The Effects of Innovation on Corporate Value in IPOs

Kiyotaka Uzaki
Department of Business Administration
Oita University

Presenter
Shozo Ichimura
Zhai Linyu
Kyoko Ikegami

March 8, 2009
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KIYOTAKA UZAKI∗
Department of Business Administration
Oita University

Abstract

The paper sought to analyze the effects innovation, a factor that has never been tested before in Japan, has on the firm values in Japanese markets when firms go for initial public offerings (IPOs). Investment in innovation, through research and development (R&D) expenses is important as it is necessary for firms to enhance their competitive advantages. It is widely accepted that innovation is the indispensable step to promote economic growth. For start-up businesses, innovation that leads to distinguished technology and services is necessary to firm growth.

Despite the current accounting principles taking investment in innovation as a key factor for the future growth of firms, it doesn’t classify investment in innovation as an accounting asset in firms’ balance sheets. This raises the argument of R&D capitalization regarding the accounting principle of conservatism and

∗ I am grateful for the helpful comments from the participants at the West Conference of Japan Finance Association in July 2008.
e-mail: kuzaki@cc.oita-u.ac.jp
uncertainty on the realization of returns on investment. Because of this, the genuine value of firms does not reflect in balance sheets. It is an important cause of information asymmetry that arises between firms and investors.

This paper analyzed the association between innovation (measured by R&D intensity as a proxy) and underpricing, on a sample of 406 Japanese IPOs issued in 2001-2006. We examine the association by dividing the sample into three groups based on the differences in R&D intensity of firms under consideration.

The study found that larger firms can better afford to undertake larger R&D than smaller firms and that they are more likely to under-price their IPOs leading to high initial rate of returns. However, this study does not suggest that there is a positive correlation between high-R&D and underpricing.

**Key Words**

Innovation, Research and Development (R&D), Initial Public Offerings (IPO), Information Asymmetry
The Effects of Innovation on Corporate Value in IPOs

KIYOTAKA UZAKI

1. Introduction

The main objective of this research is to calculate firm values when firms go for initial public offerings (IPOs) and test the effects that innovation, a factor that has never been tested before in Japan, has on the firm values in Japanese markets. Investment in innovation through R&D\(^1\) expenses is important as it is necessary for firms to enhance their competitive advantages\(^2\). It is widely accepted that innovation is the indispensable step to promote economic growth\(^3\). For start-up businesses, innovation that leads to distinguished technology and services is necessary to firm growth.

Despite the current accounting principles taking investment in innovation as a key factor for the future growth of firms, it doesn’t classify investment in innovation as an accounting asset in the firms’ balance sheets. This raises the

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\(^1\) According to “Accounting Standards regarding Research and Development Expenses” of the Business Accounting Council of Financial Services Agency, the research is exploration and inquiry for the purpose of finding new knowledge, Development is to materialize the outcomes of the research and other knowledge as a planning or design, or the planning or design of improvement dramatically on the new products, services and production methods (we call the products below). And research and development expenditures include the personnel costs, the cost of raw materials, the depreciation on fixed assets, and all costs expired for research and development such as the distribution of overhead cost.


\(^3\) The rate of R&D to GDP in Japanese Budget is six places in the world, following that Korea’s 3.61%, China, America and France. The amount of R&D based on buying power for the United States, EU-27 (EU-15), Japan, China, Germany are 42.8 trillion yen, 31.0 trillion yen (30.2 trillion yen), 18.5 trillion yen, 17.9 trillion yen, and 8.3 trillion yen respectively. France, England and Korea are also the same as Germany. See White Paper on Science and Technology 2008.
argument of R&D capitalization regarding the accounting principle of conservatism and uncertainty on the realization of returns on investment. Because of this, the genuine value of firms does not reflect in balance sheets. It is an important cause of information asymmetry that arises between firms and investors. It is an accounting-related information asymmetry because it applies not only to R&D expenditure, but also many intangible assets (for example, patents).⁴

There are a few research works that scrutinize the relationship between innovation and the value of firms, particularly the relationship between innovation and the value of Japanese firms when they issue IPOs. A study by Allen and Faulhaber (1989) indicates that firms with innovative characters tend to under-price their IPOs (the difference between offering prices and initial prices) to convey the information about firm value to the market.

Focusing on the information asymmetry between firms and investors, this research analyzes the relationship between investment in innovation (measured by R&D as a proxy) and firm values when IPOs are done under the assumption that the innovation investment is a signal for conveying the quality of the firm to investors. The results of this research, therefore, are also expected to contribute significantly to solving the problem of information asymmetry between firms and investors.

⁴ See Barth, M.E. and R. Kasznik (1999).
First of all, we examine the issue of underpricing of IPOs over the last few decades. Ibbostson, Sindelar and Ritter (1988) established the average initial rate of return for 8,988 American firms between 1960 and 1984 as 16.3%. Loughran, Ritter and Rydqvist (1994) also found that, high initial rates of return are not only observed in the United States but also in many other countries. The initial rate of return of China, India and Brazil are particularly high (see Figure 1).

**Figure 1**

Initial rate of return of IPO in main countries around world during 1990-2003


The study employed the signaling model, as used by Allen and Faulhaber
(1989), to analyze the association between the abnormal rate of return on IPOs and R&D investment. Allen and Faulhaber (1989) established that good start-up firms with the penchant to innovate and which have better dividend payout expectations should initially offer a fraction of their equity to the public in order to finance their innovative efforts. They further stated that firms have information about the quality of their investment projects that is not available to external investors. As Chin et al (2006) indicated, external investors however, can discern the existence of higher and lower quality firms by observing:

a) the price and proportion of equity issued in the IPO, and

b) the dividends at the end of each period.

In view of this, higher quality firms would like to fix a lower offering price to distinguish themselves from lower quality firms. They may end up signaling their firm’s quality to investors. An underpriced IPO is therefore considered a credible signal of the firm’s quality because only high quality firms are expected to be able to issue new shares at better prices later\(^5\).

Researches on the association between R&D and stock price are gradually increasing. However, very few researches analyze the association between R&D and stock prices of IPOs in Japan. This research assumes that innovation gives signals to the capital market and the larger the R&D investment, the more innovative the firm

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\(^5\) See Ritter & Welch, 2002, for a review of the literature on, and discussion of, signaling theories.
is. The remainder of the study is organized as follows. Section 2 reviews previous empirical studies on the association between IPOs and R&D. Section 3 describes the measurement of variables and sample selection procedures. Section 4 reports the results of the empirical test and descriptive statistics. The last section presents the concluding remarks.

2. Previous research

According to neoclassical financial theory, when the market is efficient, there are neither transaction costs nor information asymmetry. The high rate of return on IPOs is indicative of the fact that they are underpriced. This means that the market is inefficient. As observed in the previous section, the practice of underpricing IPOs is not typical of the United States and Japan, but is a global phenomenon.

Many researchers have used different approaches to gaining understanding into the issue of underpricing IPOs by using various models\(^6\). This study examines the phenomenon by using information asymmetry. It assumes that stock prices after IPOs do not reflect the actual values of firms in the presence of information asymmetry.

\(^6\) Jenkinson and Ljungqvist (2001), and Ritter and Welch (2002) state it is difficult to explain the underpricing phenomena by only one model after examining many theories and testing many models. See Tinic (1988). Especially, there are many discussions and empirical studies in the frame work of information asymmetry, for example, Winner’s Curse Hypothesis, Information Relation Hypothesis, Principle-Agent Hypothesis, and Signaling Hypothesis.
asymmetry. When there is information asymmetry, interest groups – the firm issuing the IPO, underwriters (the lead security company), venture capital, banks and investors who buy the stocks – have different sets of information from one another.

Allen and Faulhaber (1989), Grinblatt and Hwang (1989), Welch (1989), and Jegadeesh, Weinstein, and Welch (1993) have examined the information asymmetry between firms and investors. They posit that investors with poor information face the problem of adverse selection if the firm issuing the IPO has better information than they do about the present value of future cash flows and risks.

A firm with a good quality IPO must distinguish itself from bad ones by availing all necessary information to investors. One way is to under-price their IPOs, which cost is recoverable as a result of the high seasoned equity offerings (SEOs) after the initial offer. A bad quality firm cannot recover the cost if the information asymmetry gets eliminated, even if they also decide to under-price their IPOs. Consequently, IPOs from good quality firms can drive out bad quality ones from the market by using underpricing as a signal.

Analytical researchers have explained underpricing using signaling models in respect of the size of the IPOs, profitability, ownership structure, and so on. Lev and Sougiannis (1996) found that the adjusted earnings and book values for R&D capitalization are strongly associated with stock prices and returns. Ichikawa and
Nakano (2005) analyzed the association between R&D and corporate value of 49 firms in the Pharmaceutical and the Chemical industry listed on the Tokyo Stock Exchange in 1980-2001. They reveal that the correlation between R&D and corporate value is positive in Japanese chemical industry.


Sakakibara et al (2006) analyzed 4,173 manufacturing firms listed on the first and second sections of the Tokyo Stock Exchange under three considerations:

a) firms ending in March,

b) the book value of equity and the current returns are positive, and

c) capital costs are more than the $ROE \times (1 - \text{pay-out ratio})$, an indication of a sustainable growth rate.

They concluded that the markets that evaluate R&D investments create an opportunity for company growth.

A few prior researches have examined the association between R&D and underpricing even though many researchers have examined the association between R&D and corporate value. Guo, Lev and Shi (2003) analyzed the association between IPO anomalies and innovation investments of 2,696 IPOs in the United States.
States in 1980-1995. Their results show that R&D is positively correlated with underpricing of IPOs and is positively related to long-term performance.

Chin et al (2006) investigated the association between IPO anomalies – underpricing and long-term under-performance – and innovation capital using 623 Taiwanese industries in 1991-2001. They established that innovative firms are more likely to under-price their IPOs.

3. Measurement of variables and sample selection

In Japan, not until 1998, management of firms had been allowed to use their discretion to classify research and development expenses (R&D) either as assets or expenditures. However, the Accounting Standards regarding Research and Development Expenses of the Business Accounting Council of Financial Services Agency has ruled that expenses on research and development must be recorded in full as expenditures as and when it occurs.

Under this generally accepted accounting principle, despite investment in innovation being an important factor for the future growth of the firm, research and development cannot be recorded as assets in balance sheets but as expenditures. This way of classification of investment in research and development is different from the classification of investment in other assets such as lands and property. Recording research and development as expenditures reduces profits and total
assets of firms. Because accounting profits and book value of assets are crucial in determining firm value, when firms offer their stocks to the public for the first time, the classification of investment in innovation as expenditures will render offering prices low.

Furthermore, the value of patents recorded in accounting books generally includes legal expenses for patent application and other expenses related to it. In spite of patent being potential sources of future cash flows, it is classified as an expense. Consequently, firms usually choose either to omit or ignore the value of patent in their balance sheets. This leads to low valuation of the book value of firms’ assets which leads to low public offering price of IPOs. The classification of investment in innovation at the time it occurs as expenditures:

a) lowers firms’ operating incomes and net profits, and

b) creates the problem that important intangible assets that will be sources of future cash inflows are not recorded in balance sheets of firms.

Noma (2006) states that firms’ profits usually increase in periods when investment in R&D decreases. Despite this accounting practice, management usually has strong confidence that investment in R&D will lead to increased future cash inflows. R&D investment is thus seen as the managerial signal of increasing future profits of firms. With the same amounts of R&D investment, before public announcement of accounts, firms with lower value would create higher returns than
firms with higher value after the public announcement.

This research employs the method used by Lev and Sougiannis (1996) to redefine investment in R&D as capital expenditures to reflect future cash flows of firms, in the equation shown below.\(^7\)

\[
RDC_{t,i} = RD_{t,i} + 0.8 \times RD_{t,i-1} + 0.6 \times RD_{t,i-2}
\]

- \(RDC\): Research and Development Capital
- \(RD\): Research and Development Expense

We calculated R&D intensity by dividing RDC by total equity. When necessary, the model used in calculating R&D intensity was tested and reformulated. Through the degree of concentration on innovation, the correlation coefficient that examines the relationship between investment in innovation with R&D expenses as a proxy and underpricing of IPOs was calculated. Thus, under the circumstances of information asymmetry that arises between firms and investors, it will be possible to analyze the effects that investment in innovation has on firm value when their stocks are initially sold to the public (IPOs). The results of this research will shed some light on the solution for the problem of information asymmetry between firms and investors.

\(^7\) Lev and Sougiannis (1996), and Noma (2006) defines RDC as follows.

\[
RDC_{t,i} = RD_{t,i} + 0.8 \times RD_{t,i-1} + 0.6 \times RD_{t,i-2} + 0.4 \times RD_{t,i-3} + 0.2 \times RD_{t,i-4}
\]
3.1. Dependent Variable: Underpricing

Our initial sample consists of 429 JASDAQ initial public offerings. Owing to lack of data, accounting variables and financial firms were excluded from our initial sample. IPO-related financial variables for all industrial firms that issued IPOs in the period of 2001 to 2002 were derived from “Kabushiki Tentou Hakusyo (OTC White Paper)”, “Kabushiki Jyoujyou Hakusyo (Stock Exchange Listing White Paper)” in 2003-2004, “Kabushiki Jyasudaku Jyoujyou Hakusyo (JASDAQ’s IPO White Paper)” in 2005, and “Kabushiki Koukai Jyoujyou Hakusyo (IPO White Paper)” in 2006. The rest were sourced from the home pages of JASDAQ, EDINET of Finance Services Agency, and Nikkei NEEDS-Financial Quest.

The final sample includes 406 IPOs issued in 2001-2006. The sample selection process is summarized in Table 1.
Table 1

Sample Selection Criteria

<table>
<thead>
<tr>
<th>Sample Selection Step</th>
<th>No. of Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of IPOs’ firm during 2001-2006</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>59</td>
</tr>
<tr>
<td>2005</td>
<td>68</td>
</tr>
<tr>
<td>2004</td>
<td>71</td>
</tr>
<tr>
<td>2003</td>
<td>63</td>
</tr>
<tr>
<td>2002</td>
<td>70</td>
</tr>
<tr>
<td>2001</td>
<td>98</td>
</tr>
<tr>
<td></td>
<td>429</td>
</tr>
<tr>
<td>Less: Observations lacking required accounting variables</td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>409</td>
</tr>
<tr>
<td>Less: financial firms</td>
<td></td>
</tr>
<tr>
<td>Final sample</td>
<td>406</td>
</tr>
</tbody>
</table>
Our sample covers industries in the following sectors – services, retail trade, information and communication, wholesale merchant, real estate, electric appliances and general machinery, other products. Many R&D-oriented firms – chemicals,
precious instruments, electric appliances, and general machinery – have gone public.

The initial rate of return of the $i^{th}$ firm in IPOs is defined as follows.

$$R_i = \frac{P_1 - P_0}{P_0}$$

$R_i$ : The initial rate of return of the $i^{th}$ firm on first day of issuing IPO

$P_0$ : The offering price of the $i^{th}$ firm on first day of issuing IPO

$P_1$ : The closing price of the $i^{th}$ firm on first day of issuing IPO

The initial rate of return on IPOs between the period 2001 and 2006 is depicted in Table 3.

<table>
<thead>
<tr>
<th>Year</th>
<th>Average</th>
<th>Median</th>
<th>Sample Std. Dev.</th>
<th>Minimum</th>
<th>Maximum</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>35.44</td>
<td>20.00</td>
<td>52.97</td>
<td>-72.50</td>
<td>275.00</td>
<td>93</td>
</tr>
<tr>
<td>2002</td>
<td>30.34</td>
<td>9.38</td>
<td>66.13</td>
<td>-37.04</td>
<td>420.31</td>
<td>65</td>
</tr>
<tr>
<td>2003</td>
<td>36.09</td>
<td>19.53</td>
<td>53.39</td>
<td>-35.14</td>
<td>212.50</td>
<td>62</td>
</tr>
<tr>
<td>2004</td>
<td>98.28</td>
<td>80.60</td>
<td>99.48</td>
<td>0.87</td>
<td>515.38</td>
<td>68</td>
</tr>
<tr>
<td>2005</td>
<td>109.06</td>
<td>84.00</td>
<td>103.26</td>
<td>0.00</td>
<td>676.92</td>
<td>64</td>
</tr>
<tr>
<td>2006</td>
<td>60.70</td>
<td>21.00</td>
<td>84.66</td>
<td>-2.70</td>
<td>430.30</td>
<td>54</td>
</tr>
<tr>
<td>2001-2006</td>
<td>60.21</td>
<td>30.20</td>
<td>83.58</td>
<td>-72.50</td>
<td>676.92</td>
<td>406</td>
</tr>
</tbody>
</table>

Table 3 shows large changes in the initial rate of return on IPOs in
2001-2006 with an average of 60.21%. As stated earlier, Ibbostson et al (1988), in a study of 8,988 American industries over the period 1960-1984 established an average initial rate of return of 16.3% on IPOs. Loughran et al (1994) also established a similar trend for many other countries, notably, China, India and Brazil are high (see Figure 1).

Table 4 shows the initial rate of return of IPOs by industry during the period 2001 to 2006.

Table 4

Initial Rate of Return of IPO by Industry for the period 2001 to 2006

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Average</th>
<th>Sample Std. Dev.</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Median</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Services</td>
<td>74.43</td>
<td>106.29</td>
<td>-72.50</td>
<td>676.92</td>
<td>50.00</td>
<td>92</td>
</tr>
<tr>
<td>Info. and Communication</td>
<td>60.98</td>
<td>106.22</td>
<td>-37.04</td>
<td>515.38</td>
<td>16.67</td>
<td>51</td>
</tr>
<tr>
<td>Wholesale Merchant</td>
<td>50.92</td>
<td>66.68</td>
<td>-23.08</td>
<td>288.89</td>
<td>34.62</td>
<td>45</td>
</tr>
<tr>
<td>Real Estate</td>
<td>71.13</td>
<td>72.44</td>
<td>-30.00</td>
<td>210.00</td>
<td>36.40</td>
<td>37</td>
</tr>
<tr>
<td>Electric Appliances</td>
<td>55.87</td>
<td>83.19</td>
<td>-13.04</td>
<td>306.25</td>
<td>23.50</td>
<td>27</td>
</tr>
<tr>
<td>Retail Trade</td>
<td>50.12</td>
<td>57.66</td>
<td>-35.14</td>
<td>230.00</td>
<td>30.00</td>
<td>64</td>
</tr>
<tr>
<td>General Machinery</td>
<td>36.23</td>
<td>35.07</td>
<td>-2.94</td>
<td>100.00</td>
<td>19.10</td>
<td>21</td>
</tr>
<tr>
<td>Other Products</td>
<td>76.32</td>
<td>105.99</td>
<td>-2.65</td>
<td>366.67</td>
<td>29.63</td>
<td>15</td>
</tr>
<tr>
<td>Chemicals</td>
<td>56.43</td>
<td>84.18</td>
<td>-5.26</td>
<td>212.50</td>
<td>16.17</td>
<td>10</td>
</tr>
<tr>
<td>Construction</td>
<td>32.97</td>
<td>39.62</td>
<td>-13.70</td>
<td>101.32</td>
<td>18.68</td>
<td>8</td>
</tr>
<tr>
<td>Precision Instruments</td>
<td>70.67</td>
<td>64.26</td>
<td>3.75</td>
<td>212.50</td>
<td>49.23</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>60.21</td>
<td>83.58</td>
<td>-72.50</td>
<td>676.92</td>
<td>30.20</td>
<td>406</td>
</tr>
</tbody>
</table>
The Average initial rate of return on IPOs and sample standard deviation in services, information and communication, real estate, and precision instruments are large. Meanwhile, there are large differences between the initial rates of return on IPOs within each industry. One the one hand, the initial rate of return of retail trade, general machinery, other products and precision instruments are between 40% and 50%. On the other hand, that of foods, metal products, transport machinery, and securities and commodity is between 6.6% and 15.7%. The latter batch seems to have been underpriced compared with the former.

3.2 Independent Variables

Previous researches show that the extent to which IPOs are underpriced is determined by many factors. We use some of these factors as independent variables in this research as follows.

1. Innovation capital (INNOVATION)

Innovation capital is measured by R&D intensity. The R&D intensity is calculated as the rate of annual R&D expenditures to scale. R&D expenditures and sales are provided from the last fiscal year before the IPO. We divided our sample into three groups of firms to analyze, those without R&D (No-R&D IPOs), low R&D intensity (Low-R&D IPOs), and high R&D intensity (High-R&D IPOs).
2. The natural log of issue proceeds (LNSIZE)

Previous research\footnote{See Barth and Kasznik(1999).} indicates that information asymmetry is less likely to exist for large firms than for small-medium firms since large firms often make large issues, and such firms are generally less risky than small-medium firms. We measure the issue proceeds as a proxy firm size and transform it logarithmically. Previous researches found it to be negatively associated with underpricing.

3. The pre-offer demand (SECOND)

This variable is the rate of offering sold by pre-IPO shareholders.

Strong demand for shares before IPOs will result in an upsurge of the initial price on the first day of IPOs. It is expected to be positively associated with underpricing.

4. The percentage ownership retained by insiders (INSIDE)

The percentage of shares that firms’ insider retain serve as a signal for firm quality and the expectation of the firm’s future performance. The association between the degree of underpricing and the level of insiders’ ownership is positive.

5. The percentage of shares retained by venture capital (VC)

The percentage of shares that venture capital retain is expected to signal
issue quality since it reduces the perceived uncertainty over firm value. The association between the degree of underpricing and the level of venture capital’s share is negative.

4. Empirical Analysis

We redefined R&D investments to capital expenditures on based on Lev and Sougiannis (1996). Table 5 gives the descriptive statics of the estimated model. The results are given under three portfolios – firms without R&D, firms with low R&D intensity and firms with high R&D intensity (above medium). R&D intensity is calculated as the rate of annual R&D expenditures to scale.

This paper sought to establish the effect high R&D intensity has on the correlation between innovation investment and underpricing. It also analyzed how innovation investments affect corporate value when firms go public in the presence of information asymmetry.
Table 5

Descriptive Statistics of Selected Variables for Portfolios Classified by R&D to Scale

<table>
<thead>
<tr>
<th>Variable</th>
<th>Average</th>
<th></th>
<th></th>
<th>Median</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>No-R&amp;D</td>
<td>Low-R&amp;D</td>
<td>High-R&amp;D</td>
<td>Total</td>
<td>No-R&amp;D</td>
</tr>
<tr>
<td>R&amp;D/SALES</td>
<td>0.89</td>
<td>0.00</td>
<td>0.42</td>
<td>4.59</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>I. R.R.</td>
<td>60.21</td>
<td>66.88</td>
<td>37.52</td>
<td>58.65</td>
<td>30.20</td>
<td>36.38</td>
</tr>
<tr>
<td>SECOND</td>
<td>79.55</td>
<td>80.29</td>
<td>79.54</td>
<td>76.90</td>
<td>80.52</td>
<td>80.52</td>
</tr>
<tr>
<td>PROCEEDS</td>
<td>34,772.97</td>
<td>45,152.26</td>
<td>26,210.53</td>
<td>5,566.31</td>
<td>1,128.00</td>
<td>1,059.30</td>
</tr>
<tr>
<td>LNSIZE</td>
<td>9.78</td>
<td>9.91</td>
<td>9.59</td>
<td>9.49</td>
<td>8.80</td>
<td>8.78</td>
</tr>
<tr>
<td>MV</td>
<td>1,152,903.33</td>
<td>1,134,308.23</td>
<td>1,447,490.76</td>
<td>925,981.44</td>
<td>6,639.26</td>
<td>6,496.16</td>
</tr>
<tr>
<td>VC</td>
<td>6.96</td>
<td>6.35</td>
<td>7.58</td>
<td>8.57</td>
<td>2.98</td>
<td>2.58</td>
</tr>
<tr>
<td>INSIDE</td>
<td>66.57</td>
<td>69.35</td>
<td>61.39</td>
<td>61.62</td>
<td>71.40</td>
<td>73.85</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>69.70</td>
<td>0.00</td>
<td>48.00</td>
<td>345.03</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>SALES</td>
<td>15,502.43</td>
<td>16,685.77</td>
<td>17,855.59</td>
<td>8,966.68</td>
<td>7,352.50</td>
<td>7,551.50</td>
</tr>
<tr>
<td>SAMPLE</td>
<td>406</td>
<td>262</td>
<td>72</td>
<td>72</td>
<td>406</td>
<td>262</td>
</tr>
</tbody>
</table>

The average and median statics of the initial rate of return in high-R&D are larger than that of low-R&D. This indicates that the higher the R&D intensity the greater is the tendency to under-price IPOs. Furthermore, the relatively large average and medium figures of the SIZE variable for high-R&D firms lead to the conclusion that large firms can better afford large R&D expenditures.

The results show that the average value of high-R&D high but the median values are lower than that of low-R&D. However, both the average and median values of the percentage of ownership retained by insiders in high-R&D are larger. This is indicative of the fact that insiders see a potential for future profitability.

The table below presents the regression results in a bid to establish an
association between innovation investment and the underpricing in the presence of high-R&D intensity.

Table 6

Regression Statistics of the Relationship between the Initial Rate of Return of IPOs, R&D Intensity and Other Selected Explanatory Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total</th>
<th>No-R&amp;D</th>
<th>Low-R&amp;D</th>
<th>High-R&amp;D</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERCEPT</td>
<td>-20.59</td>
<td>-200.30**</td>
<td>-158.62*</td>
<td>15.98</td>
</tr>
<tr>
<td></td>
<td>(-0.61)</td>
<td>(-2.61)</td>
<td>(-1.99)</td>
<td>(0.28)</td>
</tr>
<tr>
<td>SECOND</td>
<td>0.80*</td>
<td>3.06**</td>
<td>2.57*</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>(2.40)</td>
<td>(3.52)</td>
<td>(2.61)</td>
<td>(-0.38)</td>
</tr>
<tr>
<td>LNSIZE</td>
<td>-2.25</td>
<td>-2.65</td>
<td>-4.85*</td>
<td>-0.42</td>
</tr>
<tr>
<td></td>
<td>(-1.42)</td>
<td>(-1.30)</td>
<td>(-2.13)</td>
<td>(-0.09)</td>
</tr>
<tr>
<td>VC</td>
<td>0.73</td>
<td>1.03</td>
<td>0.59</td>
<td>0.67</td>
</tr>
<tr>
<td></td>
<td>(1.54)</td>
<td>(1.46)</td>
<td>(0.82)</td>
<td>(0.76)</td>
</tr>
<tr>
<td>INSIDE</td>
<td>0.51*</td>
<td>0.59*</td>
<td>0.29</td>
<td>0.39</td>
</tr>
<tr>
<td></td>
<td>(2.47)</td>
<td>(1.97)</td>
<td>(1.15)</td>
<td>(0.87)</td>
</tr>
<tr>
<td>R&amp;D/SALES</td>
<td>0.65</td>
<td>36.88</td>
<td>1.31</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.36)</td>
<td>(1.80)</td>
<td>(0.48)</td>
<td></td>
</tr>
<tr>
<td>F-value</td>
<td>2.38*</td>
<td>3.87**</td>
<td>3.44**</td>
<td>0.22</td>
</tr>
<tr>
<td>AdjR²</td>
<td>0.02</td>
<td>0.04</td>
<td>0.15</td>
<td>-0.06</td>
</tr>
<tr>
<td>Sample</td>
<td>406</td>
<td>262</td>
<td>72</td>
<td>72</td>
</tr>
</tbody>
</table>

The adjusted coefficient of determination results of 0.15 in Low-R&D and -0.06 in High-R&D in Table 6 clearly depicts a relationship between the initial rate of return of IPOs and R&D intensity. The results therefore do not establish a statistically significant relationship between innovation investment and underpricing.
when there is high R&D intensity.

5. Conclusion

The paper sought to calculate the value of firms when they go for initial public offerings (IPOs) and test the effects that innovation, a factor that has never been tested before in Japan, has on their values in Japanese markets. This was done at the backdrop of an accounting principle which considers R&D as an expense rather than as investment leading to the undervaluing of firms and their IPOs.

The paper employed the method used by Lev and Sougiannis (1996) to redefine investment in R&D as capital expenditures to reflect future cash flows of firms. The study found that the average and median statics of the initial rate of return in high-R&D are larger than that of low-R&D in Japan. This indicates that the higher the R&D intensity the greater is the tendency to under-price IPOs. Furthermore, the relatively large average and medium figures of the SIZE variable for high-R&D firms lead to the conclusion that large firms can better afford large R&D expenditures. However, the regression failed to establish a significantly positive relationship between innovation investment and underpricing when there is high R&D intensity. An extensive data sample might be able to establish this relationship.

Furthermore, there is the need to do an intra-industry analysis of this relationship since the degree of relationships between R&D intensity and
underpricing in each industry may vary.
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