

**THE IMPACT OF VENTURE CAPITAL PARTICIPATION ON  
UNDERPRICING IN HOT AND COLD MARKET: EVIDENCE  
FROM KOREAN IPO'S ON THE KOSDAQ MARKET**

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## **Abstract**

Numerous studies have documented that underpricing in the short-run of Initial Public Offerings (IPOs) of common stock, and they have attempted to understand the meaning of these phenomena. While most of the discussion has concentrated on the information asymmetry problem that comes up between issuer, underwriter and investor, it has been shown that a reputable financial player acting as certifying uncertain IPO firms can significantly reduce the information gap, thus decreasing the degree of underpricing. Venture capital companies have been considered as institutions that can play this role. This thesis analyses how venture capital companies affect the underpricing of IPO firms on the Korean KOSDAQ market, Korea's second-tier stock market. KOSDAQ has grown dramatically since 1999 and about half of the firms listed in KOSDAQ during this period were VC-backed, thus providing a good testing ground for an empirical analysis. We analyse how VC-backing, the reputation of VC and institutional affiliation of VC with financial institutions (banks and security companies) affect the pricing effects of IPO firms. We use data on 372 firms brought to IPO during the period of 1999-2001 in KOSDAQ. In this period as a whole a boom or 'hot' market period was followed by a severe fall into a 'cold' market period. We therefore analyse separately the whole sample period, the hot market period, and the cold market period. Our findings are as follows. In the whole sample period and in the hot market, VC-backing is related to higher underpricing. However, in the cold market, VC-backing shows lower underpricing, which is insignificant, though. The reputation of venture capitalist is found to have little impact. The bank-affiliated VC-backing is associated with higher underpricing in the whole sample period and in the hot market, but shows a lower underpricing in the cold market period. The security company-affiliated VC-backing is related to lower underpricing in the whole sample period and in the hot market, but shows a higher underpricing in the cold market period. While stock market situation greatly affects the underpricing of IPO firms, we find evidence of the impact of certification and conflict of interest that VC-backing and the institutional affiliation of VC bring to KOSDAQ, especially in the cold market condition.

**EFM Classification Codes:** 150 (Corporate Governance), 620 (Emerging Markets) 810 (Venture Capital)

**Key words:** Initial Public Offering; Underpricing; Venture Capital; Certification; Conflict of Interest

## **The Impact of Venture Capital Participation on Underpricing in Hot and Cold Market: Evidence from Korean IPO's on the KOSDAQ Market**

### **A. Introduction**

The Initial Public Offering (IPO) market has attracted a great deal of attention from academic researchers and financial practitioners in the 1990s and 2000. Small and Medium Sized Enterprises (SMEs) based on Information and Communication Technology (ICT) realised huge gains on their stock market debut. The IPO market was a catalyst attracting new issues by innovative SMEs, which were regarded as promoting the development of the “new knowledge economy”. In particular, the enormous growth of NASDAQ, which is the electronically operated secondary stock market for high-tech SMEs in the US, fostered the financing of high-tech SMEs and resulted in the establishment of similar types of stock markets in other countries. Most of these markets were born in the late 1990s, including AIM in the UK and Euro.NM network in Europe. KOSDAQ, the secondary stock market in Korea was launched in 1996 following this global trend and has played a substantial role in financing a number of Korean high-tech SMEs since the late 1990s. The market capitalisation volume of KOSDAQ was one of the largest global second-tier stock markets by the end of 1999. The growth of KOSDAQ was matched by a growth in the Korean venture capital industry.

This paper aims to examine the relationship between the involvement of venture capitalists in the ownership and management of going-public firms and the stock market performance that is measured as underpricing (interchangeably used as initial return) in the KOSDAQ setting. It has been known, from various sources, that a venture capitalist has the capability to reduce the extent of underpricing by acting as a certifying agent and value-adding financial player for the IPO firms. Venture capitalists not only supply funding, but also participate in the ownership and management of IPO firms by holding shares and dispatching board of directors. They also have diverse tools to minimise agency costs and information asymmetries between themselves and the firms. However, some venture capitalists are known to cause conflict of interests between themselves and the public investors by acting as only money-game players, being more interested in the short-term capital gain after IPO, rather than adding value through the mechanisms mentioned.

This article analyses the determinants of IPO underpricing in terms of the certification and conflict of interests that the venture capitalists may bring to the stock market. What we are interested basically lies in how the quality, reputation and the ownership structure of a venture

capitalist are acknowledged in the stock market in a very short term after and IPO. This study is done in a very particular national setting, KOSDAQ, in a very particular period 1999~2001 which can be divided into “hot” and “cold” stock market situations. We implemented empirical analysis which focused on the applicability of the VCs’ certification and conflict of interest theories in both periods, and found that the impact of venture capital participation was remarkably different in both periods, particularly in terms of VC ownership. Very few studies in the literature have analysed Korean IPOs in these periods. This detailed analysis of KOSDAQ allowed for an independent set of tests of IPO underpricing and updated the previous results in other studies. We expect that the academic readers of this thesis can understand the underpricing performance pattern of KOSDAQ IPOs over the period 1999~2001 when KOSDAQ experienced a dramatic surge in the hot market period and the following abrupt decline in the cold market period, respectively, and how VC-backing and other reputational and ownership effects influenced the firm performances.

## **B. Institutional Background**

The Korean venture capital industry has experienced dramatic growth since the late 1990s, after many years of negligible activities in the venture capital market. Korea ranks third in terms of venture capital investment as a share of GDP among the leading OECD countries over the period 1998-2001, following the USA and Canada, and has the largest venture capital market relative to its economy among Asian countries (OECD, 2003). The venture capital market had remained stagnant until 1997 when Korea was deeply affected by the East Asian Financial Crisis. However, it has started to see a significant increase since 1998 and reached a peak of KRW 2 trillion (0.63% of GDP) in 2000, almost quadrupling from 1998. However, in 2001, Korean venture capital investment experienced a steep decline due to the worldwide economic recession, but less so than other OECD countries. The remarkable growth of Korean venture capital investment was prompted by the government policy which was designed to amend the fundamental flaw that had made the country vulnerable to the 1997 financial crisis. The Korean government attributed one of the main causes of the Korean financial crisis to intrinsic structural problems, mainly caused by the big conglomerates (*chaebols*)-concentrated industry policy and implemented an intensifying structural reform to withdraw support toward uncompetitive groups of big conglomerates and to launch new promising technology-oriented SMEs. Moreover, this period had seen the advent of a strong economy in which high-technology firms with computer hardware and software and internet communication were regarded as the driving

forces behind the significant growth of the global economy.

The Korean venture capital industry has grown sharply in recent years. Venture capital funds remarkably increased the amount of capital that they invested in portfolio firms. In 1998, the venture capital industry invested USD 280.9 million in 21 new firms, but invested USD 1,658 million in 136 firms in 1999 and USD 2,834.7 million in 567 firms in 2000, showing an enormous growth of investment in portfolio firms: the total value of disbursements jumped by 490.5 % from 1998 to 1999 and an additional 70.9 % from 1999 to 2000, and the number of the firms invested leapt by 547.6 % from 1998 to 1999 and by a further 316.9 % from 1999 to 2000. This extraordinary growth in the Korean venture capital industry during 1999 and 2000 is in line with the increasing trend of venture capital investment in other major countries over the same year (See Figure 1). In general, the amount of venture capital disbursement, referred to as investments in portfolio companies, significantly increased during 2000 throughout the world.

[Insert Figure I]

Behind the considerable growth of the venture capital industry in Korea since the late 1990s was the existence of a well-functioning IPO market. The KOSDAQ (Korean Securities Dealers Automated Quotation) stock market, the over-the-counter stock market in Korea, took a lead in all the IPO listings over this period. KOSDAQ was established in July 1996 to promote the advancement of high technology firms and SMEs (Small and Medium Enterprises) into the public stock market. KOSDAQ had been going through its fledgling stage before 1997, when the Asian Financial Crisis clouded the Korean economy. However, the financial crisis was, in a sense, a disguised blessing to SMEs financing and the development of KOSDAQ. In a situation where the high-debentured and uncompetitive chaebols collapsed, the government used this opportunity to reform the Korean economy by lifting up the SMEs' position in the Korean economy. As was mentioned earlier, the governments enforced the measures to expand the role of high technology-oriented SMEs in 1998, especially by enhancing their financing. In 1999, a new administrative measure designed to promote IPOs in KOSDAQ was implemented: for example, some listing requirements were eased and tax incentives were given to the KOSDAQ-listed companies. What with the government efforts to stimulate the direct financing of SMEs through KOSDAQ and the unprecedented expansion of IT investment in computer hardware/software and online internet businesses, KOSDAQ experienced dramatic growth from mid-1999. The KOSDAQ index more than tripled from 75.18 points at the end of 1998 to 256.14 points by the end of 1999. Market capitalisation volume increased astoundingly from

KRW 7,892 billion in 1998 to KRW 98,704 billion in 1999. Total trading volume in 1999 was KRW 8,754 billion, representing an increase of more than 40 times relative to that in 1998. However, following the decline of the global stock market and the downfall of the IT boom in 2000, KOSDAQ suffered a dramatic drop from the previous year in terms of market index and market capitalization volume.

KOSDAQ is one of the most successful second-tier stock markets in the OECD countries at the present. The number of IPO companies has risen from 453 in 1999 to 843 in 2002, showing about a 90% increase. As shown in Figure II, in terms of the listed companies, KOSDAQ is bigger than any other stock market, except for the NASDAQ (3,725 companies in 2002) and Canadian Venture Exchange (2,504 companies in 2002), being followed by AIM (Alternative Investment Market) in the UK (704 companies) and Neuer Markt in Germany (240 companies), the Swedish O-List market (235 companies), and the French Nouveau Marche (154 companies).

[Insert Figure II]

## C. Related Literature Review

### *C.1. Information Asymmetry Theory and Underpricing*

It is well known that stocks going public are frequently associated with large initial returns, in other words, underpricing (Loughran, Ritter et al., 2003)<sup>1</sup>. This underpricing phenomenon was especially remarkable in the late 1990s and the beginning of 2000<sup>2</sup>.

A lot of theoretical and empirical research has been made in order to grasp the meaning of the underpricing, with the results being mixed in diverse perspectives. For the underpricing, the discussion was concentrated on the information asymmetry problem that could exist between issuer and investor. When issuers face lemons problem, they need to separate themselves from the lower-quality issuers by pricing the IPO below its true value, which lower

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<sup>1</sup> Among 34 nations surveyed in Loughran, Ritter et al (2003), no stock markets realized less than 0% on average on the initial returns of going public firms across the years, which indicates that offer prices of IPO stocks on average were underpriced. Only four countries (Austria, Canada, Chile, and Denmark) show less-than-10% initial returns on average over the period surveyed in the literature.

<sup>2</sup> If we take the example of the US, this phenomenon seems very evident. The average initial return of IPO stocks was 18.4% over the period 1960~2001. But, if we separate this return into different periods, the underpricing was 14.5% in 1980 and reached 65.0 percent in 1999 and 2000, but fell back to 14.0 percent in 2001 in the US (Ritter and Welch, 2002).

quality issuers find it hard to imitate. Issuers are able to get back the costs of IPO underpricing by selling the shares they retained at a higher price after IPO than they would not have sold without signalling. Their signal is reinforced by the announcement of high dividends (earnings) after IPO (Allen and Faulhaber, 1989), future issuing activities by selling additional shares on more favourable conditions (Welch, 1989), retained ownership (Grinblatt and Hwang, 1989), or analyst coverage (Chemmanur and Fulghieri 1998). Moreover, when investors have different information on the issuer, IPO stocks may be underpriced because too high priced stocks may lead investors and issuers to fear a “winner’s curse”. In Rock (1986)’s winner’s curse model, well-informed investors will subscribe to only underpriced issues that are priced lower than the firms’ true value in order to earn abnormal return, but less-informed investors will be allocated all of the undesirable overpriced issues avoided by well-informed investors. Consequently, less-informed investors face the ‘winner’s curse’ and will not purchase the IPO stocks unless they are not underpriced. Furthermore, where bookbuilding method is used for the setting of offer price, investment banks may underprice IPOs to induce regular investors to reveal their information about their truthful valuations on the firms. Through the process of “bookbuilding” and “road show”, underwriters acquire the information of the market demand on the shares to sell (Benveniste and Spindt, 1989). When market demand is higher, the offer price will be set higher than original price. When potential investors come to know that their willingness to pay a high price will lead to higher offer price, underwriters should offer something in return for the investors’ revealing the information about the demand on the shares: underpricing and more allocation (Ritter 1998).

Because these information asymmetry hypotheses assume that issuers should underprice their shares to attract investors, if information asymmetry problems disappear, there should be no underpricing. Some literature related to “reputation” states that issuers are able to alleviate the degree of information asymmetry by employing highly prestigious underwriters, auditors or financial advisors in the process of IPO. Titan and Truman (1986) suggest that the employment of a prestigious auditor or other financial advisors to the issuing company may be interpreted by investors as a positive signal of issue value, leading to less underpricing. Holland and Horton (1993) examine the relation between the reputations of the professional advisors involved in IPO (specifically, the sponsor, the accountant and the auditor) and the short-term performance. They find that more reputable financial advisors are linked to lower initial returns, which can be thus interpreted as lower underpricing. Carter, Dark et al.( 998) and Carter and Manaster (1990) also found an evidence that high-quality underwriters seem to be associated with less underpricing. These literature indicates that, where there exists a great degree of

information asymmetry, the involvement of highly prestigious financial institutions in the IPO process will reduce the extent of information asymmetry and help the issuers to set their offer price in accordance with the firms' true value.

### *C.2. Venture Capitalists: Certification and Conflict of Interests*

A lot of literature in finance regarded venture capitalists as implementing similar functions like reputational underwriters or auditors for going public firms, that is, lessening the information asymmetry between investors and issuers, thus resulting in the reduced underpricing of IPO firms (Barry, Muscarella et al., 1990; Megginson and Weiss, 1991). Venture capitalists have been known to provide funding to entrepreneurial firms (in general, new high-tech SMEs) which suffer from the difficulty in getting finance from conventional institutions such as banks etc. due to their greater default risks (Westhead and Storey, 1997). However, venture capitalists invest in these kinds of uncertain entrepreneurial firms in the expectation of abnormal returns in the future in return for their risky equity investment (Wright and Robbie, 1998). Venture capitalists play a role in raising a firm from the early development stage through expansion and production stage to the stage of IPO or other exit routes. When entrepreneurial firms invoke agency problem and information asymmetry, which are inherent in their uncertain operation, between investors and themselves, venture capitalists can alleviate the concerns by acting as an informed financial intermediary (Chan, Siegel et al., 1987). To do this, venture capitalists utilize various control mechanism and resource allocation for venture capital investment. Venture capitalists often invest through syndicates in which one or more venture capitalists play the leading role (Admati and Pfleiderer, 1994; Lerner, 1994). Venture capitalists generally provide financing in the form of staged financing matched with the development in the life cycle of the entrepreneurial firms (Sahlman, 1990; Gompers, 1995). Venture capitalists may employ convertible debts to avoid the entrepreneurs' short-termistic behaviour aimed at receiving the funding at each financing round (Gompers and Lerner, 1996; Cornelli and Yosha, 1997). Entrepreneurs can benefit from the strategic guidance provided by venture capitalists who are often specialists in a particular industry or technology (Kortum and Lerner 1998; Hellmann and Puri, 2000). Venture capitalists provide entrepreneurs with business, managerial and technological skills and guidance through its own experts, or consultants, or diverse practitioners in their networks (Stuart, Hoang et al. 1999). All the investment behaviour, funding mechanism and strategic guidance of venture capitalists can be recognized as alleviating information asymmetry that exists between public investors and issuing firms, so certifying



those firms to outside investors when firms go public. Furthermore, venture capitalists are the “repeated players” in IPO market. Espenlaub and Garrett (1999) stated that venture capitalists are very cautious in screening, selecting and monitoring investee firms, because they may lose their reputation by taking the poorly qualified firms to IPO market. They are not one-off, but repeated players in the IPO market. Jain and Kini (2000) argued that venture capitalists’ reputational capital is enhanced by repeated interaction and interlocking arrangements with the market intermediaries. Venture-capital-backed issuers are able to exert influence on institutional investors, prestigious investment bankers and analysts to support them to a great degree in pre-IPO and post-IPO period.

While there is a body of literature supporting the IPOs-certifying role of venture capitalists, other literatures are sceptical about venture capitalists’ ability to certify entrepreneurial firms. It has been known that venture capital investment and the decision of going public heavily move in line with the stock market trend. Venture capitalists tend to increase their investment when the stock market is hot and looks favourable. Venture Economics (2002) reports that US venture capital investment has increased about by 6 times from 1996 to 2000. In 2000, \$105 billion was raised for venture capital investment. Venture capital investment dramatically began to decrease since then in line with the decline of NASDAQ index. Venture capital investment in 2002 is only just as large as the level of 1998. This indicates that venture capitalists may be more interested in mature entrepreneurial firms that are on the threshold of IPOs, rather than trying to incubate the firms in early stages having business idea, but lacking in seed money. Gompers (1996) noticed that venture capitalists’ willingness to bring entrepreneurial firms public earlier than a more appropriate time even when the entrepreneurs are in less-mature situation for IPOs. He observed that this behaviour of venture capitalists is more remarkable for young venture capitalists, which he names ‘grandstanding’. That is, it was seen that young companies take companies to the public market earlier than more established firms in order to raise their profile in the market. This is costly both to the young venture capitalists and to other issuing firms’ shareholders because the greater uncertainty and information asymmetries with younger firms indicate that IPOs sponsored by inexperienced and younger firms are more underpriced. While the diverse mechanisms by venture capitalists to enhance the value of the firms are generally acknowledged, we cannot exclude the possibility that all the venture capitalists are not the same, so that their qualities and different reputational factors will be judged by investors.

### *C.3. VC Ownership: Certification and Conflict of Interest*

Some researchers note the possibility that institutional difference of venture capital could affect the financial performance of IPO firms, because market may treat each IPO backed by venture capitalists differently according to the ownership of venture capital firms (Gompers and Lerner 1999; Hamao, Packer et al. 2000; Li and Masulis, 2003, Bessler and Kurth, 2003).

IPOs backed by venture capital that is affiliated with investment bank provide a good testing ground for universal banking (Gompers and Lerner 1999)<sup>3</sup>. Gompers and Lerner (1999) seminally introduced the universal banking perspective in their venture-capital-backed IPO research by focusing on the conflicts of interest that can occur between underwriters who hold an equity stake in IPO firms through venture capital subsidiaries and investors. They note the possibility that, when investment banks underwrite firms in which they have shares through a venture capital subsidiary, they may incur conflicts of interest between investors and themselves. They document the fact that an investment bank has an incentive to set a high price for IPO shares as an agent and this incentive is strengthened when it has an ownership in the IPO companies as a result of more aggressive marketing. However, the investment bank is also worried about losing its reputation by pricing the firms too high. The investment banks should also consider the institutional investors, their long-term clients on the demand-side. The IPO price will be determined in equilibrium by considering all these concerns. Both how the investment banks set the offering price in the end and how the stock market reacts to their decisions depend on the a priori perceptions of investors. When investors anticipate this conflict of interests, they will require a discount on the IPO pricing, which will result in a higher underpricing.

However, despite the plausible conflicts of interests that can be found in this universal banking perspective, “banks-affiliated” venture capitalists can lead to great certification roles for the issuance of the firms. This is because, as “banks”, they have a great “information advantage” over other financial institutions acquired through the on-going lending relationship with a company. In this sense, when a “commercial bank” in a universal banking group (without

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<sup>3</sup> IPOs backed by venture capital that is affiliated with investment bank provide a good testing ground for universal banking (Gompers and Lerner 1999). The benefits and costs of universal banks have been debated, in particular, since early 1990s in line with the intensified discussion about financial institutions’ role in economic development of a country and the recent trend of mergers in financial sector (Saunders and Walter 1996; Canals 1997). The reason why the debate on the universal banking has significance for the venture capital research is that venture capital firms affiliated with other financial institutions are parallel to the subsidiaries of universal banks, so the debate can be directly applied to the different organizations of venture capital firms.

acting as an underwriter as an “investment bank” in a universal banking group does) participates in the ownership of venture capital, this can convey a greater positive signal certifying the entrepreneurial firms. Banking institutions can obtain a lot of information about the firms by appointing a specialist to transmit funds, screening the loan applicants, monitoring the firms’ managerial performances and profits and enforcing specific contracts that discipline managers (Calomiris and Ramirez, 1996). Holding shares in a firm is considered as a mechanism of certification by means of which banks can reduce the agency costs associated with debt (Prowse, 1990; Aoki, 1994). Banking institutions are more willing to provide funding for long-term investment (Edwards and Fischer, 1994). Aoki (2000) has documented the concept of relational financing<sup>4</sup> in the world of competition and has said that banks’ role in gathering information by making transactions with diverse firms, thus creating ‘informational rents’, is still very significant in funding firms. These information rents allow banks to create a reputation mechanism. A bank as a relational financier whose subsidiary is a venture capital company may decrease its monitoring role from the hands-on intervention in the firms’ operations before IPO to a hands-off “arm’s length” type of financing after IPO, because they know the firms and their people very well already and permit the firms to have more discretion in their management. Hellmann, Lindsey et al (2003) propose the possibility that banking organisations may invest in the venture capital industry through their subsidiaries in order to develop client relationships between themselves and their client companies for their core lending activities. If all these certifying and value-adding functions of banks are recognised in the market, IPO firms backed by banks-affiliated venture capital companies are expected to experience less underpricing.

#### *C.4. Behavioural Perspective: Hot Issue Market*

Information asymmetry theories assume that there tends to be the problem of placement of shares among investors, because supply of shares is supposed to exceed demand on them in their model. However, these theories have some difficulties in explaining the severe underpricing of IPOs during late 1990s, in which it was impossible to leave shares unsold because of the strong interest by a lot of investors. Rather, It seems that “hot issue market” theory may plausibly explain the phenomenon of underpricing in the late 1990s and 2000. In this case, underpricing is interpreted as the outcome of irrational behaviour of investors.

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<sup>4</sup> Their working definition of “relational financing” is as follows: relational financing is a type of financing in which the financier is expected to make additional financing in a class of uncontractible states in the expectation of future rents over time. They refer to types of financing that are not relational as “arm’s length” financing.

Ibbotson and Jaffe (1975) originally documented the hot issue puzzle – a type of cyclical pattern in the IPO market in which waves of IPOs have higher than average initial returns. Ritter (1984) extended this study using a later time period and found that the hot issue markets continued to exist. Ibbotson, Sindelar et al. (1994) show that high initial returns have a tendency to be followed by rising IPO volume and vice versa. It may be natural that when IPO volumes are rising, initial returns will be lowered because the increased transaction supply volume in the stock markets is expected to take effect of watering the market, leading to reducing the return on the stock investment. But it has been seen that for the considerable time period when stock market is hot, the initial returns went up. Aggarwal and Rivoli (1990) argued that big underpricing was caused by “market fads” which can be defined as temporary overvaluation about the IPO firms by investors in early IPO stage. Higher levels of noise trading are likely to happen not in accordance with rational expectation on the firms’ value, but according to irrational overoptimism. Rajan and Servaes (1997) attribute underpricing to overoptimism in earning potentials and long-term growth prospects of recent IPOs. Recently Loughran and Ritter (2002) and Lowry and Schwert (2002) show that initial returns are positively autocorrelated in a specific period. We expect that, when the hot market prevails, the underpricing tends to be higher than other less hot periods.

### *C.5. Overhang*

There is a theory that the “share overhang” is related to the degree of underpricing. Firms that go public often sell only a small portion of their outstanding shares or sell lower volume of new shares relative to their outstanding shares in the IPO. Overhang is defined as the ratio of pre-IPO shares retained in a firm relative to the number of shares filed for sale to the public.

Bradley and Jordan (2002) find that the overhang appears to have risen in recent years and a greater overhang is positively related to the extent of underpricing. When underpricing occurs, it is only the shares actually sold to the public in the IPO that are undervalued. The shares retained by insiders are valued at market. Thus, for a given level of underpricing, the economic cost per retained share (the dilution cost) is offset by the economic gain that is realised to the pre-IPO shareholders. This cost declines as overhang rises. So, it is natural to conjecture that the firms with greater overhang will allow for greater underpricing. This chance of greater underpricing with greater overhang is also explained by Loughran and Ritter (2002) “prospect theory”. In their model, when underpricing occurs, insiders recognise that share value has been diluted. However, these same insiders also generally experience an unexpected

increase in wealth. Accordingly, it can be stated that the existing shareholders are willing to “leave money on the table” for new shareholders, when the wealth impact can more than offset the dilution as overhang rises. It is expected that higher overhang is associated with higher underpricing.

### *C.6. Partial adjustment*

Partial adjustment model of Benvensite and Spindt (1989) states that underwriters must reward investors for truthfully revealing their private demand for an issue when bookbuilding is issued. When an underwriter learns that an issue is in high demand, the offer price is raised, but not to full market value. The result is that the offer price partially adjusts to the private information, with the rest of the adjustment coming in the form of underpricing, which compensates the suppliers of information. Those issues with upward (downward) file price revisions are expected to be more (less) underpriced. Hanley (1993) tested the empirical implications of the model and found that those issues with upward revisions are the most underpriced, being consistent with the theory. Bradley and Jordan (2002) take one step further by considering the file range amendments, which can take place well before an issue is actually priced. They find that, as expected, issues with upward (downward) revision in the file range are more (less) underpriced than issues with no revisions.

## **D. Data and Methodology**

### *D.1. Data Sources*

We collected the large volume of data required from diverse sources. First, all the IPO data of 372 going-public firms are based on the IPO prospectus which they report to Korean FSS (Financial Supervisory Service) prior to IPO for the purpose of getting the approval for being listed in KOSDAQ. The IPO prospectuses include all the basic data associated with IPO such as volume of market capitalisation, gross spreads, costs of underwriting, name of underwriter etc, along with the history, business and operation of the IPO firms. The ownership of the IPO firms at the time of IPO is available from these prospectuses, where we also extracted the information on VC-backing for the firm: names of venture capital companies that participated in the ownership and the volume (and percentage) of shares they own. IPO firms must report the

identity and the shareholdings of venture capitalists (and other large shareholders<sup>5</sup>) if they hold 5% and more of the total shares at IPO<sup>6</sup>. FSS arranged in addition for securities companies (underwriters) and auditors in operation in Korea to report their turnover and the number of underwriting and auditing activities, respectively, for the period of 1998~2000, and provided us with the summarised data, which were greatly helpful to calculate their market shares in Korean IPO market that were used to build up the reputation indicators of these organisations.

Daily stock prices of each firm, including both IPO firms and their matched firms were offered by Tong-Yang Securities Co. which shares the daily stock prices of every firm listed in KSE and KOSDAQ with other financial institutions through the electrical network operated by KIS (Korea Information Service). The IPO offering price of each IPO firm and daily KOSDAQ index were supplied by KOSDAQ. The Korean Stock Exchange provides us with daily KOSPI (Korea Stock Price Index) data. Yearly financial statements were supplied by Tong-Yang Securities Co, too.

The IPO numbers in each year in KOSDAQ and KSE were found in the annual report published by KSDA (Korea Securities Dealers Association) and KOSDAQ website (<http://www.kosdaq.or.kr>). Information on the institutional identity of each venture capital company, i.e., the parenting investor of the venture capital company was provided by KVCA (Korean Venture Capital Association). Two-digit Korean Industry Classification (KIC) codes that classified the 372 firms into various industry groups were found in the website of Ministry of Commerce, Industry and Energy (<http://www.mocie.go.kr>).

The data set was collected as in the most comprehensive way as possible to analyse Korean IPOs in this period and represents a major research input.

## *D.2. Selection Issues*

There are at least two potential issues regarding sources of bias in the collected data that may happen in our empirical analysis.

First, considering only IPO firms in the empirical analysis has the obvious limitation of ignoring other firms that realised venture capital investment by M&A or other exit routes. VC-

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<sup>5</sup> These large shareholders include personals, banks, other financial institutions and corporate venturing companies, government etc.

<sup>6</sup> If the venture capitalists invest in the IPO firms by less than 5%, they do not appear in the ownership section of IPO prospectuses. Where the venture capitalists own less than 5% share of an IPO firm, the firm is classified as 'non-VC-backed' in our analysis. Holdings of less than 5% may indicate that the venture capitalists are not interested in the management of the IPO firm as minor shareholders. In this case, they are considered as not contributing to the certification and the value-addition of the firm.

backed IPO firms tend to be mainly among the most successful ones since venture capitalists tend to bring highly qualified firms to IPO to achieve abnormal returns and build-up their reputation (Gompers, 1995). As a result, the impact of VC-backing on performance might be overestimated by looking only at the firms that were exited by IPO (Rindermann, 2002). However, this potential bias toward the selection of the most successful firms into our sample may also apply to the non-VC-backed IPOs in our sample.

Second, we treat the VC-backing as an exogenous variable that is randomly distributed. However, it may represent an endogenous choice between entrepreneurs and venture capitalists (Rindermann, 2002). All entrepreneurs do not want venture capital financing and not all of them receive it even though they want it. The endogenous preference for the eventual exit from the entrepreneurs might lead to a non-random distribution of VC-backed IPOs. Hence, the difference in the types of entrepreneurs and their preference for the venture capital funding to other kinds of financing might introduce a selectivity bias (Lee and Wahal, 2002). The preference of venture capitalists to concentrate in the specific types of firms and industries might also be reflected in both firm and IPO characteristics, such as the size and age of firms (Gompers and Lerner, 2001; Lee and Wahal, 2002). To capture high-tech industry and other selection effects which may happen due to the endogenous preferences of venture capitalists for specific types of firms and industries, the multivariate analysis employs various types of control variables, and specifically a dummy variable for the high-tech industries of the IPO firms<sup>7</sup>.

### *D.3. Calculation of Initial Return*

To estimate the effect of underpricing, initial returns will be calculated. Initial returns are generally calculated as price change from the offering price to the first day closing price of IPO stock (Barry, Muscarella et al, 1990; Megginson and Weiss, 1991).

However, the closing price on the first day is not an appropriate measure for calculating initial returns in our KOSDAQ samples, because the KOSDAQ regulated daily price movements with a band of plus and minus 12%, and in many IPOs the closing price of the first-day trading reaches the upper limit and often keeps on rising by hitting the daily limit several days in a row with a small volume of trading, until a large trading occurs (Kim and Park, 2002,

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<sup>7</sup> Lee and Wahal (2002) suggested using Heckman-style two-stage regressions to control for the impact of endogenous choice of venture capital funding on the initial return, but we find that the significant difference of initial returns in both VC-backed and non-VC-backed IPO groups disappears in multiple regressions when we employ various types of control variables.

Berkman and Lee, 2002). In addition, the price band for the first-day trading is widened upward from plus 12% to 100% from July 25, 2000. Therefore, instead of using the first-day return as initial return (underpricing), we use another method in order to calculate the initial return, in a way analogous to the method that was suggested by Kim and Park (2002)<sup>8</sup>.

Initial return is calculated as the difference between the offer price and the closing price on the first day that the IPO stock did not hit the daily upper limit<sup>9</sup>. We then adjust that by the movement in the KOSDAQ index<sup>10</sup> between the first day of trading and the first day that the IPO stock did not hit the daily upper limit. Accordingly, the initial return is defined as

$$IR_{it} = \frac{P_{it} - P_{i0}}{P_{i0}} - \frac{KQ_{it} - KQ_{i0}}{KQ_{i0}}$$

Where  $P_{i0}$  is the offer price of an IPO firm  $i$ ,  $P_{it}$  is the closing price on the first day that the IPO firm did not hit the daily upper limit,  $KQ_{i0}$  is the KOSDAQ index on the first day of the IPO stock trading, and  $KQ_{it}$  is the KOSDAQ index on the first day that the IPO firm did not hit the daily upper limit. We adjust initial return by KOSDAQ index because our return is calculated over several days from the first-day of trading, following the suggestion of Kim and Park (2002).

#### *D.4. Regression Specification*

In the following section, we implement multiple regressions (in addition to univariate tests) in order to understand how stock market performances are affected by venture capital factors, when other factors are taken into account. We attempt to understand the relationship between the initial return as dependent variables and diverse independent variables representing the venture capital, underwriter and auditor factors and other variables used to control for other effects such as ex-ante uncertainty, high-tech industry and the hot market situation.

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<sup>8</sup> In other research, initial returns are occasionally calculated as the difference between the offer price and the closing price after some days of trading, for example, six days in Espenlaub, Garrett et al (1999), in order to calculate the degree of underpricing that is not fully reflected in the first-day price.

<sup>9</sup> It took 9 days on average up until July 25, 2000 that an IPO stock did not hit the daily upper limit for the first time after IPO, while it took 3 days on average after this date.

<sup>10</sup> This adjustment of the underpricing by market index was suggested in Aggarwal and Rivoli (1990).



#### *D.4.1. VC-Backing and Its Reputation*

To assess whether VC-backing has a specific impact on the performances of IPOs, we introduce a dummy variable (*VC*) which take the value of 1 when an IPO firm is backed by venture capital and 0 when it is not. VC-backing is confirmed in the IPO prospectuses when, at least, a venture capital company invests in the IPO firm by 5% and more. Entering a dummy variable representing venture capital backing in this way is used in many studies (Barry, 1990; Megginson, 1991; Espenlaub, 1996; Hamao, 2000). This variable representing VC-backing (*VC*) is expected to show positive coefficients in long-term performances regressions and negative coefficients in underpricing regressions. As we discussed earlier, there may be differences in the quality of VC-backing and the reputation of venture capitalist. These differences may be reflected in the representation of board of directors (Barry, Muscarella et al, 1990), pre- and post-issue equity shares owned by venture capitalists (Field and Hanka, 2000), the number of venture capitalists having equity position in the IPO firm (Gompers, 1995), the age of lead venture capitalist at the time of IPO (Gompers, 1996) or dummy variable representing the Big VCs holding a greater market share of IPOs (Beatty, 1989)<sup>11</sup>. In this empirical analysis, we design a dummy variable representing the quality and reputation of venture capitalist. We include a dummy variable (*VC3*) representing the “Big Three” venture capital companies [KTB, Korean Technology Investment (KTI), Korean Development Bank Capital (KDBC)] whose IPO market shares are greater than other venture capital companies. When these three venture capital companies back an IPO firm as lead venture capitalists, the dummy variable (*VC3*) takes the value of 1. KTB, KTI and KDBC are considered as the major big three venture capitalists to distinguish themselves from other venture capital companies in their capability and occupy the majority of VC-backed IPOs as the lead venture capitalists in our sample. If these monitoring proxies are linked to the quality and reputation of venture capitalist, a negative coefficient on the initial returns is expected.

#### *D.4.2. Institutional Difference of Venture Capital*

We devise three mutually exclusive dummy variables that take the value of 1 if the lead venture

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<sup>11</sup> In a separate analysis not reported here, we carried out estimations of our performance equation using the shareholdings held by VC, VC age and VC size. We found that they were not significantly related to underpricing and long-term performance. In the results below, we follow Beatty’s (1989) approach in which the reputation of auditors was represented in value of the Big-Eight group dummy variable that took the value of 1 and others that took the value of 0.

capitalist of an IPO firm is affiliated with bank (*VCbank*), securities company (*VCsecu*), or other companies or individuals (*VCetc*), respectively (Hamao, Parker et al, 2000). Furthermore, in order to capture the effect of direct bank ownership and other financial institutions ownership in an IPO firm, a dummy variable (*Bank*) that takes on the value of 1 when banks have shareholdings of going-public firms at IPO and a dummy variable (*Secu*) that takes on the value of 1 when security companies have ownership in the IPO firm are introduced (Hamao, Parker et al 2000). We expect that if bank-affiliated venture capital (*VCbank*) and banking ownership (*Bank*) takes a positive impact on the underpricing, a negative sign of the regression coefficients will be shown on the underpricing. In the cases of securities company-affiliated venture capitalist (*VCsecu*) and security companies ownership (*Secu*), signs of the coefficients in the regressions will be expected as the opposite of those of bank-affiliated venture capital.

#### *D.4.3. Reputation of Underwriter and Auditor*

In line with the previous studies on IPO performances, our empirical analysis includes a variable regarding the reputation of the underwriter and auditor. In order to classify highly reputable underwriters (auditors) from less reputable underwriters (auditors), we borrow the concepts of the underwriter and auditor reputation from Megginson and Weiss (1990) and Beatty (1989) by constructing two dummy variables: a variable representing highly reputable “Big Three” underwriters (*Und3*) and highly reputable “Big Three” auditors (*Aud3*) whose value is set equal to 1<sup>12</sup>. The underwriter and auditor reputation coefficients of the underpricing regressions will be expected to show negative signs.

#### *D.4.4. Control Variables*

To avoid model specification errors due to omitted variables, the multiple regressions employ control variables representing firm characteristics and stock market condition. To control for size effects, we employ the natural logarithm of market capitalisation at the time of IPO (*LMC*)

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<sup>12</sup> The big three underwriters and auditors occupy the majority of market share, respectively. The big three underwriters are LG Investment and Security, Daishin Securities and Samsung Securities Co. and the big three auditors are Samil Accounting Co., Ahn Kwon & Co. and Anjin Deloitte Touche Tohmatsu. Dummy variables are based on the relative market share of underwriters and auditors, respectively. The market share of an underwriter is estimated by dividing the whole gross spreads of the IPO firms that it sponsored by the sum of gross spreads of all the IPO firms. The auditor market share is estimated by the turnover of each auditor for an IPO firm from 1998~2000 divided by the sum of turnover of all auditors during the same period.

(Gompers and Lerner, 1999; Wang, Wang et al, 2002). In a similar way, to control for book-to-market effect, we employ the book-to-market ratio at the time of IPO (*BMR*) (Hamao, Packer et al, 2000). Other control variables such as the natural logarithm of firm age (*Lage*) (Kutsuna, Cowling et al, 2000), shareholdings of CEO and their related persons at IPO time (*ShCEO*) (Ljungqvist and Wilhelm, 2003) are also included. These variables control for the ex-ante uncertainty of the IPO firms. These control variables are expected to have a negative relationship with underpricing. Additionally, a dummy variable (*Hi-Tech*) which equals to 1 if IPO firms belong to high-tech industry and 0 if in other industries is included to control for industry effects<sup>13</sup>. This high-tech variable is expected to have a positive relationship with underpricing. To capture stock market effects, we employ three variables. The number of all IPOs in KOSDAQ on the last month prior to an IPO (*NumIPO*), the average of daily KOSDAQ index on the last month prior to an IPO (*KQindex*), and the monthly proportionate change of the average of the daily KOSDAQ index between the second last month and the last month prior to an IPO (*KQchange*) to capture hot market effects, market index performance, and monthly change of market index, respectively (Arosio, Giudici et al, 2000; Loughran and Ritter, 2002). These variables are expected to have a positive relationship with underpricing. In other words, IPO firms will show very high initial returns when they come to stock market in the hot market period. We also use share overhang (*Overhang*) and file price change from original price to final price (*Opchange*). As discussed in the previous sections, these two variables are expected to show positive signs on the underpricing.

## **E. Descriptive Statistics**

### *E.1. Trend of IPO*

Our sample consists of 372 IPOs that took place in KOSDAQ during the period of 1999 ~ 2001. As can be seen in Table I, 94 IPOs occurred in 1999, 172 in 2000, and 106 in 2001. Over this period, the number of firms listed in KOSDAQ dramatically increased. At the end of 1999, there were 453 firms in KOSDAQ, but the number of listed firms increased to 608 at 2000 year-end and 721 2001 year-end, showing 34.2% and 18.5% rise each year, respectively.

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<sup>13</sup> The classification of high-tech industry and non-high-tech industry follows that in Loughran and Ritter (2001). The high-tech industries include Other Machinery and Equipment (KIC 29), Computers and Office Machinery (30) Electrical Machinery and Apparatuses (31) Electronic Components, Radio, Television (32) Medical, Precision and Optical Instruments (33), Computer and Related Activities (72).

[Insert Table I]

On the other hand, KSE IPO market has remained stagnant in the same period. The total number of KSE firms has been slightly decreasing from 725 in 1999 to 689 in 2001. From 1999 to 2001, very few firms went to KSE for the purpose of going public, but all the firms that had been planning to put themselves in public stock markets seem to come to KOSDAQ, which laid down less strict standards on a firm's listing than KSE. KOSDAQ was utilized as a conduit that facilitated the IPOs of high-tech firms and other SMEs, who became willing to list their shares due to relaxed requirements for IPOs (KSDA, 2002). Table II shows that VC-backed IPOs account for more than 40% of total IPOs each year from 1999 to 2001, although their share fell by 10% between 1999 and 2001.

[Insert Table II]

Figure III shows the monthly number of IPOs in KOSDAQ. There is considerable volatility. IPOs peaked in December 1999 and decreased in January and February 2000. The IPO market was hot enough to attract more than 20 firms in July 2000, February 2001, July 2001, and August 2001.

[Insert Figure III]

We can see from Figure III that the number of IPOs each month is more volatile than, but broadly consistent with, the trend of KOSDAQ and KSE index generally. Even though the monthly averaged KOSDAQ index reached the highest point in March 2000, three months after KOSDAQ recorded the highest number of IPOs in December 1999, higher monthly number of IPOs generally coincides with the increasing values of the KOSDAQ index and the KSE index. The figure also shows that the KOSDAQ market index had been more volatile than KSE from March 1999 to September 2001. It seems that going-public firms wanted to take advantage of the "windows of opportunity" by timing the IPOs when the KOSDAQ market index was significantly rising in late 1999, as suggested by Aggarwal and Rivoli (1990) and Lowry and Schwert (2002). However, while the number of IPOs peaked in December 1999, the number of IPOs sharply declined in January and February 2000 which predated the sharp decline of market index in March 2001. After that, the number of IPOs tends to increase when KOSDAQ index is going up. It is interesting that, while the KOSDAQ index continued to decline after March 2000

and did not recover to the previous highest level, firms continued to make their debut in KOSDAQ. In fact, 235 firms (63% in our sample) were taken public between May 2000 and September 2001.

### *E.2. Industry Distribution*

Table III shows the industry distribution of IPO firms. Like other international over-the-counter-stock markets, KOSDAQ attracted a lot of high-tech firms. When the IPO firms were classified by the two-digit KIC codes, the top three high-tech industries occupy almost 50% out of whole sample. “Electric components, radio, television and communication” industry amounts to 71 IPOs (19.1%), “Computer and related activities” industry 70 IPOs (18.8%) and “Other machinery and equipment manufacturing” industry 45 IPOs (12.1%). These industries are closely related to computer, multimedia and internet hardware/software products that led the development of “new economy” throughout 1990s.

[Insert Table III]

The top three high-tech industries are followed by the other industries such as “Chemical and chemical products” industry (29 IPOs), “Electrical machinery” industry (17 IPOs), “Wholesale trade” industry (17 IPOs), “Medical and optical instruments” industry (15 IPOs) and “Computer and office machinery” industry (14 IPOs). It seems that the traditional industries such as construction (6 IPOs) and textiles (4 IPOs) did not take a major role in KOSDAQ IPOs. This industry classification of KOSDAQ IPO firms clearly shows that KOSDAQ has focussed on financing high-tech firms (KSDA, 2001).

Table III also shows that VC-backed IPOs are concentrated in the high-tech industries. Even though VC-backed IPOs are less than majority (173 IPOs, 46% out of 372 sample firms) on the whole, they exceeded non-VC-backed IPOs in the top two high-tech industries. VC-backed IPOs represent 46 IPOs (26.6% out of VC-backed IPOs) in “Electric components, radio, television and communication manufacturing” industry. For “Computer and related activities” industry, VC-backed IPOs amounts to 42 IPOs (24.3% out of VC-backed IPOs). This implies that venture capitalists explicitly show a clear preference in high-tech firms and tend to concentrate on some narrow set of industries (Hellmann and Puri, 2000).

### *E.3. IPO Firm Characteristics*

Table IV provides a detailed analysis of the characteristics of the IPO firms grouped by VC-backed and non-VC-backed status.

[Insert Table IV]

A comparison of the size and age of the firms shows that VC-backed IPOs are smaller and younger than those of non-VC-backed IPOs. Age of firm of VC-backed IPOs is, on average, 8.2 years, whereas that of non-VC-backed IPOs is 12.8, with the difference being significant at 1% level under both the parametric and non-parametric tests. Average market capitalization volume, which is the multiplication of offer price and number of shares outstanding, of VC-backed IPOs (50.4 BW<sup>14</sup>) is significantly lower than that of non-VC-backed IPOs (100.2 BW). Overhang, which is defined as the ratio of Pre-IPO outstanding shares to the shares for filing, of VC-backed IPOs is significantly higher than that of non-VC-backed IPOs (3.59 vs. 3.28). It is also shown that VC-backed IPOs (23.2%) had, on average, significantly higher offer price revision than non-VC-backed IPOs (4.8%).

The average shareholdings of the CEO is similar between VC-backed IPOs (32.2%) and non-VC-backed IPOs (31.8%). Average shareholdings of board of directors do not differ significantly between VC-backed IPOs (7.8%) and non-VC-backed IPOs (9.7%). However, the average shareholdings of the CEO's family show significant differences (6.1% for VC-backed IPOs, 13.0% for non-VC-backed IPOs). The sum of shareholdings of CEO and their related persons<sup>15</sup> (family and board of directors) shows that there is a significant difference between VC-backed IPOs (46.2%) and non-VC-backed IPOs (54.4%). The average shareholding of VCs in VC-backed firms is 15.1%. This figure is quite low, especially compared with the average holding of US venture capitalist at IPO (36.6%), as shown in Megginson and Weiss (1991). While corporate venturing companies accounted for only 5.2% of total shareholdings of VC-backed IPOs on average, they explain 14.0% of those of non-VC-backed IPOs. This difference is significant at 1% level. It is also shown that banks have average shareholdings of 1.3% for VC-backed firms and 0.7% for non-VC-backed firms. Security companies have 1.6% for VC-backed firms and 2.2% for non-VC-backed firms. While the shareholdings held by banks are

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<sup>14</sup> BW: Billion Won, MW: Million Won

<sup>15</sup> Commercial Law in Korea states that CEO's family and board of directors are classified as "persons that have special relationship with CEO".

significantly different between VC-backed and non-VC-backed groups at 5% level by Mann-Whitney test, those held by security companies are not significantly different between the groups. Given the life cycle of the financing of entrepreneurial firms, venture capitalists filled the equity gap of VC-backed firms when they had suffered from insufficient funding from insiders such as family and parenting companies (various types of corporate venturing companies) (Berger and Udell, 1998).

Table IV also exhibits the sources of funds of VC-backed and non-VC-backed firms at the last year before IPO. VC-backed firms seem to rely less on securing loans from banks and financial institutions<sup>16</sup>. The funding from financial institutions as a whole, including banks, shows a big difference between two groups: 4.3 BW for VC-backed firms vs. 47.1 BW for non-VC-backed firms. This difference is significant at the 5% level using the non-parametric test. The lack of significance on a parametric basis suggests some extreme values in the variables within each group. Furthermore, VC-backed firms and non-VC-backed firms do not present any significant differences in profitability ratios. Net income margin of VC-backed firms was 7.8%, compared with 8.2% of non-VC-backed firms.

## **F. Empirical Analysis**

### *F.1. Univariate Analysis*

#### *F.1.1. Underpricing by VC-backed and non-VC-backed IPOs*

In this section, we display a bivariate analysis of underpricing by VC-backed IPOs and non-VC-backed IPOs respectively cross-classified by hot market, age, market capitalisation and industry. Table V shows that the initial returns of VC-backed firms and non-VC-backed firms are statistically significantly higher in the hot market than in the cold market, for young firms than old firms, and for small firms than for big firms. However, the difference of initial returns is not significant for high-tech and non-high-tech groups. Panel A shows that the initial return of VC-backed firms is statistically significantly higher in the hot market (3.61) than in the cold market (1.11). Although the initial return of non-VC-backed firms is also higher in hot market (2.00) than in cold market (1.25), the difference of the initial returns is not as severe as in the case of VC-backed firms. But, the difference is still significant at 5% level. This tendency for the initial return to be higher in the hot market regardless of VC-backing clearly shows that the high initial

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<sup>16</sup> These other financial institutions include “merchant banking corporations” and “mutual savings banks”.

returns of the whole sample in KOSDAQ might be driven by the overreaction of investors in the hot market (Kim and Park, 2002). In the cold market, there is little difference in the initial returns and, in fact, the non-VC backed IPOs have slightly higher underpricing than VC-backed IPOs. In Panel B, young firms show higher returns than old firms in both VC-backed and non-VC-backed IPOs. The initial return of young firms in VC-backing group is 2.37, compared with 1.41 of old firms in the same group. The difference of the initial returns is significant at 5% level using the t-test. For non-VC-backed firms, the difference of initial returns between young firms (1.58) and old firms (1.44) is no less acute than the case of VC-backed firms, but the difference is only significant at 10% level using Mann-Whitney test. In Panel C, small firms present statistically significantly higher underpricing than large firms for both VC-backed and non-VC-backed firms. VC-backed small firms recorded 2.42 while VC-backed big firms recorded 1.77 and the difference of initial returns between two groups is significant at 1% level using Mann-Whitney test. Non-VC-backed firm also show the difference of initial returns between small firms (1.73) and big firms (1.14), which is significant at 5% level by t-test and 1% level by Mann-Whitney test. Panel D shows that the average initial return of high-tech firms in VC-backing group is 1.93, compared with 2.34 of non-high-tech firms in the same group. For non-VC-backing group, the mean initial return of high-tech firms is 1.55, while that of non-high-tech firms is 1.44. However, high-tech firms do not provide evidence of significantly higher underpricing than non-high-tech firm for both VC-backed and non-VC-backed groups.

[Insert Table V]

Table V also shows a significant difference between VC-backed and non-VC-backed IPOs across rows in each panel. It is found that the initial returns of VC-backed IPOs are significantly higher than those of non-VC-backed IPOs in the hot market, for young firms, for small firms, for big firms and for non-high-tech firms. The initial returns of VC-backed IPOs are higher than those of non-VC-backed IPOs for high-tech firms, but the difference is not significant. However, in the cold market and old firms group, VC-backed IPOs show lower underpricing than non-VC-backed IPOs. The difference of initial returns in these two cases is not significant, though. The comparison of underpricing by VC-backing and non-VC-backing with the different types of IPOs across columns shows that the significantly higher returns are found in hot market, young firms group and small firms group. The difference of initial return in these three groups is higher for VC-backed IPOs than for non-VC-backed IPOs. The comparison of underpricing across rows also exhibits that VC-backed IPOs show significantly higher initial returns in each of the



different groups of IPOs. This analysis shows that VC-backed IPOs were related to higher underpricing in the KOSDAQ IPOs over the period 1999~2001 as a whole, thus rejecting our hypothesis H1a (the impact of VC-backing on underpricing). However, the higher underpricing of VC-backed IPOs seems to fade away in the cold market, which prompts a research question on the role of VC-backing in the hot and cold market period, respectively.

### *F.1.2. Underpricing by types of Institutional Affiliation of VC-backing*

Table VI compares the initial returns of IPOs backed by bank-affiliated VC, security company-affiliated VC and other institution-affiliated VC cross-classified by hot market issue, age, market capitalisation, and industry. It is shown that the IPOs backed by three different organisations of VCs all show higher underpricing in the hot market than in the cold market. The initial return of bank-affiliated case in the hot market is 4.68, compared with 0.72 in the cold market. The security company-affiliated case shows the underpricing of 1.48 in the hot market and 1.22 in the cold market. The other institution-affiliated VC shows the underpricing of 3.54 in the hot market, compared with 1.19 in the cold market. The difference of the initial returns is significant for bank-affiliated and other institution-affiliated at 1% level<sup>17</sup>.

[Insert Table VI]

When the IPO firms were divided into age groups, other institution-affiliated VC shows a significant higher underpricing for young firms (2.51) compared with old firms (1.29). Bank-affiliated VC shows higher initial return for young firms (2.54) than old firms (2.01) and security company-affiliated VC also exhibit higher underpricing for young firms (1.41) than old firms (0.85), but the difference of the initial returns for both types of IPOs with young and old firms is not significant. The initial return of young firms is significantly higher than that of old firms in the case of other institution-affiliated VCs. For market capitalisation groups, the underpricing is higher for small firms than big firms in all three cases. The difference of the initial returns is, however, not statistically significant for the security company-affiliated group. There is no difference between high-tech and non-high-tech sectors grouped by three different organisations of VCs. Furthermore, the comparison of initial returns across rows in each panel

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<sup>17</sup> In interpreting the results for the security company-affiliated VCs, it is important to note that there are only 19 cases of security company-affiliated VCs. So we are dealing with small sample sizes. Our non-parametric test is still robust in these circumstances (Conover, 1980).

seems to show that the difference of initial returns among bank-affiliated, security company-affiliated and other institution-affiliated is not significant for each different types of IPOs, except for the hot market issue and non-high-tech group.

### *F.1.3. Underpricing by Overhang and File Price Revision in VC-backed and Non-VC-backed IPOs*

Figure IV plots the frequency of overhang in our sample. This figure shows that the overhang is an evident phenomenon that has been considered in the KOSDAQ IPOs. A majority of IPO firms (205 firms) is concentrated in “3 to 4” overhang group. The next frequent overhang is observed in “2 to 3” overhang group (126 firms). Our sample shows that about 90% of IPO firms had overhang measure between 2 to 4.

[Insert Figure IV]

It is shown that VC-backed IPOs have greater overhang measure than non-VC-backed IPOs. Although more VC-backed IPOs are found in “3 to 4” group than non-VC-backed IPOs, non-VC-backed IPOs constitute about two-thirds in “2 to 3” group. This suggests that VC-backed IPOs sold a relatively small fraction of the company to the public.

To examine whether overhang and underpricing might be related, Figure V plots average initial returns against overhang. As shown, there is a clear tendency for underpricing to be much more pronounced at higher overhang levels. Even though the “less than 1” overhang group has the second greatest initial return among five groups, it appears that this observation is very exceptional, considering the small samples (only 2 IPOs) of this group. However, in other overhang groups, we find that the initial return has a tendency to increase as overhang rises, which is consistent with our earlier discussion.

[Insert Figure V]

It also appears that VC-backed firms had greater underpricing in the overhang groups. Taking only two most frequent groups (“2 to 3” and “3 to 4”), we observe that VC-backed IPOs recorded higher initial returns than non-VC-backed IPOs.

To investigate the impact of file price revision, we classify issues in Table VII based on whether or not the file price is amended, in hot and cold market, respectively. We report

underpricing separately for VC-backed and non-VC-backed firms. Overhang is also reported for each group.

[Insert Table VII]

In the hot market, about 70% IPO firms (93 firms out of 127 firms) experienced offer price revision. It is also shown that relatively more IPO firms went through the offer price revision in VC-backed samples than in non-VC-backed samples in the hot market. About a quarter of firms did not amend the offer price, but only 4 firms amended the original offer price downward. However, in the cold market, the offer price revision dramatically changed. Although firms tended to amend the offer price upward, a relatively smaller proportion of firms did so. Rather, 94 firms (about 40%) in total in the cold market amended their offer price downward. It seems that the investors undervalued the IPOs in the cold market, especially after the hot market issues in our sample period collapsed. However, VC-backed IPOs relatively had less “amend down” compared to the non-VC-backed IPOs in the cold market.

In the hot market, those issues that final offer price was amended upward had the greater initial returns, compared to those firms that it was not amended or was amended downward. The initial return of “amend up” was 298.14%, while that of “amend down” and “do not amend” was 109.99% and 247.23%, respectively. This result is consistent with the previous research. VC-backed samples are similar in this regard, but non-VC-backed samples show the highest initial return in “do not amend” group. However, the cold market initial returns show very interesting result. Those issues that amended the offer price downward had higher initial returns than those that amended the offer price upward or did not amend offer price. This tendency is observed in both VC-backed and non-VC-backed samples. This is contradictory to the discussion earlier, but it appears that this observation reflect the intended underpricing in the cold market.

The results in Table VII display an interesting disparity for overhang measure in the hot and cold market. In each three group, there was tendency for the hot market issues to have larger overhang than the cold market issues. This indicates that the hot market issues sold relatively lower fraction of the company to the public, and there might be a scarcity premium for firms with larger overhang, as was implied by Ritter (2002).

## *F.2. Multivariate Analysis*

Table VIII exhibits the regression coefficients of underpricing of all IPOs in three periods:

whole market period, hot market period and cold market period, respectively.

In the whole market period, market capitalisation (*LMC*), the book-to-market ratio (*Bmr*), and the shareholding of CEO and his related persons (*ShCEO*) are negatively related to underpricing at 5% level for the two modes. This result is evidence that market capitalisation, the relative size of book value of equity to first-day market capitalisation and the shareholdings of CEO and his related persons functioned positively in reducing underpricing by alleviating *ex-ante* uncertainty of IPO firms. This negative relationship of market capitalisation is not consistent with the finding in Gompers (1996) and Gompers and Lerner (1999). The negative relationship of the book-to-market ratio is consistent with the finding in Hamao, Packer et al. (2000). The negative coefficients of CEO and his related persons on underpricing are consistent with the finding in Ljungqvist and Wilhelm (2003). The table also shows that stock market conditions are closely related to underpricing. The number of IPOs in the last month before an IPO firm gets listed (*NumIPO*) has a negative relationship with underpricing. This is consistent with the demand for IPO stocks being satisfied by a higher supply of shares (Arosio, Giudici et al, 2000). The market index at the last month before an IPO firm get listed (*KQindex*) and monthly change of market index (*KQchange*), which is calculated as the difference between the KOSDAQ index of the second last month and that of the last month before an IPO firm comes to listing, have a positive relationship with underpricing. All coefficients for these two variables are significant at 1% level. Underpricing seems, therefore, to be positively related to the market index and the monthly change of market index. As was also expected, the offer price change (*OPchange*) is positively related to the underpricing at 5% level. For the venture indicators, VC-backing indicator (*VC*) is not significantly associated with underpricing. It is only the security company-affiliated VC-backing indicator that shows a significantly negative coefficient, which is contrary our expectation derived from the information asymmetry discussion.

[Insert Table VIII]

In the hot market period, the regression results are generally consistent with those of the whole market period. Although the effects of some control variables relating to firm characteristic are not valid, stock market situation variables strongly explain the underpricing. The monthly change of market index (*KQchange*) is very strongly related to the underpricing (with a t-statistics of 4.07 and 3.70). The change of offer price (*OPchange*) is also positively associated with underpricing at 5% and 1% level. As for the venture indicators, the results are the same with those in the whole market period. Cold market issue period presents show a consistent sign

of coefficients with the cases of the hot market for the firm characteristics and stock market situation variables. The significant effect of offer price change (*OPchange*) in the hot market is not found in the cold market period. The striking change in the regression results is pronounced in the VC ownership variable. Although the significance of security-affiliated VC-backed IPOs (*VCsecu*) disappears, the bank-affiliated VC-backed IPOs (*VCbank*) turn out to have negative relationship with underpricing at 1% level, which is consistent with the information asymmetry theory.

Table IX presents the regression coefficients of underpricing of only VC-backed IPOs in the three periods, too. In the whole market and the hot market, the profitability variable, net income margin (*NIM*) shows significantly positive coefficients. High-tech dummy variable (*High-tech*) show the significantly contrasting coefficients in the hot (positive) and cold market (negative). For stock market situation variables and offer price change, the results are primarily in line with those in Table VIII.

[Insert Table IX]

For venture indicators, it must be admitted that we were not able to get the more convincing results, because *VCbank* and *VCsecu* were dropped automatically in the midst of regression procedures, mainly due to the insufficient number of samples. However, we find the results which are mainly consistent with those in the regressions of all IPOs in Table VIII. In the hot market, bank-affiliated VC-backed IPOs (*VCbank*) have significantly positive relationship with the underpricing. In the cold market, the relationship is negative, which is insignificant, though.

The conflicting results of institutional affiliation of VC-backing in the hot market and the cold market are interesting<sup>18</sup>. It seems that, in the hot market where the demand for shares exceeds the supply of shares, overreaction of investors tends to lean towards the IPO stocks. In this case, regardless IPO shares pricing, investors may pull up the prices of IPO stocks at the initial period, especially if they are considered as a good target for the investment. However, in the cold market where the demand of shares is likely to be not enough to purchase all the shares, issuing firms should allow for underpricing to occur in order to attract investors by assuring a

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<sup>18</sup> Actually, the coefficients of the dummy variables relating to VC-backing and the reputation of VC-backing had a tendency to show contradictory results in the hot market and the cold market, even though the coefficients are not significant. The coefficient of VC-backing (*VC*) was positive in the hot market, but negative in the cold market. In the same way, the coefficient of the reputation of VC-backing (*VC3*) was also positive in the hot market, but negative in the cold market. The coefficients of underwriter and auditor reputation (*Und3* and *Aud3*) are not consistently opposite in the hot and cold market unlike those of VC-backing and the reputation of VC-backing.

high initial return (Rock, 1986; Ritter, 1998). However, the reputable financial player that reduces the information asymmetry between issuer and investor can alleviate the degree of underpricing (Carter and Manaster, 1998). Therefore, the significantly negative relationship of bank-affiliated VC with underpricing in the cold market may show that the bank-affiliated VC was recognised as certifying the IPO firm by reducing information asymmetry problems. On the other hand, the significantly positive relationship of security company-affiliated VC with underpricing in the cold market may indicate that the security company-affiliated VC may incur the conflict of interest due to the possibility that they may overprice an IPO firm. However, we can see that in the hot market the underpricing based on the information asymmetry and the certifying agent does not realise in the pattern we expect in the cold market. IPO stocks backed by more reputable financial players are likely to be evaluated highly by investors at the initial stage of IPOs, thus with prices of the IPO firms rising sharply for a short period after IPO. It seems that the cold market fits our hypotheses relating to information asymmetry and the certifying role of the financial agents but the hot market does not. Loughran and Ritter (2002) argued the underpricing theory relating to information asymmetry and the certifying role of financial agents is for the period 1980s when the stock market return did not experience as enormous initial returns as in the late 1990s and early 2000. We find that our underpricing hypotheses based on the traditional information asymmetries theories were rejected in the whole period and the hot market period, but worked well in the cold market period, thus in line with Loughran and Ritter (2002)'s argument.

## **G. Conclusion**

What we tested in this paper was that VC-backing, the reputation of venture capitalists and the institutional affiliation of VC-backing could make a specific impact on the IPO pricing. We found in fact that the venture capital participation did not lead to the expected results. VC-backing was found to incur higher underpricing. This result tended to be reinforced by the tests for the sample of the hot market issues. However, the analyses in the cold market showed the expected results, even though the findings were not always significant statistically. The contradictory findings of VC-backing in the hot and cold market imply that the information asymmetry theories fit in the cold market, where the demand for IPO shares is relatively low. The issuing firms should therefore allow for some underpricing in order to attract investors by assuring a high initial return. In this situation, reputable financial players can reduce the degree of underpricing by certifying the IPO firms. Our results for the hot market are consistent with an overreaction of investors pulling up the prices of IPO stocks when the demand for shares

exceeds the supply of shares. In these circumstances, the conventional information asymmetry theory did not work well. We also found results contradicting our hypotheses about the impact of bank-affiliated VC-backing and security company-affiliated VC-backing on the pricing. However, while the bank-affiliated VC-backing and security company-affiliated VC-backing did not lead to the expected results for underpricing in the hot market, they showed the right signs for underpricing in the cold market and were also statistically significant. In addition to the implication for information asymmetry theories mentioned above, this finding may be evidence that the institutional affiliation of VC-backing is closely related to the quality of IPO firms backed by venture capitalists. This may be especially so in an emerging stock market such as KOSDAQ which experienced a dramatic growth in a short period. It can be argued that bank-affiliated venture capitalists can bring a certifying and value-adding effect through the “information advantage” acquired through the process of lending relationships, while the security company-affiliated venture capitalists incur a conflict of interests between issuers and investors because of their motivation to overprice an IPO. In a situation such as of KOSDAQ experiencing a period of a remarkable growth, the quality of venture capitalists seems to be assessed by reference to their ownership. It is not clear that this difference of pricing between bank-affiliated VC-backing and security company-affiliated VC-backing is a particular phenomenon in an emerging stock market or can be generalised in other established stock markets. However, in the Korean cases, these results show that the certification and value-adding role of a reputable large institution such as bank can lead to a specific advantageous effect to the IPO firms and their shareholders. However, we also see that when the IPO market is carried away by the overreaction of the investors, this impact was not found. It is also found that it was stock market situation and the offer price revision that affected the underpricing to a considerable degree.

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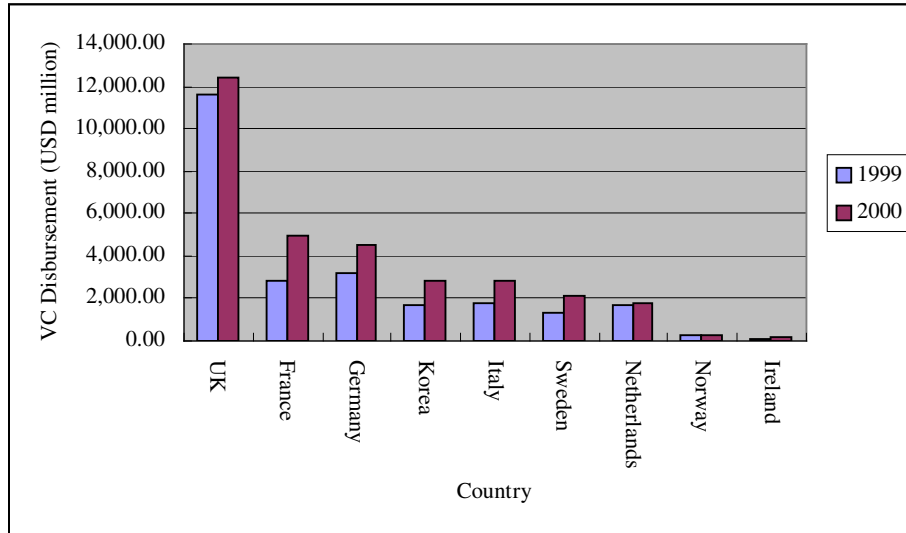
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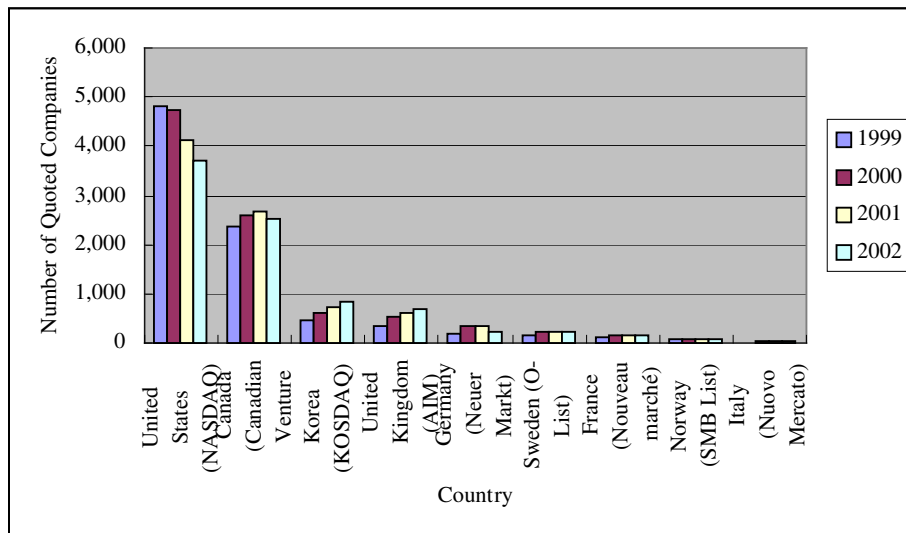
**Figure I Venture Capital Disbursements by Major Countries**

Sources: KVCA (2001), EVCA (2001)



**Figure II Number of Quoted Companies in Major Countries**

Sources: OECD (2003) (Compiled by OECD Secretariat from national sources)



**Table I Number of VC-Backed and Non-VC-Backed IPOs by Year on KOSDAQ and Number of Firms on KOSDAQ and KSE**

The total number of firms listed in KOSDAQ and KSE contains mutual funds. The information on VC-backed and non-VC-Backed IPOs was found by the author from the ownership structure section in the IPO prospectuses. An IPO firm, which has any venture capitalist holding 5% or more of the shareholdings in the ownership structure section, is considered as a VC-backed firm.

	KOSDAQ	KSE	VC-Backed IPO	Non-VC- Backed IPO	All IPO
1999	453	725	49	45	94
2000	608	704	78	94	172
2001	721	689	46	60	106

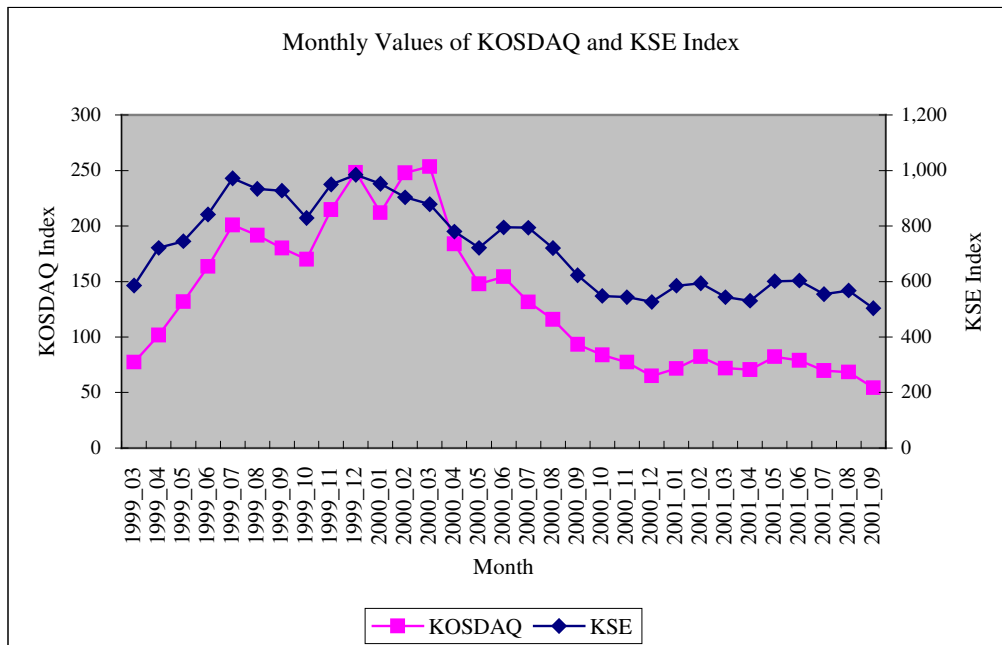
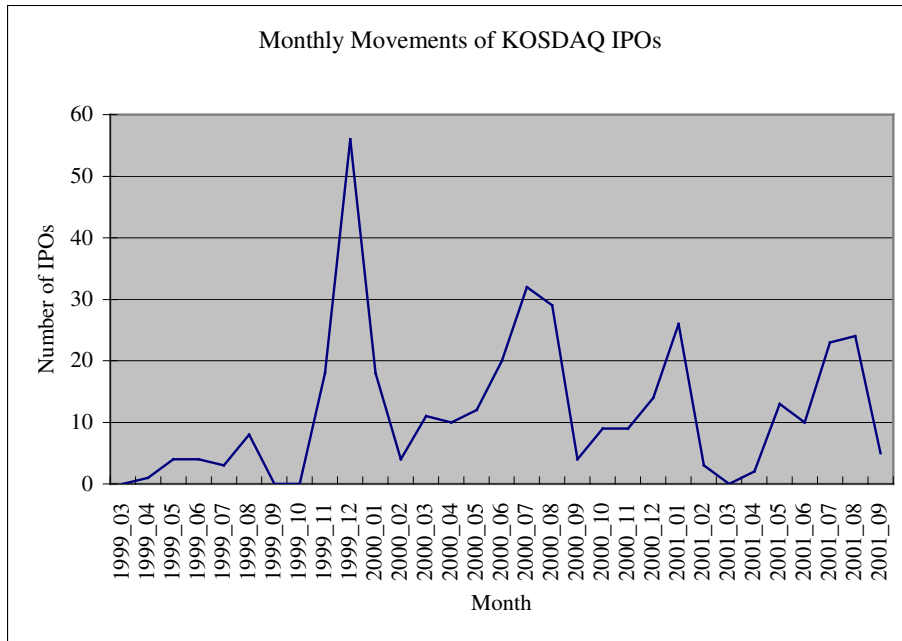
Source: KSDA (2002) and KOSDAQ website ([www.kosdaq.or.kr](http://www.kosdaq.or.kr)).

**Table II The % Distribution of VC-Backed and Non-VC-Backed IPOs by Year**

Year	VC	Non-VC	All
1999	52.1	47.9	100.0
2000	43.6	56.4	100.0
2001	41.5	58.5	100.0

Source: Author's own calculations

**Figure III Monthly Movements in KOSDAQ IPOs and the KOSDAQ and KSE Stock Market Indices**



Source: KOSDAQ ([www.kosdaq.or.kr](http://www.kosdaq.or.kr)) and KSE ([www.kse.or.kr](http://www.kse.or.kr))

**Table III Industry Distribution of KOSDAQ IPO firms 1999~2001**

\*) We grouped all industries with 2 or less samples into a group called 'other industries'. These include Manufacture of Rubber and Plastic Products (25), Retail Trade (52), Supporting and Auxiliary Transport Activities (63), Real Estate Activities (70), Motion Picture, Broadcasting and Performing Arts Industries (87), Tanning and Dressing of Leather, Manufacture of Luggage and Footwear (19), Manufacture of Other Non-metallic Mineral Products (26), Manufacture of Furniture (36), Hotels and Restaurants (55), Land Transport (60), Air Transport (62), Professional, Scientific and Technical Services (74), Education (80)

KIC	Industry	Total		VC		Non-VC	
		No	%	No	%	No	%
32	Manufacture of Electronic Components, Radio, Television	71	(19.1)	46	(26.6)	25	(12.6)
72	Computer and Related Activities	70	(18.8)	42	(24.3)	28	(14.1)
29	Manufacture of Other Machinery and Equipment	45	(12.1)	20	(11.6)	25	(12.6)
24	Manufacture of Chemicals and Chemical Products	29	(7.8)	11	(6.4)	18	(9.0)
51	Wholesale Trade and Commission Trade	18	(4.8)	5	(2.9)	13	(6.5)
31	Manufacture of Electrical Machinery and Apparatuses	17	(4.6)	5	(2.9)	12	(6.0)
33	Manufacture of Medical, Precision and Optical Instruments	15	(4.0)	10	(5.8)	5	(2.5)
30	Manufacture of Computers and Office Machinery	14	(3.8)	10	(5.8)	4	(2.0)
28	Manufacture of Fabricated Metal Products	10	(2.7)	1	(0.6)	9	(4.5)
88	Other Recreational, Cultural and Sporting Activities	10	(2.7)	4	(2.3)	6	(3.0)
64	Post and Telecommunications	9	(2.4)	3	(1.7)	6	(3.0)
22	Publishing, Printing and Reproduction of Recorded Media	6	(1.6)	2	(1.2)	4	(2.0)
34	Manufacture of Motor Vehicles, Trailers and Semitrailers	6	(1.6)	2	(1.2)	4	(2.0)
45	General Construction	6	(1.6)	1	(0.6)	5	(2.5)
15	Manufacture of Food Products and Beverages	5	(1.3)	0	(0.0)	5	(2.5)
18	Manufacture of Sewn Wearing Apparel and Fur Articles	5	(1.3)	1	(0.6)	4	(2.0)
75	Business Support Services	5	(1.3)	1	(0.6)	4	(2.0)
17	Manufacture of Textiles, Except Sewn Wearing apparel	4	(1.1)	1	(0.6)	3	(1.5)
21	Manufacture of Pulp, Paper and Paper Products	3	(0.8)	0	(0.0)	3	(1.5)
27	Manufacture of Basic Metals	3	(0.8)	1	(0.6)	2	(1.0)
73	Research and Development	3	(0.8)	2	(1.2)	1	(0.5)
	Other industries *	18	(4.8)	5	(2.9)	13	(6.5)
Total		372	(100.0)	173	(100.0)	199	(100.0)

Source: IPO prospectuses (industry information); Ministry of Commerce, Industry and Energy (<http://www.mocie.go.kr>) website (KIC code).

**Table IV Descriptive Characteristics of IPOs on KOSDAQ 1999~2001**

BW and MW indicate billion Won and million Won (Korean currency), respectively. Exchange rate of Won to British pounds is roughly W2,000 / £1 over recent years. Asterisks denote significance at the level of 1% (\*\*\*), 5% (\*\*), and 10% (\*).

	VC-Backed IPOs' Mean <i>Median</i>	Non VC- Backed IPOs' Mean <i>Median</i>	T-statistics by t- test	Z-scores by Mann-Whitney test
<i>A. General and IPO Characteristics</i>				
Age of firm (Year)	8.2 <i>6.7</i>	12.8 <i>10.7</i>	-5.70 ***	-5.90 ***
Market capitalisation volume (BW)	50.4 <i>30.1</i>	100.2 <i>20.0</i>	-1.28	-2.15 **
Book-to-market Ratio	0.2 <i>0.1</i>	0.5 <i>0.3</i>	-5.68 ***	-7.33 ***
Overhang	3.59 <i>3.86</i>	3.28 <i>3.57</i>	2.43 **	-2.31 **
Offer price revision (%)	23.2 <i>20.0</i>	4.8 <i>0.00</i>	5.09 ***	-5.33 ***
<i>B. Ownership Structure</i>				
Shareholdings of CEO (%)	32.2 <i>32.8</i>	31.9 <i>31.7</i>	0.18	-0.65
Shareholding of CEO's family (%)	6.1 <i>1.4</i>	13.0 <i>5.7</i>	-4.60 ***	-3.13 ***
Shareholdings of board of directors (BoD) (%)	7.8 <i>4.2</i>	9.7 <i>2.3</i>	-1.35	-0.86
Shareholdings of CEO and their related persons (%) (CEO+ family + BoD)	46.2 <i>48.0</i>	54.4 <i>57.1</i>	-3.05 ***	-3.41 ***
Shareholding of corporate venturing institutions (%)	5.2 <i>0.0</i>	14.0 <i>0.0</i>	-4.00 ***	-3.74 ***
Shareholding of venture capitalists (%)	15.1 <i>13.5</i>	0.0 <i>0.0</i>	26.06 ***	-18.00 ***
Shareholding of banks (%)	1.3 <i>0.0</i>	0.7 <i>0.0</i>	1.25	-2.11 **
Shareholding of security companies (%)	1.6 <i>0.0</i>	2.2 <i>0.0</i>	-0.88	-0.16
<i>C. Source of Funds</i>				
Loans from all financial institutions, including banks (BW)	4.3 <i>1.8</i>	47.1 <i>2.8</i>	-1.07	-2.05 **
<i>D. Operating Performances</i>				
Net income margin (%)	7.8 <i>8.4</i>	8.2 <i>7.6</i>	-0.21	-1.21

Source: Korean Information System, IPO prospectuses



**Table V IPO Underpricing by VC-backing and Non-VC-backing Classified by State of the Market, Age, Market Capitalisation and Industry on KOSDAQ 1999~2001**

Note 1) T-statistics by t-test between VC-backing and non-VC-backing for each different type of IPOs. Note 2) Z-scores by Mann-Whitney test between VC-backing and non-VC-backing for each different type of IPOs. Asterisks denote significance levels at the level of 1% (\*\*\*), 5% (\*\*), and 10% (\*). KOSDAQ IPO samples are divided into two groups respectively as: (1) VC-backed Firms (when any venture capitalist owns 5% or more of total shares of an IPO firm) and Non-VC-backed Firms; (2) Hot Market issue (when an IPO was listed in KOSDAQ in the period up to March 2000) and Cold Market issue (after March 2000); (3) Young firms (when the age of firm is equal to or less than the median value, 9.6 years) and Old firms; (4) Small firms (when the market capitalisation calculated as the offer price multiplied by the number of shares is equal to or less than the median value, 2.4 billion Won) and Big firms; (5) High-tech firms (which include Other Machinery and Equipment (KIC 29), Computers and Office Machinery (30) Electrical Machinery and Apparatuses (31) Electronic Components, Radio, Television (32) Medical, Precision and Optical Instruments (33), and Computer and Related Activities (72) as was defined in Loughran and Ritter (2002) and Non-high-tech firms.

	Mean	Median	Mean	Median	T-statistics	Z-scores
Panel A: Hot Market Issue						
	Hot market		Cold market			
VC-backing (No. IPOs)	3.61 (63)	2.38	1.11 (110)	0.76	6.51 ***	-6.73 ***
Non-VC-backing (No. IPOs)	2.00 (64)	1.34	1.25 (135)	1.00	2.48 **	-2.07 **
T-statistics <sup>1)</sup>	2.84 ***		-0.74			
Z-scores <sup>2)</sup>	-3.50 ***		-0.84			
Panel B: Age						
	Young		Old			
VC-backing (No. IPOs)	2.37 (111)	1.22	1.41 (62)	1.07	2.25 **	-1.30
Non-VC-backing (No. IPOs)	1.58 (75)	1.24	1.44 (124)	0.93	0.44	-1.68 *
T-statistics	2.01 **		-0.10			
Z-scores	-0.79		-1.07			
Panel C: Market Capitalisation						
	Small		Big			
VC-backing (No. IPOs)	2.42 (67)	1.84	1.77 (106)	0.93	1.55	-3.59 ***
Non-VC-backing (No. IPOs)	1.73 (119)	1.20	1.14 (80)	0.61	2.03 **	-2.97 ***
T-statistics	2.07 **		1.70 *			
Z-scores	-2.51 **		-1.54			
Panel D: Industry						
	High-tech		Non-high-tech			
VC-backing (No. IPOs)	1.93 (133)	1.19	2.34 (40)	1.17	-0.84	-1.22
Non-VC-backing (No. IPOs)	1.55 (99)	1.02	1.44 (100)	0.98	0.38	-0.39
T-statistics	1.17		2.15 **			
Z-scores	-0.78		-2.15 **			

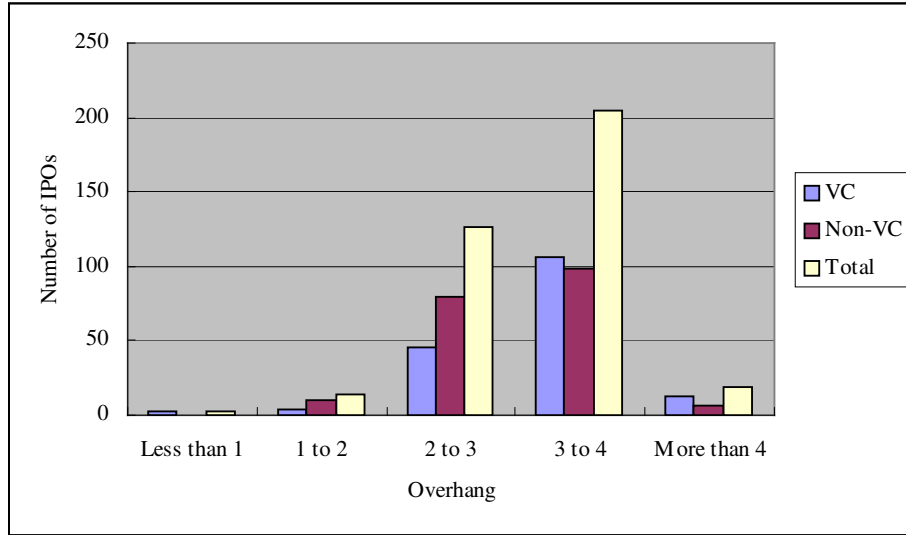
Source: Korean Information System, IPO prospectuses

**Table VI Underpricing by Institutional Type of VC-backing with the Age, Size and Industry of IPOs and the Hotness of the Market on KOSDAQ 1999~2001**

Note1) Significance of mean difference between groups by Kruskal-Wallis test. Asterisks denote significance levels at 1%(\*\*\*), 5%(\*\*), & 10%(\*). The division of samples into each four groups is equal to Table V.

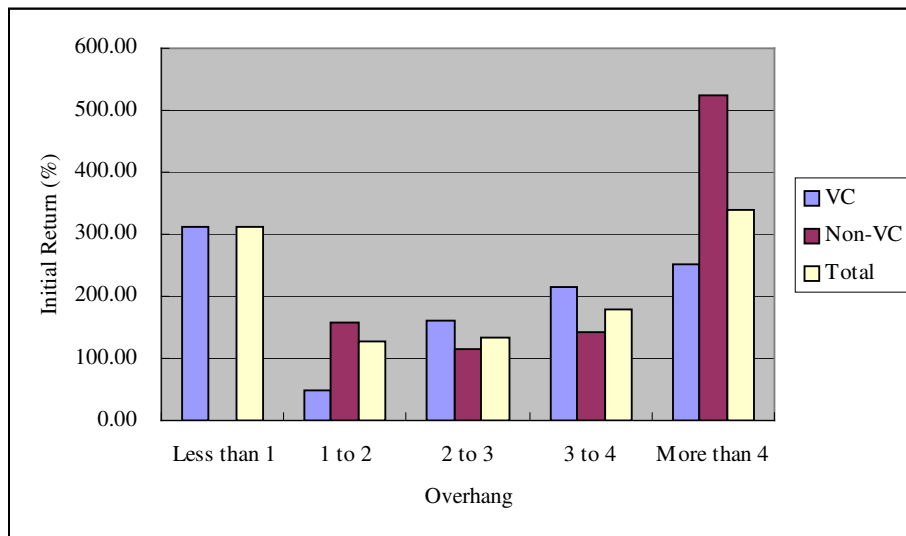
	Mean	Median	Mean	Median	T-statistics	Z-scores
(A) Hot Market Issue						
	Hot market		Cold market			
Banks-affiliated VC (a)	4.68	4.43	0.72	0.58	5.64 ***	-4.28 ***
(No. IPOs)	(13)		(19)			
Security Co.-affiliated VC (b)	1.48	2.00	1.22	0.86	0.39	-0.88
(No. IPOs)	(5)		(14)			
Other Institu.-affiliated VC (c)	3.54	2.38	1.19	0.89	4.78 ***	-5.14 ***
(No. IPOs)	(45)		(77)			
Significance <sup>1)</sup>	a > b at 5%, a > c at 10%					
(B) Age						
	Young		Old			
Banks-affiliated VC (d)	2.54	1.06	2.01	1.42	0.53	-0.40
(No. IPOs)	(19)		(13)			
Security Co.-affiliated VC (e)	1.41	1.19	0.85	0.66	0.77	-0.65
(No. IPOs)	(15)		(4)			
Other Institu.-affiliated VC (f)	2.51	1.25	1.29	0.98	2.32 **	-1.80 *
(No. IPOs)	(77)		(45)			
Significance	-					
(C) Market Capitalisation						
	Small		Big			
Banks-affiliated VC (g)	2.85	1.73	1.80	0.50	1.08	-2.11 **
(No. IPOs)	(16)		(16)			
Security Co.-affiliated VC (h)	2.30	1.67	1.10	1.10	1.56	-0.39
(No. IPOs)	(3)		(16)			
Other Institu.-affiliated VC (i)	2.29	1.85	1.91	0.93	0.72	-2.74 ***
(No. IPOs)	(48)		(74)			
Significance	-					
(D) Industry						
	High-tech		Non-high-tech			
Banks-affiliated VC (j)	2.29	1.26	2.56	1.92	-0.19	-0.74
(No. IPOs)	(28)		(4)			
Security Co.-affiliated VC (k)	1.44	1.20	0.72	0.43	1.02	-1.05
(No. IPOs)	(15)		(4)			
Other Institu.-affiliated VC (l)	1.90	1.11	2.51	1.21	-1.05	-1.56
(No. IPOs)	(90)		(32)			
Significance	-		l > k at 10%			

**Figure IV Overhang Measure by VC-backed, Non-VC-backed and Full Samples**



Source: Korean Information System, IPO prospectuses

**Figure V Initial Return by Overhang Measure, and VC-backed, Non-VC-backed and Full Samples**



Source: Korean Information System, IPO prospectuses

**Table VII Initial Returns and Overhang Measure by Partial Adjustment of Offer Price**

This table provides percentage initial returns and overhang for firms that do/do not amend their file price relative to the original one as outlined in the IPO prospectuses. Amend Down, Do Not Amend and Amend Up represent those firms that amend the original offer price downward, do not amend the original offer price and amend the original price upward, respectively.

	Hot Market			Cold Market		
	Amend Down	Do Not Amend	Amend Up	Amend Down	Do Not Amend	Amend Up
<i>VC-backed</i>						
Initial Return	0.00	295.16	373.52	137.10	36.46	96.79
Overhang	3.86	4.30	4.10	3.15	3.33	3.35
# of IPOs	(1)	(5)	(57)	(33)	(3)	(72)
<i>Non-VC-backed</i>						
Initial Return	146.65	237.65	178.78	131.79	61.62	102.08
Overhang	5.79	3.79	3.82	2.58	3.94	3.16
# of IPOs	(3)	(25)	(36)	(61)	(10)	(59)
<i>All</i>						
Initial Return	109.99	247.23	298.14	133.66	55.81	99.17
Overhang	5.31	3.87	3.99	2.78	3.80	3.27
# of IPOs	(4)	(30)	(93)	(94)	(13)	(131)

Source: Korean Information System, IPO prospectuses

**Table VIII Regression on Underpricing for All IPOs**

This table reports regression coefficients of underpricing of all IPOs. **Lage** is defined as the natural log of age of the IPO firm at the time of IPO. **LMC** is defined as the natural log of market capitalisation at the first day of IPO. **BMR** is defined as the book-to-market ratio at the first day of IPO. **ShCEO** is the sum of shareholdings of CEOs, their family and board of directors. **Loan** is the proportion of loan from the financial institutions at the end of last fiscal year to total asset at the same day. **NIM** is the net income margin over the last fiscal year prior to IPO. **Hi-Tech** is a dummy variable that equals to 1 when the IPO firm belongs to high-tech industry as defined in Loughran and Ritter (2002). **NumIPO** is the number of all IPOs in KOSDAQ on the last month prior to an IPO. **KQindex** is the average of daily KOSDAQ index on the last month prior to an IPO. **KQchange** is the monthly proportion change between the average of daily KOSDAQ index on the second last month and the last month prior to an IPO. **Overhang** is the ratio of the shares sold at the IPO to the Pre-IPO shares retained. **OPchange** is the change from original offer price to final offer price. **VC** is a dummy variable which take value of 1 when the IPO firm is backed by venture capitalist. **VCbank** is a dummy variable that takes on the value 1 when a bank-affiliated venture capitalist is the lead venture capitalist for an IPO firm. **VCsecu** is a dummy variable that takes on the value 1 when a security company-affiliated venture capitalist is the lead venture capitalist for an IPO firm. **VCetc** is a dummy variable that takes on the value 1 when another venture capitalist other than a bank-affiliated or a security-company-affiliated venture capitalist is the lead venture capitalist for an IPO firm. **Bank** is a dummy variable that is equal to 1 when any bank participated in the ownership of an IPO firm. **Secu** is a dummy variable that is equal to 1 when any security company participated in the ownership of an IPO firm. **Und3** is a dummy variable that takes on the value 1 when the big three underwriters sponsor the IPO. **Aud3** is a dummy variable that takes on the value 1 when the big three auditing firm audited the IPO firm for the last fiscal year prior to IPO. T-statistics in the parentheses are heteroskedasticity consistent. Asterisks beside t-statistics \*, \*\*, \*\*\* denotes significance at 10%, 5%, 1% level, respectively.

	Whole Market		Hot Market		Cold Market	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
<i>Intercept</i>	8.30 (3.24) ***	8.05 (2.96) ***	-2.73 (-0.67)	-4.78 (-1.01)	16.87 (4.82) ***	17.15 (4.90) ***
<b>Lage</b>	-0.17 (-0.98)	-0.23 (-1.28)	-0.59 (-1.55)	-0.56 (-1.47)	0.03 (0.21)	0.02 (0.13)
<b>LMC</b>	-0.26 (-2.46) **	-0.25 (-2.16) **	-0.02 (-0.13)	0.02 (0.13)	-0.64 (-4.43) ***	-0.65 (-4.49) ***
<b>BMR</b>	-0.60 (-2.43) **	-0.58 (-2.37) **	0.65 (1.74) *	0.64 (1.65)	-0.45 (-1.96) *	-0.45 (-1.93) *
<b>ShCEO</b>	-1.09 (-2.04) **	-0.85 (-1.57)	-1.91 (-1.31)	-1.68 (-1.22)	-0.18 (-0.53)	-0.15 (-0.42)
<b>Loan</b>	0.40 (0.90)	0.37 (0.82)	0.44 (0.51)	0.59 (0.64)	-0.15 (-0.45)	-0.14 (-0.44)
<b>NIM</b>	0.20 (0.46)	0.33 (0.81)	0.98 (0.49)	1.48 (0.78)	0.23 (1.05)	0.26 (1.16)
<b>High-Tech</b>	0.09 (0.31)	0.08 (0.27)	0.97 (1.59)	0.98 (1.51)	-0.14 (-0.78)	-0.13 (-0.76)
<b>NumIPO</b>	-0.03 (-2.90) ***	-0.03 (-2.91) ***	-0.06 (-2.32) **	-0.06 (-2.38) **	-0.06 (-6.83) ***	-0.06 (-6.69) ***
<b>KQindex</b>	0.01 (3.45) ***	0.01 (3.33) ***	0.03 (2.43) **	0.03 (2.48) **	0.01 (3.51) ***	0.01 (3.59) ***
<b>KQchange</b>	4.74 (4.23) ***	4.97 (4.38) ***	9.52 (4.07) ***	10.51 (3.70) ***	2.58 (3.29) ***	2.44 (3.06) ***
<b>Overhang</b>	0.09 (0.74)	0.08 (0.64)	0.18 (0.93)	0.17 (0.81)	0.08 (1.33)	0.08 (1.31)
<b>OPchange</b>	0.70 (2.08) **	0.68 (2.02) **	3.08 (2.33) **	2.86 (1.98) *	0.48 (1.64)	0.45 (1.52)
<b>VC</b>	-0.09 (-0.37)		0.37 (0.49)		-0.12 (-0.81)	
<b>VCbank</b>		-0.08 (-0.17)		0.62 (0.53)		-0.51 (-2.69) ***
<b>VCsecu</b>		-0.89 (-2.44) **		-2.53 (-2.64) ***		0.00 (0.01)
<b>VCetc</b>		0.05 (0.18)		0.78 (0.99)		-0.02 (-0.10)
<b>Bank</b>		0.30 (0.80)		0.52 (0.54)		-0.17 (-0.73)
<b>Secu</b>		0.30 (0.68)		0.19 (0.14)		0.20 (1.04)
<b>Und3</b>	-0.17 (-0.58)	-0.14 (-0.44)	-0.24 (-0.32)	-0.15 (-0.20)	-0.22 (-1.28)	-0.19 (-1.12)
<b>Aud3</b>	-0.23 (-1.23)	-0.23 (-1.24)	-0.77 (-1.61)	-0.43 (-0.91)	0.10 (0.87)	0.10 (0.82)
<i>Adjusted R</i>	0.29	0.30	0.35	0.38	0.44	0.46
<i>Prob &gt; F</i>	0.00	0.00	0.00	0.00	0.00	0.00
<i>No. IPOs</i>	372	372	372	372	372	372

**Table IX Regression on Underpricing for VC-backed IPOs**

This table reports regression coefficients of underpricing of VC-backed IPOs. **Lage** is defined as the natural log of age of the IPO firm at the time of IPO. **LMC** is defined as the natural log of market capitalisation at the first day of IPO. **BMR** is defined as the book-to-market ratio at the first day of IPO. **ShCEO** is the sum of shareholdings of CEOs, their family and board of directors. **Loan** is the proportion of loan from the financial institutions at the end of last fiscal year to total asset at the same day. **NIM** is the net income margin over the last fiscal year prior to IPO. **Hi-Tech** is a dummy variable that equals to 1 when the IPO firm belongs to high-tech industry as defined in Loughran and Ritter (2002). **NumIPO** is the number of all IPOs in KOSDAQ on the last month prior to an IPO. **KQindex** is the average of daily KOSDAQ index on the last month prior to an IPO. **KQchange** is the monthly proportion change between the average of daily KOSDAQ index on the second last month and the last month prior to an IPO. **Overhang** is the ratio of the shares sold at the IPO to the Pre-IPO shares retained. **OPchange** is the change from original offer price to final offer price. **VC3** is a dummy variable which take value of 1 when the IPO firm is backed by the big three venture capitalists. **VCbank** is a dummy variable that takes on the value 1 when a bank-affiliated venture capitalist is the lead venture capitalist for an IPO firm. (VCbank has been dropped in the whole market regressions) **VCsecu** is a dummy variable that takes on the value 1 when a security company-affiliated venture capitalist is the lead venture capitalist for an IPO firm. (VCsecu has been dropped in hot market and cold market regressions). **VCetc** is a dummy variable that takes on the value 1 when another venture capitalist other than a bank-affiliated or a security-company-affiliated venture capitalist is the lead venture capitalist for an IPO firm. **Bank** is a dummy variable that is equal to 1 when any bank participated in the ownership of an IPO firm. **Secu** is a dummy variable that is equal to 1 when any security company participated in the ownership of an IPO firm. **Und3** is a dummy variable that takes on the value 1 when the big three underwriters sponsor the IPO. **Aud3** is a dummy variable that takes on the value 1 when the big three auditing firm audited the IPO firm for the last fiscal year prior to IPO. T-statistics in the parentheses are heteroskedasticity consistent. Asterisks beside t-statistics \*, \*\*, \*\*\* denotes significance at 10%, 5%, 1% level, respectively.

	Whole Market				Hot Market				Cold Market			
	Model 1		Model 2		Model 1		Model 2		Model 1		Model 2	
<i>Intercept</i>	10.43	(1.86) *	8.94	(1.59)	-5.60	(-0.64)	-16.65	(-1.69) *	23.07	(3.17) ***	24.10	(3.21) ***
<b>Lage</b>	-0.52	(-1.94) *	-0.60	(-2.16) **	-0.61	(-0.65)	-0.63	(-0.60)	-0.09	(-0.53)	-0.08	(-0.46)
<b>LMC</b>	-0.30	(-1.42)	-0.24	(-1.09)	-0.15	(-0.50)	0.08	(0.22)	-0.84	(-2.91) ***	-0.88	(-3.00) ***
<b>BMR</b>	-1.57	(-1.44)	-1.37	(-1.24)	-0.39	(-0.16)	1.11	(0.36)	-1.42	(-2.06) **	-1.65	(-2.35) **
<b>ShCEO</b>	-1.23	(-1.00)	-0.98	(-0.68)	-1.70	(-0.89)	-2.24	(-1.09)	-0.54	(-0.74)	-0.78	(-0.93)
<b>Loan</b>	0.35	(0.36)	0.24	(0.25)	-2.58	(-0.94)	-1.76	(-0.69)	-0.58	(-1.26)	-0.45	(-0.95)
<b>NIM</b>	0.90	(1.99) **	1.05	(2.33) **	3.04	(1.76) *	3.37	(1.85) *	0.33	(0.96)	0.34	(0.97)
<b>High-Tech</b>	-0.47	(-0.86)	-0.45	(-0.83)	1.82	(2.27) **	1.88	(2.14) **	-0.95	(-2.36) **	-0.91	(-2.22) **
<b>NumIPO</b>	-0.04	(-1.77) *	-0.04	(-1.77) *	-0.10	(-2.95) ***	-0.12	(-3.26) ***	-0.05	(-4.38) ***	-0.05	(-4.06) ***
<b>KQindex</b>	0.01	(3.21) ***	0.01	(3.26) ***	0.06	(2.62) **	0.07	(3.39) ***	0.01	(2.56) **	0.01	(2.85) ***
<b>KQchange</b>	5.02	(2.90) ***	5.49	(3.05) ***	12.89	(2.71) ***	15.29	(2.62) **	2.32	(2.02) **	2.10	(1.77) *
<b>Overhang</b>	-0.06	(-0.48)	-0.07	(-0.54)	-0.18	(-0.70)	-0.17	(-0.60)	0.02	(0.24)	0.05	(0.52)
<b>OPchange</b>	1.05	(2.08) **	1.03	(2.02) **	9.31	(4.01) ***	9.06	(3.80) ***	0.69	(1.72) *	0.61	(1.57)
<b>VC3</b>	0.10	(0.24)			0.52	(0.52)			-0.19	(-0.91)		
<b>VCbank</b>							3.53	(2.20) **			-0.54	(-1.34)
<b>VCsecu</b>			-0.91	(-1.62)								
<b>VCetc</b>			0.17	(0.36)			4.08	(2.37) **			0.04	(0.14)
<b>Bank</b>			0.29	(0.61)			-0.37	(-0.33)			-0.48	(-1.76) *
<b>Secu</b>			0.07	(0.12)			-0.02	(-0.02)			0.27	(0.72)
<b>Und3</b>	0.07	(0.14)	0.14	(0.26)	0.10	(0.12)	0.12	(0.13)	0.04	(0.15)	0.16	(0.55)
<b>Aud3</b>	-0.35	(-0.99)	-0.34	(-0.98)	-1.10	(-1.25)	-0.34	(-0.46)	-0.02	(-0.14)	-0.05	(-0.26)
<i>Adjusted R</i>	0.36		0.37		0.53		0.58		0.56		0.58	
<i>Prob &gt; F</i>	0.00		0.00		0.00		0.00		0.00		0.00	
<i>No. IPOs</i>	372		372		372		372		372		372	

