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ORIGINAL RESEARCH

Chinese IPO activity, pricing, and market cycles

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Abstract We examine the activity, pricing, and market cycles of 1,380 Chinese A share IPOs over the period 1991–2005 and find initial underpricing of 238%. The government restrictions on IPO offer price and quota allocation cause pricing structural breaks and attribute more than half of initial underpricing. A multifactor model that includes firm's characteristics, excess demand for IPO shares, and the government restrictions explains cross-sectional initial returns, after controlling for industrial differences and stock market conditions. In addition, monthly IPO volume and average initial return are highly correlated. A VAR model indicates that initial return leads IPO volume by 6 months.

Keywords Chinese A share IPOs · Government restrictions · Initial underpricing · Cross-sectional analysis · IPO market cycles

JEL Classification G11 · G12 · G15

1 Introduction

Over the 14-year period from the second half of 1991 to the first half of 2005, the average number of Chinese A share initial public offerings (IPOs) was close to 100 issues per year.[1]

[1] There are two types of stocks in China. The A shares are denoted in Chinese currency for domestic investors and the B shares are denoted in U.S. or Hong Kong dollars for foreign investors. Since February 2001, Chinese investors can invest in B shares with foreign currencies. This paper focuses on the A share IPO market since it is much larger and more active than the B share IPO market. Chinese A share IPO activity started in the second half of 1991 and it was temperately suspended in the second half of 2005. The activity was resumed in May 2006.

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Those IPOs raised 546 billion Yuan ($80 billion) in gross proceeds, an average of 396 million Yuan ($58 million) per deal, earned an average initial return of 238.0%, and left 649 billion Yuan ($95 billion) on the table, where Yuan is the unit of Chinese currency with an exchange rate currently around 6.85 Yuan per dollar.[2] However, many Chinese IPO phenomena are not stationary. The IPO volume changes from year to year, with some years seeing more than 200 and some years seeing fewer than 30. The average initial return fluctuates significantly over time, ranging from 45.1% in 2005 to 609.4% in 1995. It also varies with firm characteristics, such as firm age, board size, offer price, and offer size.

For example, the average initial return varies from 164.3% for IPOs with firm age between 2 and 4 years to 525.5% for those with firm age between 6 and 8 years. It also fluctuates with board size, ranging from 203.9% for IPOs with board size between 11 and 13 to 495.0% for those with board size more than 16. The difference in initial return is more pronounced across IPO offer price, varying from 120.3% for IPOs with offer price between 5 and 7 Yuan to 1,310.9% for those with offer price of 1 Yuan. The difference in initial return is also substantial over offer size, ranging from 103.0% for IPOs with offer size over 464 million Yuan to 661.9% for those with offer size less than 98 million Yuan.

In addition to initial return variability over time and across firm characteristics, there exist structural breaks in pricing Chinese IPOs due to government restrictions on how to set offer price and how to allocate IPO quota across different industries and regions. As a result, the average initial return over the period 1991–1998 is 319.9% when the government used a target P/E ratio of 15 to price Chinese IPOs. It drops to 120.5% during the period 1999–2005 after the government raised the target P/E ratio to 20 to price IPOs. Similarly, the average initial return is 278.6% over the period 1991–2000 when the government adopted a quota system that limits the number of IPOs from different industries and geographical regions to balance the industrial and regional development in China. It falls to 109.8% during the period 2001–2005 after the Chinese government replaced the quota system with a verification system. The new system provides investment bankers opportunity to recommend qualified firms to the China Securities Regulatory Commission (CSRC) for IPO approval with less considerations on balancing the industrial and regional development.

Some of the results found in this paper are consistent with previous findings. Using U.S. IPO data over the period 1980–2001, Ritter and Welch (2002) report average initial underpricing of 18.8%.[3] They also find that many phenomena in the U.S. IPO market are not stationary. The average initial return varies over time and across firm characteristics. But some of the results are different. For example, Loughran and Ritter (2004) find that there is more initial underpricing for young firms than old firms in the U.S. IPO market as young firms typically carry higher level of uncertainty. However, it is found that old firms are more underpriced in the Chinese IPO market than young firms, resulting from the P/E ratio approach that the CSRC used to price IPOs. Under the P/E ratio approach, firms with different risks are priced using the same P/E multiple. Since old firms usually carry lower level of risks than young firms that leads to more underpricing for old firms.

[2] Gross proceeds and money left on the table are not adjusted for inflation.

[3] Ritter and Welch (2002) exclude bank IPOs and IPOs with an offer price less than $5.00. In this study, we include all IPOs for several reasons. First, we would like to examine the IPO activity for the entire sample and compare the results with those from earlier studies that use smaller samples. Second, there are 9 bank IPOs and 102 IPOs with an offer price of one Yuan (the lowest offer price), which is about 8% of the entire sample. Third, the offer price in China is generally low. Nevertheless, we redo the analysis after excluding bank IPOs and IPOs with an offer price of one Yuan and find that the average initial return drops to 151.8% from 238.0%. Other results remain similar.

In addition to studying the U.S. and other developed IPO markets, researchers also study the IPO performance in emerging markets. Loughran et al. (1994), among others, all report more severe initial underpricing in emerging markets, with the Chinese IPO market providing the highest average initial return of around 250%.[4] With mainly earlier data and smaller sample sizes, Mok and Hui (1998), Chan et al. (2004), and Chi and Padgett (2005) study the Chinese IPO market and report severe initial underpricing for Chinese A share IPOs.

Other than examining IPO activity, researchers focus on IPO market cycles by studying the relationship between IPO volume and average initial return. With U.S. IPO data, Ibbotson et al. (1988, 1994) document, and Lowry and Schwert (2002) confirm, that there exist pronounced market cycles between IPO volume and average initial return. Monthly average initial return tends to lead IPO volume, suggesting that more firms tend to go public after periods of high initial returns.

In this paper, we examine an up-to-date and more complete database, which provides opportunity to study and compare the initial IPO performance over a longer time horizon and across stock market cycles, industries, and firm characteristics. Furthermore, to our knowledge, this is the first attempt to investigate the influence of government restrictions and to estimate the impact of them on Chinese IPO pricing. It is also the first time to examine structural breaks in pricing Chinese IPOs. We propose a multifactor model that includes firm age as a proxy for IPO quality (risk), board size for corporate governance, offer price for IPO allocation and excess demand, offer size for firm size, along with government restrictions and find that it explains cross-sectional initial returns, after controlling industrial differences and stock market cycles.

In addition, we examine the relationship between average initial return and IPO volume for the Chinese IPO market that has never been explored before. With ± 12 month lags, we find that monthly IPO volume and average initial return are highly correlated, with average initial return leading IPO volume. Using a vector autoregressive (VAR) model, we further estimate the lead-lag relationship and confirm that average initial return leads IPO volume by 6 months.

It is particularly interesting and important to study the behavior of Chinese IPO market as Chinese financial markets have been growing rapidly over the past two decades and becoming an important part of the global financial system. China has become the world's biggest manufacturer and soon it could be the world's biggest generator of IPOs. Chinese entrepreneurs are turning their wealth made in manufacturing into new companies, and China already rivals the U.S. and Japan for spending on research and development (R&D). Those investments in R&D are leading to new companies in different industries, such as biotech, computer tech, and a number of other functional areas. Those new companies are picking the Shanghai or Shenzhen Stock Exchange to go public. The Shanghai Stock Exchange raised $11.9 billion from Chinese A share IPOs during the second half of 2006, following a temporary 1-year suspension of IPO activity from the second half of 2005 to the first half of 2006.[5] Capital raised by new listings in China exceeded $50 billion in 2007, putting China on top of the world's leading center for public offerings in 2007.

[4] It is an updated version of the information contained in Loughran et al. (1994), obtained from Ritter's website.

[5] Majority of Chinese A share IPOs are partial privatisation IPOs over the sample period. In general, there are three major groups of shareholders for each A share IPO: the government and its agency, other legal entities that include institutional investors, and individual investors, each with about one-third of the holdings. Only shares issued to individual investors are floating in the open market for trading. To increase liquidity in the Chinese stock market, China suspended its IPO activity for 1 year to reform the IPO procedure by revising its Securities Law and Corporate Law. Under the revised laws, all public shares issued domestically will be tradable after a certain period set by the CSRC, starting from May 2006 when China resumed its IPO activity.

The popularity of local stock markets for new offerings has made exchange managers in the world nervous that they may no longer benefit from hosting Chinese IPOs. Since Chinese IPOs tend to provide extremely high initial returns those IPOs have become hot issues in the market. Many exchanges and leading brokerage firms in the world are competing for business associated with Chinese IPOs. As a result, understanding Chinese IPO activity, pricing, and market cycles should provide valuable insights to all interested parties, including U.S. brokerage firms and investors. The results found in this study should help U.S. brokerage firms better set up their strategies to compete with other exchanges for Chinese IPO business and should provide U.S. investors additional investment opportunities to enhance their portfolio performance. This study serves for that purpose.

The rest of the paper is organized as follows. Section 2 provides background information on the Chinese IPO market. Section 3 discusses the data set. Section 4 presents the methodology and proposes a multifactor model. Section 5 offers empirical results and Section 6 concludes.

2 Features of Chinese IPO market

Chinese stock markets were established in the early 1990s as part of the economic reform to provide state-owned enterprises (SOE) with new financing channels to raise capital through partially privatizing their ownerships. A SOE can issue both A share and B share stocks with equal voting rights and dividends even though the B shares were traded at a huge discount until early 2001, due to less demand, low liquidity, and asymmetric information (Chan et al. 2008), resulting from entry barriers for Chinese investors. The price gap between A shares and B shares of the same company has narrowed quickly since February 2001 after Chinese investors are allowed to invest in B shares with foreign currencies.

Similar to the roles that the Securities Exchange Commission (SEC) plays in the U.S. IPO market, the CSRC regulates and approves all IPOs in China. The CSRC's approval is based on a set of criteria, including geographical and regional considerations, industrial development and balance, company's characteristics and financial performance, and market conditions. In principle, a company with strong past financial results has a higher probability to get approved.

Unlike the U.S. IPO market where investment bankers help an IPO firm determine the offer price through a discretionary book building procedure to allocate initial shares (Su and Fleisher 1999, Sherman 2000), the CSRC restricts Chinese IPOs in offer price and allocation quota across different industries and regions. The offer price for a Chinese IPO is determined by a preset P/E ratio formula by the CSRC. This ratio was set to 15 over the period 1991–1998. Since 1999 the CSRC has raised the target P/E ratio to 20 when pricing new IPOs. As a result, the average initial return is significantly different over the two sub-periods, reflecting the impact on initial pricing from the government restriction on offer price.

Even within the same time period, the P/E ratio approach restricts IPO firms with lower risks to charge higher offer prices relative to IPO firms with higher risks, leading to more severe underpricing for those IPO firms. Similarly, the quota system during the period 1991–2000 contributes to initial underpricing. Even though the CSRC adopted the verification system since 2001 the target P/E ratio approach remains as the dominant approach to price Chinese IPOs by investment bankers. The CSRC still controls the timing of IPOs.

Compared to the discretionary book building procedure to allocate majority of U.S. IPO shares, IPO shares in China are allocated through open bid with a lottery system. When bidding for an IPO starts a potential investor can bid for shares at the offer price in a multiple of one thousand, the minimum bidding size, through a participating investment banker where the investor keeps an account with enough cash. Every time, the investor bids for one thousand shares she receives a number that enters the lottery drawing after the bidding process ends. The chance of winning a lottery varies within the range from hundredths (1/100) to ten thousandths (1/10,000), depending on the number of shares an IPO offers and the amount of shares demanded in the bidding process. The chance of winning the lottery with an average IPO size and a normal demand is usually in the range of thousandths (1/1,000).

3 Data set

The entire sample comprises 1,380 Chinese A share IPOs initiated at the Shanghai and Shenzhen Stock Exchanges over the period July 1991 to June 2005.[6] The main data sets include the Chinese IPO Research (CIPO) data set and Chinese Stock Market and Accounting Research (CSMAR) data set. In addition to examining the IPO performance each year and over the entire sample, we also study the performance over various sub-periods. Two sub-periods are separated by time when different target P/E ratios are used by the CSRC to price Chinese IPOs, comprising 813 IPOs from 1991 to 1998 when the target P/E ratio was set at 15 and 567 IPOs from 1999 to 2005 when the target P/E ratio was raised to 20. Other two sub-periods are divided also by time when different methods are used by the CSRC to allocate IPOs, containing 1,048 IPOs from 1991 to 2000 when a quota system was in place and 332 IPOs from 2001 to 2005 after the quota system was replaced by a verification system.

In order to investigate IPO performance over stock market cycles, we further divide the entire sample into two sub-samples by stock market conditions: IPOs initiated either during rising or declining stock markets. We define a rising stock market as one in which the A share index rises by 30% or more from its previous low or a declining stock market where the index drops by 30% or more from its previous high, using ex post daily A share closing indices and returns from the Shanghai and Shenzhen Stock Exchanges respectively.[7] There are 754 IPOs initiated during rising stock markets (54.6% of the entire sample) and 626 IPOs issued during declining stock markets (45.4% of the entire sample).

To examine the impact of industrial differences on initial IPO pricing, we further separate the entire sample into six sub-samples according to each IPO's industrial code reported in the CIPO data set. Those codes are 1 for finance, 2 for utility, 3 for property, 4 for conglomerate, 5 for industrial, and 6 for commerce. Finally, to investigate the impact of firm characteristics on IPO pricing, we separate the entire sample according to firm characteristics, such as firm age, board size, offer price, and offer size. Specifically, we form six groups based on firm age, the time a firm has been in business before going public, obtained from the CIPO data set. Those firm age groups vary in business experience from less than a year for the youngest group to greater or equal to 8 years for the oldest group. We form five groups based on firm's board size, recorded in the CIPO data set, ranging from less than eight in the smallest board group to more than sixteen in the largest board group. We construct six groups according to offer price, ranging from 1 Yuan in the lowest

[6] The Shanghai Stock Exchange was established in late 1990 and initiated 829 A share IPOs while the Shenzhen Stock Exchange was founded in mid 1991 and initiated 551 A share IPOs, over the sample period.

[7] We extend the data to June 2006 when determining stock market cycles in late 2005. The 30% rise or drop to define stock market cycles is arbitrary. We also tried 20%, a typical definition for a bear market, and found similar results. The detailed decomposition of stock market cycles is available from the authors upon request.

offer price group to more than 10 Yuan in the highest offer price group. We form five groups based on offer size, varying from less than 98 million Yuan per deal in the smallest offer size group to more than 464 million Yuan in the largest offer size group.

4 Methodology

Consider IPO i going public on date 1 with an offer price $P_{i,0}$. The initial return is given by

$$R_{i,1} = \left(\frac{P_{i,1}}{P_{i,0}}\right) - 1, \tag{1}$$

where $P_{i,1}$ is the first day closing price of the IPO. The return on a market index on the same day, $R_{m,1}$, can be calculated similarly. The market adjusted initial return for IPO i is the difference of $R_{i,1}$ and $R_{m,1}$. If IPO i is initiated at the Shanghai Stock Exchange, $R_{m,1}$ will be the return of the value-weighted A share stock index at the Shanghai Stock Exchange. If IPO i is initiated at the Shenzhen Stock Exchange, $R_{m,1}$ will be the return of the value-weighted A share stock index at the Shenzhen Stock Exchange.

The equally weighted initial return of N IPOs is calculated by

$$\mathrm{EWIR}_1 = \frac{1}{N}\sum_{i=1}^{N} R_{i,1}, \tag{2}$$

and the equally weighted and market-adjusted initial return of N IPOs is given by

$$\mathrm{EWIRMA}_1 = \frac{1}{N}\sum_{i=1}^{N} \left(R_{i,1} - R_{m,1}\right). \tag{3}$$

We report EWIR_1 and EWIRMA_1 in Table 1.[8]

What are the factors that explain severe initial underpricing in the Chinese IPO market? Previous studies suggest that government restrictions, share allocation, corporate governance, IPO quality, and firm characteristics are important factors. For example, Loughran et al. (1994) indicate that government restrictions may cause severe initial underpricing, which certainly applies to A share IPO offerings in China. As a result, we include two government restrictions in the proposed multifactor model. The first restriction is the P/E ratio to determine offer price. The second restriction is the quota system. We expect that both restrictions attribute to initial underpricing.

Share allocation focuses on the demand and supply sides of IPOs, which affects IPO pricing (Aggarwal 2000). Since Chinese IPOs are allocated through an online lottery system the demand for new issues usually exceeds the supply by a big margin for several reasons. The first reason is that after experiencing two decades of fast growing economy some Chinese are rich. Purchasing IPO shares certainly becomes a top investment choice for them. The second reason is that other investment alternatives are limited. The third reason is that the initial investment in an IPO is typically small given that the offer price is usually low in China. That means that many Chinese investors can afford such an investment. Since demand for IPOs is price sensitive around the auction clearing price, as

[8] There is a double counting issue in calculating the market adjusted average initial return since an IPO sometimes can be a component of the market index. This bias is more pronounced when the overall market capitalization is small relative to the size of the IPO. To reduce this bias, China has announced in 2007 that returns on the first ten trading days from IPOs will not be included in calculating any market index returns.

Table 1 Summary statistics of Chinese A Share IPOs, July 1991 to June 2005

	# of IPOs	Firm age	Board size	Offer price	Offer size	Gross proceeds	Money on table	$EWIR_1$	$EWIRMA_1$
Time									
1991	4	3.64	8.50	3.75	56	225	333	403.7	n.a.
1992	39	2.14	10.00	25.88	510	19,899	36,250	413.4	n.a.
1993	123	2.05	9.69	14.16	340	41,773	147,917	520.0	519.9
1994	110	2.30	9.75	5.14	151	16,580	23,237	165.6	165.5
1995	24	5.08	9.75	3.20	99	2,368	4,997	609.4	610.2
1996	202	3.19	9.69	5.09	110	22,148	30,056	301.2	300.8
1997	206	5.89	9.72	5.90	300	61,879	83,037	266.0	266.4
1998	105	3.09	9.80	5.12	384	40,282	41,471	285.1	285.4
1999	98	2.44	9.61	6.20	515	50,503	46,866	114.2	114.0
2000	137	3.21	9.35	8.25	623	85,383	98,732	150.8	150.7
2001	79	3.92	9.35	9.80	777	61,417	48,596	169.7	169.8
2002	71	4.50	10.04	7.10	752	53,418	37,828	148.6	148.8
2003	67	4.65	10.42	7.33	705	47,242	23,760	72.0	71.9
2004	100	5.54	10.27	8.50	378	37,828	23,580	70.1	70.5
2005	15	5.45	10.06	6.65	351	5,269	2,790	45.1	45.8
1991–2005	1380	3.24	9.74	7.71	395	546,215	649,452	238.0	232.5
1993–2005	1337	3.27	9.75	7.20	393	526,090	612,868	232.4	232.5
Government restrictions									
1991–1998 (P/E = 15)	813	2.72	9.70	7.61	252	205,154	367,298	319.9	314.9
1999–2005 (P/E = 20)	567	3.98	9.79	7.86	601	341,061	282,153	120.5	120.6
1991–2000 (quota)	1048	2.76	9.65	7.56	325	341,040	512,897	278.6	272.9
2001–2005 (verification)	332	4.75	10.02	8.19	618	205,175	136,555	109.8	109.9

Table 1 continued

	# of IPOs	Firm age	Board size	Offer price	Offer size	Gross proceeds	Money on table	$EWIR_1$	$EWIRMA_1$
Stock market cycles									
Rising markets	754	3.11	9.66	7.72	392	295,666	402,396	233.2	229.4
Declining markets	626	3.38	9.83	7.70	400	250,549	247,056	243.8	236.3
Industry									
Finance	9	6.25	14.89	12.77	3,090	27,814	23,066	227.7	226.8
Utility	98	3.59	10.34	7.47	697	68,312	107,918	256.9	255.0
Property	42	4.08	8.26	11.00	300	12,610	30,955	402.6	324.4
Conglomerate	244	3.42	9.58	7.28	331	80,754	109,740	260.2	258.5
Industrial	880	3.11	9.77	7.57	383	337,411	337,056	211.0	206.8
Commerce	107	2.97	9.45	8.45	180	19,312	40,715	328.0	330.4
Firm age (years)									
Firm age < 1	428	0.29	9.48	9.62	479	204,887	304,749	182.0	168.1
1 ≤ Firm age < 2	217	1.68	9.94	7.35	495	107,520	95,261	169.8	169.9
2 ≤ Firm age < 4	357	3.33	9.84	6.84	274	96,508	100,541	164.3	157.1
4 ≤ Firm age < 6	159	5.30	9.66	7.45	318	50,607	61,755	295.8	291.4
6 ≤ Firm age < 8	113	7.21	10.16	5.76	384	43,356	51,623	525.5	527.4
8 ≤ Firm age	106	10.68	9.64	6.22	398	42,187	34,607	459.0	466.3
Board size (members)									
Board size ≤ 7	338	2.96	6.55	7.81	299	101,016	128,794	254.0	246.1
8 ≤ Board size ≤ 10	545	3.46	9.01	7.60	410	223,560	282,895	218.3	212.3
11 ≤ Board size ≤ 13	373	3.04	11.59	7.61	388	144,563	161,725	203.9	201.6
14 ≤ Board size ≤ 16	78	3.31	14.92	7.70	478	37,793	33,101	319.8	313.0
Board size ≥ 17	45	4.01	17.84	9.37	873	39,282	42,937	495.0	494.6

Table 1 continued

	# of IPOs	Firm age	Board size	Offer price	Offer size	Gross proceeds	Money on table	$EWIR_1$	$EWIRMA_1$
Offer price (Yuan)									
Offer price = 1	102	6.69	10.17	1.00	23	2,352	33,556	1,310.9	1,3347
1 < Offer price ≤ 3	63	3.57	9.44	2.28	457	28,773	32,010	410.3	386.8
3 < Offer price ≤ 5	314	2.58	9.74	4.22	341	107,223	9,1662	146.0	144.8
5 < Offer price ≤ 7	456	2.67	9.72	6.03	363	165,451	162,011	120.3	120.3
7 < Offer price ≤ 10	277	3.46	9.74	8.28	479	132,675	136,803	127.5	120.5
Offer price > 10	168	3.40	9.59	24.00	653	109,742	193,409	195.4	201.3
Offer size (mil. Yuan)									
Offer size < 98	276	4.22	9.50	5.10	48	13,153	49,990	661.9	664.2
98 ≤ Offer size < 186	276	2.46	9.52	6.75	139	38,408	60,673	163.6	149.2
186 ≤ Offer size < 297	276	3.19	9.66	7.04	240	66,263	85,319	128.9	128.7
297 ≤ Offer size < 464	276	3.37	9.75	8.43	370	102,312	135,295	132.6	130.1
Offer size ≥ 464	276	2.93	10.26	11.25	1,181	326,077	318,173	103.0	103.0

The table reports descriptive statistics on the number of IPOs, average firm age (in years), board size (in number of people), offer price (in Yuan), offer size, aggregate gross proceeds, money left on the table (all in millions of Yuan), and equally weighted initial returns without and with the market adjustment ($EWIR_1$ and $EWIRMA_1$ in percentages) by time, government restrictions, stock market cycles, industry, firm age, board size, offer price, and offer size for 1,380 Chinese A share IPOs over the period from July 1991 to June 2005. Since the market indices in China are not fully available until 1993 the table reports $EWIRMA_1$ based on 1,337 Chinese A share IPOs from 1993 to 2005 documented by Kandel et al. (1999), low offer price stimulates high demand for new shares and causes more severe initial underpricing. To incorporate that effect, we include offer price in the regression model. We expect that low offer price should stimulate high demand for IPO shares, resulting in high initial returns.

It is well documented that corporate governance affects asset return and firm value. In a recent study, Wang (2005) finds that ownership structure affects the performance of Chinese A share IPOs. Another study by Coles et al. (2008) finds a U-shaped relationship between firm value and board size. Complex firms tend to have larger boards, including more outsiders. Tobin's Q, defined as the ratio of market value of assets to book value of assets, is higher for those firms, indicating a better performance. On the other hand, small and simple firms with smaller boards also have higher Q values, showing small size efficiency. In this study, we use board size as a proxy for corporate governance and include it in the regression model. We expect that large board size should represent better corporate governance and thus higher initial returns, except for small and simple firms where smaller boards may lead to higher efficiency.

For IPO quality, we use firm age to proxy. In the U.S. IPO market, underpricing is lower for older firms since older firms usually carry lower risks, therefore, lower expected returns. However, the government restriction on pricing IPOs in China sets offer price for all IPOs using the same P/E multiple. Since older firms are less risky, this pricing approach will lead to more severe initial underpricing for older firms, relative to younger firms that carry higher risks. To investigate the impact of IPO quality on initial IPO pricing, we include firm age in the regression model. We expect that older firms with lower risks should have higher initial returns.

Banz (1981) documents the size effect in asset pricing, Fama and French (1993) identify and estimate the effect in their factor models, and other researchers confirm that firm size is an important factor in explaining cross-sectional asset returns. Consequently, we use offer size as a proxy for firm size and include it in the regression model. We expect that IPOs with small offer size should behave similarly to small size firms to earn higher initial returns.

To examine the initial IPO pricing, we propose the following cross-sectional multifactor model:

$$R_i = \alpha_i + \beta_{\text{Age}}\left(\frac{A_i - \bar{A}}{\bar{A}}\right) + \beta_{\text{Board}}\left(\frac{B_i - \bar{B}}{\bar{B}}\right) + \beta_{\text{Price}}\left(\frac{P_i - \bar{P}}{\bar{P}}\right) + \beta_{\text{Size}}\left(\frac{S_i - \bar{S}}{\bar{S}}\right) + \sum_{j=1}^{5}\gamma_j D_{i,j} + \sum_{j=1}^{3}\lambda_j Q_{i,j} + \varepsilon_i, \tag{4}$$

where R_i is the initial return of IPO i measured in decimal,[9] α_i is the intercept or the average initial return if all the explanatory variables are zero, A_i is the firm age of IPO i measured in years, $\bar{A}$ is the average age of all IPOs in the sample period when IPO i is initiated, and $\frac{A_i - \bar{A}}{\bar{A}}$ is the percentage change in firm age for IPO i relative to the average age of all IPOs in the same sample period, and β_{Age} is the age sensitivity.[10] Analogously, B_i, P_i,

[9] Traditional factor models use excess returns along with a market factor. Since the risk-free rate and daily index returns are very low during the sample period relative to IPO initial returns, it doesn't make a meaningful difference if excess returns are used, along with a market factor. Nevertheless, we redo the analysis using excess returns along with a market factor and find that the main results don't change.

[10] We use the percentage change in firm age to normalize the unit. For example, if A_i is 6 years, $\bar{A}$ is 5 years, and β_{Age} is 1.20, then IPO i should earn an additional 24% initial return, compared to an IPO with firm age of 5 in the same sample period, keeping other things constant. Similar arguments apply to the percentage changes in board size, offer price, and offer size.

and S_i are the board size, offer price, and offer size for IPO i, $\bar{B}, \bar{P}$, and $\bar{S}$ are the average board size, offer price, and offer size for all IPOs in the sample period when IPO i is initiated, $\frac{B_i-\bar{B}}{\bar{B}}, \frac{P_i-\bar{P}}{\bar{P}}$, and $\frac{S_i-\bar{S}}{\bar{S}}$ are the percentage changes in board size, offer price, and offer size of IPO i relative to the averages of all IPOs within the same sample period, and β_{Board}, β_{Price}, and β_{Size} are the sensitivities of board size, offer price, and offer size.

The first set of dummies, $D_{i,j}$, captures differences in initial returns from six industrial groups; it is one if IPO i belongs to industry j and it is zero otherwise, and γ_j is the estimated coefficient with $j = 1$ for finance, 2 for utility, 3 for property, 4 for conglomerate, and 5 for industrial. The second set of dummies, $Q_{i,j}$, catches the impact of stock market cycles and government restrictions on initial IPO pricing; it is one if IPO i is initiated during rising stock markets and is zero otherwise; it is one if a target P/E ratio of 15 is used to price IPO i and is zero otherwise; and it is one if the quota system is in place when IPO i is initiated and is zero otherwise. Specifically, λ_1 is associated with rising stock markets, λ_2 is tied to the restriction of using a target P/E ratio of 15, and λ_3 is connected to the quota system. Since we expect that government restrictions attribute to initial underpricing, λ_2 and λ_3 should be positive and significant.

Traditional factor models require that all explanatory variables are not correlated with each other to avoid multicollinearity. To consider possible correlations between firm age, board size, offer price, and offer size in regression (4), we estimate the correlation matrix and provide the result in Table 2. We then run regression (4), using the entire sample with both sets of dummies to estimate cross-sectional IPO pricing. We repeat regression (4) multiple times to estimate the impact of government restrictions on initial underpricing.

To examine structural breaks resulting from government restrictions on initial IPO pricing, we perform the Chow test. Specifically, We repeat regression (4) without the government restriction dummies to obtain sum of squared residuals for the entire sample (RSS), for the two sub-periods from 1991 to 1998 (RSS_1) and from 1999 to 2005 (RSS_2) to test whether there exists a structural break in initial IPO pricing caused by the government restriction of using different P/E ratios in those two sub-periods to price IPOs. The F-test statistic is given by

$$F = \frac{[\text{RSS} - (\text{RSS}_1 + \text{RSS}_2)]/k}{(\text{RSS}_1 + \text{RSS}_2)/(n - 2k)} \sim F(k, n - 2k), \tag{5}$$

where n is the number of observations and k is the number of regressors. Intuitively, a large difference between RSS and the sum of RSS_1 and RSS_2 indicates a structural break. Similarly, we repeat the Chow test to detect whether a switch from the quota system over the period 1991–2000 to the verification system over the period 2001–2005 causes another structural break in initial IPO pricing. To examine the initial IPO pricing over stock market

Table 2 Correlation matrix

1991–2005: 1,380 IPOs	Firm age	Board size	Offer price	Offer size
Firm age	1.00	0.02	−0.10*	−0.03
Board size		1.00	0.01	0.12*
Offer price			1.00	0.13*
Offer size				1.00

The table reports the correlation between four explanatory variables, firm age, board size, offer price, and offer size used in regression (4) for 1,380 Chinese A share IPOs over the entire sample period from July 1991 to June 2005. We use * to indicate significance at the 5% level cycles, we repeat regression (4) using IPOs issued during rising or declining stock markets separately. We report the regression results and F-test results in Table 3.

IPO market cycles have been recognized in financial literature for quite a while. Ibbotson and Jaffe (1975), Ibbotson et al. (1988, 1994), and Lowry and Schwert (2002) all report pronounced cycles in the number of new issues per month and average initial returns. Current evidence seems to indicate that high initial returns lead to more IPOs in subsequent months in the U.S. IPO market. Since there has been no research on this issue for the Chinese IPO market, we calculate monthly IPO volume and average initial return over the period 1991–2005 and plot them in Fig. 1. We further examine the cross correlation between them using ± 12 month lags and plot the result in Fig. 2.

To formally test the lead-lag relationship between those two variables, we estimate the following VAR model:

$$R_t = c + \sum_{i=1}^{m} \rho_{t-i} R_{t-i} + \sum_{i=1}^{n} \pi_{t-i} V_{t-i} + \varepsilon_{1t} \quad (6)$$

$$V_t = d + \sum_{i=1}^{p} \theta_{t-i} V_{t-i} + \sum_{i=1}^{q} \eta_{t-i} R_{t-i} + \varepsilon_{2t}, \quad (7)$$

where R_t is the average initial return measured in decimal in month t and V_t is the IPO volume in month t. In estimating the VAR model, we first examine the autocorrelation of each series to determine the optimal lags of m and p in (6) and (7) respectively. With the optimal lags, we then test whether the lagged coefficients π_{t-i} and η_{t-i} are significantly different from zero. We report the results in Table 4.[11]

5 Empirical results

In this section, we first provide summary statistics. We then present the correlation matrix. After that, we provide the results from the multifactor model and structural break tests. We further offer descriptive evidence to demonstrate IPO market cycles and cross correlation between monthly IPO volume and average initial return. Finally, we provide the results from the VAR model to confirm the lead-lag relationship.

5.1 Summary statistics

As shown in Table 1, we find that many Chinese IPO phenomena are not stationary over time. The average firm age fluctuates, from 2.05 years for the IPOs in 1993 to 5.89 years for the IPOs in 1997. The average board size varies from 8.50 for the IPOs in 1991 to 10.42 for the IPOs in 2003. The average offer price changes from the lowest of 3.20 Yuan in

[11] We treat the system of Eqs. 6 and 7 as if they were "seemingly unrelated equations", which allows us to estimate one equation at a time to justify the optimal lags of m and p first and then test for significance of the lead-lag relationship. Another way to estimate the system is to estimate both equations simultaneously. Using the same optimal lags of m and q, we perform both tests and find that the results are very similar. Therefore, we only report the results, treating the system as "seemingly unrelated equations". The detailed procedure is available upon request.

Table 3 Cross sectional analysis and structural breaks, 1991–2005

Sample period	1991–2005 (4a)	1991–2005 (4b)	1991–1998 (4c)	1999–2005 (4d)	1991–2000 (4e)	2001–2005 (4f)	1991–2005 (4g)	1991–2005 (4h)	Rising markets (4i)	Declining markets (4j)
Size	1380	1380	813	567	1048	332	1380	1380	754	626
α	1.12 (2.58*)	3.24 (8.53*)	3.39 (6.94*)	2.32 (8.21*)	3.30 (7.70*)	2.89 (5.42*)	1.48 (3.53*)	1.34 (3.08*)	2.69 (5.41*)	3.86 (6.55)
β_{Age}	1.19 (11.32*)	0.90 (8.61*)	1.68 (10.54*)	0.10 (0.65)	1.41 (10.62*)	0.05 (0.51)	1.12 (10.87*)	1.19 (11.17*)	1.12 (8.43*)	0.60 (3.46*)
β_{Board}	0.85 (2.34*)	0.83 (2.22*)	1.36 (2.52*)	0.35 (1.67)	1.29 (2.92*)	0.77 (2.22*)	0.78 (2.16*)	0.93 (2.56*)	0.61 (1.24)	1.03 (1.76)
β_{Price}	−0.15 (−1.71)	−0.17 (−1.93)	−0.06 (−0.48)	−0.14 (−1.35)	−0.07 (−0.72)	−0.09 (−0.67)	−0.16 (−1.86)	−0.14 (−1.56)	−0.15 (−1.19)	−0.18 (−1.32)
β_{Size}	−0.14 (−2.56*)	−0.27 (−4.92*)	−0.33 (−2.38*)	−0.07 (−3.48*)	−0.39 (−4.02*)	−0.05 (−2.04*)	−0.15 (−2.62*)	−0.18 (−3.28*)	−0.35(−3.50*)	−0.24 (−3.47*)
γ_1	−0.74 (−0.53)	−0.29 (−0.20)	−0.27 (−0.11)	−0.54 (−0.78)	−0.04 (−0.02)	−1.37 (−1.28)	−0.57 (−0.41)	−0.82 (−0.59)	2.01 (0.84)	−1.40 (−0.75)
γ_2	−0.33 (−0.62)	−0.62 (−1.13)	−0.04 (−0.05)	−1.22 (−3.52*)	−0.22 (−0.35)	−1.71 (−2.74*)	−0.32 (−0.61)	−0.44 (−0.82)	−0.10 (−0.14)	−1.18 (−1.37)
γ_3	0.92 (1.33)	0.22 (0.94)	1.90 (1.88)	−0.21 (−0.46)	1.50 (1.73)	−0.36 (−0.52)	0.85 (1.22)	0.93 (1.34)	1.64 (1.67)	−0.31 (−0.29)
γ_4	−0.15 (−0.35)	−0.73 (−1.62)	−0.01 (−0.07)	−0.85 (−2.79*)	−0.39 (−0.74)	−1.87 (−3.28*)	−0.14 (−0.30)	−0.39 (−0.87)	−0.24 (−0.42)	−1.23 (−1.67)
γ_5	−0.55 (−1.41)	−1.11 (−2.76*)	−0.39 (−0.72)	−1.22 (−4.24*)	−0.54 (−1.17)	−1.84 (−3.43*)	−0.62 (−1.59)	−0.64 (−1.63)	−0.50 (−0.94)	−1.76 (−2.82*)

Table 3 continued

Sample period	1991–2005 (4a)	1991–2005 (4b)	1991–1998 (4c)	1999–2005 (4d)	1991–2000 (4e)	2001–2005 (4f)	1991–2005 (4g)	1991–2005 (4h)	Rising markets (4i)	Declining markets (4j)
Size	1380	1380	813	567	1048	332	1380	1380	754	626
λ_1	−0.39 (−1.69)						−0.03 (−0.15)	−0.81 (−3.64*)		
λ_2	1.58 (5.20*)						2.26 (10.35*)			
λ_3	1.21 (3.20*)							2.59 (9.45*)		
$\bar{R}^2$	0.19	0.11	0.18	0.11	0.16	0.12	0.18	0.17	0.15	0.08
RSS	19392	21070	17662	840	18728	625	19538	19777	10675	10211
F-value			14.46*		9.24*					

The table reports the cross-sectional regression results over the entire sample and sub-periods from

$$R_i = \alpha_i + \beta_{\text{Age}}\left(\frac{A_i - \bar{A}}{\bar{A}}\right) + \beta_{\text{Board}}\left(\frac{B_i - \bar{B}}{\bar{B}}\right) + \beta_{\text{Price}}\left(\frac{P_i - \bar{P}}{\bar{P}}\right) + \beta_{\text{Size}}\left(\frac{S_i - \bar{S}}{\bar{S}}\right) + \sum_{j=1}^{5}\gamma_j D_{i,j} + \sum_{j}^{3}\lambda_j Q_{i,j} + \varepsilon_i, \quad (4)$$

where R_i is the initial return of IPO i measured in decimal, α_i is the intercept or the overall average initial return if all the explanatory variables are zeros, A_i, B_i, P_i, and S_i are the firm age, board size, offer price, and offer size of IPO i, while $\bar{A}, \bar{B}, \bar{P}$, and $\bar{S}$, are the averages of firm age, board size, offer price, and offer size of all IPOs in the same sample period when IPO i is initiated, and β_{Age}, β_{Board}, β_{Price}, and β_{Size} are the sensitivities associated with firm age, board size, offer price, and offer size. The first set of dummies $D_{i,j}$ captures the difference in industry; it is one if IPO i belongs to industry j and is zero otherwise, and γ_j is the coefficient associated with dummy j with $j = 1$ for finance, 2 for utility, 3 for property, 4 for conglomerate, and 5 for industrial. The second set of dummies $Q_{i,j}$ catches the impact of stock market cycles and government restrictions on initial IPO pricing; it is one if IPO i is initiated during rising stock markets and is zero otherwise; it is one if the target P/E ratio of 15 is used to price IPO i and is zero otherwise; and it is one if the quota system is in place when IPO i is initiated and is zero otherwise; while λ_1, λ_2, and λ_3 are the coefficients associated with the stock market, P/E ratio, and quota system dummies. F-values test structural breaks caused by government restrictions on pricing Chinese IPOs using different target P/E ratios and on switching from the quota system to the verification system. RSS stands for the sum of squared residuals. We report t-values in parentheses and use * to denote significance at the 5% level

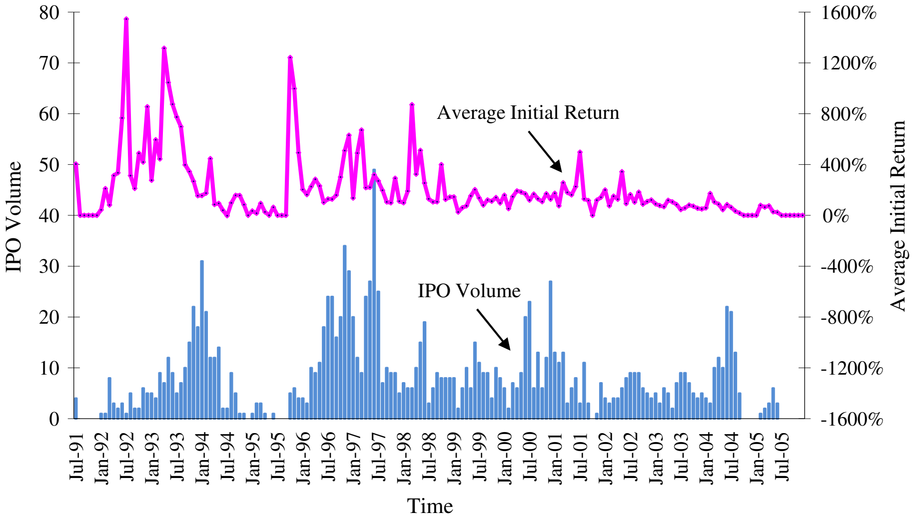

Fig. 1 Monthly IPO volume and average initial return. The figure demonstrates monthly IPO volume and average initial return for 1,380 Chinese A share IPOs over the period from July 1991 to June 2005

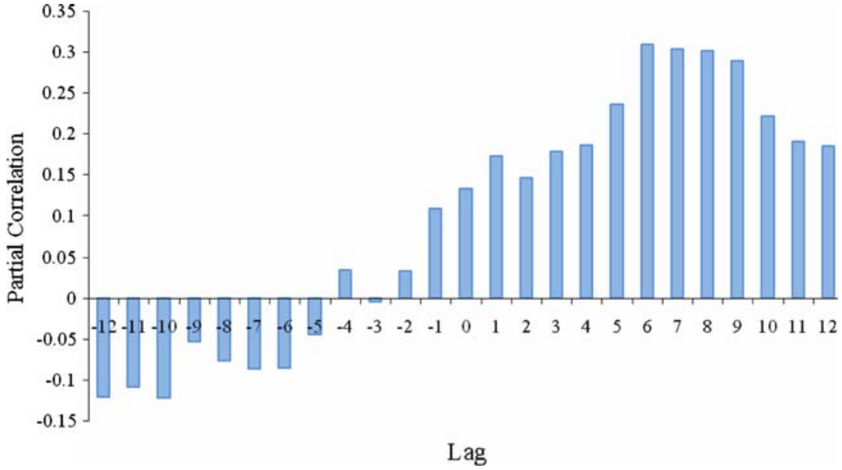

Fig. 2 Cross correlation between monthly IPO volume and average initial return. The figure shows the cross correlation between monthly IPO volume and average initial return for 1,380 Chinese A share IPOs over the period July 1991 to June 2005, using ± 12 month lags

1995 to the highest of 9.80 Yuan in 2001, with exceptions in 1992 and 1993.[12] The average offer size also fluctuates, from the smallest of 56 million Yuan per deal in 1991 to the largest of 777 million Yuan per deal in 2001. Gross proceeds vary with the number of IPOs and offer size, increasing quickly from 225 million Yuan in 1991 to 41,773 million Yuan in 1993, peaking at 85,383 million Yuan in 2000, before falling to 5,269 million Yuan in

[12] In 1992, the Shanghai Stock Exchange started initiating IPOs with a book value of 10 Yuan (compared to 1 Yuan for all other IPOs in the sample) along with higher offer prices, resulting higher average offer prices. It began to use a book value of 1 Yuan along with lower offer prices from the second half of 1993.

Table 4 Vector autoregressive model

Estimated coefficient	Regression (6)	Regression (6)	Regression (7)	Regression (7)
c	0.85 (4.07*)	1.22 (4.11*)		
d			2.34 (3.82*)	1.81 (2.67*)
ρ_{t-1}	0.59 (9.43*)	0.58 (9.07*)		
θ_{t-1}			0.71 (13.12*)	0.67 (11.94*)
π_{t-10}		−0.04 (−1.68)		
η_{t-6}				0.45 (2.73*)
Adjusted R-squared	0.34	0.35	0.49	0.52

The table reports the results from estimating the following VAR model from July 1991 to June 2005, treating the system as "seemingly unrelated equations":

$$R_t = c + \sum_{i=1}^{m} \rho_{t-i} R_{t-i} + \sum_{i=1}^{n} \pi_{t-i} V_{t-i} + \varepsilon_{1t} \tag{6}$$

$$V_t = d + \sum_{i=1}^{p} \theta_{t-i} V_{t-i} + \sum_{i=1}^{q} \eta_{t-i} R_{t-i} + \varepsilon_{2t} \tag{7}$$

where R_t is the average initial return in decimal in month t and V_t is the IPO volume in month t. We first examine the autocorrelation of each series to determine the optimal lags of m and p in regressions (6) and (7). With the optimal lags, We then test whether the lagged coefficients π_{t-i} and η_{t-i} are significantly different from zero. We report t-values in parentheses and use * to denote significance at the 5% level

2005. Money left on the table depends on gross proceeds and initial returns. It reaches the highest level of 147,917 million Yuan in 1993. It has dropped since 2001 and reaches the second lowest level of 2,790 million Yuan in 2005. Also from Table 1, we find that $EWIR_1$ varies dramatically over time, from as high as 609.4% in 1995 to as low as 45.1% in 2005.[13] The average initial return for the entire sample is 238.0%.

Over sub-periods, we find that the average firm age and offer size are much smaller for the IPOs in early years compared with those in late years while the average board size and offer price don't seem to be significantly different. The $EWIR_1$ is significantly higher during the period 1991–1998, reflecting the impact on initial underpricing from the government restriction on IPO offer price. Similarly, the $EWIR_1$ is significantly higher during the period 1991–2000, another indication of the impact from the government restriction on the number of IPOs across industries and regions on initial underpricing.

Over the stock market cycles, we find that the average firm age, board size, offer price, and offer size don't seem to be significantly different, but gross proceeds and money left on the table are higher during rising stock markets, presumably caused by more IPOs during rising stock markets. The $EWIR_1$ is 233.2% during rising stock markets, which is lower than the average initial return of 243.8% during declining stock markets, which could be caused by higher demand for new IPOs during declining stock markets when Chinese investors have fewer other investment alternatives.

Chinese IPO phenomena, as expected, are different across industries. For example, there are only 9 finance IPOs, compared with 880 industrial IPOs over the entire sample. The average firm age for finance IPOs is 6.25 years while it is only 2.97 years for commerce IPOs. The average board size for finance IPOs is 14.89, the largest in all six industries, compared with 8.26 for property IPOs, the smallest in all industries. The average offer

[13] We also report the market adjusted returns in Table 1. Since the IPO underpricing is so severe it doesn't make a real difference in initial returns with and without the market adjustment. Therefore, we focus the discussion on $EWIR_1$.

price and offer size are 12.77 Yuan and 3,090 million Yuan for finance IPOs, which far exceed the overall average of 7.71 Yuan in offer price and 395 million Yuan in offer size for the entire sample. Conglomerate IPOs have the smallest average offer price of 7.28 Yuan while commerce IPOs have the smallest average offer size of 180 million Yuan. The $EWIR_1$ varies with industries, from the highest of 402.6% for property IPOs to the lowest of 211.0% for industrial IPOs.

Across firm age, we find that IPOs in the smallest age group have the highest offer price and the second largest offer size. However, the $EWIR_1$ for the group is 182.0%, much lower than the overall average of 238.0%. IPOs with higher firm age tend to have lower offer prices and earn higher initial returns. For example, the $EWIR_1$ for IPOs between 6 and 8 years or more than 8 years are 525.5 and 459.0% respectively, the highest and second highest in all the groups ranked by firm age. This result is different from that found in Loughran and Ritter (2004) and suggests that underpricing is more severe for the IPOs with higher firm age, resulting from the government restriction on offer price since the P/E ratio approach to price IPOs limits older firms with lower risks to charge higher offer prices, relative to younger firms with higher risks.

Across board size, we find a U-shaped relation between the $EWIR_1$ and board size, which is consistent with the findings in Coles et al. (2008). IPOs with large board size tend to earn much higher initial returns while IPOs with very small board size also earn higher initial returns, compared with the average initial return over the entire sample. Since the U-shaped pattern skews to the large board side we conclude that overall, board size, as a proxy for corporate governance, has a positive impact on initial returns, except for IPOs with very small board size and efficient management.

Across offer price, we find that the IPOs with the lowest offer price of 1 Yuan earn the highest $EWIR_1$ of 1,310.9%, the most severe initial underpricing group in the entire sample. However, the relationship between $EWIR_1$ and offer price is not strictly monotonic. As seen in Table 1, the $EWIR_1$ decreases to 410.3% for the IPOs with offer price between 1 and 3 Yuan. It reaches the bottom of 120.3% for the IPOs with offer price between 5 and 7 Yuan before it rises to 195.4% for the IPOs with the highest offer price of more than 10 Yuan. Over offer size, we observe an almost monotonic pattern: IPOs with smaller offer size tend to earn higher initial returns. This evidence suggests that offer size, as a proxy for firm size, has a significant impact on initial IPO pricing.

5.2 Correlation matrix

Table 2 provides the correlation matrix between explanatory variables used in regression (4). Over the entire sample, we find that the correlation between firm age and offer price is −0.10 and it is significant. This result indicates that IPOs with higher offer prices tend to be younger firms, which is consistent with the findings in Table 1. The correlation between board size and offer size is 0.12 and it is also significant. Since offer size serves as a proxy for firm size, IPOs with larger offer size are typically larger firms that usually require more board members. The correlation between offer price and offer size is 0.13 and significant. This result indicates that IPOs with higher offer prices usually represent larger IPOs. Other correlations are not significant at the 5% level.[14]

[14] We also estimate the correlation matrix over sub-periods and find that the correlation between firm age and offer size becomes significant over the sub-period 1991–1998. Over the sub-period 1999–2005, we find that the correlation between offer price and offer size is no longer significant. All other correlations remain similar over the two sub-periods.

To deal with the correlation issue, we repeat regression (4) several times to estimate the impact of the correlation on the robust of the regression by excluding one factor at a time. We find that the proposed multifactor model with all four explanatory variables works the best and the correlation is not a severe issue to distort the results.

5.3 Cross-sectional regression and Chow test

Table 3 provides the results from the cross-sectional regression and Chow test. Over the entire sample with both sets of dummies in Table 3 (4a), we find that the intercept is 1.12 (or 112%) and it is significant. The estimated sensitivity for firm age is 1.19 with a *t*-value of 11.32, suggesting that firm age, as a proxy for IPO quality, has a significantly positive impact on initial returns. The estimated sensitivity for board size is 0.85 with a *t*-value of 2.34. It indicates that board size, as a proxy for corporate governance, also has a significantly positive impact on initial pricing. The estimated sensitivity for offer price is −0.15 with a *t*-value of −1.71, which is significant at the 10% level. This result seems to indicate that a lower offer price tends to stimulate a higher demand for new IPO shares, which in turn leads to a higher initial return. The estimated sensitivity for offer size is −0.14 with a *t*-value of −2.56, suggesting that offer size, as a proxy for firm size, has a significantly negative impact on initial IPO pricing.

By examining the coefficients associated with industrial dummies, we find that except for the property dummy that has a positive coefficient, all the others have negative coefficients. This result is consistent with the previous findings in Table 1 that the property group earns the highest average initial return, all compared with the benchmark of the commerce group that has a zero coefficient by design. The coefficients associated with industrial dummies are not statistically significant at the 5% level, mainly due to high variations within each group even though the average initial returns across different industries seem different.

It is particularly interesting to examine the coefficients associated with the second set of dummy variables that catches the effects of stock market cycles and government restrictions. The estimated coefficient associated with rising stock markets is −0.39 with a *t*-value of −1.69 that is significant at the 10% level, indicating that the average initial return of IPOs issued during rising stock markets is lower than that of IPOs issued during declining stock markets. This result is consistent with the findings in Table 1 and could be attributed to fewer alternatives to invest for Chinese investors during declining stock markets. The coefficient associated with the P/E ratio dummy is 1.58 (or 158%) with a *t*-value of 5.20, a strong indication that the government restriction on pricing Chinese IPOs leads to severe initial underpricing. Moreover, the coefficient associated with the second government restriction, the quota system, is 1.21 (or 121%) with a *t*-value of 3.20, another strong evidence to suggest that the government restriction on the IPO allocation across industries and regions further attributes to initial underpricing. The adjusted *R*-squared for the regression in (4a) is 0.19 and the RSS is 19,392.

To further examine the impact of government restrictions on initial IPO pricing and to test for structural breaks, we repeat regression (4) multiple times. First, we repeat it without the second set of dummy variables. From (4b) in Table 3, we find that the coefficients associated with four explanatory variables remain the same in sign and similar in significance. The obvious changes occur in three statistics: the estimated intercept, adjusted *R*-squared, and RSS. The new intercept rises to 3.24 (or 324%) from 1.12 (or 112%), the adjusted *R*-squared drops to 0.11 from 0.19, and the RSS increases to 21,070 from 19,392. By comparing the intercepts from (4a) and (4b) along with the estimated coefficients associated with government restriction dummies in (4a), it suggests that government restrictions play an important role in initial IPO pricing and attribute more than half of IPO underpricing. Therefore, including government restrictions in the regression model helps explain cross-sectional initial returns, justified by highly significant coefficients, a higher adjusted *R*-squared, and a lower RSS.

The results for the Chow test are reported in (4c)–(4f) in Table 3. From (4c) and (4d), we find that the *F*-value is 14.46, which is significant at the 5% level. The result suggests that there exists a structural break in initial IPO pricing from 1991 to 1998 and from 1999 to 2005, which is caused by the CSRC to raise the target P/E ratio from 15 to 20 to price Chinese IPOs. The *F*-value for the second structural break test from (4e) and (4f) turns out to be 9.24 and it is also significant at the 5% level. This result indicates that switching from the quota system to verification system by the CSRC to allocate new IPOs starting from 2001 causes another structural break in pricing Chinese IPOs.

To further distinguish the impact on the initial underpricing from each government restriction, we repeat regression (4) by including only one restriction at a time. From the results in (4g) and (4h) in Table 3, we find that each restriction captures more initial underpricing when the other is not present but the model with both restrictions provides the best model fit, evidenced by a significantly lower RSS and higher adjusted *R*-squared, compared with those from (4g) and (4h). Therefore, we conclude that (4a) is the best model to explain cross-sectional initial returns.

The results from (4d) and (4f) indicate that the impact of firm age on initial IPO pricing has been weakening in recent years, especially after the verification system replaces the quota system in 2001. This result is consistent with the adoption of the verification system that requires investment bankers to investigate each firm’s performance and prepare the necessary documents before a firm goes public. Since the verification system increases IPO quality and transparency and thus it decreases the impact from firm age that serves as a proxy for IPO quality.

Examining the results from (4i) and (4j) over stock market cycles without the second set of dummies, we find that most of the results are consistent with those in (4b), obtained from the entire sample without the second set of dummies. The intercept stays huge and significant at 2.69 (or 269%) during rising stock markets and 3.86 (or 386%) during declining stock markets. Both firm age and board size have positive impact on initial returns and the impact remains significant for firm age. Offer price and offer size have negative impact on initial returns and the impact from offer size remains significant. The adjusted *R*-squared is 0.15 from (4i) in rising stock markets and it is 0.08 from (4j) in declining stock markets, suggesting that the model fits better during rising stock markets.

5.4 IPO market cycles

Figure 1 plots monthly IPO volume and average initial return for 1,380 Chinese A share IPOs over the period July 1991 to June 2005. It appears that periods with higher initial returns tend to be followed by spurts of IPO volume. For example, the average initial returns are 1,315% and 1,045% in April and May 1993. The number of IPOs in November 1993 and January 1994 is 22 and 31 respectively, which is the first spurt seen in Fig. 1. Another example is in October and November 1995. The average initial returns are 1,242% and 997% respectively. The number of IPOs in July and August 1996 is 24 each.

To further examine the lead-lag relationship between monthly IPO volume and average initial return, we calculate the cross correlation between them and plot the result in Fig. 2, using ±12 month lags. The plot clearly indicates that there exists a strong correlation between them. Looking forward, we find that the highest correlation of 0.30 occurs at the 6th month lag, which is significant at the 5% level. In general, the correlation is strong between the 6th and 9th month forward, ranging from 0.30 to 0.29. Looking backward, we find that the two series are negatively correlated most of the time, with the highest correlation of −0.12 occurring at the −10th month lag even though it is not statistically significant at the 5% level. This result is consistent with the findings in Lowry and Schwert (2002) with U.S. IPO data.

Table 4 provides the results from the VAR model. We find that both monthly IPO volume and average initial return are highly autocorrelated. The autocorrelation is particularly strong at lag one. After controlling for autocorrelation at lag one, we find that average initial return leads IPO volume by 6 months, evidenced by a significantly positive coefficient associated with the 6th month lagged return in (7). The coefficient is 0.45 with a t-value of 2.73. The adjusted R-squared rises to 0.52 from 0.49. Also from Table 4, we find that the 10th month lagged volume seems to affect average initial return negatively from (6), even though the coefficient associated with it is not statistically significant at the 5% level. As a result, we conclude that there exist IPO market cycles in China: high initial returns tend to lead to more IPOs in the consequent months. The lead period is about 6 months, which is consistent with the time between a firm files for IPO and gets approved from the CSRC. Following spurts in IPO volume, there tend to be periods with lower initial returns, often occurring 10–12 months after volume spurts, even though this relationship doesn't appear as strong as the relationship that average initial return leads IPO volume.

6 Conclusions

This paper examines the Chinese A share IPO activity, pricing, and market cycles with an enlarged database, which offers a unique opportunity to investigate the IPO performance over a longer time horizon and across stock market cycles, government restrictions, industries, firm age, board size, offer price, and offer sizes. We find that many Chinese IPO phenomena are not stationary and initial underpricing is severe. To explain initial underpricing in the Chinese IPO market, we propose a multifactor model that includes firm age to proxy for IPO quality, board size to represent corporate governance, offer price to capture excess demand, and offer size to catch firm size, along with government restrictions and find that the model explains cross-sectional initial returns, after controlling for stock market conditions and industrial differences.

More importantly, we find that government restrictions on pricing IPOs and allocating IPOs across different industries and regions cause structural breaks in initial IPO pricing and attribute significantly towards initial underpricing. Firm age and board size have a positive impact while offer price and offer size have a negative impact on initial IPO pricing, even though the impact from firm age has been weakening in recent years. In addition, we find evidence that monthly IPO volume and average initial return are highly correlated. The cross correlation between them is as high as 0.30, with average initial return leading IPO volume by 6 months. This result suggests that more companies in China tend to file for IPOs after observing high average initial returns from previous IPOs.

Understanding Chinese IPO activity, pricing, and market cycles helps brokerage firms and investors, both domestic and international, to set up better strategies to compete for Chinese IPO business and to make better investment decisions, especially when the global financial markets are highly integrated. International investors can use Chinese IPOs as other alternatives to improve portfolio performance. As Harvey (1995) suggests that the inclusion of international equities in domestic portfolios actually reduces portfolio's total risk. Thus, Chinese IPOs provide an additional investment opportunity that international investors can choose to enhance their portfolio returns and/or to reduce their portfolio risks.

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