ability to signal the quality of IPOs to investors. Additionally, the major decrease in underpricing from the pre-reform to the post-reform group, the strong positive correlation between GAP and underpricing in the overall and pre-reform

groups, and the loss of statistical significance in the GAP coefficient in the post-reform group all suggest that inequality of supply and demand played a major role in underpricing before the government instituted its reforms from 2000 to 2002, but that these reforms were clearly effective in reducing this inequality for future IPOs. Regardless, it is clear that IPO underpricing will continue to be viewed in the Chinese IPO markets, but it is likely to converge on the standard degree of underpricing for IPO markets around the globe. Given China's position as a rising economic and political superpower, such a modernization and normalization of equity markets is a relatively unsurprising occurrence, likely occurring alongside a number of other financial changes that are making Chinese markets similar to the markets of other large industrialized countries throughout the world. Nevertheless, both the sheer size of the Chinese economy and the fact that the Chinese markets may be expanding for many years to come make the Chinese equity markets an important and attractive area for continued study.

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*Appendix1: Complete Table of Adjusted and Non-Adjusted Regressions*

| Dependent Variable | Independent Var | Coefficient | Standard Error | T Value | P>t |
|---|---|---|---|---|---|
| | GAP | 0.0350083 | 0.006496 | 5.39 | 0 |
| | TECH | -0.7475199 | 0.5626851 | -1.33 | 0.185 |
| **Overall Adj Underpricing** | FLOAT | 1.693774 | 0.7687306 | 2.2 | 0.028 |
| | EPS | 0.4907455 | 1.053704 | 0.47 | 0.642 |
| | LOGSIZE | -3.945547 | 0.5641518 | -6.99 | 0 |
| | Constant | 33.33681 | 4.75297 | 7.01 | 0 |
| | GAP | 0.0350083 | 0.0100259 | 3.49 | 0.001 |
| | TECH | -0.7475199 | 0.4098373 | -1.82 | 0.069 |
| **Overall Adj Underpricing** | FLOAT | 1.693774 | 1.201177 | 1.41 | 0.159 |
| **(Robust Standard Errors)** | EPS | 0.4907455 | 0.5977971 | 0.82 | 0.412 |
| | LOGSIZE | -3.945547 | 1.553274 | -2.54 | 0.011 |
| | Constant | 33.33681 | 12.92699 | 2.58 | 0.01 |
| | GAP | 0.0350372 | 0.0064961 | 5.39 | 0 |
| | TECH | -0.7482672 | 0.562695 | -1.33 | 0.184 |
| **Overall Non Adj Underpricing** | FLOAT | 1.691905 | 0.7687442 | 2.2 | 0.028 |
| | EPS | 0.4913225 | 1.053722 | 0.47 | 0.641 |
| | LOGSIZE | -3.942864 | 0.5641617 | -6.99 | 0 |
| | Constant | 33.31529 | 4.753054 | 7.01 | 0 |
| | GAP | 0.0350372 | 0.0100195 | 3.5 | 0.001 |
| | TECH | -0.7482672 | 0.4098467 | -1.83 | 0.069 |
| **Overall Non Adj Underpricing** | FLOAT | 1.691905 | 1.201106 | 1.41 | 0.16 |
| **(Robust Standard Errors)** | EPS | 0.4913225 | 0.5976915 | 0.82 | 0.412 |
| | LOGSIZE | -3.942864 | 1.553378 | -2.54 | 0.012 |
| | Constant | 33.31529 | 12.92808 | 2.58 | 0.01 |
| | GAP | 0.0371474 | 0.0106386 | 3.49 | 0.001 |
| | TECH | -0.2878768 | 1.61513 | -0.18 | 0.859 |
| **Pre-Reform Adj Underpricing** | FLOAT | 6.604001 | 2.19374 | 3.01 | 0.003 |
| | EPS | 2.363428 | 5.051909 | 0.47 | 0.641 |
| | LOGSIZE | -11.68448 | 1.738892 | -6.72 | 0 |
| | Constant | 94.61037 | 14.29056 | 6.62 | 0 |
| | GAP | 0.0371474 | 0.0056764 | 6.54 | 0 |
| | TECH | -0.2878768 | 0.8183128 | -0.35 | 0.726 |
| **Pre-Reform Adj Underpricing** | FLOAT | 6.604001 | 3.513983 | 1.88 | 0.062 |
| **(Robust Standard Errors)** | EPS | 2.363428 | 4.121409 | 0.57 | 0.567 |
| | LOGSIZE | -11.68448 | 4.000057 | -2.92 | 0.004 |
| | Constant | 94.61037 | 32.15056 | 2.94 | 0.004 |
| | GAP | 0.0371804 | 0.0106384 | 3.49 | 0.001 |
| | TECH | -0.2906753 | 1.615109 | -0.18 | 0.857 |
| **Pre-Reform Non Adj Underpricing** | FLOAT | 6.599833 | 2.193711 | 3.01 | 0.003 |
| | EPS | 2.336264 | 5.051841 | 0.46 | 0.644 |
| | LOGSIZE | -11.68212 | 1.738868 | -6.72 | 0 |
| | Constant | 94.59787 | 14.29037 | 6.62 | 0 |
| | GAP | 0.0371804 | 0.0056712 | 6.56 | 0 |
| | TECH | -0.2906753 | 0.8175085 | -0.36 | 0.723 |
| **Pre-Reform Non Adj Underpricing** | FLOAT | 6.599833 | 3.513819 | 1.88 | 0.062 |
| **(Robust Standard Errors)** | EPS | 2.336264 | 4.121391 | 0.57 | 0.572 |
| | LOGSIZE | -11.68212 | 4.000373 | -2.92 | 0.004 |
| | Constant | 94.59787 | 32.15363 | 2.94 | 0.004 |
| | GAP | -0.0162865 | 0.0106231 | -1.53 | 0.128 |
| | TECH | 0.0527335 | 0.1058671 | 0.5 | 0.619 |
| **Post-Reform Adj Underpricing** | FLOAT | -0.6070983 | 0.1622151 | -3.74 | 0 |
| | EPS | 0.2398577 | 0.1604546 | 1.49 | 0.137 |
| | LOGSIZE | -0.3717734 | 0.1052985 | -3.53 | 0.001 |
| | Constant | 4.742031 | 1.068913 | 4.44 | 0 |
| | GAP | -0.0162865 | 0.0116501 | -1.4 | 0.165 |
| | TECH | 0.0527335 | 0.0843367 | 0.63 | 0.533 |
| **Post-Reform Adj Underpricing** | FLOAT | -0.6070983 | 0.2143024 | -2.83 | 0.005 |
| **(Robust Standard Errors)** | EPS | 0.2398577 | 0.1465244 | 1.64 | 0.104 |
| | LOGSIZE | -0.3717734 | 0.0978203 | -3.8 | 0 |
| | Constant | 4.742031 | 1.144401 | 4.14 | 0 |
| | GAP | -0.0157739 | 0.0106626 | -1.48 | 0.141 |
| | TECH | 0.0509037 | 0.1062611 | 0.48 | 0.633 |
| **Post-Reform Non Adj Underpricing** | FLOAT | -0.6110732 | 0.1628188 | -3.75 | 0 |
| | EPS | 0.2425618 | 0.1610518 | 1.51 | 0.134 |
| | LOGSIZE | -0.3666044 | 0.1056904 | -3.47 | 0.001 |
| | Constant | 4.690895 | 1.072891 | 4.37 | 0 |
| | GAP | -0.0157739 | 0.0117206 | -1.35 | 0.181 |
| | TECH | 0.0509037 | 0.0850126 | 0.6 | 0.55 |
| **Post-Reform Non Adj Underpricing** | FLOAT | -0.6110732 | 0.215816 | -2.83 | 0.005 |
| **(Robust Standard Errors)** | EPS | 0.2425618 | 0.1476723 | 1.64 | 0.103 |
| | LOGSIZE | -0.3666044 | 0.0983646 | -3.73 | 0 |
| | Constant | 4.690895 | 1.150292 | 4.08 | 0 |