Asymmetric Information and IPO Size

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ABSTRACT

We build a model of an IPO for firms with private information about their earnings profile over time and test the model's predictions using a complete sample of newly listed Chinese companies between 1992 and 2007. The model predicts that IPO size is positively correlated with short-term operating performance that is not directly consistent with traditional theories. It also provides an explanation for negative correlation between debt and profitability that is not consistent with standard trade-off theory or signaling theory. The empirical results provide strong support for our model.

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I. Introduction

A firm's initial public offering (IPO) decision has been one of the top issues in corporate finance theory. Over the years financial economists have formulated and tested various theories of IPO, including models based on asymmetric information, market timing, and many others. Despite the tireless efforts, this issue has not been completely resolved.

The focus of our research is the link between firm's IPO size and subsequent operating performance. Existing theories of equity issues based on asymmetric information usually predicts that equity issue is a negative signal about firm's performance. Pecking-order theory (Myers and Majluff, 1984) for example predicts that firms prefer internal funds to finance investments and that equity will only be used as a last resort. Firms issuing equity will be undervalued. Consequently only firms with low expected performance may issue equity. Therefore one should expect a negative correlation between the size of equity issues including IPO and post-offer performance. Signalling theory usually suggests that debt issues can be used as a positive signal of firms performance (Leland and Pyle, 1977) as opposite to equity issues (negative signal).

The empirical literature usually focuses on the link between IPO decision and long-term operating performance after IPO although there is no research that focuses specifically on the link between IPO size and operating performance after issue. Jain and Kini (1994), Mikkelson, Partch, and Shah (1997), and Loughran and Ritter (1997) document the long-run operating underperformance of equity issuing firms compared to non-issuing firms. This is indirectly consistent with negative correlation between IPO size and firm's long-term performance. We have not found any research that focuses specifically on the link between IPO decision and short-

term performance after issue. The evidence on short-term performance is mixed however. Some studies document the superior absolute performance of equity-issuing firms before and immediately after the issue (Jain and Kini, 1994; Loughran and Ritter, 1997). According to Jain and Kini (1994) the operating return on assets is higher for IPO firms in the first years after the issue and the operating cash flow on assets is higher in year "0" (immediately after issue). In Loughran and Ritter (1997) profit margins are higher in years 0 and +1, although there is different evidence about operating returns. In Mikkelson, Partch and Shah (1997) IPO firms have higher performance in year 0.

This study contributes to the literature in two significant ways. First, we build a model of equity financing for firms with private information about their earnings profile over time. The model predicts that IPO size is positively correlated with short-term operating performance that is not directly consistent with traditional theories. It also provides an explanation for negative correlation between debt and profitability that is not consistent with standard trade-off theory or signaling theory. Second, we test the model's predictions using a complete sample of newly listed Chinese companies between 1992 and 2007. The empirical results provide strong support for our model.

The rest of the paper proceeds as follows. The next section presents our model of IPO size. Section III offers empirical examination of our model. Section IV discusses our results and compares them with existing evidence in the literature. Section V summarizes and concludes.

II. The Model

2.1 Standard signalling model

We start with the standard signaling model. Consider a one-period environment where a firm considers equity financing for an investment project with cost C. The firm has an amount I

of internal funds (publicly observable) which can also be used to finance the project.[1] A firm's insiders have private information about the project future earnings. The firms are of two types, type a and type b, with respective earnings θ_a and θ_b. The risk-free interest rate is zero. There exists universal risk-neutrality and perfect competition among investors, which implies zero market profit and risk-neutral valuation for any security issued. The net-present value of investment for type j is $\theta_j - C, j = a, b$.

Let x_a be a part of the project which is financed with equity (respectively $1 - x_a$ is the part of the project which is financed with internal funds; also the amount of dividends to existing shareholders equals $I - (1 - x_a)C$) by the type a**.** Investors require a fraction of equity s_a such that:

$$s_a\theta_a = x_aC \tag{1}$$

Now consider the payoff of shareholders of b in case b decides to mimic a. This equals $(1 - sa)\theta b + I - 1 - xaC$. If a signaling equilibrium exists where a issues equity, the shareholders' payoff for type b is $\theta_b - C + I$ (the present value of b). Thus, a separating equilibrium exists if $(1 - s_a)\theta_b + I - (1 - x_a)C \leq \theta_b - C + I$. Using (1), this can be simplified to:

$$s_a(\theta_a - \theta_b) \leq 0 \tag{2}$$

Obviously, if $x_a > 0$ (and $s_a > 0$ by (1)) this can be simplified to $\theta_a \leq \theta_b$. In other words, a separating equilibrium can exists only if a has inferior quality compared to type b. If $x_a = 0$ (and $s_a = 0$ by (1)), (2) holds automatically. In other words, if a uses internal funds to finance

[1] Pre-IPO cash holdings and subsequent problem of pre-IPO dividend payments is relatively new in the literature. Its importance and its link to IPO decision is mentioned, for example, in Martin and Zeckhauser (2009). As anecdotal evidence note that in May 2006, Burger King conducted an Initial Public Offering (IPO). It sold primary shares to raise 400 million USD in new funds. However, shortly before going public, they paid out a dividend of 367 million USD to old shareholders in February 2006. Also note that introducing debt financing in the model will not change major results of our model as we discuss in the text.

the project, mimicking type a does not increase the payoff of b. Similar analysis applies when one considers equity financing by type b. A separating equilibrium condition is $\theta_a \geq \theta_b$. If we assume without loss of generality that $\theta_a > \theta_b$, then the only possible separating equilibrium is $x_a = 0$ and $x_b > 0$. This leads to the following.

If $I > C$ both firms can use internal funds to finance the project to avoid adverse selection problems. This will not generate any conclusions about the link between the size of equity issues and firms performance. Also a separating equilibrium may exist where type with superior performance uses internal funds and the one with inferior performance issues equity to finance the project or uses a mix of internal funds and equity to finance the project. Thus one should observe empirically a negative relationship between the size of equity issue and the firm's performance after issue. If $I < C$, a separating equilibrium does not exist. However, if one assumes that firms can issue risk-free debt then a separating equilibrium can exist where better firm uses a mix of internal funds and debt and inferior firm uses a mix of internal funds, debt and equity. Again the prediction would be that the size of equity issue is negatively correlated to firm's performance after issue.

So the prediction of standard signaling theory of capital structure is that the size of equity issue is a negative signal about firm's future operating performance. For other examples see Leland and Pyle (1977) or Ross (1977). As we will discuss further however, empirically it is not clear whether this result holds. It is also not clear whether the performance in the standard model is short-term or long-term. It is not clear also why good quality firms pay large pre-IPO dividends (leading respectively to larger IPO) mentioned in Martin and Zeckhauser (2009).

2.2 Our model

We build a model with asymmetric information that allows for focusing on a firm's

performance profile over time and its effect on IPO size. Consider a firm that consider equity financing for a two-period investment project with cost C_t in period t, $t = 1,2$. A firm's insiders have private information about expected earnings in each stage. The firms are of two types, type a and type b, with respective earnings θ_{at} and θ_{bt} in stage t. The risk-free interest rate is zero. There exists universal risk-neutrality and perfect competition among investors, which implies zero market profit and risk-neutral valuation for any security issued. The net-present value of investment in stage t for type j is $\theta_{jt} - C_t$, $j = a, b$.

Suppose a issues equity for each stage of investments and distributes period 1 earnings as dividends**.** Let x be a part of the first stage of the project which is financed with equity (respectively $1 - x$ is the part of the project which is financed with internal funds) by the type a**.** In stage 2, investors require a fraction of equity s_2 such that:

$$s_2\theta_{a2} = C_2 \tag{3}$$

In stage 1 investors require a fraction of equity s_1 such that:

$$s_1\theta_{a1} + s_1(1 - s_2)\theta_{a2} = xC_1 \tag{4}$$

Now consider the payoff of shareholders of b in case b decides to mimic a. This equals $(1 - s1)\theta b1 + I - 1 - xC1 + (1 - s1)(1 - s2)\theta b2$. If a signaling equilibrium exists, the shareholders' payoff for type b is $\theta_{b1} + \theta_{b2} + I - C_1 - C_2$ (the present value of b). Thus, a separating equilibrium exists if $(1 - s_1)\theta_{b1} + I - (1 - x)C_1 + (1 - s_1)(1 - s_2)\theta_{b2} < \theta_{b1} + \theta_{b2} - C_1 - C_2 + I$. If $x > 0$, then using (3) and (4), this can be simplified to:

$$\frac{\theta_{a1} + \theta_{a2} - xC_1 - C_2}{\theta_{b1} + \theta_{b2} - xC_1 - C_2} < \frac{\theta_{a1} + \theta_{a2} - C_2}{\theta_{b1} + \theta_{b2}(1 - \frac{C_2}{\theta_{a2}})} \tag{5}$$

If $x = 0$, this can be simplified to

$$\theta_{a2} < \theta_{b2} \tag{6}$$

It means that if type a does not issue equity in period 1 and issues equity in period 2 then in order for separating equilibrium to exist type a should have inferior performance in period 2.

A similar condition can be developed for type b.

Poposition 1. *Suppose* $\theta_{a1} > \theta_{b1}$ *. A separating equilibrium where type* a *issues a larger amount of equity than type* b *dominates a separating equilibrium where* b *issues a larger amount of equity, i.e. the first one should be observed more frequently.*

Proof. See Appendix.

Proposition 1 implies a positive correlation between the size of IPO and firm's short-term performance after issue.

To illustrate the proof of Proposition 1 consider the case $\theta_{a1} + \theta_{a2} = \theta_{b1} + \theta_{b2}$ (i.e. suppose firms have the same total earnings over two periods and differ only in earnings profile over time). One can see that (5) becomes $\theta_{a2} < \theta_{b2}$. It means a separating equilibrium exists where type a issues equity and type b does not issue equity ($x = 0$ for type b otherwise condition (5) will not hold for type b).

What explains this result? Intuitively, the value of shares in period 1 depends on the firm's total value and not on the firm's performance in a particular period, while the value of shares in period 2 depends on period 2's performance. The firm with high second-period earnings can have a loss from period 2 undervaluation.

III. Empirical Evidence

3.1 Data and summary statistics

The complete sample of Chinese domestic A-share IPOs completed from the start of 1992 to the end of 2007 is obtained from the GTA's IPO database. GTA is the first and largest research data vendor in China. The data provided is considered high quality and contains both

stock market and macro-economic information for academic research on China. The database provides not only information about the IPO such as the offer price, offer size and first-day return, but also balance sheet and operating performance data three years prior to and three years after the IPO.

The final sample contains a total of 1,571 newly listed Chinese firms. Table 1 displays the number of IPOs by year as well as some summary statistics. The mean offer price of all IPOs is yuan 8.0 (roughly one US dollar). The first-day return, calculated as the percentage difference between the first-day close price and the offer price, averages 227.4%, making Chinese IPOs among the most underpriced around the world.

The average amount of gross proceeds raised from the IPO is yuan 750.9 million. The number of employees at the time of the IPO is on average slightly over 2,000. It is well known that many of the IPO firms are state-owned enterprises being privatized. The mean percentage of equity owned by the state is 55.1% before the IPO and 39.5% afterwards.

3.2 Operating performance of IPO firms

Three metrics are used to measure the operating performance of an IPO firm, based on the firm's reported accounting data: 1) sales; 2) net profit; and 3) earnings before interest and taxes (EBIT). The results are reported in Table 2. Panel A of the table presents the means and medians of the three performance measures from three years prior to and three years after the IPO. Panel B reports the year over year percentage change in each of the operating performance gauges from year -3 to year +3, where year 0 is the IPO year. In calculating the percentage

changes, we exclude those firms that have negative or zero starting values, since their results are meaningless.

The median figures indicate that sales, net profit and EBIT all grow at about 20% each year in the three years leading up to the IPO. Sales continue to grow steadily at about 15% each year in the three years following the IPO. Net profit and EBIT, on the other hand, seem to have peaked at the time of the IPO, and stagnate in the post-IPO years. EBIT, for instance, increases at an annual rate of around 20% in the three years leading up to the IPO, but its growth rate drops to 10.7%, 1.1%, and 3.0%, respectively, in the subsequent three years. The results for the net profit are similar.

3.3 Correlation coefficients

Table 3 presents the correlation coefficients of offer size with a plethora of variables. It can be seen that offer size is positively correlated with total assets and sales, both of which are proxies of firm size.

Offer size is also positively correlated with state ownership either before or after the IPO. This positive correlation can be interpreted in two ways. First, state ownership may proxy for firm size, as state-owned enterprises (SEOs) are typically large. Second, SEOs may be allowed by the stage regulator to have larger offers. Additionally, the correlation between offer size and EBIT growth from year 1 to year 2 after the IPO is positive and significant at the 5% level.

Relative offer size, which is offer size scaled by total assets, is also positively correlated with EBIT growth from year 1 to year 2. However, relative offer size is negatively correlated with state ownership prior to the IPO.

3.4 Cross-sectional regressions and results

The key prediction of our model of new issues under asymmetric information is that firms will sell more new shares when they expect higher short-term earnings or lower long-term earnings. To test this prediction, we run the following regression:

$$\textit{Relative Offer Size} = \alpha + \beta_1 * \textit{State ownership} + \beta_2 * \ln(\textit{Sales}) + \beta_3 * \textit{Performance} + \varepsilon$$

The dependent variable is the relative offer size, which is offer size (gross proceeds from the IPO) scaled by total assets in the IPO year. State ownership is the percentage owned by the state government prior to the IPO. Since the Chinese state regulator may favor state-owned enterprises (SEOs) when choosing which firm can go public, it is expected that SEOs have larger relative offer in their IPOs. Sales is the annual sales in the IPO year, measured in yuan millions and in logarithm. Sales is included to control for firm size.

We use EBIT growth in the three years after the IPO for short-term operating performance. Specifically, operating performance is measured by the year-over-year percentage changes in EBIT up to three years after the IPO, as below:

EBIT_0Y1 = percentage change from year 0 to year 1

EBIT_1Y2 = percentage change from year 1 to year 2

EBIT_2Y3 = percentage change from year 2 to year 3

EBIT_0Y2 = cumulative percentage change from year 0 to year 2

EBIT_0Y3 = cumulative percentage change from year 0 to year 3

The OLS regression results are reported in Table 4. The results show that relative offer size is negatively associated with sales, a proxy for firm size. This result implies that large firms have relatively lower offer size. State ownership prior to the IPO only marginally affects relative offer size, and the effect, if any, is negative. This negative association between state ownership and relative offer size is at odds with the notion that state-owned enterprises are favored to sell more shares in their IPO debuts. The result, however, may reflect the intention of the state government to maintain adequate control over the newly listed firm.

Turning to the operating performance variables, the focus of our investigation, in the first three regressions we add the year-over-year growth in EBIT in the three years after the IPO separately. The coefficients of EBIT_0Y1 and EBIT_1Y2 are positive and significant statistically. The results suggest that IPO firms sell more shares relative to their assets when the EBIT growth is higher in each of the two years after the IPO. The change in EBIT from year 2 to 3 (i.e., EBIT_2Y3), on the other hand, does not have any significant impact on relative offer size. In regression 4, we include all three year-over-year changes in EBIT. The results are similar.

In the next regression, we use the cumulative change in EBIT in the first two years post offer. The coefficient on this new variable is positive and significant at the 1% level. In the last regression, the cumulative EBIT growth in the first three years is added as independent variable. Its coefficient is, again, positive and significant at the 1% level.

Overall, the empirical results are consistent with the prediction of our model.

IV. Discussions

Our model predicts that the size of the IPO is positively correlated with firms expected

earnings after issue. Our empirical findings confirm this result.

Among basic rational market intuitions, the following theories are notable. The theory of agency cost of equity (Jensen and Meckling, 1976) underlines the idea that larger equity issues decrease the manager's stake in the company and reduce the incentive to undertake value maximizing projects. This results in post-offer underperformance of the firm, though the theory does not compare the performance in the short run with that in the long run after the issue. Also note that the link between post-offer underperformance and a low managerial fraction of equity is empirically controversial. For instance, Pagano et al. (1995), Cai and Loughran (1998) and Mickelson et al. (1997) do not confirm the positive correlation between the fraction of insiders' equity and firm performance.

The trade-off theory in its standard form, proposing that firms equalize the marginal tax benefits associated with additional debt to the marginal cost of bankruptcy, suggests that more profitable firms should issue more debt (or less equity). However, it will not predict the link between the size of equity issues and dynamic profile of performance after the issue (long-term performance versus short-term performance). For instance, it will predict that type *a* (high expected performance in the first period) should issue less equity or more internal funds and more debt if available than type *b* in the first period in contrast to our results. According to the free cash flow theory (Jensen, 1986) debt is an instrument for solving the problem of a manager's entrenchment and thus more debt should lead to higher overall performance. However, this theory does not give an explanation for why firms should issue equity. This theory would also suggest that type *a* (with high expected performance in the first period) should use internal funds or issue more debt in order to prevent managers from overspending. Recently several dynamic versions of the trade-off model were developed which combine taxes, bankruptcy costs and

different kinds of agency costs. Typically, these models lead to less extreme and more realistic predictions than the basic ideas do. However, we have not found a model which systematically analyzes the link between IPO size and dynamic profile of operating performance after the issue. We will provide more discussion of dynamic trade-off models later when we discuss the correlation between debt and profitability.

The market timing argument (see, for instance, Baker and Wurgler, 2002) points out that while in Modigliani and Miller environment the capital structure decisions (and consequently an IPO size decision) are not affected by the magnitude of share prices or by the "hotness" of the market, in reality one observes that firms tend to issue equity when the market prices are relatively high and do not issue equity when the prices are relatively low. To relate this observation to the evidence about operating performances, one line of the literature focuses on non-rational aspects of investors behavior. For instance, some research argues that investors tend to be overoptimistic during new issues or that the analysts' forecasts are inadequately high.[2] The firms thus sell shares when they are overvalued or the firm is expected to perform poorly compared to the price of the issue. Theo, Welch and Wong (1998) argue that managers manipulate earnings (sacrifice future earnings by pushing up current earnings) prior to going public in order to attract more non-informed investors. We share with this paper the idea that managers may be involved in earnings management leading to their private information about the timing of cash flows. However our framework assumes completely rational investors which infer information about a firm's earnings profile from observing its financing decision.[3] The difference between these two approaches (rational market versus non-rational) is not only

[2]For references see Ritter and Welch (2002) or Loughran and Ritter (1997).
[3]Stein's (1989) model explains earnings inflation in a rational world but it does not explicitly analyzes an IPO size problem.

theoretical. Some recent empirical research argues in favor of efficient market version of the market timing argument (Schultz (2003) and Butler, Grullon and Weston (2005)) -"pseudo-market timing"- where shares are not overpriced.

When investors are rational the prices are supposed to correctly reflect firms' current and future earnings and not only current earnings. In such an environment and assuming that there is no asymmetric information or agency costs, how can one explain that first, firms time their issues and second, why the firms issue shares when operating performance is high and why it becomes low in the long run after issue? The literature based on rational investors is able to argue why firms may be interested in issuing equity in periods when market prices are high although it is not focused on explaining the link between IPO size and changes in operating performance after issue.[4]

Both the agency and trade-off theory also provide insight into market timing. According to the debt overhang problem (Myers, 1977) an excessive senior debt may lead the firm to forego some valuable investment opportunities. Thus, a firm with high market value of shares and good investment opportunities respectively will lose more from underinvestment and will thus issue equity instead. However it is not straightforward to predict a link between the size of equity issues and subsequent operating performance consistent with observable evidence without making additional assumptions about, for instance, the link between share price and current

[4]In Berkovitch and Narayanan (1993) firms can time their projects and the financial market is imperfect (there are switching rents imposed by intermediaries). Low-profit projects tend to be financed with equity. Firms will develop only the projects with sufficiently high quality. In recession, only highly profitable projects will be undertaken and low-profit projects will be shelved until an expansion occurs. This paper offers an explanation for why more equity is issued during expansions. Lucas and McDonald (1990) explains why equity issues on average are preceded by abnormally positive stock returns and why equity issues are positively correlated with stock market performance. See also "money left on the table" idea in, for example, Ranjan (2004).

operating performance.[5] An advantage of the present paper compared to Myers (1977) (and some other theories mentioned in this section) is that it is not based on the link between profitability and investment opportunities (for instance Jain and Kini (1994) and Loughran and Ritter (1997) do not find that post-offer underperformance is due to the lower or higher amounts of investment). In our model, all firms invest the same amount of funds and the difference comes only from future operating performance profiles. Finally note that Baker and Wrugler (2002) do not find a lot of support for underinvestment theory of market timing.

Our model predicts that leverage is negatively correlated with profitability.[6] As was mentioned above, IPO size is negatively related to debt/equity ratio so firms with higher leverage (and smaller IPO size) should be more profitable. Note that the trade-off theory in its standard form is inconsistent with the negative correlation between debt and profitability because highly-profitable firms should tend to finance with debt in order to reduce their taxes. Hennessy and Whited (2005) develop a dynamic trade-off theory with the idea that a profitable firm does not have to distribute its earnings immediately as the standard models assume. This may reduce the incentive to reduce taxes by issuing debt. The financing decision depends on the next period financing margin or what the firm is going to do in the future: to issue more equity, to distribute more earnings or to remain neutral. While providing a valid intuition about why the static trade-off may not work, the authors do not obtain a theoretical proposition about the link between debt and profitability. However, they do show numerically that under some plausible values of parameters one can observe the negative correlation between debt and profitability in their model.

[5]If one assumes that high current performance corresponds to the high share price then it can explain point (ii). It will still be difficult to explain why a firm issuing more equity should underperform in the long run after issuing equity and undertaking all its investment opportunities.

[6]See, for instance, Titman and Wessels (1988) and Rajan and Zingales (1995).

Zwiebel (1996) develops a dynamic model of capital structure based on the managers' entrenchment argument. The paper suggests that when a firm has more valuable investment opportunities the need to issue new debt as a disciplinary device decreases which leads to the situation where firms with lower debt (and larger equity) are likely to be more profitable. While providing an idea about the negative correlation between debt and profitability the paper does not explain why firms issuing equity underperform in the long run. Also equity financing is not explicitly analyzed in the model.

Signalling theory suggests that firms can signal their quality by changing their capital structure. A common prediction of signaling models is that debt serves a signal of positive information about future earnings (Ross, (1977), Leland and Pyle (1977)). Evidence on the positive market reaction on debt issues does not support signaling theories. Eckbo (1986) as well as Antweiler and Frank (2006) find insignificant changes in stock prices in response to straight corporate debt issues.

According to signaling theory, high-quality firms should issue debt and low-quality firms should issue equity. The empirical prediction is that firm value (or profitability) and the debt-to-equity ratio is positively related. The evidence, however, is ambiguous. Most empirical studies report a negative relationship between leverage and profitability as discussed earlier. In a similar spirit, some studies document the superior absolute performance of equity-issuing firms before and immediately after the issue (Jain and Kini, 1994; Loughran and Ritter, 1997). Several studies examine long-term firm performance following capital structure changes. Shah (1994) reports that business risk falls after leverage-increasing exchange offers but rises after leverage-decreasing exchange offers. Jain and Kini (1994), Mikkelson, Partch, and Shah (1997), and

Loughran and Ritter (1997) document the long-run operating underperformance of equity issuing firms compared to non-issuing firms.

Hennessy, Livdan, and Miranda (2010) develop a dynamic model of the firm under repeated hidden information. In equilibrium, firms signal positive information by substituting debt for equity, which explains the inverse relationship between leverage and net worth. Firms with negative private information are unlevered, which is consistent with debt conservatism.

Investors such as banks can sometimes obtain information on a firm's quality and produce analytical information. Fulghieri and Lukin (2001) show that good firms want to partition their securities so that some claims are informationally sensitive. If the cost of becoming informed is low and the degree of asymmetric information is high, firms may prefer a higher information sensitive security to promote information production by "specialized" outside investors. This explains the negative correlation between debt and firm value because firms with low profitability do not need to issue equity, which is sensitive to a firm's value. Fulghieri and Lukin also predict that younger firms with good growth opportunities are more likely to be equity financed. These firms can be especially interested in information production by outside investors.

V. Summary and Conclusions

A firm's IPO decision has been one of the top issues in corporate finance. Over the years financial economists have formulated and tested various theories of IPO, including models based on asymmetric information, market timing, and many others. Despite the tireless efforts, this issue has not been completely resolved.

The focus of our research is the link between IPO size and subsequent operating performance. Existing theories of equity issues based on asymmetric information usually predicts that equity issue is a negative signal about firm's performance. We establish a theoretical model of IPO size under asymmetric information. The model focuses on a firm's performance profile over time and its effect on IPO size. The model predicts that IPO firms will sell more shares when insiders expect stronger short-term future earnings growth.

We offer an empirical examination of the model's predictions using a sample of newly listed Chinese firms. The results provide strong support for our model. Specifically, the relative offer size of an IPO is positively correlated with the firm's earnings growth in the three years after the issue.

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Table 1
Sample and Summary Statistics

This table presents the sample and summary statistics of newly listed Chinese firms. Offer price is the price of the IPO shares. First-day return is the percentage difference between the first-day close price and the offer price. Offer size is the gross proceeds (in yuan millions) from the IPO. State ownership is the equity owned by the state government.

Year	N	Offer Price (yuan)	First-day return	Offer size (in yuan millions)	Number of employees	State ownership before IPO	State ownership after IPO
1992	40	25.9	487.0%	608.6	3,672	21.7%	36.6%
1993	129	13.1	380.7%	274.5	3,005	46.5%	42.2%
1994	106	5.2	158.8%	156.7	2,997	54.5%	38.8%
1995	28	3.9	542.7%	200.4	3,933	49.2%	35.9%
1996	206	5.2	333.3%	130.9	2,248	49.4%	36.7%
1997	209	6.1	265.8%	323.3	2,652	65.2%	45.5%
1998	104	6.2	292.9%	383.8	3,432	76.0%	54.0%
1999	97	6.3	116.2%	522.1	2,969	70.2%	48.6%
2000	133	8.0	154.7%	611.7	1,883	70.6%	47.8%
2001	75	9.0	229.9%	764.7	9,340	68.0%	47.3%
2002	71	7.0	148.7%	761.7	2,797	67.4%	45.0%
2003	67	7.3	72.0%	705.1	2,002	58.6%	38.8%
2004	100	8.5	70.1%	361.1	1,705	39.9%	26.1%
2005	15	6.6	45.1%	384.2	2,761	41.2%	25.1%
2006	65	8.2	84.8%	1970.5	13,242	37.3%	26.2%
2007	126	11.5	193.1%	3878.7	14,236	27.0%	21.3%
Overall	1,571	8.0	227.4%	750.9	4,276	55.1%	39.9%

Table 2
Operating Performance of Newly Listed Chinese Firms

Sales, Net Profit and EBIT are measured in yuan millions. In calculating the year-over-year percentage changes, observations with negative or zero starting values are excluded. Year 0 is the IPO year.

Panel A: Operating Performance from Year -3 to Year +3								
		Year -3	Year -2	Year -1	Year 0	Year +1	Year +2	Year +3
Sales	N	1443	1490	1266	1542	1430	1368	1359
	Mean	1348.1	1633.3	1990.1	2609.5	1617.8	1443.8	1778.1
	Median	211.0	261.0	316.0	366.5	411.0	461.0	528.0
Net Profit	N	1428	1475	1253	1391	1391	1367	1359
	Mean	221.5	268.4	326.8	446.7	217.5	106.8	132.3
	Median	22.0	29.0	35.0	46.0	48.0	44.0	44.0
EBIT	N	1443	1487	1264	1542	1430	1368	1359
	Mean	299.0	393.3	458.4	570.2	319.8	150.0	170.5
	Median	29.0	36.0	44.0	56.0	60.0	54.0	53.0

Panel B: Year over Year Percentage Changes from Year-3 to Year +3							
		(-3, -2)	(-2, -1)	(-1,0)	(0, +1)	(+1, +2)	(+2, +3)
Sales	N	1,441	1,238	1,246	1,416	1,362	1,354
	Mean	67.8%	37.6%	27.3%	28.2%	22.3%	23.6%
	Median	22.5%	18.7%	15.4%	16.1%	14.2%	14.4%
Net Profit	N	1,426	1,226	1,145	1,262	1,277	1,259
	Mean	93.4%	50.7%	35.0%	-5.1%	-42.7%	96.6%
	Median	24.3%	18.8%	24.0%	9.6%	1.8%	3.1%
EBIT	N	1,439	1,234	1,246	1,412	1,316	1,262
	Mean	97.8%	46.4%	56.5%	60.8%	-17.8%	51.0%
	Median	23.9%	18.0%	20.2%	10.7%	1.1%	3.0%

Table 3
Correlation Coefficients

This table presents the correlation coefficient matrix. Offer size is the gross proceeds from the IPO, in yuan millions. Rel_Size is the relative offer size, defined as offer size divided by total assets in the IPO year. Sales is the annual sales (in yuan millions) in the IPO year. TA is total assets (in yuan millions) in the IPO year. State_Own0 and State_Own1 are, respectively, the state ownership before and after the IPO. EBIT_0Y1, EBIT_1Y2, and EBIT_2Y3 are, respectively, the change in EBIT from year 0 to 1, from year 1 to 2, and from year 2 to 3.

	Offer size	Rel_Size	TA	Sales	State_Own0	State_Own1	EBIT_0Y1	EBIT_1Y2	EBIT_2Y3
Offer Size	1.00								
Rel_Size	0.274*	1.00							
TA	0.714*	-0.040	1.00						
Sales	0.501*	-0.029	0.643*	1.00					
State_Own0	0.088*	-0.067*	0.043	0.040	1.00				
State_Own1	0.177*	0.000	0.069*	0.073*	0.898*	1.00			
EBIT_0Y1	-0.001	0.051	-0.018	-0.007	-0.107*	0.005	1.00		
EBIT_1Y2	0.086*	0.168*	0.064*	0.011	-0.058*	0.021	-0.111	1.00	
EBIT_2Y3	-0.007	-0.011	-0.001	-0.001	-0.035	-0.041	-0.019	-0.022	1.00

Table 4
Regression Results of Offer Size/Total Asset

The dependent variable is the offer size/TA ratio, where offer size is the gross proceeds from the IPO, and TA is the yearend total assets in the IPO year. State ownership is the percentage equity owned by the state prior to the IPO. Sales is the annual sales, in yuan millions, in the IPO year. EBIT_0Y1, EBIT_1Y2, and EBIT_2Y3 are, respectively, the percentage change in EBIT from year 0 to 1, from year 1 to 2, and from year 2 to 3. EBIT_0Y2 is the cumulative percentage change in EBIT from year 0 to 2, while EBIT_0Y3 is the cumulative percentage change in EBIT from year 0 to 3. For the year-over-year percentage changes, observations with negative or zero starting values are excluded. *** indicates significance at 1% level, ** indicates significance at 5% level, and * indicates significance at 10% level.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	0.693 [8.54]***	0.719 [7.91]***	0.719 [7.58]***	0.684 [7.14]***	0.554 [6.94]***	0.682 [7.71]***
State ownership	-0.059 l-1.48]	-0.070 [-1.62]	-0.078 [-1.72]*	-0.049 [-1.07]	-0.031 [-0.81]	-0.072 [-1.69]*
Ln(Sales)	-0.052 [-3.85]***	-0.053 [3.45]***	-0.052 [-3.24]***	-0.053 [-3.27]***	-0.034 [-2.53]**	-0.048 [-3.25]***
EBIT_0Y1	0.008 [1.82]*			0.011 [2.29]**		
EBIT_1Y2		0.017 [3.31]***		0.073 [6.00]***		
EBIT_2Y3			0.000 [-0.45]	0.000 [-0.25]		
EBIT_0Y2					0.087 [17.15]***	
EBIT_0Y3						0.029 [4.28]***
Adj. R^2	0.01	0.02	0.01	0.04	0.19	0.02
F-value	7.83	9.47	5.50	10.92	105.04	11.71

Appendix

First consider $\theta_{a2} > \theta_{b2}$. In this case a separating equilibrium does not exist because b mimicks a. To see this note the following. Let D be the difference between the left and right side of Equation (5). If D is large enough, a separating equilibrium where a issues equity does not exist.

Proposition 2. $\frac{\partial D}{\partial x} > 0$ if $\theta_{a1} + \theta_{a2} > \theta_{b1} + \theta_{b2}$ and $\frac{\partial D}{\partial x} < 0$ if $\theta_{a1} + \theta_{a2} < \theta_{b1} + \theta_{b2}$.

Intuitively, it means that if a has higher overall value than b then issuing more equity by a makes separating equilibrium harder to achieve and vice versa. So if we can show that a separating equilibrium does not exist even when $x = 0$ it will be no separating equilibrium when $x > 0$. When $x = 0$ Equation (5) becomes $\theta_{a2} < \theta_{b2}$. So the separating equilibrium does not exist. There are no predictions regarding the size of IPO and firm performance.

Second consider $\theta_{a2} < \theta_{b2}$. In order to analyze this case, let us denote the total expected cash flow for type j over both periods $v_j = \theta_{j1} + \theta_{j2}$. Also let g_j denote the rate of earnings growth (θ_{j2}/θ_{j1}). The expected earnings in each stage are then:

$$\theta_{j1} = \frac{v_j}{1+g_j} \text{ and } \theta_{j2} = \frac{v_j g_j}{1+g_j} \tag{7}$$

Equation (5) can be rewritten as

$$\frac{v_a - xC_1 - C_2}{v_b - xC_1 - C_2} < \frac{v_a - C_2}{\frac{v_b}{1+g_b} + \frac{v_b g_b}{1+g_b}\left(1 - \frac{C_2(1+g_a)}{v_a g_a}\right)}$$

Or

$$\left(1 - \frac{xC_1}{v_a - C_2}\right)\left(\frac{v_b}{1+g_b} + \frac{v_b g_b}{1+g_b}\left(1 - \frac{C_2(1+g_a)}{v_a g_a}\right)\right) < v_b - xC_1 - C_2 \tag{8}$$

Proposition 3. $\frac{\partial D}{\partial v_a} > 0$.

Proof. Using (1), (2) and (5) we have: $V = \left(1 - \frac{C_1}{v_a - C_2}\right)\left(\frac{v_b}{1+r_b} + \frac{v_b r_b}{1+r_b}\left(1 - \frac{C_2(1+r_a)}{v_a r_a}\right)\right)$

Next using the following identity:

$$\frac{\partial V}{\partial v_a} = \frac{\partial V}{\partial s_1}\left(\frac{\partial s_1}{\partial \theta_{a1}}\frac{\partial \theta_{a1}}{\partial v_a} + \frac{\partial s_1}{\partial \theta_{a2}}\frac{\partial \theta_{a2}}{\partial v_a}\right) + \frac{\partial V}{\partial s_2}\frac{\partial s_2}{\partial \theta_{a2}}\frac{\partial \theta_{a2}}{\partial v_a}$$

we get: $\frac{\partial V}{\partial s_t} < 0, t = 1,2.\ \frac{\partial s_1}{\partial \theta_{at}} < 0, t = 1,2.\ \frac{\partial s_2}{\partial \theta_{a2}} < 0.\ \frac{\partial \theta_{at}}{\partial v_a} > 0, t = 1,2$ and finally $\frac{\partial V}{\partial v_a} > 0$.

On the intuitive level Proposition 2 is straightforward: under asymmetric information a firm's expected surplus increases if the market value of the firm (the value of the firm from the investor's viewpoint) increases. A more intriguing question is how do changes in a firm's earnings growth rate affect D. This question is at the core of the analysis below.

From (7) an increase in the rate of earnings growth increases the firm's expected performance in the second period. We know that the price of equity depends on the value of the firm, and not just first-period performance. The value of any claim issued by the firm in the second period depends heavily on the firm's second-period expected performance. Hence an increase in the market's perception of the firm's rate of earnings growth increases the expected payoff of the firm issuing equity.

Proposition 4. $\frac{\partial D}{\partial g_a} > 0$.

Using (1), (2), (5) and the following identity:

$$\frac{\partial V}{\partial r_a} = \frac{\partial V}{\partial s_1}\left(\frac{\partial s_1}{\partial \theta_{a1}}\frac{\partial \theta_{a1}}{\partial r_a} + \frac{\partial s_1}{\partial \theta_{a2}}\frac{\partial \theta_{a2}}{\partial r_a}\right) + \frac{\partial V}{\partial s_2}\frac{\partial s_2}{\partial \theta_{a2}}\frac{\partial \theta_{a2}}{\partial r_a}$$

we get: $\frac{\partial V}{\partial r_a} = \frac{(1-s_1)\theta_{b2} C_2 v_a}{(\theta_{a2})^2 (1+r_a)^2} > 0$. *End proof.*

Let us return to the case $\theta_{a2} < \theta_{b2}$. Two cases are possible. If $\theta_{a1} + \theta_{a2} < \theta_{b1} + \theta_{b2}$ a separating equilibrium where b issues equity does not exist while a separating equilibrium where a issues equity can exist. So the prediction will be that there is positive relationship between the size of IPO and firm's performance after issue. To see this consider the case with the same type a and a type b' such that $g_b = g_{b'}$ and $v_a = v_{b'}$. As was shown above a separating equilibrium

where b' issues equity does not exist. Also by proposition 2 a separating equilibrium does not exist where b issues equity.

Now consider $\theta_{a1} + \theta_{a2} > \theta_{b1} + \theta_{b2}$. In this case contrary to any case considered above a separating equilibrium can exist where type b issues a larger amount of equity than type a. We will show however that if a separating equilibrium exists where b issues more equity than a then there also exists the following separating equilibrium with types a_{new} and b_{new} with the following expected earnings: $\theta_{a1new} = \theta_{b2}$; $\theta_{a2new} = \theta_{b1}$; $\theta_{b1new} = \theta_{a2}$; $\theta_{b2new} = \theta_{a1}$ where a_{new} issues the same amount of equity as type b in initial equilibrium and type b_{new} issues no equity. This follows from the above analysis for firms with the same value and also propositions 2 and 3 because $v_a < v_{b'}$ and $g_a < g_{b'}$. b_{new} does not mimick a_{new} because in initial equilibrium type a does not mimick type b and $v_{a_{new}} = v_b$ and $v_{b_{new}} = v_a$ and $g_{a_{new}} < g_b$. The opposite however is not true. A summary of our findings is shown in the following table.

Case	Equilibrium	Empirical prediction
$\theta_{a1} > \theta_{b1}; \theta_{a2} > \theta_{b2}$	No separating equilibria	No correlation between IPO size and performance after issue
$\theta_{a1} > \theta_{b1}; \theta_{a2} < \theta_{b2}; \theta_{b1} + \theta_{b2} > \theta_{a1} + \theta_{a2}$	In a separating equilibria type a issues more equity than type b	Positive correlation between IPO size and firm's performance after issue
$\theta_{a1} > \theta_{b1}; \theta_{a2} < \theta_{b2}; \theta_{b1} + \theta_{b2} < \theta_{a1} + \theta_{a2}$	Separating equilibria where type a issues more equity than type b prevails over separating equilibria where type b issues more equity	Positive correlation between IPO size and firm's performance after issue