An Empirical Investigation of Underpricing in Chinese IPOs

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January 24, 1997

*We thank Gary Jefferson, Wei Li, Audrey Light, Barry Naughton, Bruce Weinburg and seminar participants at the American Economics Association in New Orleans for helpful comments and discussions. The first author would like to acknowledge financial support from a Dice Fellowship.

Abstract

In this paper, we empirically identify some of the causes of cross-sectional differences in underpricing of Chinese initial public offerings (IPOs) using data compiled for 308 firm-commitment A-share IPOs and 57 B-share IPOs.

We first formulate and estimate a benchmark empirical model that relates IPO initial returns to variables widely used in studies of IPO underpricing. Then we test three hypotheses that may help explain the high A-share IPO underpricing in China. We find that IPO underpricing is the largest at the earliest stage of development of stock markets in China. The extraordinarily large IPO underpricing is at least partially due to a relatively small aggregate supply of shares. We also find that A-share IPO underpricing is better explained by a signaling model that relates IPO underpricing to subsequent equity offerings (SEOs) than by one linking government or employee ownership to equilibrium IPO underpricing. Issuers with larger IPO underpricing are more likely to raise larger amounts of capital through SEOs more quickly. The results support the notion that the primary purpose for Chinese firms going public is to raise capital, not to transfer ownership from state to private citizens. Moreover, we do not find any evidence that lottery mechanisms have contributed to the high IPO underpricing in China.

Finally, we find some evidence that the difference in IPO underpricing among A and B shares can be explained by the differences in domestic and foreign investors' investment opportunities and investment sentiments.

An Empirical Investigation of Underpricing in Chinese IPOs

1 Introduction

Initial public offering (IPO) underpricing, or high IPO initial return, is a phenomenon common to most stock markets—both in developed and emerging economies [Loughran, Ritter and Rydqvist (1994)]. A common perception is that underpricing of IPOs is a contradiction to market efficiency and may hurt emerging firms trying to raise capital for expansion. Therefore it has spawned an extensive literature attempting to explain this apparent financial anomaly. A number of theories of IPO underpricing have been put forth and tested against the data of various stock markets.

This paper studies the underpricing of Chinese IPOs. The Chinese case is of interest primarily because of the extreme magnitudes that have been observed since market trading of stocks began in late 1990. A noteworthy measure is that the mean IPO initial returns, defined as the difference between the first-day market closing price minus the IPO price divided by the IPO price averaged over a sample of 308 domestic A shares that went public before January 1, 1996 is 948.59%! In other words, the first-day market closing price is on average almost eleven time as high as the initial price offered to the domestic Chinese investors. However, the average degree of IPO initial returns for 57 B shares, which are offered only to foreign investors by firms who have already issued domestic A shares, is merely 37.13%.

In this paper, we are primarily interested in empirically identifying the cross-sectional differences in underpricing of Chinese IPOs using data for 308 firm-commitment A-share IPOs between December 1986 and January 1996 and 57 B-share IPOs between February 1992 and January 1996, respectively. We are also interested in explaining the differences in the underpricing between A- and B-share IPOs.

We consider the following peculiarities of the characteristics of the new-issue and offering process that distinguish the Chinese case from those of other markets:

1. The aggregate amount of new shares issued each year is determined by a quota set by the security regulatory authorities.

2. Different share types have been introduced by the government in transferring part of the ownership of state-owned enterprises to the public.

3. Subsequent equity offerings (SEOs) are very frequently observed. About 91% of the Chinese firms that went public before June 30, 1994 have issued subsequent equities.

4. The IPO mechanism adopted by most Chinese firms is quite different from those observed in mature stock markets and has undergone several substantial changes over time.

In Section 2, we provide more institutional details of the new-issue and offering process in China.

A positive IPO initial return occurs when demand for a firm's shares exceeds the supply of shares at the IPO price. Therefore, we believe that any attempt to explain the positive IPO return should be framed in terms of: (1) the determination of IPO price; (2) the determination of the size of initial sale; (3) the factors affecting investors' demand for shares.

In Section 3, we estimate a benchmark empirical model that relates IPO initial return to some economic variables that are widely used in studies of IPO underpricing using data for A-share IPOs. The empirical model is similar to that of Jagadeesh, Weinstein and Welch (1993).

In Section 4, we expand the benchmark model to consider hypotheses based on aggregate supply of shares, information asymmetry and offering mechanisms. In particular, we test three hypotheses: (1) Underpricing of A-share IPOs is partially due to relative small aggregate supply of shares; (2) IPO underpricing is an equilibrium outcome under asymmetric information among issuers and investors; (3) Lottery mechanism in share allocation contributes to A-share IPO underpricing.

In Section 5, we extend our approach to examine the difference in IPO underpricing between A shares (available only to Chinese investors) and B shares (available only to foreign investors).

In Section 6, we summarize the findings and propose future research in this area.

2 Institutional Background

There are several interesting characteristics of the new-issue and offering process in China:

First, the aggregate amount of new shares to be issued each year is determined by a quota set by the State Planning Committee, the central bank and the China Securities Regulatory Committee (CSRC). The quota is then distributed to individual provinces. The stated criteria used for allocation of new issues among provinces reflect the central security regulatory authorities' perceived regional development needs and provincial differences in production structure and industrial base. Within each regional quota, the local security regulatory authorities invite enterprises to request a listing and make a selection based on criteria which combine good performance as well as

sectoral development objectives. Infrastructure enterprises, especially those specializing in electricity and water supply, are given priority for approval.

Second, the Chinese government has introduced a variety of share categories to allow ownership of state-owned enterprises to be dispersed among the government itself, other state-owned enterprises, firms' own employees, domestic public and foreign investors. There are currently five types of shares: (1) government shares, which are retained in the state institutions and government departments and are non-tradable; (2) legal entity shares, or C shares, which can only be held by other state-owned enterprises. C shares can not be listed in the two official exchanges (Shanghai and Shenzhen Security Exchange), but a very small number are traded on the Security Trading and Automatic Quote System (STAQS) and National Electronic Trading System (NETS); (3) employee shares, which are non-tradable until the firm allows their convertibility; (4) ordinary domestic individual shares, or A shares, which can only be purchased and traded by private Chinese citizens in the two official exchanges in China; (4) foreign individual shares, which can only be purchased and traded by the foreign investors in security exchanges in China (B shares), in Hong Kong (H shares) or in NYSE (N shares)[1].

Third, most stock sales are partial sales. The government still maintains control in varying degree over many firms. The size of government ownership ranges from 10% to 88%. Only 89 out of 308 issuers going public between December 1986 and January 1996 do not report government ownership of shares. However, none of these 89 issuers has reported IPO size that is above 50% of its total market capitalization, which indicates that a larger portion of its shares are still controlled by other state-owned enterprises.

Fourth, the average time elapsed between the announcement of IPO and the first day market trading is 260 days for A shares and 72 days for B shares, which is considerably higher than other countries. There are a number of steps a firm must take after it is selected for initial public offering and before the market trading begins. Some typical steps include: (1) publication of a prospectus in newspapers and selection of underwriters; (2) purchase of application forms by prospective investors; (3) a lottery to determine which individual and institutional investors will be allowed to purchase new issues at the IPO price; (4) delivery of shares to the lottery winners after payments are made.

Fifth, the lottery mechanism, which remains the primary method of share allocation,

[1]An issuer of B shares must, besides satisfying requirements stated in the securities regulations, meet the following conditions: (1) It must have obtained approval from the relevant authorities for its use of foreign investment or for its conversion into a foreign-funded enterprise. (2) It must have a stable source of adequate foreign exchange income and the total amount of its annual foreign exchange income must be sufficient to pay the annual dividend. (3) The proportion of B shares to the total number of shares must not exceed the ceiling determined by the relevant authority. The aggregate amount of shares is fixed in each year and the total number of firms allowed to issue foreign shares is also limited. An issuer of H or N shares is not subject to the quota restriction, but is subject to case-by-case approval.

has undergone several substantial changes. Before 1992, the security regulatory authorities designed a lottery system based on a pre-announced fixed number of application forms. Each retail investor was allowed to purchase a limited number of lottery forms from the central bank and its subsidiaries. Lottery winners were entitled to a certain number of shares per winning form. With the number of lottery forms pre-determined, the odds of winning the lottery was known to investors. In 1993, the security regulatory authorities introduced two new lottery mechanisms to replace the old one: One mechanism was based on unlimited number of application forms. The central bank sold as many lottery forms as investors were willing to buy. Therefore, the odds of winning the lottery was unknown to investors at the time of lottery. The other lottery mechanism was based on savings deposit certificates. Investors were required to deposit a certain quantity of funds into a special saving account when submitting application for shares, which could not be withdrawn until the lottery was completed. These special saving accounts were given relatively low interest.

In 1994, two kinds of auction mechanisms were introduced. Under the first auction mechanism, an issuer set an initial price and investors were required to bid for the price and quantity. The final offer price was set at the level where the accumulative quantities demanded by investors equaled the total number of new shares available. Under the second auction mechanism, the IPO price was fixed and investors were invited to bid for the quantity of shares. In case of oversubscription, all investors were guaranteed a certain amount of shares and the remaining shares were distributed in proportion to investors' bids.

3 A Benchmark Model

A part of our data consists of all the firm-commitment IPOs of A-share common stocks occurring between December 1986 and January 1996. A detailed description is included in Appendix 1. In order to study the effects of subsequent equity offerings and government ownership on IPO underpricing, we also extract a sub-sample of firms that went public between December 1986 and June 1994. This is because we allow 548 days for a firm to issue SEOs.

We define IPO initial return ($IPORETN$) as[2]

$$IPORETN = \frac{\text{First-day market closing price} - \text{IPO price}}{\text{IPO price}}$$

[2]The $IPORETN$ variable defined here is the raw IPO initial return. We do not use the market-adjusted IPO initial return in this investigation because a number of firms have gone public before the emergence of secondary markets in China.

Some well-known variables that have been used to explain cross-sectional differences in IPO initial returns are:

$$
\begin{aligned}
RCPIPO &= \text{the reciprocal of IPO price} \\
LNIPOSZ &= \text{logarithm of IPO size measured in Chinese yuan} \\
PROFSHA &= \text{the ratio of the profit a year before the IPO date divided by the} \\
&\quad \text{outstanding shares at the time of IPO} \\
LNTOSIZE &= \text{logarithm of the sum of IPO size and SEO size} \\
LNAGE &= \text{logarithm of the age of the firm} \\
TIMEIPO &= \text{number of days elapsed between the announcement of an IPO} \\
&\quad \text{and the first-day market trading} \\
SIC(K) &= \text{industry dummies, } K = 1, 2, \cdots, 6 \\
YEAR(T) &= \text{IPO year dummies, } T = 1, 2, \cdots, 6
\end{aligned}
$$

Descriptive statistics for the above variables are presented in table 1. The correlation matrix for some of the variables is presented in table 2.

The benchmark regression is

$$
\begin{aligned}
IPORETN_i &= \alpha_0 + \alpha_1 RCPIPO_i + \alpha_2 LNIPOSZ_i + \alpha_3 PROFSHA_i \\
&\quad + \alpha_4 LNTOSIZE_i + \alpha_5 LNAGE_i + \alpha_6 TIMEIPO_i \\
&\quad + \alpha_K SIC(K) + \alpha_T YEAR(T) + \epsilon_i
\end{aligned} \tag{1}
$$

The OLS regression estimates for A-share IPOs presented in table 3 show that: (1) the smaller the IPO price, the larger the IPO initial return; (2) the smaller the size of initial offering, the higher the IPO initial return; the larger the size of total offerings, which is the sum of IPO and all SEOs, the higher the IPO initial return. This implies that firms with small IPOs relative to their total offerings have a relatively high degree of IPO underpricing; (3) time elapsed between the announcement of an IPO and the first-day market trading does not affect the IPO underpricing[3]; (4) the age of the firm and the profit per share variables do not seem to be related to the IPO initial return, indicating that available information about a firm at the time of the IPO is not related to IPO underpricing[4]; (5) durable and non-durable goods industries have

[3]This contradicts Chowdhry and Sherman (1994), who show that IPO underpricing is positively related to the time period between IPO date and first trading date.

[4]This is in contrast to that of Ritter (1991), who found significant negative relationship between IPO underpricing and past information for the U.S. firms.

Table 1

Descriptive Statistics For Variables To Explain IPO Initial Returns

Variable	Description	N	Mean	Median	Std. dev.	Minimum	Maximum
A-share full sample, between December 1986 and January 1996							
IPORETN	IPO initial return	308	9.4859	2.3125	29.677	-0.1858	383
RCPIPO	reciprocal of IPO price	308	0.3781	0.2632	0.2844	0.0747	1
LNIPOSZ	logarithm of IPO size	308	9.0781	9.2053	0.9955	5.4806	12.241
PROFSHA	profit per share	308	0.254	0.1737	0.5002	0.0153	0.9885
LNAGE	logarithm of firm's age	308	2.4849	2.7701	0.8929	0.6931	4.4773
LNTOSIZE	logarithm of the sum of IPO and SEO sizes	308	10.681	10.628	1.0975	7.1701	15.772
TIMEIPO	time elapsed between offer and trade dates	308	260.12	135	341.24	3	1868
LNGOVNT	logarithm of the size of government ownership	308	6.0294	8.0194	4.0055	0	12.9078
LNEMPLOY	logarithm of the size of employee shares	308	5.6087	5.7038	1.5882	0	9.8522
LNMKTCAP	logarithm of firm's stock-market capitalization	308	10.4359	10.4996	1.221	5.4806	14.6162
A-share sub-sample, between December 1986 and June 1994							
IPORETN	IPO initial return	268	10.431	2.7124	31.663	-0.1	383
RCPIPO	reciprocal of IPO price	268	0.3811	0.2685	0.2811	0.0978	1
LNIPOSZ	logarithm of IPO size	268	9.0635	9.177	1.0099	5.4806	12.2405
PROFSHA	profit per share	268	0.2486	0.1634	0.5258	0.0153	0.9885
LNAGE	logarithm of firm's age	268	2.7743	2.6391	0.9016	0.6931	4.4773
LNTOSIZE	logarithm of the sum of IPO and SEO sizes	268	10.77	10.678	1.0583	8.2295	15.772
TIMEIPO	time elapsed between offer and trade dates	268	251.04	142	305.98	3	1831
LNGOVNT	logarithm of the size of government ownership	268	6.0898	8.0283	4.0101	0	12.9078
LNEMPLOY	logarithm of the size of employee shares	268	5.6935	5.7038	1.3461	0	9.8522
LNMKTCAP	logarithm of firm's stock-market capitalization	268	10.4072	10.4727	1.2207	5.4806	14.6162

TABLE 2

CORRELATION MATRIX FOR VARIABLES TO EXPLAIN IPO INITIAL RETURN

Industry and year dummies are omitted for brevity.

A-share full sample, between December 1986 and January 1996						
	RCPIPO	LNIPOSZ	LNTOSIZE	PROFSHA	LNAGE	TIMEIPO
RCPIPO	1					
LNIPOSZ	-0.6152	1				
LNTOSIZE	-0.0936	0.1797	1			
PROFSHA	-0.0202	-0.0562	0.1573	1		
LNAGE	-0.0687	0.123	-0.1271	-0.0626	1	
TIMEIPO	0.5831	-0.5703	0.12	0.0151	-0.0247	1
A-share sub-sample, between December 1986 and June 1994						
	RCPIPO	LNIPOSZ	LNTOSIZE	PROFSHA	LNAGE	TIMEIPO
RCPIPO	1					
LNIPOSZ	-0.5971	1				
LNTOSIZE	-0.0475	0.1388	1			
PROFSHA	0.0062	-0.0725	0.1647	1		
LNAGE	-0.1048	0.1264	-0.1342	-0.0468	1	
TIMEIPO	0.5083	-0.5713	0.2308	0.0487	-0.0497	1

larger IPO underpricing than other industries, suggesting that the proportion of high-value firms going public is larger in durable and non-durable goods industries than in other industries; (6) IPO initial returns were significantly higher at the early stage of development of Chinese stock markets.

Our benchmark model successfully relates the cross-sectional differences in IPO underpricing to some economic variables. In the next section, we test three hypotheses that may help explain the extraordinarily high A-share IPO underpricing that characterizes the Chinese markets.

4 Hypotheses and Empirical Results

Hypothesis 1 *Underpricing of A-share IPOs is partially due to relatively small aggregate supply of A shares.*

Before the emergence of stock markets, Chinese households had access to a very limited number of investment instruments, mainly savings deposits at relatively low interest rates. At the same time, China's household savings rate was one of the world's highest, about 40% of total disposable income. Potential demand for new shares was extremely high when the stock markets emerged.

Table 3

OLS Regression Estimates For The Benchmark Model

The dependent variable is the IPO initial return. The independent variables are the reciprocal of IPO price ($RCPIPO$), logarithm of IPO size measured in dollars ($LNIPOSZ$), profit per share ($PROFSHA$), logarithm of the age of the firm ($LNAGE$), logarithm of the size of total offerings ($LNTOSIZE$), time elapsed between the offer date and the first trading date ($TIMEIPO$), industry dummies ($SIC(K)$) and IPO year dummies ($YEAR(T)$). The six industry dummies are: durable goods ($SIC1$), non-durable goods ($SIC2$), transportation and public utilities ($SIC3$), finance, insurance and real estate ($SIC4$), services including restaurants, department stores and hotels ($SIC5$) and domestic and foreign trade ($SIC6$). IPO year dummies are set to one for the year of issue and zero otherwise. Figures in parentheses are t-statistics. *, † denote 5% and 10% level of significance, respectively.

	Constant	RCPIPO	LNIPOSZ	PROFSHA	LNAGE	LNTOSIZE
Full sample	-69.6048*	22.9758*	-5.0583*	-4.1638	2.3892	10.0695*
	(-3.0612)	(3.4019)	(-2.4754)	(-1.4312)	(1.4162)	(6.1995)
Sub-sample	-93.6159*	25.1627*	-4.1532†	-4.4099	2.5793	11.1672*
	(-3.7446)	(3.4513)	(-1.8391)	(-1.4059)	(1.3741)	(5.9527)
	TIMEIPO	SIC1	SIC2	SIC3	SIC4	SIC5
Full sample	-0.0172	7.8147†	10.7099*	1.6218	2.8004	5.0636
	(-1.0161)	(1.7232)	(2.1654)	(0.2802)	(0.4782)	(0.9657)
Sub-sample	-0.0141	9.9033†	14.0239*	3.2262	3.8525	8.193
	(-1.2724)	(1.9049)	(2.4707)	(0.4773)	(0.5565)	(1.384)
	YEAR1	YEAR2	YEAR3	YEAR4	YEAR5	$\bar{R}^2$
Full sample	43.5243*	-7.6043	0.6983	-3.9135	0.7963	0.3581
	(3.3936)	(-0.8122)	(0.0868)	(-0.5362)	(0.1014)	
Sub-sample	44.4975*	-8.5893	-0.9173	-3.6153		0.3757
	(3.3733)	(-1.0246)	(-0.1385)	(-0.6443)		

On the other hand, the aggregate value of new shares to be issued each year is set by the State Planning Committee and China Securities Regulatory Committee and is part of the national investment and credit plan. The aggregate supply of shares in China probably falls far short of the quantity demanded at any price-earning ratio that would be considered "normal" in more mature stock markets. In this sense, there has been a persistent excess demand for new shares in China. For example, the ratio of stock market capitalization to GDP was 4.8% in 1991, which is very small compared to other countries where IPO underpricing is far less than in China.

The regression coefficient (t-statistic) for $YEAR1$ in the benchmark model is 43.5243 (3.3936) for the full sample, which indicates that IPO initial return was highest when stock markets emerged in China. To test the hypothesis that IPO underpricing has been partially dependent on the relatively small aggregate supply of new shares, we replace the year dummies with the following two variables:

$TIME$ = variable representing time trend, which takes value 1 for a firm going public before January 1, 1991, takes value 2 for a firm going public after January 1, 1991 but before January 1, 1992, and so on.

$MKTCAP$ = the ratio of the total stock-market capitalization to GDP, which is a proxy for the aggregate supply for shares relative to aggregate demand for shares

The augmented benchmark regression is:

$$\begin{aligned} IPORETN_i &= \alpha_0 + \alpha_1 RCPIPO_i + \alpha_2 LNIPOSZ_i + \alpha_3 PROFSHA_i \\ &\quad + \alpha_4 LNTOSIZE_i + \alpha_5 LNAGE_i + \alpha_6 TIMEIPO_i \\ &\quad + \alpha_7 TIME_i + \alpha_8 MKTGDP_i + \alpha_K SIC(K) + \epsilon_i \end{aligned} \tag{2}$$

Table 4 presents the OLS estimates for the augmented benchmark model. The coefficient estimates for $MKTGDP$ (t-statistic) are -4.1977 (-5.2823) for the full sample and -5.1576 (-5.0602) for the sub-sample, which are consistent with the hypothesis that the smaller the stock market capitalization-to-GDP ratio, or the smaller the excess demand for shares at a "normal" price-earning ratio, the higher is IPO underpricing. The coefficient estimates for the $TIME$ variable are statistically insignificant, suggesting that the $MKTGDP$ variable has removed the time effect in the cross-sectional regression.

Table 5 shows the relationship between the average degree of IPO underpricing and the stock market capitalization-to-GDP ratio for a sample of countries. Countries that have larger stock-market capitalization-to-GDP ratios, such as the U.S., U.K. and Japan,

Table 4
OLS Regression Estimates For Augmented Benchmark Model

The dependent variable is the IPO initial return. The independent variables are the reciprocal of IPO price ($RCPIPO$), logarithm of IPO size ($LNIPOSZ$), profit per share ($PROFSHA$), logarithm of the age of the firm ($LNAGE$), logarithm of the size of total offerings ($LNTOSIZE$), time elapsed between the offer date and the first trading date ($TIMEIPO$), industry dummies ($SIC(K)$), IPO time trend ($TIME$) and a proxy variable for investors' relative demand for shares as measured by the stock market capitalization to GDP ratio ($MKTGDP$). Figures in parentheses are t-statistics. *, † denote 5% and 10% level of significance, respectively.

	Full sample	Sub-sample		Full sample	Sub-sample
Constant	-6.2012	-27.562	$SIC1$	$7.1854^\dagger$	$9.6356^\dagger$
	(-0.2235)	(-0.8691)		(1.6808)	(1.8506)
$RCPIPO$	21.0434^*	24.1561^*	$SIC2$	10.1581^*	13.9356^*
	(3.1182)	(3.3228)		(2.0432)	(2.4475)
$LNIPOSZ$	-4.8632^*	$-3.8549^\dagger$	$SIC3$	2.0087	3.9815
	(-2.3674)	(-1.7061)		(0.3449)	(0.5883)
$PROFSHA$	-3.6443	-4.5946	$SIC4$	2.7036	4.3636
	(-1.2633)	(-1.4769)		(0.4594)	(0.6284)
$LNAGE$	2.2085	2.459	$SIC5$	5.5267	9.0541
	(1.3018)	(1.3081)		(1.0522)	(1.5294)
$LNTOSIZE$	9.5395^*	10.7874^*	$TIME$	-0.7321	1.3305
	(5.8661)	(5.7598)		(-0.3737)	(0.507)
$TIMEIPO$	-0.0118	-0.0096	$MKTGDP$	-4.1977^*	-5.1576^*
	(-1.4227)	(-0.883)		(-5.2823)	(-5.0602)
			$\bar{R}^2$	0.3484	0.3719

TABLE 5
IPO UNDERPRICING AND STOCK-MARKET CAPITALIZATION-TO-GDP RATIO[a]
(1991)

Country	IPO Underpricing	Market Capitalization-to-GDP
China	948.59%	4.8%
Brazil	78%	31%
Korea	60%	37%
Taiwan	45%	74%
U.S.	16%	74%
U.K.	15%	99%
Japan	12%	93%

[a]Source: International Finance Corporation, Emerging Stock Markets Factbook (1992) and Loughran, Ritter and Rydquist (1994)

exhibit smaller degree of IPO underpricing. The stock-market capitalization-to-GDP ratio was only 4.8% in China when stock market emerged. At the same time, the average degree of IPO underpricing was enormous.

Therefore, we conclude that one of the causes of high IPO underpricing in China has been the relatively small aggregate supply of shares.

Hypothesis 2 *Underpricing of A-share IPOs is an equilibrium outcome under asymmetric information among issuers and investors.*

There are two classes of signaling models of IPO underpricing that assume asymmetric information among issuers and investors:

i. IPO underpricing is an equilibrium outcome for an issuer to signal its quality to investors.

   Allen and Faulhaber (1989), Grinblatt and Huang (1989), Welch (1989) and Chemmanur (1993) have proposed a class of signaling models of IPO underpricing in which issuers have superior information than investors. In their models, an issuer maximizes the value of the firm through initial sale and subsequent equity offerings. In the absence of complete information, investors do not know whether an issuer is of "high value" or "low value". Underpricing is an equilibrium outcome for an issuer to signal its quality to the investors. A "high value" issuer can afford to underprice its IPO because it can capture larger revenues through subsequent equity offerings (SEOs). A "low value" issuer can not afford to underprice its IPO because it can not raise more capital through after-market SEOs.

Their models work as follows: An issuer gives out "free samples" to the public by underpricing and induces the public to learn more about the issuer. The learning process leads to a higher price on the first day of market trading than would otherwise occur—but for "high value" issuer only. This effect on the market price allows "high value" issuer to quickly return to the market with SEOs and thereby reap the return from underpricing its IPO.

Testable implications from the signaling models include: (1) Issuers with larger IPO underpricing are more likely to issue subsequent equities than issuers with lower IPO underpricing; (2) Issuers with larger IPO underpricing are more likely to issue larger amounts of SEOs; (3) Issuers with larger IPO underpricing will issue SEOs more quickly after the initial sales[5].

ii. Underpricing of state-owned enterprises' IPOs is an equilibrium outcome for a government issuer to signal its commitment to pro-market privatization policies.

Perotti (1995) presents a model of IPO underpricing and privatization for state-owned enterprises under government policy uncertainty. In Perotti's model, a government maximizes the sum of expected revenues from IPOs and SEOs plus the dividends on the retained shares during the privatization process. Under policy uncertainty, a government may choose to retain a large stake of the state enterprises and underprice a partial sale to signal its intent to credibly commit to future pro-market privatization policies. The model implies that IPO underpricing is positively related to the uncertainty of government policies, negatively related to the size of IPOs, and positively related to the size of government ownership and the length of time the government is expected to retain significant ownership.

Dewenter and Malatesta (1996) argue that government may also pursue political objectives other than maximizing firm's value in the privatization process. For example, government may allocate underpriced shares to the employees who may otherwise have misgivings about privatization. Therefore, underpricing may be related to the size of the employee shares in an offering.

To test the signaling models of IPO underpricing, we add the following three variables to the augmented benchmark regression[6].

[5]Jagadeesh, Weinstein and Welch (1993) test this class of signaling models using U.S. data and find weak evidence that firms that underprice their IPOs are more likely to issue subsequent equity and on average have larger subsequent offerings.

[6]Obviously, the second implication in the first class of signaling models—that IPO underpricing and the size of SEOs are positively related—is tested and not rejected in the benchmark model.

$$
\begin{aligned}
LNGOVNT &= \text{logarithm of the size of government ownership} \\
LNEMPLOY &= \text{logarithm of the size of employee shares} \\
LNMKTCAP &= \text{logarithm of the sum of IPO size, government shares, legal entity} \\
&\quad \text{shares and employee shares at the time of IPO}
\end{aligned}
$$

The augmented benchmark regression used in testing signaling equilibrium of IPO underpricing is:

$$
\begin{aligned}
IPORETN_i &= \alpha_0 + \alpha_1 RCPIPO_i + \alpha_2 LNIPOSZ_i + \alpha_3 PROFSHA_i \\
&\quad + \alpha_4 LNTOSIZE_i + \alpha_5 LNAGE_i + \alpha_6 TIMEIPO_i \\
&\quad + \alpha_7 LNGOVNT_i + \alpha_8 LNEMPLOY_i + \alpha_9 LNMKTCAP_i \\
&\quad + \alpha_{10} TIME_i + \alpha_{11} MKTGDP_i + \alpha_K SIC(K) + \epsilon_i
\end{aligned} \tag{3}
$$

Table 6 presents the OLS regression estimates. The coefficient estimates (t-statistic) for $LNIPOSZ$ and $LNTOSIZE$ are -8.1461 (-2.5569) and 9.6519 (5.8777) for the full sample and -7.1106 (-1.9984) and 10.7496 (5.6876) for the sub-sample, which indicate that the smaller the IPO size relative to the size of the total offerings, or the larger the size of SEOs, the higher the IPO underpricing. Therefore, there is a positive relationship between the degree of IPO underpricing and the size of SEOs. The coefficient estimates for $LNGOVNT$, $LNEMPLOY$ and $LNMKTCAP$ are of the expected signs in the full sample, but not statistically significant. Therefore, of the two classes of signaling models, the one linking SEOs to a process of equilibrium IPO underpricing appears to have greater explanatory power than the one linking government or employee ownership to equilibrium IPO underpricing.

We also estimate the following three separate tobit regressions that relate IPO underpricing to the relative size of SEOs, government ownership and employee shares[7],

$$
\left(\frac{SEOSIZE}{TOSIZE}\right)_i = \begin{cases} \delta_0 + \delta_1 IPORETN_i + \delta_2 LNIPOSZ_i \\ \quad + \delta_K SIC(K)_i + \delta_K YEAR(K)_i + \varepsilon_i & \text{if RHS} > 0 \\ 0 & \text{otherwise} \end{cases} \tag{4}
$$

[7]We allow 548 days for a firm to issue its first SEO. About 91% of the firms that went public between December 1986 and June 1994 issued subsequent offerings after the initial sales. However, we do not observe the true SEO behavior for firms who have not yet issued SEOs between July 1994 and January 1996. Therefore, the sub-sample suffers from selectivity bias and tobit specification is desirable.

Table 6

OLS Regression Estimates For The Signaling Models Of IPO Underpricing

The dependent variable is the IPO initial return. The independent variables are the reciprocal of IPO price ($RCPIPO$), logarithm of IPO size ($LNIPOSZ$), profit per share ($PROFSHA$), logarithm of the age of the firm ($LNAGE$), logarithm of the size of total offerings ($LNTOSIZE$), time elapsed between the offer date and the first trading date ($TIMEIPO$), logarithm of the size of government ownership ($LNGOVNT$), logarithm of the size of employee shares ($LNEMPLOY$), logarithm of the size of market capitalization ($LNMKTCAP$), industry dummies ($SIC(K)$), IPO time trend ($TIME$) and stock market capitalization to GDP ratio ($MKTGDP$). Figures in parentheses are t-statistics. *, † denote 5% and 10% level of significance, respectively.

	Full sample	Sub-sample		Full sample	Sub-sample
Constant	-2.5967	-25.8576	$SIC1$	5.8185	8.2169
	(-0.0915)	(-0.7831)		(1.251)	(1.5269)
$RCPIPO$	19.8627*	24.3932*	$SIC2$	8.6381†	12.2601*
	(2.8121)	(3.0056)		(1.701)	(2.0918)
$LNIPOSZ$	-8.1461*	-7.1106*	$SIC3$	0.9076	2.5651
	(-2.5569)	(-1.9984)		(0.1521)	(0.3689)
$PROFSHA$	-3.4473	-4.3911	$SIC4$	0.5589	2.0589
	(-1.1862)	(-1.3951)		(0.0925)	(0.2854)
$LNAGE$	1.8791	2.2909	$SIC5$	5.0107	8.6202
	(1.0675)	(1.1605)		(0.9494)	(1.444)
$LNTOSIZE$	9.6519*	10.7496*	$TIME$	-0.707	1.1064
	(5.8777)	(5.6876)		(-0.3582)	(0.4179)
$TIMEIPO$	-0.0126	-0.0104	$MKTGDP$	-4.2688*	-5.1365*
	(-1.5071)	(-0.9466)		(-5.2362)	(-4.9778)
$LNGOVNT$	0.4579	0.3293	$LNMKTCAP$	2.2492	2.7621
	(1.1735)	(0.72)		(0.9274)	(0.978)
$LNEMPLOY$	0.3978	-0.0633			
	(0.4081)	(-0.0448)	$\bar{R}^2$	0.3475	0.3686

$$\left(\frac{GOVNT}{MKTCAP}\right)_i = \begin{cases} \eta_0 + \eta_1 IPORETN_i + \eta_2 LNIPOSZ_i & \\ +\eta_K SIC(K)_i + \eta_K YEAR(K)_i + \mu_i & \text{if RHS} > 0 \\ 0 & \text{otherwise} \end{cases} \quad (5)$$

$$\left(\frac{EMPLOYEE}{MKTCAP}\right)_i = \begin{cases} \theta_0 + \theta_1 IPORETN_i + \theta_2 LNIPOSZ_i & \\ +\theta_K SIC(K)_i + \theta_K YEAR(K)_i + \nu_i & \text{if RHS} > 0 \\ 0 & \text{otherwise} \end{cases} \quad (6)$$

where $\left(\frac{SEOSIZE}{TOSIZE}\right)_i$ is the ratio of the total SEOs to the total offerings for the ith firm, $\left(\frac{GOVNT}{MKTCAP}\right)_i$ is the relative size of government shares to the total stock-market capitalization for firm i and $\left(\frac{EMPLOYEE}{MKTCAP}\right)_i$ is the fraction of employee shares in firm i's total stock-market capitalization.

Tables 7 presents the tobit regression estimates for the relationship among IPO underpricing, size of SEOs, size of government ownership and size of employee shares.

The tobit regression results indicate that: (1) the higher the IPO underpricing, and the smaller the initial offering, the larger are the amount of subsequent equity issues; (2) the size of government ownership is positively related to the degree of IPO underpricing, but the relationship is not statistically significant; (3) the size of employee shares is negatively related to IPO underpricing.

Therefore, the tobit regression estimates support the signaling models that relate A-share IPO underpricing to subsequent equity offerings. However, the estimation results do not provide enough evidence to justify the signaling models that relate A-share IPO underpricing to the government or employee ownership. Chinese issuers going public seem to care more about raising capital through intertemporal maximization than credibly transferring ownership from state government to private citizens.

To further test the hypothesis that issuers with larger IPO underpricing are more likely to issue SEOs, we estimate the following logit model,

$$P_i^{SEO} = \frac{1}{1 + e^{-[\beta_0 + \beta_1 IPORETN_i + \beta_2 LNIPOSZ_i + \beta_K SIC(K) + \beta_T YEAR(T) + \varepsilon_i]}} \quad (7)$$

where P_i^{SEO} is the probability that the ith issuer will issue equity offerings after the initial sale. The independent variables are the degree of IPO underpricing ($IPORETN$) and the logarithm of IPO size ($LNIPOSZ$). We also allow the probability of SEOs to vary across industries and years by including the industry and year dummies.

The logit regression estimates are presented in table 8. The slope coefficient for $IPORETN$ (t-statistic) is 0.1539 (1.8648), which indicates a positive relationship between the degree of IPO underpricing and the probability for a firm to issue SEOs. The

Table 7

Tobit Regression Estimates For The Relationship Among IPO Underpricing, Size of SEOs, Size Of Government Ownership And Size Of Employee Shares

The dependent variables are the ratio of total size of SEOs to the total size of offerings for the ith firm $\left(\frac{SEOSIZE}{TOSIZE}\right)_i$, the fraction of government shares in a firm's total market capitalization $\left(\frac{GOVNT}{MKTCAP}\right)_i$ and the fraction of employee shares in a firm's total market capitalization $\left(\frac{EMPLOYEE}{MKTCAP}\right)_i$, respectively. The independent variables are the IPO initial return ($IPORETN$), logarithm of IPO size measured in dollars ($LNIPOSZ$), industry dummies ($SIC(K)$) and IPO year dummies ($YEAR(T)$). The sub-sample includes 268 firm-commitment IPOs between December 1986 and June 1994. Figures in parentheses are asymptotic t-statistics. *, † denote 5% and 10% level of significance, respectively.

	IPORETN	LNIPOSZ	SIC1	SIC2	SIC3	SIC4
$\left(\frac{SEOSIZE}{TOSIZE}\right)$	0.0011*	-0.1243*	0.0458*	0.061†	-0.0741†	-0.0264
	(2.0877)	(-7.7112)	(2.0099)	(1.9313)	(-1.7423)	(-0.3791)
$\left(\frac{GOVNT}{MKTCAP}\right)$	0.0013	0.0878*	0.4772*	0.5205*	0.4092*	0.6087*
	(1.4806)	(14.27)	(3.8292)	(3.8518)	(3.0874)	(4.3921)
$\left(\frac{EMPLOYEE}{MKTCAP}\right)$	-0.0012*	-0.0193*	0.0397*	-0.0341†	-0.1094*	-0.0435*
	(-2.6241)	(-3.2567)	(2.5487)	(-1.7683)	(-2.1697)	(-2.0637)
	SIC5	YEAR1	YEAR2	YEAR3	YEAR4	
$\left(\frac{SEOSIZE}{TOSIZE}\right)$	0.0053	0.3613*	0.3013*	0.2524*	0.22524*	
	(0.1227)	(7.1118)	(5.0571)	(8.3867)	(6.9953)	
$\left(\frac{GOVNT}{MKTCAP}\right)$	0.1925	-0.0537	-0.3282*	0.0708	0.1017†	
	(1.408)	(-0.3305)	(-2.7587)	(0.821)	(1.9102)	
$\left(\frac{EMPLOYEE}{MKTCAP}\right)$	0.111*	-0.2591*	-0.3602*	-0.3122*	-0.2202*	
	(2.7833)	(-2.8127)	(-2.8112)	(-2.8841)	(-2.7463)	

Table 8

Logit Regression Estimates For The Relationship Between IPO Underpricing And Probability Of SEOs

The dependent variable is the probability for the ith firm to issue SEOs (P_i^{SEO}). The dependent variable takes value 1 if SEOs are observed and 0 otherwise. The independent variables are the IPO initial return ($IPORETN$), logarithm of IPO size ($LNIPOSZ$), industry dummies ($SIC(K)$) and IPO year dummies ($YEAR(T)$). We allow two years for a firm to issue SEOs, therefore our sample only consists of firm who went public between December 1986 and June 1994. There are 268 firms in the sample. Figures in parentheses are asymptotic t-statistics. *, † denote 5% and 10% level of significance, respectively.

Variable	Coefficient	t-statistic
$IPORETN$	0.1539†	(1.8648)
$LNIPOSZ$	-0.5386†	(-1.7947)
$SIC1$	0.9914	(1.1828)
$SIC2$	-0.2342	(-0.2475)
$SIC3$	-0.2786	(-0.2567)
$SIC4$	0.4207	(0.6765)
$SIC5$	0.428	(0.399)
$YEAR1$	28.8958*	(2.4317)
$YEAR2$	20.3371*	(2.5623)
$YEAR3$	2.217	(0.4312)
$YEAR4$	1.4042	(1.1632)

slope coefficient for $LNIPOSZ$ (t-statistic) is -0.5386 (-1.7947), which shows that the smaller the size of initial offering, the higher the probability of SEOs.

Finally, we examine the relationship between IPO underpricing the time elapsed between the IPO and the first SEO using the following tobit model:

$$TIMESEO_i = \begin{cases} \gamma_0 + \gamma_1 IPORETN_i + \gamma_2 LNIPOSZ_i & \\ +\gamma_K SIC(K)_i + \gamma_K YEAR(K)_i + \varepsilon_i & \text{if RHS} > 0 \\ 0 & \text{otherwise} \end{cases} \tag{8}$$

where $TIMESEO$ is the number of days between the IPO date and the first SEO date.

The tobit regression estimates are presented in table 9. The slope coefficient (t-statistic) for $IPORETN$ is -0.8983 (-2.134), which indicates that issuers with higher IPO initial returns tend to return to the market and make subsequent offerings more quickly than issuers with lower IPO initial returns. The slope coefficient (t-statistic) for

Table 9

Tobit Regression Estimates For The Relationship Between IPO Underpricing And Time Between IPO And First SEO

The dependent variable is the number of days between the IPO date and the first SEO date for the ith firm $TIMESEO$. The independent variables are the IPO initial return ($IPORETN$), logarithm of IPO size ($LNIPOSZ$), industry dummies ($SIC(K)$) and IPO year dummies ($YEAR(T)$). We allow two years for a firm to issue SEOs, therefore our sample only consists of firm who went public between December 1986 and June 1994. There are 268 firms in the sample. Figures in parentheses are asymptotic t-statistics. *, † denote 5% and 10% level of significance, respectively.

Variable	Coefficient	t-statistic
$IPORETN$	-0.8983*	(-2.134)
$LNIPOSZ$	3.2786*	(2.4911)
$SIC1$	-46.557*	(-2.2159)
$SIC2$	-40.8944	(-0.8791)
$SIC3$	-25.8421	(-0.4605)
$SIC4$	24.4944	(0.4226)
$SIC5$	23.2237	(0.4802)
$YEAR1$	116.3721*	(2.6601)
$YEAR2$	191.7672†	(1.9459)
$YEAR3$	-51.2614	(-1.0385)
$YEAR4$	42.2481	(0.9261)

$LNIPOSZ$ is 3.2786 (2.4911), which indicates that firms with smaller IPO sizes tend to issue subsequent offerings more quickly than firms with larger IPO sizes.

To summarize, we find strong evidence from Chinese A-share data that supports the signaling models that link IPO underpricing to SEOs. We find that Chinese issuers who underprice their A-share IPOs more heavily are more likely to return to the secondary market more quickly and issue larger amounts of after-market equities. However, there is very weak evidence that supports Perotti's argument that IPO underpricing is best understood in the context of a model in which government signals commitment to a credible policy of pro-market privatization.

Hypothesis 3 *Lottery mechanism in share allocation contributes to high IPO underpricing.*

Five different offering mechanisms have been used in allocating A shares in China[8].

[8]These offering mechanisms are: lottery mechanism based on fixed amount of application forms,

A team of World Bank specialists argued that offering mechanism affects the degree of underpricing ("China: The Emerging Capital Markets" Vol. II, p. 96).

> ... the allocation mechanism adopted for the new share issue affects the degree of underpricing. Non-discretionary allocation of shares, by mechanisms such as a lottery, exacerbate the tendency to underprice.

However, we disagree with their assertion. According to the classical capital asset pricing model (CAPM), available information about a firm and the expected future payoffs affect an investor's demand for shares. The number of investors bidding for an IPO affects the overall demand for shares and therefore affects the degree of IPO underpricing, given the fixed IPO price and the amount of initial sale. Offering mechanisms designed to allocate oversubscribed shares do not affect the demand or the supply for new shares and therefore will not affect the IPO initial return.

Fortunately we are able to identify the offering mechanisms adopted by each individual firms at the time of A-share IPOs, so we test the hypothesis that that the mean A-share IPO initial returns for firms using lottery mechanism is higher than the mean A-share IPO initial returns for firms using other offering mechanisms, after controlling for variables such as the IPO size, the year of an IPO and the industry a firm belongs to.

We add to the benchmark regression (1) a dummy variable (LD) that takes value 1 if a firm uses a lottery mechanism in allocating A shares and 0 otherwise and estimate the model. We also examine the effects of five different kinds of offering mechanisms on A-share IPO initial returns by adding a set of offering mechanism dummies (OD) to (1) and estimate the regression coefficients again. The estimation results in table 10 show that none of the coefficients for LD and OD variables is statistically significant. Therefore, there is no evidence that offering mechanisms affect the degree of IPO underpricing, after controlling for other variables that affect IPO initial returns.

5 Underpricing of B-share IPOs

We now examine the underpricing of B-share IPOs using data for 57 firms that issued both A and B shares between February 1992 and January 1996. Table 11 presents the sample statistics for firms issuing both A and B shares. As noted in the data appendix, that the average degree of IPO initial returns is 37.13% for the 57 B shares

lottery mechanism based on unlimited amount of application forms, lottery mechanism based on certificate of deposit receipts, auction mechanism with quantity and price bids and auction mechanism with only quantity bids.

Table 10
OLS Regression Estimates for the Relationship Between IPO Underpricing and Offering Mechanisms

The dependent variable is the IPO initial return. In addition to the independent variables included in regression (1), the following dummy variables are added to test the hypothesis that offering mechanisms affect IPO underpricing: (i) LD, which takes value one if a firm uses lottery mechanism in allocating new shares and 0 otherwise; (ii) OD, set of five dummy variables representing the lottery mechanism with fixed number of application forms, the lottery mechanism with unlimited number of application forms, the lottery mechanism based on CD receipts, the auction mechanism with quantity and price bids and the auction mechanism with only quantity bids. Figures in parentheses are t-statistics and *, † denote 5% and 10% level of significance, respectively.

	Full sample		Sub-sample	
$RCPIPO$	22.972*	22.5151*	25.1338*	24.8412*
	(3.3954)	(3.2211)	(3.4378)	(3.2832)
$LNIPOSZ$	-5.0359*	-4.9117*	-4.1113†	-4.0008†
	(-2.4233)	(-2.3179)	(-1.7861)	(-1.7066)
$PROFSHA$	-4.1577	-4.0039	-4.3952	-4.1984
	(-1.4259)	(-1.3432)	(-1.3969)	(-1.2912)
$LNAGE$	2.3723	2.4539	2.5445	2.6041
	(1.3862)	(1.4143)	(1.3299)	(1.3412)
$LNTOSIZE$	10.0659*	10.044*	11.1622*	11.1502*
	(6.1827)	(6.1203)	(5.9363)	(5.8862)
$TIMEIPO$	-0.0172	-0.0175	-0.0141	-0.0144
	(-1.0136)	(-1.0268)	(-1.2722)	(-1.2822)
$SIC1$	7.8267†	7.8219†	9.9417†	9.9522†
	(1.7214)	(1.7114)	(1.9032)	(1.8937)
$SIC2$	10.7449*	10.6334*	14.1095*	13.9905*
	(2.155)	(2.1113)	(2.4526)	(2.4068)
$SIC3$–$SIC5$	estimation results not reported			
$YEAR1$	43.4031*	42.4265*	44.2613*	43.6987*
	(3.3404)	(3.185)	(3.2955)	(3.1926)
$YEAR2$–$YEAR5$	estimation results not reported			
LD	0.2502		0.4713	
	(0.0624)		(0.099)	
$OD1$		2.579		2.9664
		(0.3157)		(0.3088)
$OD2$		0.8813		1.7952
		(0.1312)		(0.2161)
$OD3$		2.5108		2.5531
		(0.3348)		(0.7778)
$OD4$		0.157		1.2298
		(0.0212)		(0.1319)
$\bar{R}^2$	0.3559	0.3498	0.3733	0.366

Table 11
Descriptive Statistics For Variables To Explain B-share IPO Initial Returns

Variable	Description	Mean	Median	Std. dev.	Minimum	Maximum
57 B-share IPOs						
$IPORETN$	IPO initial return	0.3713	0.2143	0.4755	-0.2114	2.3645
$RCPIPO$	reciprocal of IPO price	0.2825	0.2745	0.1293	0.0934	0.839
$LNIPOSZ$	logarithm of IPO size	9.7911	9.6897	0.8321	8.5156	11.9764
$LNTOSIZE$	logarithm of the sum of IPO and SEO sizes	10.553	10.3187	1.0204	8.5172	13.5174
$TIMEIPO$	time elapsed between offer and trade dates	71.807	44	81.98	6	348
$PROFSHA$	profit per share	0.2753	0.2141	0.1848	0.0864	0.8975
$LNAGE$	logarithm of firm's age	2.6598	2.3979	0.9521	0.6931	4.3307
$LNEMPLOY$	size of employee shares	5.7674	5.8295	0.6972	3.3322	7.1493
$LNGOVNT$	size of government shares	6.058	8.4683	4.5147	0	11.1125
$LNMKTCAP$	logarithm of firm's stock-market capitalization	11.0643	11.1175	1.0526	6.9078	13.0152
57 Corresponding A-share IPOs						
$IPORETN$	IPO initial return	8.3891	2.7059	12.27	0.0457	45.1429
$RCPIPO$	reciprocal of IPO price	0.2911	0.25	0.1956	0.0978	1
$LNIPOSZ$	logarithm of IPO size	9.1039	9.1844	0.7826	6.1137	10.7509
$LNTOSIZE$	logarithm of the sum of IPO and SEO sizes	11.14	11.2241	1.053	8.2941	13.0806
$TIMEIPO$	time elapsed between offer and trade dates	208.54	142	225.13	3	980

but is 838.91% for the corresponding 57 A shares. A further comparison of the sample statistics in tables 1 and 11 shows that, on average, firms issuing both A- and B shares initially price their A-shares higher than firms who raise equity capital only in China. The difference in average IPO underpricing raises two questions: First, why will a firm issue foreign-owned B shares? Second, what determines the differences in underpricing of these two classes of shares?

We believe that Chinese firms issue foreign-owned shares to: (1) obtain foreign capital that is otherwise difficult to get under government's foreign currency control regime; (2) expand markets for raising funds and enhance the reputation of the firm. Therefore, firms with larger stock-market capitalization and better performance in terms of higher profit per share are more likely to issue B shares than firms with smaller stock-market capitalization and smaller profit per share. A comparison of the sample statistics in table 11 with those for all firms issuing shares in table 1 shows that on average, Chinese firms that offer B shares are considerably larger in terms of total market capitalization; have higher profit per share; have larger total offerings of A shares; and price their A-share IPO's higher than the firms that have not offered B shares.

A convenient way to sort out the characteristics distinguishing Chinese firms that offer B shares from those of firms that offer only A shares is to estimate the following logit model, which we apply to all firms issuing A shares.

$$\begin{aligned} \ln\left(\frac{P_i^B}{1-P_i^B}\right) &= \phi_0 + \phi_1 LNIPOSZ_i + \phi_2 PROFSHA_i + \phi_3 LNAGE_i \\ &\quad + \phi_4 LNGOVNT_i + \phi_5 LNEMPLOY_i + \phi_6 LNMKTCAP_i \\ &\quad + \phi_7 TIMEIPO + \beta_K SIC(K) + \beta_T YEAR(T) + \varepsilon_i \end{aligned} \tag{9}$$

where P_i^B is the probability that the ith firm will issue B shares after it has offered A shares. $P_i^B = 1$ if firm i issues B shares and 0 otherwise.

The logit regression estimates presented in table 12 indicate that: (1) holding constant the firm's stock-market capitalization, the smaller the size of A-share IPO, the more likely the firm will issue B shares; (2) holding constant the IPO size, the larger the firm's stock-market capitalization, the more likely the firm will issue B shares; (3) the larger the profit per share, the more likely it will issue B shares; (4) the shorter the time elapsed between the announcement of A-share IPO and first-day trading, or the more efficient the firm's A-share IPO process, the more likely it will issue B shares.

One of the most interesting features distinguishing the IPO process for B shares from that of A shares is that lottery mechanism has never been used in allocating B shares. Moreover, foreign securities firms such as Sassoon and J. P. Morgan are allowed to participate in the B-share underwriting process. The IPO prices for B shares

Table 12

Logit Regression Estimates For The Probability A Firm Will Issue B-share

The dependent variable is the probability for the ith firm to issue B shares after it completes offering A shares (P_i^B). The independent variables are the logarithm of IPO size ($LNIPOSZ$), profit per share ($PROFSHA$), logarithm of the age of the firm ($LNAGE$), time elapsed between the offer date and the first trading date ($TIMEIPO$), logarithm of the size of government ownership ($LNGOVNT$), logarithm of the size of employee shares ($LNEMPLOY$), logarithm of the size of market capitalization ($LNMKTCAP$). We also allow the probability of issuing B shares to vary across industries ($SIC(K)$) and years ($YEAR(T)$). Figures in parentheses are asymptotic t-statistics. *, † denote 5% and 10% level of significance, respectively.

Variable	Coefficient	t-statistic
$LNIPOSZ$	-1.6*	(-5.945)
$PROFSHA$	1.4225*	(2.712)
$LNAGE$	-0.0848	(-0.634)
$LNGOVNT$	0.0326	(1.049)
$LNEMPLOY$	-0.0417	(-0.528)
$LNMKTCAP$	1.553*	(7.35)
$TIMEIPO$	-0.4212*	(-2.361)
$SIC1$	0.2871	(0.739)
$SIC2$	0.3098	(0.757)
$SIC3$	0.1711	(0.356)
$SIC4$	-0.0089	(-0.189)
$SIC5$	-0.1916	(-0.382)
$YEAR1$	3.0433*	(3.005)
$YEAR2$	3.4993*	(4.053)
$YEAR3$	2.9352*	(3.513)
$YEAR4$	2.1152*	(2.908)
$YEAR5$	1.0292	(1.312)

are announced approximately one month prior to the target market trading date and foreign investors are invited to bid for the quantity of shares they wish to purchase. The absence of lottery mechanisms for B shares indicates that in contrast to A shares, oversubscription is not a big problem in the new issue and offering process for B shares. There is no persistent excess demand for B shares by foreign investors at a "normal" price-earning ratio. Therefore, it is very likely that the difference in the average degree of underpricing between A and B shares can be explained by the differences in domestic and foreign investors' available investment opportunities as well as the differences in their investment sentiments.

Table 13 contains estimates of the augmented benchmark model (3) for 57 B-share IPOs. The OLS regression estimates in table 13 indicate that: (1) the smaller the B-share IPO price, the larger is the IPO initial return; (2) holding constant the size of the total B-share offering, the size of the initial offering does not significantly affect the B-share IPO initial returns; (3) holding constant the IPO size, the smaller the size of the total offering, the higher is the IPO initial return; (4) the size of government ownership and the size of employee shares do not seem to have affected the B-share IPO initial returns. (5) The IPO time trend variable remains significantly negative in the augmented benchmark model; (6)The stock-market capitalization-to-GDP ratio has no explanatory power for B-share IPO underpricing, as it does for A-shares. This contrast reinforces our maintained hypothesis that the stock-market capitalization-to-GDP ratio is a useful proxy for a shortage of stock-market investment opportunities for Chinese investors. Presumably, international investors face no such shortage and are thus not tempted to purchase Chinese stocks at extraordinarily high price-earnings ratios.

The results reported in table 13 contrast with those reported for A-shares in that neither class of the signaling models discussed in Section 4 appears capable of explaining the underpricing of B-share IPOs. Moreover, available information about the issuers, as reflected in past profit per share, is positively and significantly related to the IPO initial return. These two contrasts are consistent in the sense that both suggest foreign investors rely more on information gathered prior to purchasing shares than do domestic investors. A complementary explanation is that Chinese firms participating in both domestic and foreign share markets are those that can signal their quality through available information about their histories and performance and do not need to "signal" as strongly as firms participating only in domestic equity markets through the mechanism of underpricing their IPOs. A comparison of the A-share sample statistics in table 11 with those in table 1 show that the difference between the logarithms of total offering size and IPO size is 2.04 for the subsample of firms issuing B shares and only 1.70 for the entire sample of firms issuing both A-share IPOs and SEOs, while the mean IPO price for the subsample is more than a third higher than for the entire sample of firms that

make both IPOs and SEOs. These comparisons suggest that the subsample participating in international equity markets do not need to underprice their IPOs to the same extent as firms issuing only A shares to stimulate demand for their SEOs.

6 Conclusion

In this paper, we have empirically identified some causes of the cross-sectional differences in underpricing of Chinese IPOs using data compiled for 308 firm-commitment A-share IPOs and 57 B-share IPOs. We first formulate and estimate a benchmark empirical model that relates IPO initial returns to variables widely used in studies of IPO underpricing. Applying this model to A-share IPO data, we find that:

(1) IPO underpricing was largest at the earliest stage of development of stock markets in China.

(2) Available information about a firm at the time of IPO is not related to IPO underpricing.

(3) Time elapsed between the announcement of an IPO and the first-day market trading is not related to IPO underpricing.

(4) Durable and non-durable manufacture goods industries exhibit higher IPO underpricing than other industries.

After testing three hypotheses on the high A-share IPO underpricing in China, we find that:

(5) Underpricing of A-share IPOs has been at least partially due to a relatively small aggregate supply of equity instruments available to Chinese investors. This hypothesis is consistent with an international (negative) correlation between stock-market capitalization-to-GDP ratios and the average degree of IPO underpricing.

(6) Of the two classes of signaling models, the one linking SEOs to a process of equilibrium IPO underpricing appears to have greater explanatory power than that linking government or employee ownership to equilibrium IPO underpricing.

(7) Issuers with larger IPO underpricing are more likely to raise larger amounts of capital through SEOs and to do so more quickly. This is consistent with the hypothesis that the primary purpose for Chinese firms going public is to raise capital, not to transfer ownership.

Table 13

OLS Regression Estimates For The Augmented Benchmark Model For B-share IPOs

The dependent variable is the IPO initial return for B shares. The independent variables are the reciprocal of B-share IPO price ($RCPIPO$), logarithm of B-share IPO size ($LNIPOSZ$), profit per share ($PROFSHA$), logarithm of the age of the firm ($LNAGE$), logarithm of the size of the total B-share offerings ($LNTOSIZE$), time elapsed between the offer date and the first trading date for B shares ($TIMEIPO$), logarithm of the size of government ownership ($LNGOVNT$), logarithm of the size of employee shares ($LNEMPLOY$), logarithm of the size of market capitalization ($LNMKTCAP$), industry dummies ($SIC(K)$), IPO time trend ($TIME$) and firm's stock market capitalization to GDP ratio ($MKTGDP$). Figures in parentheses are t-statistics. *, † denote 5% and 10% level of significance, respectively.

Variable	Coefficient	t-statistic
$RCPIPO$	0.3115*	(3.5485)
$LNIPOSZ$	0.3819	(1.6074)
$LNTOSIZE$	-0.5218*	(-2.7239)
$PROFSHA$	1.5195*	(2.6405)
$LNAGE$	0.0575	(0.6938)
$TIMEIPO$	0.0787	(0.8451)
$LNGOVNT$	-0.0163	(-1.2421)
$LNEMPLOY$	-0.1703	(-1.2458)
$LNMKTCAP$	0.2065	(1.2889)
$TIME$	-0.381*	(-3.4102)
$MKTGDP$	0.0161	(0.693)
$SIC1$	-0.1722	(-0.7709)
$SIC2$	-0.4844*	(-2.0991)
$SIC3$	0.2159	(0.8232)
$SIC4$	0.1426	(0.52)
$SIC5$	0.248	(0.7991)
$\bar{R}^2$	0.3709	

(8) There is no evidence that various lottery mechanisms have contributed to the high A-share IPO underpricing in China.

When we apply our approach to the B-share data, we find that:

(9) The underpricing of B-share IPOs is on average much smaller than that of A shares. The difference in IPO underpricing among A and B shares can evidently be explained by the differences in domestic and foreign investors' investment opportunities.

(10) Traditional signaling equilibrium models for IPO underpricing do not explain differences in B-share IPO initial returns. Instead, past information about the issuers have better explanatory power. We take this as evidence that international investors in Chinese equities rely more on prior acquisition of information than do Chinese domestic investors. Perhaps this is because the current sample of international investors in Chinese equities is heavily weighted with experienced, professional investors, while the vast majority of Chinese investors in A shares are inexperienced in equity markets.

We have offered explanations of the extraordinarily high IPO underpricing that characterizes the Chinese stock markets in this paper. However, a rigorous test of the hypothesis that the differences in underpricing between two classes of shares can be explained by differences in investors' investment opportunity sets and differences in their methods of formulating expected returns on investments requires explicit modeling of firms' share supply decisions and investors' portfolio choices. Moreover we have not considered possible rent-seeking behavior by the government or individuals who have access to the limited quota during the new-issue and offering process. These fascinating problems await further research.

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Appendix 1: Data Description

The data used to analyze the distribution of initial returns consists of all the firm-commitment IPOs of common stocks occurring between December 1986 and January 1996[9]. There are 308 A-share IPOs in the full sample. A sub-sample of 268 IPOs between December 1986 and January 1996 is extracted from the full sample to allow studies on IPO underpricing and SEOs. Another sub-sample of 57 firms that issued both A and B shares are also taken out to allow studies on the differences in underpricing among A and B shares.

Returns are measured as $\frac{P_t - P_{op}}{P_{op}}$, where P_t is the market price at time t and P_{op} is the offering price. Table A1 presents the descriptive statistics for variables representing after-market one-day returns ($IPORETN$, defined as the difference between the first-day market closing price and the IPO price divided by the IPO price), after-market one-week returns ($IPORETN1$), after-market two-week returns ($IPORETN2$) and after-market four-week returns ($IPORETN3$). The results in table A1 show that IPO returns remain high and are invariant to the way they are measured.

Figure 1A is the histogram of the cross-sectional distribution of the after-market one-day returns for 308 firm-commitment IPOs. As shown in the figure, about 6 IPOs have initial returns above 5000%. Figures 1B and 1C are the histograms of the cross-sectional distribution of the after-market one-day returns and after-market four-week returns after eliminating the outliers. A comparison of both figures indicates that the distributions of after-market one-day IPO returns and after-market four-week IPO returns are very similar.

All of our data come from Shanghai Shenyin-International Securities, Xiamen Branch, from the Chinese Stocks and Futures Encyclopedia published by Shanghai Xian Zi Information Co., Ltd. and from various copies of annual reports of Shanghai and Shenzhen securities exchanges.

[9]Since some companies used private placement in issuing stocks before "Corporate Law" was implemented on December 29, 1993, we discard those stocks from the sample.

Table A1

Descriptive Statistics For Variables Representing IPO Returns

Variable	Description	Mean	Median	Std. dev.	Min.	Max.
Full Sample, between December 1986 and January 1996						
IPORETN	after-market one-day return	9.4859	2.3125	29.6766	-0.1858	383
IPORETN1	after-market one-week return	9.5098	2.2199	34.9891	-0.1764	489.2
IPORETN2	after-market two-week return	9.559	2.2	35.7948	-0.2795	504.1
IPORETN3	after-market four-week return	8.9839	2.0386	36.6929	-0.4205	524.7
Sub-sample, between December 1986 and June 1994						
IPORETN	after-market one-day return	10.431	2.7124	31.6625	-0.1	383
IPORETN1	after-market one-week return	10.5117	2.5368	37.3834	-0.1744	489.2
IPORETN2	after-market two-week return	10.586	2.5159	38.2476	-0.2795	504.1
IPORETN3	after-market four-week return	9.9394	2.2821	39.2312	-0.4205	524.7
Sub-sample, 57 firms that issue both A and B shares						
IPORETN (B)	after-market one-day return	0.3713	0.2143	0.4755	-0.2114	2.3645
IPORETN1 (B)	after-market one-week return	0.3319	0.1976	0.4869	-0.2577	2.2243
IPORETN2 (B)	after-market two-week return	0.31	0.1919	0.502	-0.5187	1.8855
IPORETN3 (B)	after-market four-week return	0.356	0.1852	0.5824	-0.4538	1.9434
Sub-sample, 57 firms that issue both A and B shares						
IPORETN (A)	after-market one-day return	8.3891	2.7059	12.27	0.0457	45.1429
IPORETN1 (A)	after-market one-week return	7.5239	2.76	11.372	0.0217	52
IPORETN2 (A)	after-market two-week return	7.9227	2.775	11.6729	-0.0196	48.1
IPORETN3 (A)	after-market four-week return	7.3428	2.53	10.6262	-0.087	45.375