The Roles of Innovation Input and Outcome in IPO Pricing

--Evidence from the Bio-Pharmaceutical Industry in China

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Abstract

Using the data from bio-pharmaceutical industry in China, this paper studies the effect of innovation information on IPO pricing. Two indices are constructed based on a series of information to measure the dimensions of innovation input and outcome. The results show that the two dimensions play different roles in IPO pricing. The index of innovation outcome contributes to both issuing price and trading price relative to market price of matched peers and relative to book value, and large extent of IPO first day return. Furthermore, the firms with higher level of pre-IPO innovation outcome have a higher buy and hold abnormal return in 24 and 36 months after IPO. While innovation input does not seem to be incorporated into the IPO price by both the primary and secondary market investors, it results in worse performance in terms of market return and predicts lower operating profitability after IPO.

Keywords: Innovation input; Innovation outcome; Bio-Pharmaceutical industry; IPO pricing; Post-IPO performance

I. Introduction

Recently China's stock market has become the second largest stock market in terms of market value in the world. Meanwhile, Chinese government is striving to upgrade her industrial structure from manufacturing China to innovative China. Existing literature proposes that a highly developed financial market helps promote innovation through improving capital allocation, reducing the cost of capital and evaluating projects (e.g Brown, Fazzari and Peterson, 2009; Hsu, Tian and Xu, 2013). However, previous studies reveal that it is quite difficult to decipher how innovation will ultimately impact the market value. The difficulties lie in the facts that innovation investment has a nature of uncertainty and subsequently problem of information asymmetry is severe to value the innovation projects. Thus empirical evidence on relationship between innovation and firm value in general industries is mixed (Chan, Lakonishok and Sougiannis,2001; Lev and Sougianni,1996；Eberhart，Maxwell and Siddique, 2004). Research regarding to emerging market such as China is even scarce. With a sample of bio-pharmaceutical firms, the paper investigate the how stock market investors react to information on innovation in Chinese IPO market.

Bio-pharmaceutical IPOs provide a suitable setting for studies on information of innovation. The reasons firstly lie in the role of innovation is especially crucial for these young and technology- intensive new issuers. These emerging firms have different value drivers compared with those of traditional manufacturing firms, normally financial profitability, and their successes are more rely on innovation (Bartov, Mohanram and Seethamraju, 2002; Guo, Lev and Zhou, 2005). Secondly, the innovation in

Bio-pharmaceutical is characterized with high risk, long R&D circle, and extensive capital investment, which creates a larger extent of uncertainty, and subsequently a higher demand from stock market investors for information disclosure on innovation. Typically the development of a new medicine have to go through four stages, which are pre-clinical research, clinical tests, the acquirement on official approval and trial production, and then mass production (see details in appendix 1). In china, the duration from new medicine proposal to acquire approval for production will last at least three to five years, or even over ten years in some cases[1]. Moreover , the fast innovation pace and the low barriers to entry enhance competition and the consequent proprietary cost of disclosure, resulting in larger information asymmetry between investors and insiders, which increases the importance of information (Guo, Lev and Zhou, 2004). In China practice, with the support of money and resources to favored industries under China's five-year plan, bio-pharmaceutical industry has been growing at a steady pace with a double digit growth in both revenues and profits over the past a few years. However, the difficulty in pricing bio-pharmaceutical IPOs creates a lot of confusion. For example, Haipurui (stock code: 002399), a manufacturer of biological products with FDA certificate, initiated the public offering in 2010 at price of 148 *yuan* and P/E ratios of 73, the highest IPO price in China new issue market by that time. However, the price on secondary market dropped rapidly below issuing price only four days after listing. Another recent example is Aosaikang, producer of material for anti-cancer medicines, proposed its IPO with the ratio of issuing price to earnings is 67 times in January 2014. However the market reaction to the proposed

[1] According to the essay titled with "the analysis on the entry barrier of chinese pharmaceutical industry" on www.askci.com on 4/29/2014

high price is so negative that the IPO process has to be stopped.

As recent research point out, to evaluate innovation activities properly, market investors should use more dimensions of information other than innovation investment i.e. R&D expenditure alone (Cohen, Diether and Malloy, 2013; Hirshleifer, Hsu and Li, 2013). In this paper we classify the information describing innovation activities into two dimensions: innovation input and outcome. We argue that the two dimensions may have different implications to investors. First, innovation input is apparently with higher level of uncertainty and the outcomes are more certain and ready to apply. Second, the credibility of disclosure is different. Disclosure on innovation input is much discretionary, while the information on outcome, such as patents, is more credible with the endorsement of legal documents. Thus, we expect the two dimensions of information play different roles on IPO pricing.

With two indices constructed to represent the input and outcome of innovation, we investigate their impacts on IPO pricing. From a short-run perspective, issuing price, market price on first trading day, and IPO first day return are examined. Issuing price on primary market and trading price on secondary market reflect the reactions to information of issuers from different groups of investors. In China's IPO system, issuing price has been partially determined by insiders, including underwriter and issuers, and qualified institutional investors through a book-building system since year 2004[2], though it is also subject to the regulatory upper limit of ratio of price to earnings before year 2009[3].. Since the institutional investors buy in the shares of new issues at primary market and are

[2] Before year 2004, when book-building system was adopted, the issuing price is determined by underwriter and issuer, with the regulatory upper limit of ratio of price to earnings.

[3] The regulation on issuing price was released from year 2009.

constrained to sell them until nine months later, trading price on first trading day reflects the reactions mostly from individual investors. The part of trading price in excess of issuing price is the IPO first day return, which is one of IPO anomaly that interest academia for decades. Then, from a long-run perspective, we test whether the firms with high level of innovation input or outcome have a worse or better market performance in post-IPO period. Post-IPO market return could be at least partially attributed to the reversal of over-reaction of investors at the IPO stage. At last, we examine how the pre-IPO innovation information predicts the operating profitability after IPO and whether it is consistent with market reactions.

We find the information on innovation input and outcome plays different roles in IPO pricing. While the index of innovation outcome contributes positively in both issuing price, trading price and first day return, the index of innovation input seems not to be incorporated into the price by both primary and secondary market investors, and in turn, no significant effect on the first day return. The results reveal that in China only the innovation outcome of new issuers is valued by investors, and investors on secondary market value it more than the investors on primary market. Regarding to post-IPO market return, the two dimensions of information work in opposite directions. While issuers with higher level of innovation input have worse buy-and-hold abnormal returns for 12 to 24 months after IPO, those with higher level of innovation outcome perform significantly better for 24 and 36 months after IPO. Furthermore, consistent with the market reactions, pre-IPO innovation input also predicts worse profitability after IPO. However we find little evidence on significant association between the level of innovation outcome and post-IPO operating

profitability.

The paper contributes to the existing literature from the following aspects. First, we differentiate the value effect of innovation information from information on innovation input and outcome in China's bio-pharmaceutical industry. Although proxies on innovation input and output are widely used in literature, their implications in valuation are seldom differentiated. Especially for innovation input, measured by R&D expenditure usually, whether investors take it as a positive signal for future growth or negative signal for large uncertainty is not clear. Recent studies show that market investors could not integrate all relevant information when pricing innovation. For example, Cohen, Diether and Malloy (2013) track the past records of the firm's ability in translating R&D into sales to measure R&D ability. Hirshleifer, Hsu and Li (2013) use the ratio of patents and their citation to R&D investment as measures of innovation efficiency. Both of the studies find the market isn't efficient enough to react to above information timely and sufficiently, though it is thought to be good predictor of future operating performance ex post. This paper establishes different dimensions of innovation information from above studies. Innovation input and outcome are more direct and observable to investors compared to above indirect measures on R&D "ability" and "efficiency". Furthermore, focusing on one industry allows us to take advantage of homogenous innovation activities and use more diversified measures to capture the characteristics of innovation input and outcome. For example, the indices of innovation input and outcome used in this paper are constructed based on seven types of information relevant to innovation. The empirical results are also different from those two papers in that stock investors are not stick to the information on innovation input

and react to the two dimensions of information differently.

Second, we provide new evidence in pricing bio-pharmaceutical IPO companies on the largest emerging market. Bio-pharmaceutical is an industry with intensive innovation investment and thus a suitable setting to study how innovation affects value of stock. Studying the biotech companies in U.S, Guo, Lev and Zhou (2004) point out that product-related information is crucial to extent of the information asymmetry at IPOs. Specifically, stage of product development and availability of patent protection determine the cost of information disclosure at IPOs due to the intensive competition in this industry. Guo, Lev and Zhou (2005) find that both R&D and patents are value drivers at the IPO stage. While R&D does not make any difference in post-issuance performance, patents attribute to a worse market performance in three years after issuance, which implies information related to patents is overvalued at the IPO stage. This paper shows a different pattern that the innovation input is not priced at the IPO stage. It is the innovation input instead of the patent-related outcome affects post-IPO performance negatively. The different evidence may be attributed to greater uncertainty of innovation input or the less credibility of information in emerging market, i.e. China, than the mature market, i.e. U.S .

Third, this paper provides new evidence on the explanation of IPO anomalies, that is, IPO first day return and post-IPO underperformance in China. Most studies on western market justify the large first day return as “underpriced” issuing with assumption that the trading price is “fair”(See a detailed review in Ritter and Welch (2002)). Following this framework, studies on the role of innovation on IPO first day return engage a debate on whether innovation is a source of risk which enlarges the IPO underpricing (Aboody and

Lev, 2000; Guo, Lev and Shi, 2006; Chin et al.,2006) or a signal that reduces information asymmetry and decreases the IPO underpricing (Heeley et al., 2007;). However, Purnanandam and Swaminathan (2004) are against above argument by pointing out that IPO firms are actually overvalued even in offering price and the high first day return is attributed to over-optimism of IPO investors. This view is more consistent with the common phenomenon of long-run underperformance in post-IPO period, in terms of both market return (Ritter, 1991; Loughran and Ritter, 1995) and operating profitability (Jain and Kini,1994; Mikkelson, Partch and Shah,1997). Following this explanation, Guo, Lev and Shi (2006) argue that the extent of investors' optimism will be offset by the uncertainty of R&D activities. As a result, the new issuers with intensive innovation investment will underperform less or even over-perform others. However, the argument is not consistent with the study by Guo, Lev and Zhou (2005), which documents pre-IPO innovation leads to a more serious underperformance in the bio-pharmaceutical industry. the a. This paper finds that consistent with Purnanandam and Swaminathan (2004), averagely the issuing price and market price on the first trading day of bio-pharmaceutical IPOs in China are both higher than the market price of comparable seasoned peers. That is, the IPOs are seems to be overpriced. The first day returns reflect that extent of overpricing is larger in secondary market dominated by individual investors than in the primary market participated by underwriters, issuers and institutional investors. Although, the level of innovation input doesn't affect issuing price and trading price, it predicts a long-term underperformance after IPO in both market return and operating profitability. While the innovation outcome associate with trading price and first day return positively there's not

only no reversal in long-term market return, but higher post-IPO returns. Thus, the overpricing of the IPOs is resulted from insufficient discount on innovation input instead of the overvaluation on innovation outcome.

The rest of the paper is organized as follows. Section 2 introduces the sample and measures; Section 3 tests the impact of innovation information on IPO pricing from a short-run perspective; Section 4&5 examine the impact on post-IPO market returns and operating profitability respectively; Section 6 concludes.

II. Sample and Measures of Innovation

The sample of this paper is composed of new IPOs of bio-pharmaceutical companies in China A-share market from period of year 2002-2012. During that period China keeps a relatively consistent policy in IPO regulation. The total number of bio-pharmaceutical IPOs during this period is 75, accounting for 5.3% of the total number of IPOs on A share market in same period. The yearly and listing board distribution could be found in Table 1. While 14 of the 75 firms are listed on the main board market, a large proportion of observations are listed on markets for small and median-sized Enterprises (SME) and ChiNext, which is a new board designed for new ventures with higher potential of growth.

To measure the innovation input and outcome respectively, we hand collect two sets of variables from the prospectuses. The first set of variables is related to the financial and nonfinancial input of innovation activities, including (1) ratio of R&D expenditure to sales, (2) natural logarithm of the number of collaborating alliances on R&D projects, and (3) natural logarithm of number of ongoing research projects. The largest principle factor of

the three variables is used to measure the scale of innovation input (I_INPUT). The second set of variables is relevant to the outcome of innovation activities, including (1) nature logarithm of number of patents acquired, (2) nature logarithm of number of patents in application, (3) nature logarithm of number of products covered by patents, and (4) the stages of ongoing R&D projects. Typically, the research on producing a new medicine has to experience a series of steps (see appendix 1). We classified the steps into four stages: pre-clinical (stage 1), clinical test (stage 2), Trial production (stage 3) and mass production (stage 4). The average rank of research stage, weighted by the number of projects at each stage, is used to measure the stage of ongoing R&D projects. Similarly, we use the largest principle factor of the four variables as index for innovation outcome (I_OUTCOME). The descriptive statistics of the indices and their components are shown in Panel A of Table 2.

Figure 1 shows the change of above indices by year. While index of innovation input fluctuates around zero, there is an overall trend of increasing in index of innovation outcome before year 2009. It goes down afterward, which may be resulted from the inclusion of young companies with less accumulative outcome of innovation after the open of board of ChiNext in year 2009.

Panel B of Table 2 presents the descriptive statistics of pre-IPO fundamentals of issuers. To exclude the year effect, all the ratios are adjusted by the year-median of whole A–share companies. The mean of adjusted return on assets (ROA) is 21% and the median is 18.5%. Mean (median) of adjusted operating cash flow scaled by total assets（CFO） is 17.3% (15.9%) . The average adjusted gross margin scaled by sales (GM) is 36.2% and the median

is 37.9%. Mean (median) of adjusted net income scaled by sales (NI) is 15% (11.3%). Nature logarithm of total assets (TA) is with mean of 19.746 and median of 19.669. ACCRUAL is the accounting accrual calculated by deducting cash flow from operating from net income, scaled by total assets. The mean and median of this variable are 0.1% and 0.4% respectively.

III. The Short-run Impacts on IPO Pricing

In this session, we examine whether the information on the input and outcome of innovation plays different roles on pricing at issuing and listing stage. First, we measure the IPO price with the ratio of issuing price to pre-IPO book value (Issuing P/B) and the ratio of closed price on first trading day to pre-IPO book value (Trading P/B). Both are adjusted by year-median of ratio of issuing price to pre-IPO book value of all new issues on A share market to exclude the year effect. Second, as mentioned above, whether the new issues is underpriced or overpriced at this stage is still controversial, depending on the measure of "fair value". In this paper, we follow Purnanandam and Swaminathan (2004) and use market price of seasoned peers as benchmark to measure the relative IPO price. , Specifically we match each of the observations with a seasoned bio-pharmaceutical firm with comparable sales and earnings. Here "seasoned" is defined as a listed firm, initiating its public offering at least three years before the IPO year of the our sample. We group IPO firms and all potential matched firms in bio-pharmaceutical industry into three portfolios based on the sales per share and then each sales portfolio into three portfolios based on past earnings per share. Each IPO observation of our sample is then matched to the appropriate

sales per share and earnings per share portfolio. From the portfolio, we find a matching firm that is closest to sales per share of the IPO firms. Furthermore, we try to make sure that each IPO get a unique matching firm in a given cohort year. Then the relative prices of IPOs to the matched firm are calculated by:

$$\text{IssuingP/V} = \frac{(Issuing\ price/sales\ per\ share)_{IPO}}{(market\ price/sales\ per\ share)_{match}} \quad (1)$$

$$\text{Trading P/V} = \frac{(Trading\ price/sales\ per\ share)_{IPO}}{(market\ price/sales\ per\ share)_{match}} \quad (2)$$

From Panel C of Table 2, we can read that the mean and median of Issuing P/B are 6.865 and 4.234. Those of Trading P/B are 9.742 and 7.303 respectively. The mean and median of Issuing P/V is 1.530 and 1.126 respective, consistent with Purnanandam and Swaminathan (2004) in that these IPOs in China are overpriced at issuing stage relative to seasoned peers instead of being underpriced. We regress indices of innovation input and outcome on Issuing (Trading) P/B and Issuing (Trading) P/V respectively. Control variables include pre-IPO profitability measured by return on assets (ROA), cash flows from operating (CFO), size of assets (LNTA), reputation of underwriter (UW) and whether the issuer is backed with venture capital (VC). Besides, we use the total number of IPOs (IPONO) and median of IPO first day return on A-share market (IPORET) in the issuing month to control for the market sentiment at time of IPOs (Baker and Wurgler, 2007). The results are shown in column 2-5 of Table 4 . While the index of innovation input has no significant association with these two dependent variables, the index of innovation outcome contributes to the price significantly except the regression on Issuing P/B. For example, the coefficient of I_OUTCOME is 1.434 in regression on Trading P/B with level of significance at 5% and is 0.550 in regression on Issuing P/V with level of significance at

1%. We interpret the result as that although the innovation input may bring benefit in future, its value is offset by the uncertainty. Investors are more interested in the acquired innovation outcome. Besides, the information on innovation outcome is more credible than that on input due to the guarantee from legal recognition on patents.

Next, we examine how the information affects first day return at IPO, which is calculated by the ratio of closed price on first trading day to offering price minus one. The mean and median of first day return are 64.7% and 43.6% respectively (see Panel C of Table 2), which are much larger than 13% and 4% of the bio-pharmaceutical IPOs in the U.S. respectively, as documented by Guo, Lev and Zhou (2005). In the regression of the IPO first day return, we use the nature logarithm of proceedings in IPO (PROCEED) to control the size of offering (Dunbar, 2000) instead of size of asset. Other control variables are the same as in the previous regressions. The results are shown in Table 4 column 6. The coefficient on index of innovation outcome is 0.145, significant at the 5% level. However, the coefficient on index of innovation input is -0.012, which is not statistically significant. The index of innovation outcome increases the first day return because it is valued more on the secondary market than primary market. The innovation input is not valued on both the primary market and secondary market. As a result, it does not affect IPO first day return. Besides, the results also show that IPO first day return is negatively related to proceeds collected and positively related to the market sentiment measured by median of first day return in the same month of the whole IPO market.

IV. The Impact on Post-IPO Market Returns

To examine the effect of innovation input and outcome on post-IPO market return, we

calculate the buy and hold abnormal return (BHAR) of samples from the second month of trading to the subsequent 6, 12, 24, 36-month by compounding the monthly returns in excess of value weighted buy and hold return of all firms on A-share market. Table 5 shows that buy and hold returns of the new bio-pharmaceutical issuers underperform the market by 5.2% for the 6 months and 3.1% for 12 months after IPO. However, the phenomenon of underperformance does not last long. From 24 month after IPO, the bio-pharmaceutical companies actually outperform the market by 11.2% (24 months), 4.5% (36 months), 30.3% (48 months) and 28.7% (60 months).

Then we divide the sample into groups based on the level of innovation input and outcome. Specifically, firms with the index of innovation input (outcome) above the median of concurrent year are labeled as HIGH input (outcome) group and the remaining firms are labeled as LOW input (outcome) group. The univariate comparisons in Table 5 show no significant difference in BHAR between the groups of HIGH and LOW input. However, the HIGH outcome group outperforms LOW outcome group in most post IPO periods significantly. For example, the 12-month BHAR of HIGH outcome group is 3.2% and that of LOW outcome group is -9.9%. The portfolio return will be up to13.1% when buying in the HIGH outcome group and selling out the LOW outcome group, which is significant at level of 5%. Investors will earn buy and hold abnormal return as high as 53.1% if they hold the strategy for 5 years, which is very significant economically.

In Table 6, we do multivariate analysis by regressing the buy and hold abnormal return for 12, 24, and 36 months after IPO on the indices of innovation input and innovation outcome. According to Loughran and Ritter (1995) we include logarithm of market

capital(LNMV) and logarithm of book to market ratio (LNBV/MV) as control variables. According to Teoh, Welch and Wang (1998), pre-IPO accounting discretionary accrual leads to the subsequent underperformance. For that reason, we also control accounting accrual scaled by total assets (ACCRUAL) in the regression. Besides, reputation of underwriter (UW) and ownership of venture capital (VC) are included in control variables. The results show that the index of innovative input has a negative impact on post-IPO return. The coefficients are -0.308, -0.410 and -0.238 in regressions of BHAR of 12 months, 24 months and 36 months respectively. The first two coefficients are significant at either 5% or 1% level. However, the coefficients on index of innovation outcome are all positive in the above three regressions and those in regressions of 24-month and 36-month BHAR are significant at the 5% level.

The regression results indicate that the innovation input is a significant factor in explaining post-IPO underperformance. Firms with higher level of innovation input before IPO underperform worse at least within 24 months after issuing. The results could be interpreted as that the investors do not fully discount the new issues based on the uncertainty of innovation input at IPO stage. The innovation outcome is a different case. The results generally present that the index of innovation outcome associates with post-IPO return positively, suggesting it is not fully valued at the time of IPO.

V. The Impact on Post- IPO Operating Profitability

The above analysis documents that the uncertainty of innovation input has not been fully recognized at the IPO stage, which results in worse post-IPO market performance. In this session, we examine whether innovation input (outcome) before IPO could predict the

profitability afterward. We use two financial ratios to measure the post-IPO profitability. One is the ratio of gross margin to sales (GM) and the other is the ratio of net income to sales (NI). To exclude the year effect, we adjust the above ratios by deducting the median of ratios of all A-share listing firms in that year. As explanatory variables, besides the two innovation indices, we also include the LNTA to control the size effect and the adjusted pre-IPO GM and NI to control for the pre-IPO performance. Panel A of Table 7 presents the results of regressing GM and NI in the first year, the second year and the third year after IPOs on the two indices respectively. The post-IPO profitability is highly related to the pre-IPO performance. Since the coefficients are all smaller than 1, which implies that on average the profitability in these bio-pharmaceutical samples declines. While the coefficients of the index of innovation outcome are not significant in all regressions, the relationships between index of innovation input and post-IPO profitability are significantly negative for first two years after the IPO. For example, the coefficients on I_INPUT are -8.954 and -10.464 in regressions on the GM in the first and second year after IPO, both significant at the 5% level. The results of regressions on NI are quite similar. Panel B of Table 7 replicates the regressions with the variable OUT_INPUT, but no significant results are found.

The negative impact of innovation input on post-IPO operating profitability gives support to the high degree of uncertainty of innovation activity and incredibility of information at IPO stage. However, we have not found evidence that innovation outcome could enhance future operating to support that information is valued reasonably high at the stage IPO.

VI. Conclusion

Using the data from bio-pharmaceutical industry in China, this paper studies the effect of innovation information on IPO pricing. Two indices are constructed based on series of information to measure the dimensions of innovation input and outcome. The results show that the two dimensions play different roles in IPO pricing. From a short-run perspective, the index of innovation outcome is positively associated with both issuing price and trading price relative to market price of matched peers, and trading price relative to book value. It also contributes to large extent of IPO first day return, which implies it is valued more by the investors on secondary market. Furthermore, the firms with higher level of pre-IPO innovation outcome have a higher buy and hold abnormal return in 24 and 36 months after IPO. While innovation input does not seem to be incorporated into the IPO price by both the primary and secondary market investors, it results in worse performance in terms of market return and predicts lower operating profitability after IPO.

Overall, the results demonstrate that IPO investors value innovation outcome more than the innovation input. This is probably because the uncertain nature of innovation activities and the incredibility of information on innovation input. However, investors at IPO stage fail to discount on innovation input and value innovation outcome sufficiently, which leads to further decline in stock price in firms with high level of innovation input and increase in firms with high level of innovation outcome in post-IPO period. These findings reveal that different value effects from the different dimensions of information on innovation in IPO pricing.

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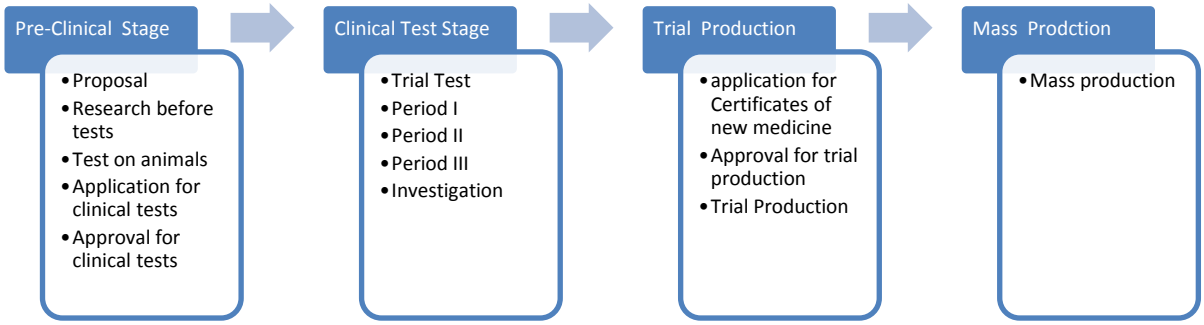
Appendix 1 Stage of R&D Projects in Bio-pharmaceutical Industry



Appendix 2 Definition of Variables

Variables	**Definition**
Dependent variables	
Issuing P/B	Offering price scaled by pre-IPO book value per share adjusted by the year-median of that variable of all A-share new issues
Trading P/B	Closed price on first trading day scaled by pre-IPO book value per share adjusted by the year-median of that variable of all A-share new issues
Issuing P/V	The offering price (closed price on first trading day) relative to price of the matched peer.
Trading P/V	Closed price on first trading day relative to price of the matched peer.
First DAY RET	The ratio of difference in close price on first trading day to issue price
BHAR_12(24,36) months	The abnormal buy and hold return by compounding the monthly returns for 12(24,36) months started from the next month to the listing, in excess of value weighted buy and hold return of all firms on A share market
GM_1st (2nd , 3rd) Year	The gross margin scaled by sales one (two, three)- year after the year of IPO and adjusted by the year-median of all A-share listed companies
NI_1st (2nd , 3rd) Year	The net income scaled by sales one (two, three)- year after the year of IPO and adjusted by the year-median of all A-share listed companies.
Independent Variables	
I_INPUT	The index of innovation input
I_OUTCOME	The index of innovation outcome
R&D	R&D expenditure scaled by sales
ALLIANCE	The logarithm of number of alliance to collaborate on R&D projects
PRJTNO	The logarithm of number of research projects
PATENT	The logarithm of number of existing patents
PATENT_APP	The logarithm of number of patents in application
PRDTCOV	The logarithm of number of products covered by patents
STAGE	The average research stage of ongoing R&D projects
ROA	The return on assets one year before IPO, adjusted by the year-median of all A-share listed companies
CFO	The cash flow of operating one year before IPO, scaled by total assets at end of that yea
GM	The gross margin scaled by sales one year before IPO, adjusted by the year-median of all A-share listed companies
LNTA	The logarithm of total assets one year before IPO.
NI	The ratio of net income to sales, one year before IPO, adjusted by the year-median of all A-share listed companies.

ACCRUAL	The accounting accrual in pre-IPO earnings, scaled by total assets
PROCEED	The logarithm of total proceeds in IPO
UW	The dummy of underwriter reputation, which indicates the top five underwriters in terms of accumulative offering amount on A share market for period of 2002-2012
VC	The dummy indicates that whether the IPOs is backed by at least one venture capital firm
LNMV	The logarithm of market value at time of first trading day, which is the closing price on first trading day times the shares of outstanding common stocks
LNBV/MV	The logarithm of book to market ratio on first trading day, in which book value is the amount of pre-IPO equity plus the net proceedings in IPO
IPONO	The logarithm of total number of IPOs on A share market in the issuing month of firms
IPORET	The median of IPO first day return on A share market in the issuing month of firms.

Figure1 The Indices of Innovation Input and Outcome by IPO year

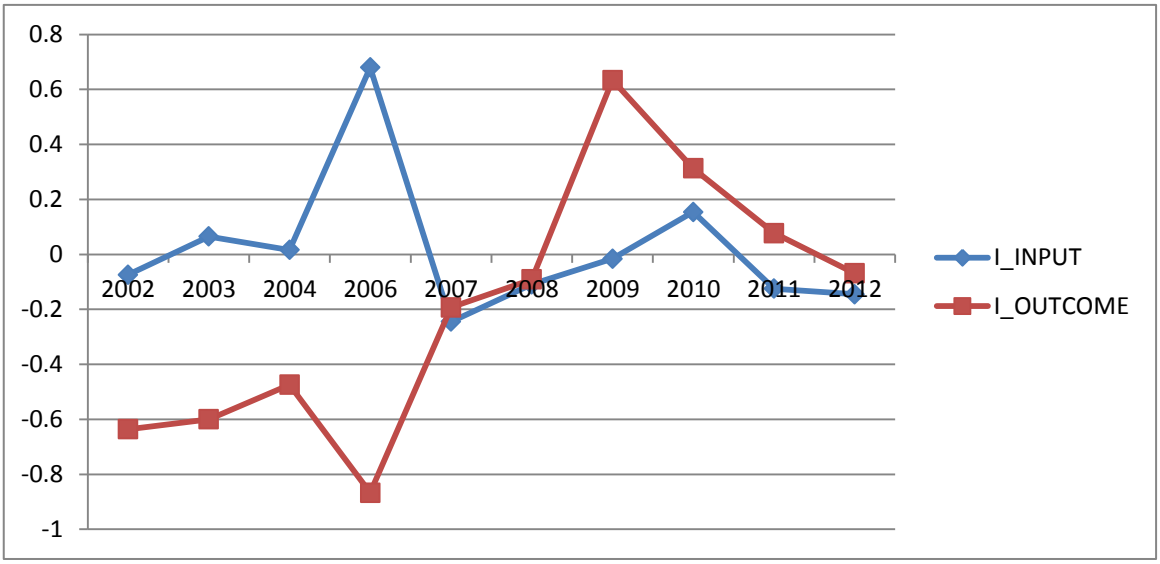


Table 1 Distribution of Sample

YEAR	#of Bio-pharmaceutical IPOs				#of IPOs on A Share Market
	Mainboard*	SME**	ChiNext***	Total	
2002	4	--	--	4	68
2003	3	--	--	3	67
2004	7	7	--	14	99
2005	--	--	--	--	14
2006	--	1	--	1	65
2007	--	4	--	4	126
2008	--	2	--	2	77
2009	--	5	5	10	99
2010	--	11	8	19	349
2011	--	4	8	12	282
2012	--	4	2	6	155
Total	14	38	23	75	1401

*Mainboard: Board for mature firms with higher required profitability and size of assets, established in year 1992.

**SME: Board for small and median enterprises, established in year 2004

***ChiNext: Board for relatively young and growing enterprises, established in year 2009.

Table 2 Descriptive statistics of Bio-pharmaceutical IPO issuers. N=75.

VARIABLE	MAX	MIN	MEAN	MEDIAN	STD
Panel A :Pre-IPO Innovation Indices and the Components					
I_INPUT	0.751	-1.078	0.000	-0.012	0.407
R&D	0.111	0.000	0.042	0.041	0.021
ALLIANCE	2.773	0.000	1.364	1.386	0.664
PRJTNO	4.317	0.000	2.234	2.302	0.951
I_OUTCOME	2.190	-1.557	0.000	-0.145	0.804
PATENT	4.174	0.000	1.176	1.099	0.941
PATENT_APP	4.060	0.000	1.239	1.099	1.183
PRDTCOV	3.258	0.000	1.484	1.609	0.699
STAGE	4.000	0.000	2.387	2.429	0.807
OUT_INPUT	1.971	-1.613	0	-0.108	0.838
Panel B: Pre-IPO Fundamentals					
ROA*	0.961	0.052	0.217	0.185	0.132
CFO*	0.573	-0.029	0.173	0.159	0.106
GM*	0.745	-0.010	0.362	0.379	0.195
LNTA	21.927	18.603	19.746	19.669	0.616
NI*	0.458	-0.018	0.150	0.113	0.108
ACCRUAL	0.329	-0.306	0.001	0.004	0.086
Panel C: IPO Variables and Market Sentiment					
Issuing P/B	46.656	0.022	6.865	4.234	7.729
Trading P/B	55.502	-0.968	9.742	7.303	9.467
Issuing P/V	6.294	0.165	1.530	1.126	1.155
Trading P/V	8.048	0.337	2.273	1.818	1.560
First Day RET	3.501	-0.056	0.647	0.436	0.689
PROCEED	22.504	18.626	20.119	20.029	0.827
UW	1	0	0.080	0	0.273
VC	1	0	0.347	0	0.479
LNMV	24.973	20.614	21.962	21.883	0.821
LMBV/MV	-0.634	-2.303	-1.480	-1.410	-0.355
IPONO	37	4	20.89	21	9.502
IPORET	2.289	-0.022	0.569	0.509	0.465
Panel D: Post-IPO Long-run Performance					
BHAR_12months	1.794	-0.572	-0.031	-0.118	0.353
BHAR_24months	2.335	-0.662	0.113	-0.018	0.523
BHAR_36months	2.133	-0.724	0.045	-0.064	0.523
GM_1st Year	0.711	-0.068	0.329	0.333	0.180

GM_2nd Year	0.715	-0.096	0.323	0.332	0.184
GM_3rd Year	0.601	-0.221	0.290	0.323	0.185
NI_1st Year	0.460	-0.078	0.131	0.115	0.102
NI_2nd Year	0.368	-0.219	0.106	0.105	0.105
NI_3rd Year	0.497	-24.765	-0.363	0.110	3.297

Table 3 Pearson Correlation of the Variables

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14
Issuing P/B (V1)	1.00													
Trading P/B(V2)	0.94	1.00												
	***													
Issuing P/V(V3)	0.50	0.44	1.00											
	***	***												
Trading P/V(V4)	0.33	0.40	0.87	1.00										
	***	***	***											
First Day RET(V5)	-0.34	-0.07	-0.31	0.04	1.00									
	***		***											
I_INPUT(V6)	-0.16	-0.19	-0.16	-0.19	-0.08	1.00								
		*												
I_OUTCOME(V7)	0.19	0.19	0.41	0.36	-0.12	0.14	1.00							
	*	*	***	***										
ROA(V8)	0.78	0.68	0.54	0.38	-0.31	-0.26	0.10	1.00						
	***	***	***	***	***	**								
CFO(V9)	0.33	0.28	0.32	0.23	-0.18	-0.16	0.00	0.57	1.00					
	***	**	***	**				***						
LNTA(V10)	0.22	0.11	0.19	0.05	-0.36	0.34	0.39	0.14	-0.10	1.00				
	*				***	***	***							
UW(V11)	-0.07	-0.10	-0.03	-0.07	-0.09	0.02	0.02	-0.03	-0.15	0.18	1.00			
VC(V12)	0.05	0.08	-0.04	-0.04	-0.02	-0.11	-0.15	0.03	0.06	-0.18	0.10	1.00		
IPORET(V13)	-0.30	-0.10	-0.28	0.03	0.81	-0.04	-0.19	-0.30	-0.17	-0.27	-0.10	-0.06	1.00	
	***		**		***			***						
IPONO(V14)	0.35	0.29	0.04	-0.09	-0.34	0.11	0.21	0.09	-0.13	0.19	0.03	-0.09	-0.44	1.00
	***	**	0.71	0.42	***	0.35	0.07	0.44	0.25	0.11	0.77	0.46	***	
PROCEED(V15)	0.71	0.57	0.43	0.17	-0.62	0.13	0.44	0.55	0.18	0.67	0.08	-0.04	-0.54	0.50
	***	***	***		***		***							

Table 4 Regression of Innovation Indics on IPO pricing

	Issuing P/B	**Trading P/B**	**Issuing PV**	**Trading PV**	**First Day RET**
CONSTANT	-29.469*	-22.038	1.334	4.643	7.319***
	(-1.750)	(-0.971)	(0.275)	(0.699)	(4.243)
I_INPUT	-0.434	-1.272	-0.282	-0.450	-0.012
	(-0.334)	(-0.661)	(-0.873)	(-0.998)	(-0.097)
I_OUTCOME	0.523	1.434**	0.550***	0.814***	0.145**
	(1.189)	(2.102)	(2.980)	(2.928)	(2.345)
ROA	47.276***	53.496***	4.297***	4.201***	0.709
	(10.644)	(6.837)	(4.539)	(3.349)	(1.259)
CFO	-6.917	-7.363	1.033	1.251	-0.318
	(-1.470)	(-1.031)	(0.807)	(0.676)	(-0.609)
LNTA	1.009	0.456	0.027	-0.036	
	(1.237)	(0.419)	(0.094)	(-0.093)	
UW	-2.327	-3.221	-0.125	-0.185	-0.005
	(-1.227)	(-1.309)	(-0.385)	(-0.364)	(-0.034)
VC	1.429	2.799	-0.068	-0.033	0.063
	(0.961)	(1.330)	(-0.288)	(-0.094)	(0.637)
IPORET	1.298	5.692***	-0.350	0.449	1.023***
	(1.495)	(5.160)	(-1.108)	(0.845)	(7.345)
IPONO	0.232***	0.327***	-0.016	-0.022	0.010
	(3.303)	(3.386)	(-1.277)	(-0.981)	(1.559)
PROCEED					-0.378***
					(-4.180)
R2	0.713	0.606	0.454	0.332	0.735

Table 5 Post-IPO buy and hold return for 6 to 60 months adjusted by value weighted market return.

Post-IPO BHAR	ALL SAMPLE	I_INPUT			I_OUTCOME		
		HIGH	LOW	DIFF	HIGH	LOW	DIFF
6 months	-0.052	-0.061	-0.042	-0.019	-0.023	-0.083	0.059
				(0.396)			(1.237)
12 months	-0.031	-0.056	-0.004	-0.052	0.032	-0.099	0.131**
				(0.629)			(1.634)
24 months	0.112	0.137	0.085	0.052	0.192	0.020	0.172*
				(0.4229)			(1.416)
36 months	0.045	0.026	0.065	-0.039	0.093	-0.008	0.101
				(-0.291)			(0.754)
48 months	0.303	0.172	0.454	-0.282	0.587	0.056	0.531**
				(-0.982)			(1.906)
60months	0.287	0.183	0.406	-0.223	0.533	0.002	0.531*
				(0.658)			(1.632)

*,**,*** represent the level of significance at 10%, 5% and 1%

Table 6 Regressions on BHAR for 12, 24, 36 months after IPO.

	12 months	**24 months**	**36 months**
CONSTANT	2.455**	5.195***	4.821**
	(2.277)	(3.125)	(2.237)
I_INPUT	-0.308**	-0.410***	-0.238
	(-2.129)	(-2.806)	(-1.170)
I_OUTCOME	0.113	0.180**	0.183**
	(1.653)	(2.439)	(2.027)
ACCRUAL	0.173	-0.848*	-0.302
	(0.458)	(-1.824)	(-0.431)
LNMV	-0.101**	-0.221***	-0.237**
	(-2.044)	(-2.734)	(-2.150)
LNBV/MV	0.190	0.126	-0.312
	(1.295)	(0.569)	(-1.045)
VC	-0.009	-0.151	-0.161
	(-0.101)	(-1.508)	(-1.187)
UW	0.177	0.090	-0.037
	(0.950)	(0.555)	(-0.169)
R2	0.184	0.296	0.192
N	74	69	57

*,**,*** represent the level of significance at 10%, 5% and 1%. Robust t value is reported in parentheses.

Table 7 Regression on post-IPO operating profitability.

Post- IPO	Profitability=GM			Profitability＝NI		
	1st Year	2nd Year	3rd Year	1st Year	2nd Year	3rd Year
CONSTANT	-25.145	5.757	46.961	-56.911	-17.312	-427.500
	(-0.445)	(0.087)	(0.529)	(-1.480)	(-0.428)	(-0.875)
I_INPUT	-8.954**	-10.464**	-4.203	-3.931*	-7.318***	-122.331
	(-2.402)	(-2.560)	(-0.790)	(-1.672)	(-2.742)	(-0.987)
I_OUTCOME	0.280	1.478	3.488	-0.249	1.651	-3.739
	(0.151)	(0.617)	(1.252)	(-0.240)	(0.937)	(-0.326)
PRE-IPO Profitability	0.742***	0.631***	0.523***	0.629***	0.464***	-3.235
	(12.644)	(7.445)	(4.718)	(5.248)	(3.536)	(-0.850)
LNTA	1.581	0.180	-1.923	3.066	1.084	22.507
	(0.554)	(0.054)	(-0.438)	(1.589)	(0.531)	(0.886)
R^2	0.717	0.550	0.316	0.497	0.349	0.017
N	75	69	57	75	69	57