An Analysis of the IPO Underpricing for High-tech Companies in Japan

by

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Abstract

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This paper examines the factors for IPO underpricing phenomenon in Japan between year 2002 and 2007. The paper uses the IPO sample from the high-tech industry and the sample consists of 119 IPO issues over the period 2002 and 2007. Besides, the paper examines the relationship between these factors and the degree of IPO underpricing for Japanese high-tech companies. The paper finds that issue size, market return, P/E ratio and the percentage of existing shares offered play a statistically significant role in explaining IPO underpricing for high-tech companies in Japan. The percentage of existing shares offered has the strongest relation with IPO underpricing, reflecting that IPO investors really care about how exiting shareholders view their companies' future.

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Chapter 1

Introduction

1.1 Background

An initial public offering (IPO) occurs when a company's security is sold to the general public for the first time, expecting to raise funds to support potentially profitable projects in the company. Companies are wishing to raise money through the IPO market, but they have to pay some associated costs. Many companies started out by raising equity capital from a small number of investors such as venture capital or private equity, with no liquid market for selling their stocks, but they will attract more and more investors to participate in buying companies' stocks as they grow and prosper healthily. However, for the IPOs, companies need to do something to enhance the liquidity, which will allow them to raise more capital for the following issues. The IPO underpricing is one of the ways that companies use to compensate investors for the lack of liquidity associated with a privately-held company.

Nowadays, the IPO underpricing has become a worldwide phenomenon. Many studies document that the distribution of initial returns, used to measure underpricing, is highly skewed with a positive mean. The underpricing phenomenon in new issues exists in every stock market, but the degree of underpricing varies from market to market. Also, the degree of underpricing is different from industry to industry. The average initial returns can be incredibly high in some countries as well as low in other countries. Empirically, the IPOs are not severely underpriced in developed

countries such as U.S and U.K. Table 1 reports that the average initial returns are very high in some undeveloped countries. For example, the average initial returns in India and China are 88.5% and 137.4%, respectively, while that of Saudi Arabia is 264.5%!

Table 1

Equally weighted average initial returns for 49 countries

| Country	Source	Sample Size	Time Period	Avg. Initial Return
Argentina	Eijgenhuijsen & van der Valk	20	1991-1994	4.4%
Australia	Lee, Taylor & Walter; Woo; Pham; Ritter	1,562	1976-2011	21.8%
Austria	Aussenegg; Ritter	102	1971-2010	6.3%
Belgium	Rogiers, Manigart & Ooghe; Manigart DuMortier; Ritter	114	1984-2006	13.5%
Brazil	Aggarwal, Leal & Hernandez; Saito; Ushisima	275	1979-2011	33.1%
Bulgaria	Nikolov	9	2004-2007	36.5%
Canada	Jog & Riding; Jog & Srivastava; Kryzanowski, Lazrak & Rakita; Ritter	696	1971-2010	6.7%
Chile	Aggarwal, Leal & Hernandez; Celis & Maturana; Ritter	65	1982-2006	8.4%
China	Chen, Choi, & Jiang; Jia & Zhang	2,102	1990-2010	137.4%
Cyprus	Gounopoulos, Nounis, and Stylianides	66	1999-2011	20.8%
Denmark	Jakobsen & Sorensen; Ritter	164	1984-2011	7.4%
Egypt	Omran	53	1990-2000	8.4%
Finland	Keloharju	162	1971-2006	17.2%
France	Husson & Jacquillat; Leleux & Muzyka; Paliard & Belletante; Derrien & Womack; Chahine; Ritter; Vismara	697	1983-2010	10.5%
Germany	Ljungqvist; Rocholl: Ritter; Vismara	736	1978-2011	24.2%
Greece	Nounis, Kazantzis & Thomas; Thomadakis, Gounopoulos & Nounis	373	1976-2011	50.8%
Hong Kong	McGuinness; Zhao & Wu; Ljungqvist & Yu; Fung, Gul, and Radhakrishnan; Ritter	1,259	1980-2010	15.4%
India	Marisetty and Subrahmanyam; Ritter	2,964	1990-2011	88.5%
Indonesia	Suherman	386	1990-2011	25.7%
Iran	Bagherzadeh	279	1991-2004	22.4%
Ireland	Ritter	31	1999-2006	23.7%
Israel	Kandel, Sarig & Wohl; Amihud & Hauser; Ritter	348	1990-2006	13.8%
Italy	Arosio, Giudici & Paleari; Cassia, Paleari & Redondi; Vismara	273	1985-2009	16.4%
Japan	Fukuda; Dawson & Hiraki; Hebner & Hiraki; Pettway & Kaneko; Hamao, Packer, & Ritter; Kaneko & Pettway	3,100	1970-2010	40.4%
Jordan	Marmar	53	1999-2008	149.0%
Korea	Dhatt, Kim & Lim; Ihm; Choi & Heo; Mosharian & Ng; Cho; Joh; Ritter	1,593	1980-2010	61.6%
Malaysia	Isa; Isa & Yong; Yong; Ma	413	1980-2009	62.6%

Country	Source	Sample Size	Time Period	Avg. Initial Return
Mexico	Aggarwal, Leal & Hernandez; Eijgenhuijsen & van der Valk	88	1987-1994	15.9%
Netherlands	Wessels; Eijgenhuijsen & Buijs; Jenkinson, Ljungqvist, & Wilhelm; Ritter	181	1982-2006	10.2%
New Zealand	Vos & Cheung; Camp & Munro; Ritter	214	1979-2006	20.3%
Nigeria	Ikoku; Achua	114	1989-2006	12.7%
Norway	Emilsen, Pedersen & Saettem; Liden; Ritter	153	1984-2006	9.6%
Philippines	Sullivan & Unite; Ritter	123	1987-2006	21.2%
Poland	Jelic & Briston; Ritter	224	1991-2006	22.9%
Portugal	Almeida & Duque; Ritter	28	1992-2006	11.6%
Russia	Ritter	40	1999-2006	4.2%
Saudi Arabia	Al-Anazi, Forster, & Liu	76	2003-2010	264.5%
Singapore	Lee, Taylor & Walter; Dawson; Ritter	591	1973-2011	26.1%
South Africa	Page & Reyneke; Ali, Subrahmanyam & Gleason; Ritter	285	1980-2007	18.0%
Spain	Ansotegui & Fabregat; Alvarez Otera	128	1986-2006	10.9%
Sri Lanka	Samarakoon	105	1987-2008	33.5%
Sweden	Rydqvist; Schuster; Simonov; de Ridder	406	1980-2011	26.1%
Switzerland	Kunz,Drobetz, Kammermann & Walchli; Ritter	159	1983-2008	28.0%
Taiwan	Chen	1,312	1980-2006	37.2%
Thailand	Wethyavivorn & Koo-smith; Lonkani & Tirapat; Ekkayokkaya and Pengniti	459	1987-2007	36.6%
Turkey	Kiymaz; Durukan; Ince; Kucukkocaoglu	355	1990-2011	10.3%
United Kingdom	Dimson; Levis	4,877	1959-2011	16.1%
United States	Ibbotson, Sindelar & Ritter; Ritter	12,246	1960-2011	16.8%

Source: http://bear.warrington.ufl.edu/ritter/IntJuly2012.pdf

In the Table 1, Japan's average initial return is relatively high compared with that in other developed countries. Many studies documented that the internet boom contributed to the explosion in the level of initial returns in several stock markets (Ljungqvist and Wilhelm, 2003; Bradley and Jordan, 2002). During the period of 1990s, large number of high-tech related companies went public in America, Japan and other developed countries. As the Table 2 indicates, the degree of underpricing was really high between 1998 and 2000 for Japan. However, after the internet boom, the IPO underpricing degree was even higher during period of year 2002-2006.

Table 2

Number of Offerings and Average First-day Returns on Japanese IPOs

Source: http://www.fbc.keio.ac.jp/~kaneko/KP-JIPO/top.htm
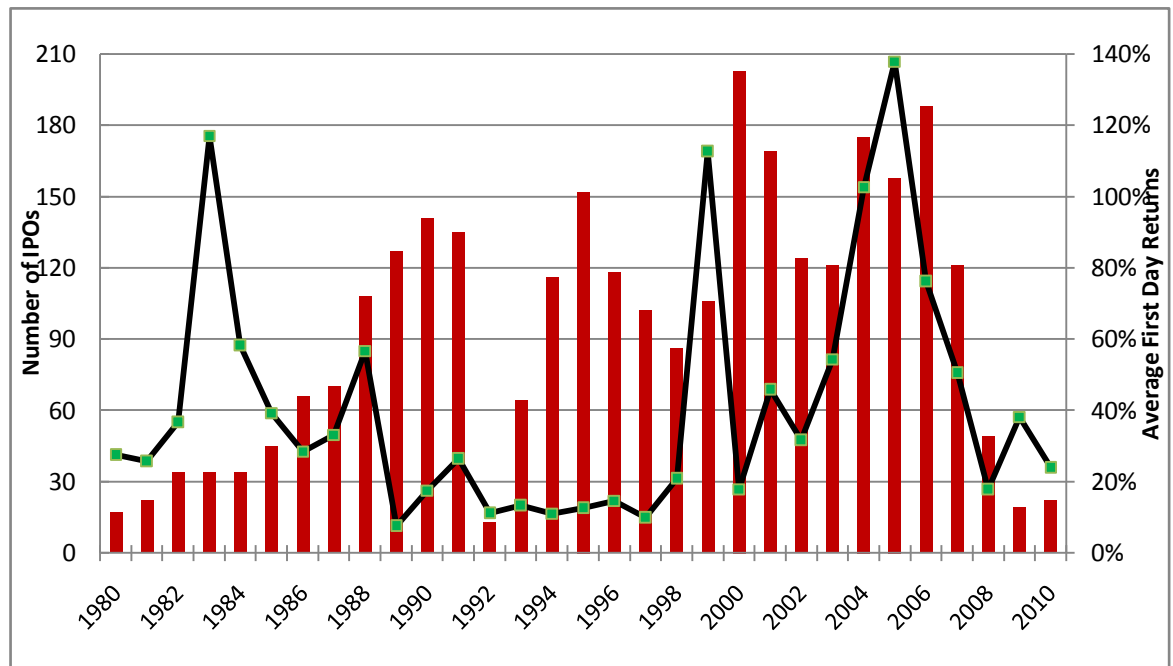
The study by Kaneko and Pettway (2003) points out the existence of hot IPO market related to high-tech companies and also suggests that underwriters set the initial offer price range too low to induce severe underpricing to occur. The study of "Bubble IPO underpricing: Evidence from Japan" also confirms that there was an IPO bubble at the end of the 1990s in high-tech industry for Japan.

In Japan, the high-tech companies are usually classified in communication industry. Recently, the IPO underpricing in communication industry is severer compared with other industries. The paper will devote to examining the IPO underpricing phenomenon between 2002 and 2007. It will try to figure out if there is relationship between severity of IPO underpricing and the high-tech industry.

1.2 Purpose of study

Japan, as a mature market in Asia, experiences serious IPO underpricing in high-tech industry in 2000s, so it is appropriate to examine the determinants of high degree of IPO underpricing. In this context, the paper will focus on examining the factors that influence IPO underpricing and the relationship between these factors and the degree of IPO underpricing in Japanese high-tech industry.

1.3 Structure of the research

The first section mainly introduces the background for underpricing phenomenon. The remainder of the paper is structured as follows: the second sectionwill provide the literature review of the factors affecting IPO underpricing. Then the third section will present the data and the methodology for the regression model, besides, I will illustrate the hypotheses of explanation for underpricing in different markets. In the model, all the IPOs in Japan from 2002 to 2007 will be chosen. Section four will focus on the analysis of the statistical results. Finally, I will draw the conclusion and give some recommendations to reduce the IPO underpricing if it is possible.

Chapter 2

Literature Review

The theories for the explanation of underpricing are well documented in the literature. Many researchers discuss the determinants of underpricing and test several hypotheses (Rock, 1986; Ritter, 1984; Allen and Faulhaber, 1989; Grinblatt and Huang, 1989).

Among the factors that affect IPO underpricing, the offer range is one of the most important factors discussed by researchers. Benveniste and Spindt (1989) argue that underwriters underprice issues to compensate investors for revealing information that aids in pricing the issues. Hanley (1993) confirms that underpricing is positively related to changes in the offer price, which will vary within the offer range. Hanley also tests the ex-ante risk of issues by examining the width of the offer price range and finds that the wider the offer range, the greater the uncertainty. This paper will examine the relationship between the offer range and the degree of underpricing.

Offer price is the initial price of an IPO. Firms can't set offer price too low because the offer price can signal the quality of the issue. Jain and Kini (1999) suggest that a low offer price may indicate low value and thus cause low demand. Ibbotson et al. (1988) show that companies offered low initial price usually have a high degree of underpricing. Hanley (1993) reports that when the final offer price is higher than the suggested price by the underwriter during the pre-IPO phase, it will result in significant higher initial returns. What's more, the high demand will even push up the

offer price, leading to higher initial returns. When the final offer price is set at the bottom of the initial price range, the initial returns will be significantly lower.

Some theories have examined the relationship between underwriters' reputation and underpricing. One of the most popular reputation ranking ways is advanced by Carter and Manaster (1990). They also find that the first-day returns are negatively related to underwriter reputation, which means that the higher-ranking underwriters will associate with lower degree of underpricing. There are also other ranking methods. Megginson and Weiss (1991) use the relative market share of underwriters to measure reputation and also find a negative correlation between initial return and underwriter reputation. However, some recent studies show that the relationship between underpricing and underwriter reputation has changed in the late 1990s. Loughran and Ritter (2004) document that IPOs enjoyed a positive relation between underwriter reputation and underpricing in the late 1990s. In Japan, Kaneko and Pettway (2003) study auctioned IPOs versus book-building IPOs, and report that prestigious underwriters are associated with high initial returns for book-building IPOs. Besides, Kirkulak and Davis (2005) find that the correlation between underwriter reputation and underpricing depends on the level of demand for the issue, namely, there is a positive (negative) correlation between reputation and degree of underpricing when the demand is high (low).

Age of the firm is another most discussed subject by researchers. Beatty and Ritter (1986) suggest that older firms have lower ex-ante uncertainty compared with younger firms. Therefore, higher degree of underpricing is expected for younger

firms. Especially, most of these young firms went public during the Internet boom. In Japan, stock markets such as Mothers, JASDAQ, and Hercules are made for young, low sales high-tech companies. The issue size is another alternative measure of ex-ante uncertainty. Empirically, larger the issue size, lower the level of underpricing. Habib and Ljungqvist (2001) suggest that firms which offer larger proportion of secondary shares have less underpricing. This paper will analyze the relationship between secondary share and initial returns.

Fluctuations in market prior to initial public offering also have great impact on underpricing. Many researchers have found that issuers or underwriters are able to successfully time their offerings when the market is optimistic about IPOs. How, Izan and Monroe (1995) analyze the Australian IPO market and confirm that the level of underpricing is high during hot periods and low during cold periods. Loughran and Ritter (2002), Derrien and Womack (2003) report that there is a positive relationship between initial returns and hot market. They find that underpricing can be severer in the rising stock market prior to offering. The paper will use the 40-trading days' adjusted return of the market before offer date to analyze the effect of market movements on the degree of underpricing.

For those young and low-sales companies in high-tech industry, they are hard to be valued exactly before IPO. Discounted Cash Flow is one of the most popular ways to value companies. However, this method has the disadvantage that predicting future cash flow is very unreliable and there is much uncertainty for young companies. The comparable firms approach is another commonly used valuation method, which uses

Price/Earnings ratio of comparable publicly traded firms. A study of Kim and Ritter (1999) shows that the comparable firms approach is better when forecasted earnings are used for calculating P/E ratios. Kaneko and Pettway (2003) report that the P/E ratios for IPO companies in communication industry are really high compared with those in other industries. Their study also shows a positive relation between first day P/E ratio and the degree of underpricing.

Lock-up period is a recent topic for IPO underpricing. It is the period during which shareholders commit themselves not to sell any shares in the aftermarket. There are many studies for explaining the existence of lockup provision in IPOs. Brav and Gompers (2003) say that lockup provisions provide an obligation to insiders in order to overcome moral hazard problems following the IPO. Other studies present lock-up as a signal of firm quality or as another way to compensate underwriters, thus, low-quality firm will have longer lockup period as insurance. Since the lockup period is the public information and can be anticipated by the market investors, it should not exert an effect on IPO price. However, the study of Ofek and Richardson (2000) shows a 1%-3% drop in the share price and a 40 percent increase in volume when the lock-up expires. Therefore, the paper will examine the relation between the lockup option and IPO underpricing for high-tech companies in Japan.

Kutsuna, Kiholmand and Smith (2006) examine the IPO price formation process and the effects of introducing over-allotment options in Japan. Their evidence indicates that the options enable issuers to select significantly narrower filing ranges and to price the IPOs more fully, thus the initial returns are lower.

Chapter 3

Data and Methodology

3.1 Data

The IPOs data are from Kaneko and Pettway's Japanese IPO Database, but the original data are chosen from many Japanese stock markets including exchanges and OTC. The summery of data sources is listed as follows: Fukuoka Stock Exchange "Q-Board" (FSEQ) is a market for start-up companies newly established by FSE in 2000. Hercules (HRLS) is a market for start-up firms established by OSE in 2002 to replace NASDAQ-Japan. JASDAQ Securities Exchange (JAQ) is a market converted from OTC in 2004. Mothers (MTH) is a market of the high-growth and emerging stocks established by Tokyo Stock Exchange. NEO is a market for start-up firms built by JASDAQ in 2007. Nagoya Stock Exchange (NSEC) is a market for start-up firms established by NSE in 1999. Sapporo Stock Exchange (SSE) is one of the local stock exchanges. SSEA, Sapporo Stock Exchange "Ambitious", is a market for start-ups established by SSE in 2000. Tokyo Stock Exchange (TSE) is the market that includes two sections.

Table 3 gives the specific information about the sample selection procedure. The particular characteristic about my data is the selection of the markets made for start-up companies' IPOs. The original sample includes 1563 IPOs listed on the above exchanges and they all use book-building system. Besides, the industry classification of each IPO firm is defined in Kaisha Shiki Ho (Japan Company

Handbook). However, there is no clear classification for high-tech issues. Most of the

IT-related issues are generally shown in Communication industry category. Out of

this original sample, I choose 887 IPOs for all industries between 2002 and 2007.

Then 141 IPOs for communication industry are chosen and the final sample numbers

119 IPOs because 22 IPOs were delisted or acquired during a short period of time.

Table 3

Distribution of Sample in Each Stock market

Market	All IPOs	Sample Size
JAQ	34	31
FSEQ	1	1
HRLS	27	26
MTH	56	42
NEO	1	1
NSEC	8	7
SSE	4	3
TSE	10	8
Total	141	119

Besides, I use the DataStream and Bloomberg to collect data for the P/E ratio and

market return. I use the JASDAQ Index to measure market performance since it has

longer history measuring the overall performance of growing companies than other

indices.

3.2 The degree of underpricing

Initial return (*IR*) is defined as the relative price change from the offer price ($P_{i,o}$) to

the closing price at the offering day ($P_{i,c}$). Also, the initial return is used to measure

the degree of underpricing (DUP).

$$DUP = IR_{i,t} = \frac{Pi,c}{Pi,o} - 1 \qquad (1)$$

The relationship between DUP and initial return is that the higher the initial return,

the higher the degree of underpricing. We can also define:

If $IR_i < 0$, the issue is overpriced.

If $IR_i = 0$, the issue is correctly priced.

If $IR_i > 0$, the issue is underpriced.

3.3 Model and hypotheses

The multiple regression model is used to examine the relation between initial return and its influencing factors. The model is presented as:

$$IR_{i=}b_0 + b_1 I\_size_i + b_2 OF\_range_i + b_3 SEO\_p_i + b_4 OF\_price_i + b_5 LogAge_i + b_6 D_1$$
$$+ b_7 Mkt\_re_i + b_8 PE\_ratio_i + b_9 D_2 + b_{10} D_3 + b_{11} D_4 + \varepsilon_i \qquad (2)$$

The variables used in the model are listed below:

1. I_size---issue size

It equals total shares times the offer price. The issue size is used by many researchers to gauge ex-ante uncertainty. According to Habib and Ljungqvist (2001), less underpricings are related to larger issues since the larger the IPO, the more information investors can get from the issue.

Hypothesis 1: There is a negative relationship between issue size and IPO underpricing.

2. OF_range---offer price range

It is the difference between the lowest and highest offer price given on the preliminary prospectus. The Japanese regulator specifies that the final offer price can't exceed the range. Since the larger range indicates greater uncertainty about the issue, Hanley (1993) confirms that underpricing is positively correlated to changes in

the offer price.

Hypothesis 2: A positive correlation between offer price range and IPO underpricing.

3. SEO_P---percent of second equity offering

It is the percentage of second equity offering in the total offering offered by shareholders. Kirkulak and Davis (2005) states that a high proportion of secondary shares sends a negative signal to investors about the risk related to the issue, thus leading to lower initial returns.

Hypothesis 3: A negative relationship between the variable and IPO underpricing.

4. OF_price---offer price

It is the final offer price for initial public offering. Underwritters and companies can partially adjust the offer price according to the market demand. When the demand is high, the higher offer price will associate with higher degree of underpricing, vice versa.

Hypothesis 4: A positive correlation for offer price and IPO underpricing.

5. LogAge---Log(Age)

It is the age of the issuing firm at the time of IPO. Age scale can be very long varying from 1 to 90 years old. The natural logarithm of the age will benefit the analysis. Empirically, younger firms tend to have higher ex-ante risk. Hence, higher underpricing is expected for younger firms.

Hypothesis 5: A negative relation between age and IPO underpricing.

6. D_1---reputation of underwriters

It is a dummy variable. According to Kirkulak and Davis (2005), they rank and

measure the reputation of the underwriters in Japan using the relative market share method. The D_1 will take on the value of 1 if the lead underwriter is ranked the top three: Nomura Securities Co., Daiwa SMBC Securities Co., Nikko Salomon Smith Barney Co. It takes 0 for others. For my sample, the top three hold more than 60% of the IPO market. Besides, they find a positive relation between IPO underpricing and reputation during hot demand period.

Hypothesis 6: A positive relationship between reputation and underpricing.

7. Mkt_re---market return

The paper uses the JASDAQ Index return of 40-trading days before the IPO. In my sample, the IPOs listed in Mothers market have the biggest weight, but the Mothers Index started on September 16th, 2003, which will not be suitable for my sample. Instead, the JASDAQ Index has a longer history of representing high-growth and low-sales companies. Besides, the number of IPOs listed in JASDAQ market is only secondary to that in Mothers. Kerins et al. (2007) find a positive relation between 40-trading days' JASDAQ Index return and IPO underpricing.

Hypothesis 7: A positive relation between market return and IPO underpricing.

8. PE_ratio---price/earnings ratio

P/E ratio equals the closing price in the first trading day divided by the earnings per share in the previous fiscal year. All the P/E ratios in my sample are positive, which is partially consistent with research result of Aharony, Lee and Wong (2002). They say "only firms with two consecutive years of positive operating income are eligible to go public." For high-tech companies, their P/E ratios are really high; some of them

even exceed 100. The high ratio indicates an optimistic expectation in the market, thus stimulating demand in IPO market.

Hypothesis 8: A positive correlation for P/E ratio and IPO underpricing.

9. D_2---IPO method

It is a dummy variable, which takes the value of 1 when companies use OTC and takes 0 for others. The IPO method consists of two choices, namely, over the counter (OTC) or exchanges. Many young companies choose OTC to sell their shares while mature companies prefer to go public on exchanges. Markets like TSE, JASDAQ, or Hercules all offer OTC services. Specifically, the JASDAQ and Mothers occupy the biggest share of OTC market for young companies. Inevitably, the IPO method will affect the IPO underpricing.

Hypothesis 9: A positive relationship between IPO choice and underpricing.

10. D_3---over-allotment option

The dummy variable takes value of 1 when the over-allotment option exists in IPO and takes 0 for others. Over-allotment options were not permitted on exchanges until February 2002. Kutsuna, Kiholmand and Smith (2006) examine the IPO price formation process in Japan and the effects of introducing over-allotment options. Their evidence indicates that the options enable issuers to select significantly narrower filing ranges and to price the IPOs more fully, so that initial returns are lower.

Hypothesis 10: A negative relation between over-allotment option and IPO underpricing.

11. D_4---lockup option

The dummy variable takes 1 for the existence of lockup option in the IPO and takes 0 for others. Since the lockup option can signal low-quality firm, the demand for IPO will be weak. We can expect a lower underpricing for companies that own lockup options.

Hypothesis 11: A negative relation between IPO underpricing and lockup option.

Chapter 4

Regression Analysis

4.1 Descriptive statistics of variables

In this section the descriptive analysis of the variables in the model is presented in
Table 4.1 and 4.2.

Table 4.1 indicates that IPOs are underpriced across all industries between 2002 and
2007 in Japan. The communication industry is quite heavily underpriced, which
owns the highest average initial return and the second largest number of IPOs among
all the industries.

Table 4.1

Distribution of Average Initial Return by Industries from 2002-2007

Industry	Avg. Initial Return% (Closing price)	Number of IPOs
Banking	6.9	6
Communication	129.9	141
Chemicals	53.1	20
Construction	115.3	16
Electric equipment	40.4	8
Electrical equipment	82.5	36
Electricity & Gas	83.9	3
Fishery & forestry	71.7	1
Food products	60.0	13
General Machinery	54.4	30
Glass & Ceramics	33.8	3
Insurance	62.2	6
Iron & Steel	45.7	2
Land transportation	43.4	3
Metal products	19.0	8
Mining	16.2	2
Non-ferrous Metals	25.6	5
Oil &Petrochemicals Products	12.5	2

Industry	Avg. Initial Return% (Closing price)	Number of IPOs
Other Financial Services	82.1	16
Other Products	58.0	24
Precision Equipment	56.1	9
Pharmaceuticals	21.5	7
Pulp & Paper	42.0	1
Real Estate	83.4	75
Retail	55.3	112
Securities & Commodities Trading	53.8	14
Service	85.6	234
Textile	21.0	2
Transportation Equipment	32.3	7
Warehousing & Distribution	29.0	5
Wholesale	75.0	76

Table 4.2 summarizes the characteristics of all the independent variables in the

communication industry for the regression analysis.

Table 4.2

Descriptive statistics of the independent variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Company	0				
Industry	0				
Age	119	13.72185	11.50259	2.1	67.5
D3	119	.3697479	.4847775	0	1
D4	119	.4453782	.499109	0	1
OF_price	119	311283.7	329235.9	400	1700000
I_size	119	2946.597	9938.24	96	104722
IR	119	129.921	128.3963	-25	640
underwrite~d	119	7.313723	.7127508	5	8.5
D1	119	.4537815	.4999644	0	1
Mkt_re	119	-1.104451	7.13636	-18.9306	21.1161
PE_ratio	119	101.5647	151.9664	4.7	1095
D2	119	.4369748	.4981092	0	1
market	0				
OF_range	119	41384.62	43864.33	20	200000
SEO_p	119	.3524044	.2047569	0	.8666667
logAge	119	2.32178	9 .7695093	.7419373	4.212128

The average initial return for communication industry is 129.921 percent. It ranges

from -60 percent to 640 percent, which is quite large. The mean of all companies' age is about 14 years, indicating that most of the companies in communication industry are quite young. There are also some old companies in this industry. From the Table 4.2, we can see that the average offer price is ¥311,283.7, but it enjoys a huge distinction between ¥400 and ¥1,700,000. At the same time, the mean of issue size is ¥2,946.597 million. It also changes dramatically from ¥96 million to ¥104,722 million. The issue size shows that there are many small and medium-sized companies in communication industry. The average market return is negative, -1.104451%. The P/E ratio is quite high for high-tech companies. The mean of P/E ratio is 101.5647%, which means that the market price per share is 101 times of the earnings per share, showing that investors are quite optimistic about the high-tech IPOs. The offer price range varies from ¥20 to ¥200,000 and the mean is 41384.62. Finally, the percent of the second equity offering ranges from 0% to 86.67%, but the mean is 35.24%, which means lots of high-tech companies are willing to exchange their existing shares for funds.

4.2 Detection of multicollinearity problem

The multicollinearity is a statistical phenomenon. It usually occurred in the multiple regression models, in which two or more variables are highly correlated. It may cause the coefficient estimates to change erratically in response to small changes in the model. The model with multicollinearity problem will not give reliable statistical results about the estimates. In the paper, a correlation matrix will be set up to detect the multicollinearity problem.

The Table 4.3 shows that IPO offer price and offer range are highly correlated, observing a variable that is equal to 0.9126. It implies that higher the offer price, larger the offer range will be. Except the high correlation between offer price and offer range, other variables indicate low correlation.

Table 4.3

Correlation matrix of dependent and independent variables

	IR	I_size	OF_range	SEO_p	OF_price	logAge	D1
IR	1.0000						
I_size	-0.1817	1.0000					
OF_range	0.1921	-0.0440	1.0000				
SEO_p	-0.3121	-0.0013	-0.0351	1.0000			
OF_price	0.1343	-0.0351	0.9126	-0.1017	1.0000		
logAge	-0.2564	0.0306	-0.3622	0.3165	-0.3047	1.0000	
D1	-0.0519	0.1920	-0.1227	0.1789	-0.1059	-0.0181	1.0000
Mkt_re	0.2124	0.0396	0.1287	0.0103	0.1130	-0.0667	0.0229
PE_ratio	0.4024	0.1948	0.2293	-0.1852	0.1428	-0.2085	0.1629
D2	-0.1310	0.0618	-0.1070	0.1019	-0.0918	0.2757	-0.0884
D3	-0.1311	0.2167	-0.1481	0.2146	-0.1145	0.1016	0.6655
D4	0.0039	0.1619	-0.1221	0.0788	-0.1170	-0.0065	0.3379

	Mkt_re	PE_ratio	D2	D3	D4
Mkt_re	1.0000				
PE_ratio	0.0905	1.0000			
D2	-0.2346	-0.1198	1.0000		
D3	0.0499	0.0190	-0.0080	1.0000	
D4	0.0178	-0.0367	-0.0054	0.2943	1.0000

As a result of this high correlation, the model will drop the variable of offer price. The model will be modified as below:

$$IR_i = b_0 + b_1 I\_size_i + b_2 OF\_range_i + b_3 SEO\_p_i + b_4 LogAge_i + b_5 D_1 + b_6 Mkt\_re_i +$$

$$b_7 PE\_ratio_i + b_8 D_2 + b_9 D_3 + b_{10} D_4 + \varepsilon_i \qquad (3)$$

4.3 Multiple regression analysis

In order to find the statistical significance of influencing factors for IPO underpricing, an Ordinary Least Squares (OLS) regression analysis is performed on the observed initial returns against the explanatory variables.

4.31 The overview of multiple regression result

In this part, the paper will present the multiple linear regression analysis, which is more comprehensive and accurate than single factor regression. Besides, it is normal that the results of multiple regression analysis are different from the hypotheses because of the interaction of all explanatory factors.

Table 4.4

Results of multiple regression analysis

Source	SS	df	MS			
Model	661706.632	10	66170.6632			
Residual	1283596.2	108	11885.15			
Total	1945302.84	118	16485.6172			

Number of obs = 119
F(10, 108) = 5.57
Prob > F = 0.0000
R-squared = 0.3402
Adj R-squared = 0.2791
Root MSE = 109.02

IR	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
OF_range	.0001112	.0002583	0.43	0.668	-.0004007	.0006232
I_size	-.0033979	.0010692	-3.18	0.002	-.0055172	-.0012785
D1	-8.61428	28.67224	-0.30	0.764	-65.44763	48.21907
Mkt_re	3.338107	1.464016	2.28	0.025	.4361739	6.240039
PE_ratio	.3253252	.0731711	4.45	0.000	.1802874	.470363
D2	4.847765	21.7249	0.22	0.824	-38.21476	47.91029
SEO_p	-133.7827	54.318	-2.46	0.015	-241.4504	-26.11498
logAge	-12.60869	15.43225	-0.82	0.416	-43.19808	17.98071
D3	-10.2947	28.68381	-0.36	0.720	-67.15099	46.5616
D4	26.02875	21.76895	1.20	0.234	-17.12108	69.17859
_cons	176.3996	42.95558	4.11	0.000	91.25414	261.545

The table 4.4 demonstrates that R-squared is 0.3402 and the adjusted R-squared is 0.2791. It means that 34.02% of the total variations in the initial return can be explained by all the independent variables. Although the R-squared value is not high, it still can be accepted since the purpose of the paper is to find some statistically significant factors that influence IPO underpricing for the sample.

The Prob(F-statistic)= 0.0000 is less than 0.05, which refers to the likelihood that the

true population parameter lie outside the confidence interval, so the multiple regression result is statistically significant. The regression model takes a 95% confidence level.

4.32 The analysis of independent variables

1. Offer price range

The Table 7 shows a statistically insignificant relationship between DUP and offer price range, but it suggest a positive relation for DUP and offer price range. It is possible that the issue size of the small companies or other factors will contribute to the insignificance.

2. Issue size

From the Table 7, we can see that the Prob(t)=0.002 <0.05. The regression result indicates that the issue size is a statistically significant factor for explaining IPO underpricing in Japan. Besides, the negative sign of coefficient shows that larger the issue size, lower the DUP will be. The result is in line with previous studies (Habib and Ljungqvist 1998).

3. Reputation

The regression result of the dummy variable D1 is not statistically significant since its Prob(t)=0.764<0.05, but it shows a negative relation between DUP and underwriters' reputation. The insignificance may due to the interactive effects of other factors.

4. Market return

The variable of market return is statistically significant and has a positive correlation

with DUP. The result implies that a higher DUP is related to "hot" market environment, which means that investors are commonly optimistic about the market, so investors like to invest more in IPO markets.

5. P/E ratio

P/E ratio variable is also statistically significant and enjoys the lowest alpha, which is equal to 0.00. The result reports that the DUP is strongly and positively correlated with P/E ratio, so the lower degree of underpricing will relate to lower P/E ratio. It is natural that investors are willing to pay more to buy those companies' shares that have bright development prospects. Consequently, it will push up the DUP.

6. IPO method

The IPO method consists of two methods, namely, over the counter and exchanges. It is not statistically significant for the sample. It's most likely that the IPO markets chosen in the sample are little different from each other. For example, many exchanges have applied over-the-counter systems, so the OTC will not be a significant factor for the DUP of IPO.

7. Percentage of second equity offering

The percent of existing share sold in the IPO statistically has an effect on the DUP because its Prob(t)=0.015, which is less than 0.05. The percent of existing shares sold to new investors will exert a negative effect on DUP. A lower degree of underpricing is related to higher percentage of existing shares sold to market. The result is in line with the study of Habib and Ljungqvist (2001), which suggests that the percent of existing shares sold to market will be a signal of the quality of the IPO

companies.

8. Age

The age shows a statistically insignificant relation with the DUP, but the negative sign of coefficient indicates a negative relationship between DUP and age of the firms. The insignificance may result from that most high-tech companies are young and the range of age doesn't change much.

9. Over-allotment option

The result also shows a negative relationship between DUP and over-allotment options, which is in line with the study of Kutsuna, Kiholmand and Smith (2006). However, it is not statistically significant.

10. Lock-up option

The result reports that the lock-up dummy variable is not statistically significant and has a positive relation with DUP.

Chapter 5

Conclusions

The paper has explored the relationship between DUP and a set of explanatory variables. The IPOs between 1999 and 2000 did experience severe underpricing and many studies have tested and confirmed. Using the sample of 119 effective IPOs for high-tech companies in Japan, the paper exams and tests the statistical significance of all variables including the age of the firms, issue size of the IPOs, the offer price range, the reputation of underwriters, the percentage of SEO in the IPOs, the going public method, the market return, the P/E ratios of the IPO firms, the over-allotment options and lockup options.

However, there are many factors in the regression analysis that are not statistically significant. The insignificance may results from the inappropriate selection of independent variables or the interactive effects of all factors. After all, the issue size, the market return, the percentage of SEO and the P/E ratios do exert an influence on the DUP for high-tech IPOs and the percentage of SEO seems to have a biggest effect on the DUP among all the factors, reflecting that the acts of shareholders who offered existing shares in the IPOs will affect investors.

The R-squared coefficient is not high in the regression analysis, which means that there are other more important factors that I have not introduced in my model. Anyway, I will improve my research in future.

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