IPO Price Determination in Chinese Growth Enterprise Market

by

Jiamin Chen

A research project submitted in partial fulfillment of
the requirements for the degree of Master of Finance

Saint Mary's University

Written for MFIN 6692.0 under the direction of Dr.
Francis Boabang

Approved: Dr. Francis Boabang
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Date: September 3, 2013

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Abstract

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After more than 20 years of development, China's capital markets are not yet mature. In order to guide the reform of mature market, the study on the IPO price determination in GEM is necessary.

We employ the factor analysis and multiple regression to analyze the issue of IPO pricing on Chinese GEM. Through factor analysis, five factors are extracted which reflect the companies' intrinsic value. The result of the regression shows that IPO pricing of Chinese GEM is fair. We verify the nonexistence of behavior which lowers the offering price by underwriter. By way of excluding the irrational pricing hypothesis, we conduct the analysis of the IPO underpricing depending on the external factors. The result proves that the market expectation and speculation from investors affect the IPO underpricing most.

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Chapter 1
Introduction

1.1 Purpose of the Study

Commonly referred to as the Chinese “NASDQ”, Growth Enterprise Market (GEM), had been established for 10 years. As a young component of secondary market, GEM offers an access for small high-tech companies to finance their capital expansion. In addition, investors see this new investment conduit as an avenue to enhance returns. As a process where a private company transforms into a public company, IPO plays an important role in the stock market. In this paper, I employ a model to analyze the rationale for IPO price determination and the factors which affect IPO underpricing.

1.2 Background

IPO is a process that private company for the first time, issues shares and sells them to general public via the stock exchange, which means the company transformation from private-held to public-held. Meanwhile, IPO offers an opportunity for early venture capital to monetize their investment. In early time, fix rate issuance were widely used in the IPO, focusing on 12 to 15 times of P/E ratio. In 2000, Chinese Securities Regulatory Commission (CSRC) adjusted the IPO issuance regulation and auction mechanism was implemented. Due to irrational prevailingness, Chinese stock market was damaged by IPO and CSRC shut down the IPO application for several times. Right now, although securities institutions keep calling on reactivating the IPO application, no news explicitly express CSRC will turn on

the green light in recently.

Compared to those in main board market, companies in Chinese GEM operate in different situation. Due to the obvious difference in tech and operation model, these companies will suffer a huge potential risk in the future. Meanwhile, investors who invest in these companies will face a large uncertainty in their expected return. Therefore, it is more complicated and important to value the IPO of GEM in a reasonable and precise price. Moreover, when GEM develops, new kinds of company with novel capital structure may be born, such as the one whose intangible assets overweight tangible assets. Accordingly, a traditional valuation method will be limited in this situation. A commentary (2013) in Chinese Economy News recently pointed out that an unreasonable valuation overdraws the growth capability. All in all, synthetically using all market information will offer an appreciated IPO of these new types of companies reflecting the true intrinsic value.

There exist two problems which always arise in IPO research. One is IPO underpricing and the other is IPO underperformance. IPO underpricing is a short run abnormality, which is represented by the significant abnormal return in the first trading day. IPO underperformance is a long run phenomenon, which is represented by the lower return of IPO companies in 3 to 5 years, compared to the non-IPO companies in the same industry. These two phenomena work more significant in China than aboard. Hongbo Jiang (2007) claimed that IPO underpricing in main board market work more significant in China than in abroad and Yin Yu (2005) used the data from 1994 to 2004 to clarify the Chinese IPO underperformance in long run.

1.3 Need for Study

IPO pricing is a core step in share issuance which will directly affect resource allocation in financial market. If price is set too low, the amount of capital financed will be limited and negatively affect the company's planned projects. On the other hand, if price is set too high, the investors will not accept the high risk share and directly result to the IPO failure. Most of researches in developed countries are based on the market efficiency hypothesis but market efficiency performs weakly in China. Therefore, the methodology should adjust to Chinese market.

According to various pricing theories, I will set up a model depending on Chinese GEM characteristics. Factor analysis and multiple regression will be used in researching the IPO valuation and IPO underpricing.

1.3.1 Factor Analysis

Factor analysis used to be applied in complex variables explanation and internal relationship exploration. It extracts the unobserved variables, called common factors, from a bunch of variables in order to simplify the model. This simplification is purchasing in a price of least variance loss so that the several new factors can describe as much as those variables can originally do. The purpose of using factor analysis here is to come up with a reasonable set of factors and combine the factor scores to establish a regression model to test the rationale of IPO price.

1.3.2 Multiple Regression

Multiple regression is a common research method in econometrics. Here, I use the linear multiple regression to examine the explanatory ability of given variables to the IPO underpricing level. According to empirical researches before, I assume the relationship of individual dependent variables and independent variables. However, in practical implementation, heteroscdasticity will exist and affect the regression which needs to be eliminated.

1.4 Statement of Problem

“Any stock market fear ‘Chinese IPO’ ” said by Haizhou Pi, Sina Finance columnist. The fear comes from Chinese type mechanism. Although investors and government keep asking for improvement, reformation is frustrating over and over. Therefore, it is obligatory to recognize China IPO clearly. A clear theoretical guideline can accelerate this reformation. In this paper, I will discuss whether the IPO is priced reasonably and test the rationale of IPO price and close price of first trading day. On the other hand, underpricing model will be examined out of an assumption of precise offering price.

Several problems exist in this paper. Firstly, because the Chinese GEM has openly traded for just 4 year, listed companies in GEM strongly focus on several industries so that the result may present some industrial bias. Chinese economy is guided by government policies, or we can say that is a kind of policy orientation market. In this paper, no variables reflect the policies effect so that there is a defect in

model’s explanatory ability. Moreover, speculation is hot in China but it can not be fully reflected among the selected variables. Similarly, some investors’ mental factors are not taken into consideration. Finally, due to time limit, sample size is not enough to represent the whole GEM.

Chapter 2
Literature Review

IPO underpricing and IPO underperformance are two hot spots in financial academic research. In late 1960s, Reilly and Hatfield used 53 IPOs' data from the 1963-1965 in American stock markets and found the significant abnormal return in the first trading day comparing to the market return at the same period. This was the prologue of IPO underpricing study. On the other hand, Ibboston (1975) was engaged in a long run study of American stocks using the new issue stocks during 1960 to 1969. This was also the first time research on new issue stocks in long run. He pointed out that the average monthly return in the first year was positive, reversing to negative in the second year and reversing to positive back again in the fifth year. Since then, IPO valuation researches have been popular in different countries.

2.1. Worldwide Underpricing Research

Underpricing is that the close price in first-day significantly exceeds the offering price. Scholars put forward the explanation to the IPO abnormal return. They thought the very reasons of this general phenomenon were information asymmetry and investors' irrational behavior. Rock K (1986) and Barry C.B. (1989) reported that IPO underpricing was widely existed and issuance was more efficient in developed countries with lower level of underpricing. Spindt (1989), Beveniste and Wilhelm (1990), Spatt and Srivastava (1991) all proved that the accumulated bidding inquiry optimized the true information collection in IPO priced so as to improve the

efficiency in IPO valuation. Loughran and Ritter (2002) reported that the escalating underpricing rate mostly resulted from the principal-agent relationship between issuance firm and underwriter although the industrial inner problems partly played a role in it as well. Ritter and Welch (2002) summarized the average first trading day return during 1980 to 2001 in the American stocks market to be 18.8%. Michelle Lowry and G.William Schwert established a model to judge the rationale of IPO valuation by analyzing whether the IPO priced interval fully reflected the public information. These theories had developed further while financial market developed wider. Kenji Kutsuna, Janet Kiholm and Richard L.Smith (2007) clarified the reason why the offering price just reflected partial positive information by analyzing JASDAQ data. Their study reported the offering price contained a guarantee that underwriter would compensate the investors because of their lack of information, which make sure the IPO could succeed. Alexey Malakhov (2007) raised a statement that more uninformative investors engaged in IPO process, higher return it would be. Here, the underwriter as the reliable information supplier improved the expected return of issuance firm, which also guaranteed an appreciated earning from issuance firm. Michael Adams, Barry Thornton and George Hall (2008) found out that the larger scale of IPO, the lower level of underpricing. Meanwhile they also explained the sharply abnormal first-day return in bullish market by investors' irrational prevailing.

2.2 Underpricing Research in China

There are three main types of underpricing research in China: the first one is to establish Chinese-type models to explain the high level of IPO underpricing phenomenon; the second one is using the models of developed countries to test how well the traditional theories can be applied in Chinese market; the third on is to combine the traditional theories and factors in China to establish new models so that we can find out what factors affect the IPO underpricing most.

Fewer people engaged in the first type research which reflects the difficulty of the model establishment. Yang (2001) established a loss function to clarify underwriter decision mechanism and underpricing. The result expressed the positive relationship between underpricing level and demand uncertainty, offering volume. Kan (2001) applied the signal models depending on Allen and Faulhaber, Welch, Grinbllat and Hwang's thought to construct a Chinese IPO pricing regulation.

More people studied in the second field. Jinbing (1997) used Rock model, imitating the methodology from Walter and Koh to explain the IPO excess return. Mock and Hui (1998) applied signal model to test the affect of following factors: period interval, equity structure, speculation bubble. Su and Fleisher (1999) applied the signal methodology as well to explain the high level of underpricing in China. They pointed out the initial offering to excess return model explained the underpricing phenomenon better than the equity structure to excess return model.

Most scholars studied in the third aspect. Gongmeng and Ning (2000) combined the western research theories and Chinese specific factors to analyze the effects of Chinese specific factors to level of underpricing. Yifeng and Xueying (2002)

identified IPOs were priced too low and there was a ‘craze share’ phenomenon which performed much better than market in long run. Chaobing and Qing (2005) pointed out the significant factors which affected the level of underpricing, including IPO timing, P/E ratio and volume, whereas, regulation change, industrial characteristics, market performance on the first trading day were less significant. Fengqi and Xiuliang (2006) applied the factors analysis to test the rational of Chinese IPO valuation. The research clarified the intrinsic value of firm was represented precisely by offering price.

2.3 IPO Research in Chinese Growth Enterprise Market

Most of researches to IPO in Chinese GEM focused on regulation and priced mechanism. These parts of researches consulted the theories and experience of developed countries and offered suggestion to issuance in GEM. Junhui and Wanchen (2001) stated in their paper that venture capital played an important role in IPO pricing, timing, volume. Meanwhile, venture capital could guarantee the IPO not to suffer from a high level underpricing loss because of the social position and relationship with underwriter. They strongly recommended the ‘Green Shoes’ mechanism and Callback mechanism. However, there are not authoritative statements to summarize the characteristics of IPO in Chinese GEM so far.

Chapter 3
Methodology and Data Source

IPO pricing depends on precise intrinsic value measure. Therefore, IPO valuation requires rational firm value estimation, which is the key step in IPO process. There are four basic methods to estimate IPO value: the comparative valuation model, discount model, option valuation model and multiple pricing model.

3.1 Summery of Stock Pricing Models

3.1.1 Comparative Valuation Model

Comparative valuation method estimates the firm's intrinsic value by comparing the competitors' ratio of value to a certain variable, such as EPS, book value or sale. The basic hypothesis is that all the companies in such industrial share very similar characteristics, which means they are comparable. Traditionally, we can use P/E ratio to estimate the IPO price, which was ever used in early time in China. However, the P/E ratio method is only applied out of a hypothesis that the firm is earning profit. If the firm is less profitable or even suffering loss, other alternative method can be used such as P/S (price to sale) ratio, P/B (price to book value) ratio.

3.1.1.1 P/E ratio model

To use P/E ratio model to determine the IPO price, comparative average P/E ratio need to be estimated. Industrial P/E ratio can be roughly regarded as the one of company who will go public. The offering price is the product of P/E ratio and the

expected earning:

Offering price = P/E ratio * Expected EPS

Widely use of P/E ratio model is because it directly connects the IPO price to the expected EPS.

Although the P/E ratio model has an obvious advantage, it is limited in application due to the disadvantages. First, those who are suffering loss can not use P/E ratio to estimate the price. Second, market values of listed companies fluctuate all the time, which will affect the IPO valuation. If the comparative companies are overvalued or undervalued, the P/E ratio will mislead the offering price. Moreover, comparative firm is a kind of subjective concept, which hardly convinces others in logic.

3.1.1.2 P/B ratio model

P/B ratio is the ratio of market price to book value per share, which reflect a ratio of an expect profitability of company's capital to the initial cost. Compared to P/E ratio model, stableness is one of the advantages which makes P/B ratio model more convincible. Furthermore, although the firm is going through a deficit, P/B ratio model will not be affected. However, the book value is easily impacted by the accounting mechanism. A different accounting mechanism will lead to a different book value.

3.1.1.3 P/S ratio model

P/S ratio model directly reflects the IPO firm's intrinsic value. Under an intensive competition, market occupation indicates the future of the firm, forecasting whether or not, the firm can survive and make money. P/S ratio model can be widely used. It is not limited by a negative variable; sale is never negative. In addition, sale is stable and seldom affected by policy change. P/S ratio model is always used in IPO of an internet firm.

3.1.2 Discount model

Discount model determines the intrinsic value of a firm by transforming the future cash flow to right now. Discount model can be divided into three categories: discount cash flow model, dividend discounted model, residual income model.

3.1.2.1 Discount cash flow model

DCF model estimates the intrinsic value of firm by discounting the free cash flow of firm to right now. It contains the requirements from not only equity holder, but also bond holder. In this model, free cash flow will be discounted by weighted average cost of capital:

$$V = \sum_{i=1}^{n} \frac{FCFF}{(1+WACC)^{i}} \tag{3.1}$$

WACC combines all source of capital---common stock, preferred stock, bond and long term debt. Free cash flow is that cash flow deducts all operating cost, capital expenditure and tax, which can pay for all bond holder and equity holder requirements.

3.1.2.2 Dividend discounted model

DDM estimated the value of common shares by transforming the future potential dividend to right now. This model applies to those firms with stable dividend payment, especially some mature companies rather than those in growth.

$$V = \sum_{i=1}^{\infty} \frac{D_t}{1+k_t} \tag{3.2}$$

Depending on this basic model, connecting to fact, DDM derives to three different situations: first, no dividend growth; second, stable dividend growth; third, random dividend growth.

3.1.2.3 Residual income model

Residual income model reflects that the value of a firm is a sum of right now book value and the residual income in future.

$$V = BV_0 + \sum_{i=1}^{\infty} \frac{RI_t}{(1+k)^t} \tag{3.3}$$

This model is most appropriate when the firm is not paying dividend or dividend unpredictable. Moreover, to those firms who have negative free cash flow but expect to generate positive cash flow in the future, RIM is preferable as well.

3.1.3 Option valuation model

Using the methodology of option valuation to price the value of firm reflects the value of potential investment option of firm. Here, firm's value contains the value of

continue operation, value of exactly investment opportunities and potential investment opportunities. This model is most appropriate to those with high growth speed but uncertainty in future.

3.1.4 Multiple pricing model

Multiple pricing model depends on the multiple regression methodology. First is to determine the main factors which will affect the price, such as profitability and growth ability. Then we need to connect the price to those factors to establish the regression model. IPO pricing regression model as follow:

$$P_i = \alpha_0 + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_n x_n + \varepsilon_i \quad (3.4)$$

ε_i is the residual of IPO price

β_i is the sensitivity of factors to IPO price

The disadvantage of this model is that the sensitivity of factors will change in different period. Here, this paper will test the rationale of IPO offering price depending on the multiple pricing model.

3.2 Model Design

3.2.1 Rationale of IPO pricing

In traditional theories, IPO underpricing results from the backroom agreement between underwriter and issuer. In China, different statements raised. Xing, Fengming and Hongyun (2001) indicated that disconnection of pricing mechanism between primary market and secondary market mainly accounted for the excess

return of IPO. External factors like turnover rate and market size are the leading factors to IPO underpricing. Fengqi and Xiuliang (2006) pointed out IPO price was more reasonable than the closing price of the first trading day. They extracted the main factors from criterions in financial statement to analyze IPO pricing in China main board market. The result indicated that the IPO price represents the firm's value more precisely rather than the closing price of first trading day.

3.2.1.1 Explanatory Variables selection

Here, I consider a hypothesis that it is reasonable for the IPO price in Chinese GEM. According to the intrinsic value theory, stock price is the present value of company's future earning, which lies on the profitability, growth ability and so on. Therefore, criterions in financial statement can used to explain the IPO price. In this paper, 12 criterions are selected to be the explaining variables.

Variables	Standard
Current Ratio	Latest before IPO
Quick Ratio	Latest before IPO
Leverage	Latest before IPO
EPS	Latest before IPO, annualized
ROE	Latest before IPO
ROA	Latest before IPO
Profit margin	Latest before IPO
Asset turnover	Latest before IPO

Total asset	Latest before IPO
Growth on Net Income	Latest before IPO, annualized
Growth on Operating Income	Latest before IPO, annualized
Free Cash Flow of Firm	Latest before IPO

3.2.1.2 Examples selection and collection

This paper uses the 254 companies IPO data listed in Chinese GEM from 2009 to 2011. Firm ID goes from 300001 to 300255 (3000080 was delisted). Most of these companies locate in Beijing, Yangtze River Delta and Zhu River Delta. On the other hand, all these companies focus on high-tech area such as IT industry, new material industry, biological medicine industry and new energy industry. Due to the time limit, this paper uses part of the firms listed on GEM so that it can not describe the whole situation of Chinese GEM.

3.2.1.3 Factors Analysis

Factors analysis can describe the variability among the observed variables by a lower numbers of potential unobserved variables, called factors. On another words, factors analysis can achieve a dimensionality reduction. In this paper, there are 12 variables and strong correlation exists among them. Factors analysis can decrease the number of variables and generate different unobserved factors which are independent with each other. Model can be express like this:

$$X = f\Lambda + \epsilon \tag{3.5}$$

$$\begin{cases} X_1 = a_{11} f_1 + a_{12} f_2 + \ldots + a_{1p} f_p + \varepsilon \\ X_2 = a_{21} f_1 + a_{22} f_2 + \ldots + a_{2p} f_p + \varepsilon \\ \ldots \\ X_n = a_{n1} f_1 + a_{n2} f_2 + \ldots + a_{np} f_p + \varepsilon_n \end{cases} \tag{3.6}$$

X is the matrix of observable variables

f is the matrix of unobservable variables called factors matrix

Λ is the matrix of factors loading

e is the independently distributed error

a_{ij} is the factors loading

Factors analysis needs to be paid attention on following steps:

1. Standardize all the data. Because the magnitude of variables here differs so much, standardization can eliminate the negative effect of large magnitude difference which may mislead the factor analysis.

2. Determine the number of factors. There are various methods to determine the number of factors. Kaiser criterion adopts those components with eigenvalues above 1; Variance explained criterion requires an appreciated level of variance explanation by selected factors, commonly accounting for more than 80% of variance; Cattell Scree test plots the relationship between components and the corresponding eigenvalues and determines the number of factors according to the inflection point. In this paper, I use the variance explained criterion as the methodology to drop the components

3. Rotate the matrix of factors loading. Rotation makes the factors loading

matrix easily understandable. Varimax rotation and quartimax rotation are most commonly used. Varimax rotation differentiates the initial variables by factors through maximizing the variance of squared factors loading. Quartimax minimizes the number of factors which are employed to explain the each variable.

4. Compute factor scores. Factor scores are the scores of each variable on each factor. To do a factor regression, factor scores are applied as parameters to establish the model to value the factors.

3.2.1.4 Regression Model

In this paper, I use the goodness of fit (R^2) to explain the rationale of IPO pricing and the closing price of first trading day. Offering price and closing price are set as the dependent variables which are regressed by several factors representing the profitability of firm, growth ability of firm, solvency ability of firm and so on. Model is showed as follow:

$$\begin{cases} P_0 = \alpha_0 + \alpha_1 f_1 + \cdots + \alpha_n f_n + \varepsilon \\ P_1 = \alpha_0 + \alpha_1 f_1 + \cdots + \alpha_n f_n + \varepsilon \end{cases} \tag{3.7}$$

By comparing the R^2 of the two regression equation, I can define that how much the price is deviated from the intrinsic value. The higher of the R^2, the better of the price.

3.2.2 Underpricing Model

Assuming the IPO offering price is reasonable, why does underpricing happen? Bubble theory supports that the underpricing phenomenon is set off by market

blinding optimism. Tinic (1998) and Ritter (1991), Aggarwal and Rivoli (1990), more of less, indicated the IPO price was not significantly lower than the firm's intrinsic value. Rather than the undervalued offering price, investment craze should respond to the high excess return. In China, most of investors are individual investors who have no clear concept to investment and always neglect the intrinsic value of firm. Therefore, both variables of market orientation and issuance orientation are taken into consideration.

3.2.2.1 Variables Definition

IPO underpricing level as dependent variable is defined as follow:

$$R = \frac{P_1 - P_0}{P_0} \tag{3.8}$$

R is the underpricing rate

P_0 is the IPO offering price

P_1 is the closing price of the first trading day.

Two kinds of independent variables should be applied to regression model:

	Variables	Description
Issuance Orientation Variables	Success Rate	
	Offering Value	
	Offering Price	
Market	Turnover Rate	

Orientation Variables	Market Index	30 days' average daily return before first trading day

Success rate indicates how much investors concern this firm. Traditionally, higher degree of concern, lower success rate is. Moreover, higher degree of concern means positive expectation to the firm which directly leads to a high demand of firm's shares. In secondary market, high demand from investors will push up the price of IPO.

Offering value represents the expected market value of IPO. Theoretically, higher offering value, larger scale the IPO is and more difficultly to manipulate. Under this condition, share price is hardly impacted by speculation and the underpricing level is lower.

Under an assumption of well IPO priced, higher offering price is less attractive to investors because of less possibility to go up forward.

Turnover rate indicate the acceptance of market. High acceptance of market, higher turnover rate is which drives the price up. On the other hand, turnover rate reflects the speculation level. All in all, there exists a positive relationship between turnover rate and underpricing level.

Market index reflects the investment environment. A bullish market drives the IPO higher without reasons, and vise versa. However, in China, the situation may be controversial. Here, I assume the positive relationship between the market performance and underpricing level.

3.2.2.2 Model Design

Before regression, I do a simple correlation test to recognize the relationship between dependent variable and individual independent variables. Pearson correlation coefficient is applied in this paper.

$$R_{xy} = \frac{\sum (X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum (X_i - \bar{X})^2 \sum (Y_i - \bar{Y})^2}} \tag{3.9}$$

After the correlation test, I use those independent variables which have linear relationship with dependent variable to regress the following function:

$$R = \beta_0 + \beta_1 X_s + \beta_2 X_p + \beta_3 X_t + \beta_4 X_m + \beta_5 X_v + \varepsilon \tag{3.10}$$

Chapter 4
Result

4.1 Rationale of IPO pricing

From the correlation matrix (Table I), we can find some variables have strong correlation like current ratio and quick ratio, EPS and ROE and ROA, growth rate on net income and growth rate on operating income, of which the correlation coefficient reaches 0.6 to 0.9. In order to eliminate the multicollinearity, data need to be adjusted.

According to the KMO test (Table II), value of KMO is significant and the score reach 0.6209, which means the variables are suitable to do a factor analysis.

After factor extraction and rotation process, 5 factors are picked up, which can explained 86.6% of initial total variance. They can describe almost information the observed variables contain.

Here, I use the variance maximum method to rotate the factors loading matrix, which can clear the meaning of each factors. After rotation, factors can be simply separated by their explanatory concept. EPS, ROE and ROA have higher loading in factor 1 so I define the factor 1 as the profitability factor named F_p; current ratio, quick ratio and leverage have higher loading in factor 2 named F_s which reflect the solvency ability; factor 3 named F_g indicates the growth ability by strong performance of growth rate on net income and operating income; factor 4 defined as company size factor named F_{cs}; factor 5 defined as operating factor named F_o.

According to the factor scores (Table V), we can calculate the 5 factors value.

So far, 12 variables has transformed to 5 independent factors: F_p; F_s; F_g; F_{cs}; F_o.

$$F_p = -0.106*x_1 - 0.111*x_2 + 0.058*x_3 + 0.381*x_4 + 0.367*x_5 + 0.323*x_6 + 0.201*x_7 + 0.088*x_8 + 0.046*x_9 - 0.087*x_{10} - 0.104*x_{11} - 0.182*x_{12}$$

$$F_s = 0.491*x_1 - 0.5*x_2 + 0.116*x_3 - 0.02*x_4 - 0.103*x_5 - 0.021*x_6 - 0.014*x_7 + 0.074*x_8 + 0.198*x_9 + 0.022*x_{10} + 0.02*x_{11} + 0.037*x_{12}$$

$$F_g = 0.059*x_1 + 0.066*x_2 - 0.113*x_3 - 0.041*x_4 - 0.052*x_5 - 0.112*x_6 - 0.021*x_7 - 0.077*x_8 + 0.055*x_9 + 0.502*x_{10} + 0.514*x_{11} + 0.193*x_{12}$$

$$F_{cs} = -0.159*x_1 - 0.173*x_2 + 0.243*x_3 - 0.253*x_4 - 0.013*x_5 + 0.105*x_6 + 0.064*x_7 - 0.011*x_8 - 0.667*x_9 - 0.005*x_{10} - 0.006x_{11} - 0.401*x_{12}$$

$$F_o = 0.119*x_1 + 0.128*x_2 - 0.066*x_3 + 0.009*x_4 + 0.093*x_5 + 0.031*x_6 - 0.45*x_7 + 0.71*x_8 + 0.113*x_9 - 0.03*x_{10} - 0.062*x_{11} + 0.19*x_{12}$$

5 factors take the place of 13 variables to regress separately the IPO offering price and close price of the first trading day. All the factors are significant at the level of 5% and the whole regression is significant as well. Adjusted goodness of fit R^2 as the evaluation standard separately reaches 0.4840 and 0.4138. The coefficients of F_p, F_s and F_g are positive. On the contrary, F_{cs} and F_o play negative effect on offering price.

4.2 IPO Underpricing

According to the result of the rationale analysis, offering price represents the intrinsic value of firms better than closing price of first trading day in Chinese GEM.

On the other hand, although the IPOs are right priced, they commonly offer an abnormal excess return in their first trading day.

	Mean	Std. dev	Largest	Median	Smallest
R	0.3937	0.3988	2.0973	0.2924	-0.1668
Success	0.0115	0.0157	0.1869	0.0074	0.0029
OfferingV	572.1157	356.2975	2070	472.36	135
OfferingP	32.5163	16.8330	110	28	9
Turnover	0.7212	0.1889	0.9592	0.7666	0.1842
Market	0.0000	0.0029	0.0063	0.0000	-0.0079

In the table above, the average underpricing level is 39.37% and the largest one reaching 209.73%, which show a strong underpricing in Chinese GEM. Success rate reaches 1.15% averagely, indicating the high demand from investors and large accumulation of money in primary market. High turnover rate reflects a strong speculation preference in Chinese stock market.

According to the correlation matrix (Table IX), all the selected explanatory variables are correlated to the explained variable. However, the correlation coefficient of offering price and offering value shows a potential multi-colinearity between these two variables so drop the offering value variable. The regression model finally shown as follow:

$$R = \beta_0 + \beta_1 X_s + \beta_2 X_p + \beta_3 X_t + \beta_4 X_m - \quad (4.1)$$

By conducting the White test, null hypothesis is rejected, heteroscedasticity is prove existed in this regression model. Therefore, data need to be adjusted.

$$R = -0.3412 + 3.0X_s34-3 \quad 0X_p00-21 \quad X_t1.+1617 \quad (4.2)$$

The adjusted regression model eliminates the heteroscedasticity and the

goodness of fit is 44.34%. F test and t test of 3 variables present significant at 5%. P-value of offering price outstrips 0.05 a little bit but it does not affect the result too much. All coefficients comply with their economical expression. Turnover rate and market return have positive effect to the underpricing level. Contrarily, success rate and offering price affect negatively to the underpricing level.

Chapter 5
Conclusion

In the IPO pricing rationale research, compared to the closing price of IPO first public trading day, the offering price responds to the firm's intrinsic value precisely. I can conclude that the IPOs in Chinese GEM are priced reasonably and the underpricing is accounted for market over-optimistic expectation and investors' speculation.

Five factors have been summarized in the paper, including profitability factor, solvency factor, growth factor, company size factor and operation factor. Four factors, except operating factor, show a clear economical concept: the positive relationship between profitability and offering price clarifies that if an IPO firm has high profitability, it always enjoys a high offering price; the positive relationship between solvency and offering price announces that low risk firm succeeds in IPO with a more appreciated price; the positive relationship between growth factor and offering price clarifies that high growth capacity enhances the IPO offering price; the negative relationship between company size and offering price indicates that large company always suffers a low IPO price. However, the economical meaning of operation factor is ambitious. The negative relationship between offering price and operation factor doesn't mean the inefficient operation enhance the price. Contrarily, combined with the factors loading, profit margin is highlighted. In growth stage of a firm, high profit margin brings more earning than high asset turnover. Therefore, the negative coefficient of operation factor indicates that IPO firm should enhance the profit margin so that the intrinsic value will increase.

Under the rational price of IPO hypothesis, underpricing results from the external factors. In this paper, issuance element and market element are taken into consideration. Market performance is the most weighted variables that affect the underpricing level among them which reflects that the underpricing level will be significant if the market performs a bullish trendency and vice versa. The positive relationship between turnover rate and underpricing indicates that the investors speculation push the level up as well. The high offering price implies the high risk of the IPO so the demand of the IPO decrease which drives the underpricing level down. The lower of success rate the higher of demand for the IPO, therefore, the underpricing level rise.

All in all, the rational price of IPOs excludes the reason of underpricing that IPOs are underestimated, meanwhile, it shifts the focus to the effect from investors, market and government. Compared to the primary market, bubbles are generated faster and bigger in secondary market. In order to establish an efficient growth enterprise market, CSEC needs to improve the IPO inquiry mechanism and information disclosure. Beside the regulatory establishment, CSEC should struggle to do more investment knowledge and theories dissemination.

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Appendix A

Table I: Table of standardized variables correlation coefficient

(obs=253)

	std_cr	std_qr	std_lv	std_eps	std_roe	std_roa	std_pm	std_at
std_cr	1.0000							
std_qr	0.9720	1.0000						
std_lv	0.6426	0.6055	1.0000					
std_eps	0.1274	0.1197	0.1632	1.0000				
std_roe	0.1041	0.1083	0.1703	0.6888	1.0000			
std_roa	0.4045	0.3906	0.6599	0.6200	0.8304	1.0000		
std_pm	0.5075	0.4919	0.5829	0.4191	0.4645	0.6574	1.0000	
std_at	-0.0996	-0.1029	-0.0108	0.1697	0.3517	0.2528	-0.4074	1.0000
std_ta	-0.2462	-0.2305	-0.4895	0.0218	-0.1457	-0.3421	-0.2390	-0.0916
std_gronni	-0.0278	-0.0284	-0.0409	0.4104	0.4542	0.3070	0.1722	0.1486
std_gronoi	-0.0271	-0.0299	-0.0299	0.3881	0.4058	0.2843	0.1878	0.1166
std_fcff	0.1844	0.1887	0.2151	0.0308	0.2511	0.2932	0.1338	0.1797

	std_ta	std_g~ni	std_g~oi	std_fcff
std_ta	1.0000			
std_gronni	-0.0249	1.0000		
std_gronoi	-0.0269	0.9541	1.0000	
std_fcff	-0.2600	0.1995	0.1898	1.0000

Strong correlation exists between variables. Multi-colinearity affects the regression model if the variables are employed directly. Therefore, it is necessary to adjust data further.

Table II: Table of KMO test

Kaiser-Meyer-Olkin measure of sampling adequacy

Variable	kmo
std_cr	0.6627
std_qr	0.6631
std_lv	0.5167
std_eps	0.9226
std_roe	0.5264
std_roa	0.6186
std_pm	0.7069
std_at	0.3886
std_ta	0.7583
std_gronni	0.5949
std_gronoi	0.5837
std_fcff	0.8707
Overall	0.6209

KMO test is the higher the better. 0.6209 is acceptable, saying the variables are suitable to implement factor analysis.

Table III: Table of eigenvalue and variance explanation and factors loading

Factor analysis/correlation — Number of obs = 253
Method: principal-component factors — Retained factors = 5
Rotation: (unrotated) — Number of params = 50

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	4.28008	1.63744	0.3567	0.3567
Factor2	2.64264	1.26240	0.2202	0.5769
Factor3	1.38023	0.20865	0.1150	0.6919
Factor4	1.17158	0.25508	0.0976	0.7895
Factor5	0.91649	0.19456	0.0764	0.8659
Factor6	0.72194	0.34054	0.0602	0.9261
Factor7	0.38140	0.07056	0.0318	0.9579
Factor8	0.31084	0.20174	0.0259	0.9838
Factor9	0.10910	0.06571	0.0091	0.9929
Factor10	0.04338	0.01658	0.0036	0.9965
Factor11	0.02680	0.01128	0.0022	0.9987
Factor12	0.01552	.	0.0013	1.0000

LR test: independent vs. saturated: chi2(66) = 3170.77 Prob>chi2 = 0.0000

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Uniqueness
std_cr	0.6417	-0.5996	0.0834	0.1613	0.4077	0.0295
std_qr	0.6278	-0.5922	0.0876	0.1654	0.4262	0.0385
std_lv	0.7038	-0.4933	-0.1442	0.0046	-0.1289	0.2239
std_eps	0.6120	0.4341	0.1819	-0.4315	0.0954	0.2087
std_roe	0.7148	0.4848	-0.1100	-0.3469	-0.0366	0.1202
std_roa	0.9071	0.1067	-0.1490	-0.2861	-0.0956	0.0526
std_pm	0.7588	-0.2242	0.4261	-0.1230	-0.2929	0.0915
std_at	0.1096	0.4032	-0.7639	-0.1407	0.3891	0.0708
std_ta	-0.4148	0.2398	0.4480	-0.2438	0.5331	0.2261
std_gronni	0.4344	0.7113	0.2300	0.4471	0.0623	0.0487
std_gronoi	0.4211	0.6890	0.2580	0.4750	0.0424	0.0539
std_fcff	0.3805	0.0552	-0.4385	0.4581	-0.0738	0.4446

Although the fifth factor shares a eigenvalue less than 1.0 but nearly, the cumulative variance explanation increase to an appreciated value. 5 factors will be extracted. After extraction, factors loading show an ambiguous relationship between variables and factors. In order to clarify the factors' meaning , factors loading need to be roated.

Table IV: Table of rotated factors loading

Factor analysis/correlation — Number of obs = 253
Method: principal-component factors — Retained factors = 5
Rotation: orthogonal varimax (Kaiser on) — Number of params = 50

Factor	Variance	Difference	Proportion	Cumulative
Factor1	2.78820	0.21519	0.2323	0.2323
Factor2	2.57301	0.52080	0.2144	0.4468
Factor3	2.05220	0.43827	0.1710	0.6178
Factor4	1.61394	0.25026	0.1345	0.7523
Factor5	1.36367	.	0.1136	0.8659

LR test: independent vs. saturated: chi2(66) = 3170.77 Prob>chi2 = 0.0000

Rotated factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Uniqueness
std_cr	0.0940	0.9720	-0.0150	0.1107	-0.0666	0.0295
std_qr	0.0826	0.9711	-0.0083	0.0920	-0.0565	0.0385
std_lv	0.3219	0.6007	-0.1587	0.5120	-0.1560	0.2239
std_eps	0.8350	0.0645	0.2421	-0.1762	0.0178	0.2087
std_roe	0.8742	0.0072	0.2615	0.1288	0.1749	0.1202
std_roa	0.8447	0.3156	0.0989	0.3501	0.0434	0.0526
std_pm	0.5637	0.4134	0.0867	0.2147	-0.6052	0.0915
std_at	0.2397	-0.0735	0.0316	0.1050	0.9243	0.0708
std_ta	-0.0905	-0.0878	0.0629	-0.8663	0.0595	0.2261
std_gronni	0.2502	-0.0431	0.9410	0.0281	0.0262	0.0487
std_gronoi	0.2186	-0.0397	0.9463	0.0341	-0.0133	0.0539
std_fcff	-0.0180	0.1822	0.3109	0.5927	0.2719	0.4446

Rotated factors loading matrix clarifies the meaning of each factor. Factor 1 represents the profitability; factor 2 represents the solvency; factor 3 represent the growth capability; factor 4 represents the firm size; factor 5 represent the operation.

Table V: Table of factor scores

Scoring coefficients (method = regression; based on varimax rotated factors)

Variable	Factor1	Factor2	Factor3	Factor4	Factor5
std_cr	-0.10623	0.49080	0.05947	-0.15785	0.11761
std_qr	-0.11173	0.49919	0.06584	-0.17236	0.12741
std_lv	0.05895	0.11702	-0.11391	0.24133	-0.06491
std_eps	0.38100	-0.02117	-0.04070	-0.25283	0.00924
std_roe	0.36705	-0.10402	-0.05162	-0.01347	0.09382
std_roa	0.32239	-0.02110	-0.11165	0.10412	0.03196
std_pm	0.20107	-0.01345	-0.02131	0.06383	-0.44938
std_at	0.08679	0.07390	-0.07621	-0.01205	0.71127
std_ta	0.04560	0.19773	0.05649	-0.66868	0.11433
std_gronni	-0.08650	0.02171	0.50186	-0.00525	-0.03014
std_gronoi	-0.10390	0.01996	0.51399	0.00590	-0.06108
std_fcff	-0.18213	0.03715	0.19257	0.40276	0.18657

Table VI: Table of factors' correlation

(obs=253)

	f1	f2	f3	f4	f5
f1	1.0000				
f2	-0.0000	1.0000			
f3	-0.0000	0.0000	1.0000		
f4	0.0000	-0.0000	-0.0000	1.0000	
f5	0.0000	-0.0000	-0.0000	-0.0000	1.0000

The factors are independent so no possibility of multi-colinearity.

Table VII: Table of regression results

Source	SS	df	MS	Number of obs =	253
				F(5, 247) =	48.28
Model	35419.2192	5	7083.84384	Prob > F =	0.0000
Residual	36238.012	247	146.712599	R-squared =	0.4943
				Adj R-squared =	0.4840
Total	71657.2311	252	284.354092	Root MSE =	12.112

offeringpr~e	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
f1	11.00326	.7630156	14.42	0.000	9.500409	12.5061
f2	1.995164	.7630156	2.61	0.009	.4923174	3.498011
f3	2.476325	.7630156	3.25	0.001	.9734778	3.979171
f4	-2.476585	.7630156	-3.25	0.001	-3.979432	-.9737378
f5	-1.798467	.7630156	-2.36	0.019	-3.301314	-.2956202
_cons	32.49458	.7615062	42.67	0.000	30.99471	33.99446

Source	SS	df	MS	Number of obs =	253
				F(5, 247) =	36.57
Model	59057.0358	5	11811.4072	Prob > F =	0.0000
Residual	79774.6211	247	322.974175	R-squared =	0.4254
				Adj R-squared =	0.4138
Total	138831.657	252	550.919274	Root MSE =	17.971

closeprice	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
f1	13.91295	1.132097	12.29	0.000	11.68316	16.14275
f2	1.863698	1.132097	1.65	0.101	-.3660968	4.093493
f3	5.326991	1.132097	4.71	0.000	3.097196	7.556785
f4	-.7250839	1.132097	-0.64	0.522	-2.954879	1.504711
f5	-2.899511	1.132097	-2.56	0.011	-5.129306	-.6697162
_cons	43.69217	1.129857	38.67	0.000	41.46679	45.91756

IPO offering price is regressed much better with adjusted R^2 =0.4840 than closing price with adjusted R^2 =0.4138 depending on the 5 factors. 5 factors present significantly according to the P value in first regression model, but doesn't in the second one.

Appendix B

Table VIII: Table of variables information

return_1st_day

Percentiles		Smallest		
1%	-.1338512	-.1667692		
5%	-.0591324	-.1419657		
10%	-.0324885	-.1338512	Obs	254
25%	.1089947	-.1214286	Sum of Wgt.	254
50%	.2923776		Mean	.3936576
		Largest	Std. Dev.	.398783
75%	.5852941	1.528788		
90%	.8708333	1.945882	Variance	.1590279
95%	1.2	1.988889	Skewness	1.402814
99%	1.945882	2.097345	Kurtosis	5.53

turnover_rate

Percentiles		Smallest		
1%	.2094	.1842		
5%	.2501	.2092		
10%	.3586	.2094	Obs	254
25%	.6615	.2119	Sum of Wgt.	254
50%	.7666		Mean	.7212378
		Largest	Std. Dev.	.1888897
75%	.8673	.926		
90%	.8941	.9349	Variance	.0356793
95%	.9049	.9458	Skewness	-1.35195
99%	.9349	.9592	Kurtosis	4.033192

success rate

Percentiles		Smallest		
1%	.0030043	.0029011		
5%	.0037278	.0029047		
10%	.0041359	.0030043	Obs	254
25%	.0054465	.0030338	Sum of Wgt.	254
50%	.0074327		Mean	.0114773
		Largest	Std. Dev.	.0157189
75%	.0114587	.0716403		
90%	.022356	.081867	Variance	.0002471
95%	.028725	.1014225	Skewness	7.056617
99%	.081867	.186914	Kurtosis	68.85747

offering_value

Percentiles		Smallest		
1%	156.96	135		
5%	196	150		
10%	237.6	156.96	Obs	254
25%	342.3	157.28	Sum of Wgt.	254
50%	472.36		Mean	572.1157
		Largest	Std. Dev.	356.2975
75%	684	1870		
90%	1026	1900	Variance	126947.9
95%	1317.8	1925	Skewness	1.808115
99%	1900	2070	Kurtosis	6.674209

Offering Price

Percentiles		Smallest		
1%	10.8	9		
5%	14.38	10		
10%	17	10.8	Obs	254
25%	20.48	11.07	Sum of Wgt.	254
50%	28		Mean	32.51626
		Largest	Std. Dev.	16.83299
75%	39	87.5		
90%	57	88	Variance	283.3495
95%	67.58	95	Skewness	1.543653
99%	88	110	Kurtosis	5.793758

average_market_return

Percentiles		Smallest		
1%	-.0079358	-.0079358		
5%	-.0039279	-.0079358		
10%	-.003464	-.0079358	Obs	254
25%	-.001999	-.0079358	Sum of Wgt.	254
50%	.0000635		Mean	.0000541
		Largest	Std. Dev.	.0027819
75%	.0017547	.0063077		
90%	.0037886	.0063077	Variance	7.74e-06
95%	.0048055	.0063077	Skewness	-.1650981
99%	.0063077	.0063077	Kurtosis	3.232167

Table IX: Table of variables correlation matrix

	r	turnover	succes~e	offeri~v	offeri~e	rm
r	1.0000					
turnover	0.6269	1.0000				
successrate	-0.2408	-0.1393	1.0000			
offeringv	-0.2400	-0.2850	0.1251	1.0000		
offeringpr~e	-0.2363	-0.1958	0.2324	0.6600	1.0000	
rm	0.3320	0.2911	-0.1623	-0.0306	-0.0744	1.0000

Offering value correlates to offering price strongly and it brings the multi-colinearity which affects the regression result.

Table X: Table of White's test

```
White's test for Ho: homoskedasticity
         against Ha: unrestricted heteroskedasticity

         chi2(14)     =     36.99
         Prob > chi2  =    0.0007

Cameron & Trivedi's decomposition of IM-test
```

Source	chi2	df	p
Heteroskedasticity	36.99	14	0.0007
Skewness	18.85	4	0.0008
Kurtosis	3.68	1	0.0550
Total	59.52	19	0.0000

The null hypothesis is homoskedasticity in regression. The p value identifies the test is located in the rejection area, which means heteroskedasticity exists in regression. The regression model needs to be adjusted.

Table XI: Table of regression result

Linear regression

					Number of obs =	254
					F(4, 249) =	58.34
					Prob > F =	0.0000
					R-squared =	0.4434
					Root MSE =	.2999

r	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
turnover	1.161655	.0860431	13.50	0.000	.9921905	1.331121
successrate	-3.034254	1.139801	-2.66	0.008	-5.279134	-.7893737
offeringpr~e	-.0021304	.0011385	-1.87	0.062	-.0043727	.000112
rm	20.88914	5.873921	3.56	0.000	9.320239	32.45805
_cons	-.3412049	.0682011	-5.00	0.000	-.4755296	-.2068803