Regulatory Environment, Changing Incentives, and IPO Underpricing at the Kosdaq Market

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Abstract

I examine the importance of opportunity cost of underpricing to agents in explaining underpricing at the Kosdaq market. I present a simple model and identify parameters that can affect underwriter's or issuer's opportunity cost of underpricing. In the model same parameters can be related to both underwriter's and issuer's opportunity cost, which prevent easy empirical identification of the relations in a homogeneous environment. Making use of the regulatory change in August 2003 that took differential impacts on underwirtier's and issuer's opportunity cost of underpricing, I formulate four testable hypotheses and find the empirical results supportive of the hypotheses. The results suggest that to fully explain underpricing, it is crucial to take into account non-informational environment including regulations that systematically influence agents' incentives to control or generate underpricing.

Keywords: Initial Public Offering (IPO), Underpricing, Incentive, Underwriter, Market Making Regulation

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1. Introduction

The stylized fact that initial equity public offerings (IPOs) are underpriced has been known to financial economists for decades. To rationalize the puzzle which apparently contradicts market efficiency, the main body of research has advanced information asymmetry-based explanations. Rock (1986) theorizes that underpricing can be an equilibrium response to 'the winner's curse' problem in the presence of asymmetrical information among differently informed group of investors. Allen and Faulhaber (1989), Grinblatt and Hwang (1989) and Welch (1989) propose that underpricing occurs as a 'signaling' mechanism to resolve informational frictions between the issuing firm and investors. Benveniste and Spindt (1989) and Cornelli and Goldreich (2001) suggest that underpricing is a monetary reward to informed investors for true 'information revelation' through the book building process.

While not refuting the information asymmetry as a crucial block of the story, another line of literature notes the importance of non-informational factors affecting agents' incentives to control or accept underpricing to fully explain underpricing. Benveniste and Wilhelm (1990) theoretically demonstrate that magnitude of underpricing may vary between different regulatory environments. In their model, the specific regulation considered is difference in restriction imposed on underwriter's leeway in allocating newly issued equities. Habib and Ljungqvist (2001) and Ljungqvist and Wilhelm (2003) observe that the opportunity cost of underpricing to issuers should be responsible for substantial variation in underpricing. They argue any exogeneous component that can change issuers' opportunity cost of underpricing will bear on the degree of underpricing by changing issuers' incentive to control underpricing. Ownership structure and the relative size of new floating to existing stocks are such components considered in their investigation. To explain the Dot-com bubble in the US market, Loughran and Ritter (2002, 2003) stress an agency problem of underwriters and key shareholders against other shareholders of an issuing firm. They posit that while underpricing results in excessive dilution of all pre-issue shareholders, an underwriter with other hot IPOs to allocate can make side payments to the key shareholders who are decision makers of an issuing firm and, thereby, persuade them to accept underpricing.

Whether specificity of these works can be extended to other countries under different market environment is an open question. Nonetheless, a more general point that significant portion of underpricing may be due to factors other than informational frictions that still influence agents' incentives to control underpricing in the IPO process remains plausible. This paper is to identify explanatory factors for IPO underpricing in the Korean Kosdaq market for the period from early 2001 to mid 2007 in this spirit. Throughout the period, IPOs in Korea were operated by the book-building method while subject to heavy regulations. Most of all

underwriters' discretion over market making and allocation of newly issued equities was substantially restricted: market making by underwriters during first post-IPO months was mandatory; certain proportion of new issues had to be distributed to retail investors; allocation of shares to institutional investors participated in a book-building survey was based on a pre-determined formula rather than underwriters' discretion. The regulations underwent a significant change during the period. In August 2003 the mandatory market making regulation was replaced by the mandatory put-back option regulation, where the main difference was that the former covered all tradable new equities while the latter was for only the new equities held by retail investors. I formalize how the regulations affected incentives of agents to control or generate underpricing, develop empirical hypotheses, and test them.

In developing hypotheses regarding the impacts of regulatory features on underpricing through changing agents' incentives, the main focus of the paper is on the mandatory market making regulation and its revision in 2003. I model that the IPO price is co-determined by underwriters and issuers through bargaining. Each party decides her bargaining effort considering opportunity cost of underpricing. Facing a large cost, each party raises bargaining effort. So, the magnitude of IPO underpricing depends on conditions that determine either underwriters' or issuers' opportunity cost of underpricing. I argue that the mandatory market making obligation must have raised underwriters' opportunity cost of overpricing, since any unexpected post-IPO underperformance would have incurred unexpected financial cost to the underwriter of the IPO. Further I argue that the replacement of the mandatory market making obligation by the put-back option regulation in 2003 must have led to decrease in underwriters' opportunity cost of overpricing, as underwriters' responsibility for post-IPO underperformance was reduced by the regulatory change.

As outgrowth of the argument, I obtain two observations. First, any variable that can proxy the degree of underwriters' mispricing risk and financial costs due to mispricing is expected to have explanatory power for the degree of underpricing. In addition, the extent of explanatory power is predicted to have changed between before and after the regulatory change in 2003. Secondly, if there were variables that affected both underwriter's and issuer's opportunity cost of underpricing but in a different direction, their relationships with IPO returns are expected to have changed between before and after the regulatory change in 2003. Since underwriters' opportunity cost of underpricing decreased while issuers' opportunity cost did not change, the relative cost of underpricing became higher for issuers after 2003 than underwriters. As the relative cost of underpricing changed between issuers and underwriters, importance of underwriters' opportunity cost of underpricing is likely to have diminished relative to issuers' cost in explaining underpricing after the regulatory

change. It implies that if a variable is positively related with underwriter's opportunity cost of underpricing but negatively with issuer's, the numerical magnitude of the relationship between the variable and IPO returns is predicted to have decreased after the 2003 change.

In transforming the first observation into a testable hypothesis, I employ volatility of pre-IPO market as a proxy variable for measuring mispricing risk. The hypothesis, I obtain then, has that the volatility variable had been positively related with IPO return and that its magnitude became smaller after the regulatory change in 2003 in regression equations explaining IPO returns. I also argue that the allocation rate of IPO shares to retail investors is expected to be positively related with financial costs of mispricing to an underwriter after the regulatory change in 2003, since after the change retail investors is the only group the underwriter provided protection from overpricing risk.

For the second observation, I hypothesize that the ratio of newly issued shares and the ratio of tradable existing stocks to the total existing stocks are such variables. In the presence of the market making obligation, the size of newly issued shares measure the marginal financial cost of mispricing to an underwriter, since it represents the size of a set of shares for which the underwriter needs to provide price support. Therefore, it is negatively related with underwriter's opportunity cost of underpricing: the underwriter prefers more underpricing for a larger-sized IPO. A similar argument can be made for tradable shares, which are defined as existing stocks not locked-up at an IPO. A larger number of tradable stocks are likely to exert negative price pressure at post-IPO market and exposes an underwriter to a larger market making risk. Given the mandatory market making obligation, it implies that a larger size of tradable stocks is negatively related with underwriters' opportunity cost of underpricing.

Complication arises because both newly offered equities and tradable shares have an opposite relationship with issuer's opportunity cost of underpricing. The size of new issues at an IPO increases issuer's opportunity cost of underpricing because underpriced new shares lead to dilution of the value of existing shares. Also the size of tradable stocks may be considered positively related with an issuer's opportunity cost of underpricing on the two grounds: the size of tradable stocks represents the portion of existing shareholders who want to liquidate their holdings as soon as possible; it takes a while for an IPO price to adjust to the fundamental value of the issuing firm, which is plausible based on the empirical fact that IPO returns are positive even after a month. Combining the two assumptions, the shareholders with liquidity need have two choices: sell their holdings now with the opportunity cost of a higher price at a later date or wait to sell later with the opportunity cost of liquidity. Their opportunity cost of underpricing is determined as the smaller of the two. Regardless of the choice, the positive relationship between issuer's opportunity cost of

underpricing and the ratio of tradable stocks arise.

Along the line of reasoning, the relationship of both the ratio of new IPO shares and the ratio of tradable stocks with IPO returns are predicted to be positive allowing for underwriters' constraint, but negative for issuers' constraint. Since they can take either sign, empirical identification of their relationships with IPO return is not easy when one uses a sample generated from a homogeneous environment. The regulatory change in 2003, however, allows one to draw testable hypotheses. Interpreting that the regulatory change loosened underwriters' constraint, numerical magnitudes of the ratio of newly issued shares and tradable shares are expected to have decreased after the regulatory change in August 2003 in regression equations explaining IPO returns.

In testing the hypotheses, I take into account possible roles of the two currently prevailing information asymmetry based theories – the information revelation and the winner's curse theory. The most well-known empirical implication of the information revelation theory is the partial adjustment phenomenon that results from underwriters' favorable treatment of the institutional investors providing favorable market information (Hanley 1993, Ritter 1998). Since the book-building method in Korea was subject to restrictions on underwriters' discretion on allocation of issued equities, one may argue that the validity of the information revelation theory for the Korean market is questionable. On the other hand, the case could be made that despite the restrictions, institutional investors were favorably treated by underwriters as a group albeit not individually: if the same group of institutional investors repeatedly participates in book-building and initial offerings, underwriters may need to give them special favor. To test validity between the two conjectures, I include the partial adjustment variable in regression equations.

To examine the applicability of the winner's curse model for the Korean data, I employ the two groups of standard variables: 'size' variables representing ex-ante uncertainty (Ritter 1991) and 'certification' variables such as underwriter reputation (Booth and Smith 1986, Carter and Manaster 1990) and venture capitalists' backing (Megginson and Weiss 1991).

Empirical findings of the paper support the hypotheses. All the four variables enter the regression equation with expected signs and their magnitudes change after the regulatory change in 2003 in consistent with the predictions of the hypotheses. I also find that underpricing increase in the partial adjustment variable especially after 2003. However, empirical results for the relations of ex-ante uncertainty variables and certification variables with underpricing are mixed.

While the prior intent of the paper is to present an evidence for the empirical significance of non-informational factors for underpricing by affecting agents' opportunity cost of underpricing, it can claim three additional contributions to the existing literature. First, it

provides a robustness test for the information asymmetry-based explanations of IPO underpricing using the Korean data during the period when various regulations were imposed. It adds to the growing literature that examines general applicability of standard explanatory variables along the line of Rock (1986) and Benveniste and Spindt (1989) for economies under diverse regulatory environments[1]. Secondly, by doing so, this paper seeks to identify a comprehensive set of explanatory variables for the underpricing in the Korean stock market during the period of analysis. Third, some empirical results of the paper have interesting implications for behavioral explanations of underpricing such as Loughran and Ritter's (2003) changing valuation explanation and Hong, Scheinkman and Xiong's (2005) bubble explanation. These behavioral explanations of underpricing are consistent with the negative relationship between the tradable shares and IPO returns. But, they cannot explain why the regulatory change results in the change in the relationship of the variable with underpricing. This paper suggests that at least for the given sample period, agents' rational decisions considering opportunity cost of underpricing derived main dynamics at the Kosdaq IPO market.

Among the empirical literature produced by Korean researchers, this paper can be related to Shin, Chang, and Chung (2004), Choi (2005), Kim and Lee (2006), and Lee and Joh (2007). Both Shin, Chang, and Chung (2004) and Kim and Lee (2006) examine the empirical relationship of the market making regulation with underpricing phenomena by comparing IPOs before and after the introduction of the regulation. Lee and Joh (2007) investigate if the put-back option regulation had explanatory power for underpricing from 2003 to 2007. A key difference between this paper and these existing works lies in the scope. Relative to this paper, they do not provide a framework to understand underpricing in the Kosdaq market, cover shorter periods; and consider a limited set of control variables in the regression.

The rest of the paper is structured as follows. In Section 2, I provide an overview of institutional characteristics of the Korean IPO market, present a theoretical discussion and draw empirical hypotheses. Section 3 explains data and specifies regression equations. Section 4 contains regression results and considers alternative explanations for empirical results. Section 5 concludes the paper.

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[1] See Ljungqvist (2006) for a recent survey.

2. Institutional Background, Theoretical Discussion and Testable Hypotheses

2.1. Institutional Background

Table 1 summarizes important changes in the regulatory environment for IPOs at the Kosdaq market from 2000 to 2007. Though the book building method was introduced by the Korea regulatory body as an official IPO method in 1999, the IPO process in Korea was quite distinct from that of other countries in that underwriter's discretion was severely limited. Underwriter's latitude on IPO price decision was limited to selecting one within the interval around the weighted average of indicated prices by book building participants. In computing the weighted average, weights were assigned to each participant according to a predetermined rule, excluding underwriter's discretion. The restriction on IPO price determination was lifted in July 2002.

Underwriter's discretion over allocation of newly issued equities was even more substantially restricted. A floor regulation was imposed on both allocation to retail and institutional investors. At least 15 and 45 percent of the newly offer shares were required to be allocated to retail and institutional investors respectively. The floor for retail investors was raised to 20 percent in March 2004, while that for institutional investors was lowered to 30 percent in September 2004 and finally abolished in June 2007. Especially, though never officially stated, de facto restriction dictated allocation to institutional investors to be fixed at 65 percent of the IPO shares, leaving the rest 35 percent to retail investment and the directed participation program[2]. The de facto regulation was maintained until March 2004. Notably, regardless of the change of the floor restriction from 45 percent to 30, throughout the period, allocation among institutional investors was determined purely by indication made during the book building process; no discretionary allocation by underwriters was allowed.

Most notable was the market making regulation. Underwriters were obliged to provide price support to all IPO shares at least for a month following the listing. The market making obligation was relaxed and replaced by the "put back option" in August 2003, which was granted only to retail investors. By the put-back option, retail investors were given an option to resell their holdings of new shares to an underwriter at 90 percent of the IPO price for a month after the listing.

[2] I confirmed this de facto restriction through interviews with market participants and inspecting actual allocation among investor groups documented in prospectuses. Until April 2004, allocation rates to institutional investors were found to be 65 percent without exception in all IPO cases.

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Table 1

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In the following analyses of the paper, I use the sample of IPOs from April 2001 to May 2007. The beginning point of the sample corresponds to the date when the revision of the IPO pricing regulation in December 2000 took effective. Since almost every year witnessed at least one regulatory change throughout the sample period, it is impossible to identify a period longer than two years without a regulatory change, which raises a challenge to securing sufficient data for robust regression analyses. Given the difficulty, I discretionarily choose to ignore minute regulatory changes which can be plausibly assumed not to have produced significant impacts on agents' behavior. Specifically, I focus only on the regulatory change in August 2003 and disregard other regulatory revisions. Thus, I divide the period starting from 2001 to June 2007 into two sub-periods, one until August 2003 and the other afterward. In other words, I suppose that the data generating process of IPO returns from April 2001 to May 2007 underwent a structural change triggered by the regulatory change in August 2003.

Among ignored regulatory changes, lifting of the IPO pricing regulation in July 2002 needs justifying discussion to be disregarded since it could take material effects on the IPO pricing mechanism by apparently extending underwriters' discretion. If the deregulation resulted in a significant change in underwriters' IPO pricing behavior, the assumption on the structural change would be problematic. However, there are evidences that market practices indeed did not alter despite the deregulation. Financial Supervisory Services (FSS), the Korean financial regulator, complained in a press release dated May 2007 that despite the deregulation in 2002, the previous IPO pricing mechanism continued in practice, and declared it would guide underwriters to abolish the practice[3]. In the same press release, FSS diagnosed that existence of the market making regulation and the put back option was responsible for the passiveness of underwriters. It is interesting to observe that FSS itself identified the market making regulation or the put back option as a critical regulation affecting underwriter's behavior. In fact, for each IPO case between July 2002 and May 2007, design of the book building process, its results including how the final IPO price is determined are explained in detail in the prospectus. I inspected prospectuses for all IPOs occurred between July 2002 and May 2007, and confirmed that underwriters applied the same IPO pricing mechanism as before July 2002 deregulation: weighted average prices

[3] FSS Press Release, May 16 2007, "Measures to Improve Practices of Underwriting Securities".

were computed based on the results from the book building phase and the final IPO price was determined within ± 30 percent of the weighted average price; no impact of the deregulation in July 2002 was found. I also confirmed that apparently the practice disappeared after July 2007, which suggests that the guide of FSS in June 2007 took effect.

2.2 Theoretical Discussion

The premise of the paper is that the regulatory change in 2003 affected the mechanism driving underpricing by changing agents' opportunity costs of underpricing. To make the point clear and facilitate derivation of testable hypotheses, I present a simple model depicting underwriter's and issuer's decision problems at the IPO. In the model, the IPO price is co-determined by the underwriter and the issuer through a bargaining. Reflecting the fact that underwriting fee is fixed relative to IPO prices as documented by Chen and Ritter (2000) for the US and Ahn, Kim and Son (2007) for Korea, I assume that the underwriter and the issuer bargain over only the IPO price.

Each party considers her opportunity cost or net benefits for a schedule of IPO prices and decides her optimal level of effort. By incurring greater bargaining effort, each party can induce a final IPO price more favorable to her. Specifically, the final IPO price (P_I) is a function of underwriter's bargaining effort (e_u) and issuer's (e_i) so that $P_I = P_I(e_u, e_i)$ where $\frac{\partial P_I}{\partial e_u}<0$, $\frac{\partial^2 P_I}{\partial e_u^2}>0$ and $\frac{\partial P_I}{\partial e_i}>0$, $\frac{\partial^2 P_I}{\partial e_i^2}<0$: the underwriter bargains to lower the IPO price while the issuer to raise it[4]. If neither party exerts any effort for bargaining, the IPO price will be set at the fundamental value of an issuing firm per share before the IPO, which is denoted by P_0. I do not introduce information asymmetry among investors at an IPO, for example, as in Rock (1986). Hence, P_0 is the highest IPO price that the underwriter and the issuer can demand to investors for newly issued equities.

For the sake of simplicity and also to focus on the plain relationship between agents' opportunity cost concerns and underpricing, I assume that each party's decision on optimal bargaining effort is made independently without considering the other party's effort level, which excludes the possibility of coordination between the two parties: formally, I assume $\frac{\partial^2 P_I}{\partial e_u \, \partial e_i}=0$. Though beneficial to each party, the change in the IPO price requires each party to incur higher effort cost, which may offset the benefit of changing IPO price. How each party chooses the level of bargaining effort naturally depends on her opportunity cost of

[4] The assumption does not mean that the underwriter always prefer lower prices. It only implies that the underwriter exerts bargaining effort only to lower the IPO price. When the underwriter prefers a higher IPO price, she can simply let the issuer set the IPO price.

underpricing or overpricing and costs of bargaining effort.

The following describes underwriter's net benefit in handling an IPO in the presence of the market making regulation.

$$\pi(P_I; f, \beta) = f \cdot P_I(e_u) \cdot \mathrm{N_n} - \beta \cdot \mathrm{N_n} \int_0^{\mathrm{P_I}} (P_I(e_u) - \mathrm{P}) \mathrm{dF(P)} - \mathrm{C}(e_u) \cdot \mathrm{N_0} \qquad (1.1)$$

The underwriter earns underwriting fee determined as a product of fee rate *f,* the IPO price and the number of new shares $\mathrm{N_n}$. Her total cost of underwriting consists of expected financial cost from market making and bargaining effort. The expected cost of market making depends on β, the portion of new shares the underwriter is responsible for and $\mathrm{F(P)}$, the probability distribution function of post-IPO share price of an issuing firm for the market making period. Though the Korean regulation required the underwriter to provide price support at 80 or 90 percent of the IPO price, for simplicity I assume that underwriter's market making is triggered at the IPO price. Underwriter's bargaining effort incurs cost by $\mathrm{C}(e_u) \cdot \mathrm{N_0}$ where $\mathrm{C}' > 0$ and $\mathrm{C}'' > 0$: cost rises in effort at an increasing rate. The cost from bargaining effort increases in not only the amount of effort but also the number of existing shares prior to the IPO, denoted by $\mathrm{N_0}$. This is so because to prepare for bargaining the underwriter needs to investigate the fundamental value of an issuing firm, which requires larger cost proportional to the size of the firm.

Normalizing $\mathrm{N_n}$ by $\mathrm{N_0}$ and denoting it by $\mathrm{n_n}$, the maximizing condition for the underwriter is given by

$$f \cdot \mathrm{n_n} \cdot \frac{\partial P_I}{\partial e_u} - \beta \cdot \mathrm{n_n} \cdot \frac{\partial P_I}{\partial e_u} \cdot \mathrm{F(P_I)} - \beta \cdot \mathrm{n_n} \cdot \frac{\partial P_I}{\partial e_u} \cdot \mathrm{P_I} - \mathrm{C}'(e_u) = 0 \qquad (1.2)$$

Without the market making obligation, the underwriter would not exert any bargaining effort and takes $\mathrm{P_0}$ as the IPO price[5]. In the presence of the market making obligation, I assume that the left hand side of equation (2) takes a positive value at $\mathrm{P_I} = \mathrm{P_0}$ with no bargaining efforts from either side. The market making regulation raises (decrease) underwriter's opportunity cost of overpricing (underpricing) substantially enough to lower her optimal IPO price. By the assumption, the underwriter's preferred IPO price is below the fundamental price $\mathrm{P_0}$, and thereby underpricing arises. In other words, the regulation is a binding constraint on underwriter's behavior.

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[5] Without the market making obligation, $\mathrm{P_0}$ is a corner solution maximizing underwriter's net benefit.

After the IPO, the fundamental price of a share of the issuing firm changes to $P_F = (P_0 \cdot N_0 + P_I \cdot N_n)/(N_0 + N_n)$. As new shares are sold at P_I, wealth loss occurs to the existing shareholders, which corresponds to the net cost of underpricing for the existing shareholders. I assume there are two types of existing shareholders, long-term and liquidity investors. The latter prefers liquidation of their holdings as soon as possible after the listing. Reflecting the fact that IPO returns are positive even after a month from the listing, I assume that it takes time for the market price of a share of an issuing firm to adjust to its fundamental value. It implies that the opportunity cost of underpricing is higher for the liquidity investors than the long-term holders. The following equation describes the total wealth loss (*wl*) of existing shareholders, where t denotes the ratio of the liquidity investors to the total existing shareholders.

$$wl = (1 - t) \cdot (P_0 - P_F) \cdot N_0 + t \cdot (P_0 - P_I) \cdot N_0 + C(e_i) \cdot N_0 \qquad (1.3)$$

The second term in the equation represents the wealth loss to the liquidity investors. To simplify, the expression is based on the strong assumption that the liquidity investors sell their shares at the IPO price. The analysis will not be changed as long as the relationship holds that the higher IPO price is, the higher the market price during the price adjustment period after the listing is[6]. The issuing firm's bargaining effort incurs cost by $C(e_i) \cdot N_0$ where $C' > 0$ and $C'' > 0$: cost rises in effort and at an increasing rate as in the underwriter case. Again the cost of bargaining effort increases in the number of existing shares. This is so because to prepare for bargaining the issuing firm needs to elicit coordination among investors, which requires larger cost for larger number of investors or shares.
The loss minimizing condition for the issuing firm is given by[7]

$$(1 - t) \cdot \frac{n_n}{1+n_n} \cdot \frac{\partial P_I}{\partial e_i} + t \cdot \frac{\partial P_I}{\partial e_i} - C'(e_i) = 0 \qquad (1.4)$$

Equation (1.4) illustrates how the issuer responds to the change in opportunity cost of underpricing, which are captured by t and n_n. Larger t means that a larger group of existing shareholders stand to lose from underpricing, who will attempt to raise the IPO price by putting more efforts into bargaining. Also larger n_n induces more bargaining effort from the

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[6] For example, suppose that it takes k trading days for a share to adjust to its fundamental value and the adjustment rate is constant. Then, P_S, a market price during the adjustment period will be $P_S = \left(\frac{P_F}{P_I} - 1\right) \cdot \frac{S}{k} \cdot P_I + P_I$. And for any given two firms, the order between the market prices of the two firms during the adjustment period after the listing will be dictated by the order of the IPO prices.

[7] Note that the given condition is the maximizing condition for (-1)*equation (1.3).

issuing firm, as the same level of underpricing incurs larger dilution to the value of existing stocks.

Equation (1.2) and (1.4) characterize how the IPO price is determined as a bargaining outcome. At the initial stage the underwriter chooses her effort level and decides her preferred IPO price by equation (1.2). Receiving the offer of an IPO price from the underwriter, the issuer determines her effort level by equation (1.4) and chooses her own preferred IPO price, which is higher than the underwriter's offer. Given the counter offer from the issuer, the underwriter increases her effort level and finalizes the IPO price by equation (1.2). I assume that interior solutions satisfying equation (1.2) and (1.4) exist, or the second order conditions of maximization hold for both agents.

To enrich empirical implications of the model, I specify parameters dictating the shape of $F(P_I)$. One easily conceivable parameter would be standard deviation or expected volatility of post-IPO share price of an issuing firm. I assume that $F(P_I)$ increases in its standard deviation σ_P. For example, consider a normal distribution. Expected mean price is P_F. Since P_I is lower than the expectation price, a higher standard deviation results in larger probability for P_I. I also assume that t, the ratio of liquidity investors increases the magnitude of $F(P_I)$. The rationale is that when a larger number of existing stocks are held by liquidity investors, there will be downward price pressure right after the IPO induced by liquidity selling by liquidity investors.

Altogether the model presents four exogenous variables β, σ_P, t and n_n, which determine the level of efforts by the two agents and the equilibrium IPO price. The relations of β, σ_P with IPO prices and so underpricing are straightforward. Larger β or σ_P increases underwriter's effort to reduce an IPO price according to the equilibrium condition (1.2). Since issuer's effort does not respond to changes in β or σ_P, larger underwriters' effort leads to a lower final IPO price and larger underpricing. Proposition 1 state the relationships[8].

Proposition 1: *Equilibrium level of underwriter's effort* e_u^* *increases in* (β, σ_P)*. Hence, the equilibrium level of the IPO price* P_I^* *decreases in* (β, σ_P)*.*

In contrast, the nature of the relationships of t and n_n with the degree of underpricing is more complicated. Not only issuer's effort to raise the IPO price but also underwriter's effort to lower the IPO price increases in t and n_n. A standard case of the structural system problem arises, rendering empirical estimation of relationships between the two parameters and IPO price difficult. In fact, due to the coexistence of the two confounding effects, the

[8] I do not provide proof for Proposition 1 as it is obvious.

theoretical relationship of t and n_n with underpricing is indeterminate, which is formally spelled out by Proposition 2.

Proposition 2: *Equilibrium level of underwriter's effort* e_u^* *as well as equilibrium level of issuer's effort* e_i^* *increases in* (t, n_n)*. As a result, signs of the relationships between* (t, n_n) *and the level of the equilibrium IPO price* P_I^* *are indeterminate: formally, the sign of* $\frac{dP_I^*}{dt}$ *and* $\frac{dP_I^*}{dn_n}$ *is indeterminate.*

Proof: See the Appendix.

Proposition 2 implies that if one regresses IPO returns on t and n_n, the estimates are mixture of the two confounding effects and so impossible to predict. Predictable relationships between (t, n_n) and underpricing, however, can be captured in view of the change in β. The change in β takes differential impact between underwriter's and issuer's opportunity cost of underpricing. For example, for any given level of (t, n_n), a larger β implies smaller cost of underpricing for the underwriter, induces larger underwriter's effort, and results in a lower IPO price. In contrast, issuer's level of effort is insensitive to β. As a result, though the relationships between (t, n_n) and underpricing themselves are indeterminate, the direction of changes in the relationships induced by β is predictable: the magnitude of the relationships between (t, n_n) and underpricing increases in β. Moreover, the same prediction is valid also for σ_P: the magnitude of the relationship between σ_P and underpricing increases in β. Proposition 3 summarizes the observations.

Proposition 3: *Magnitudes of the positive responsiveness of the equilibrium IPO price* P_I^* *to* (t, n_n, σ_P) *decreases in* β*: formally,* $\frac{dP_I^*}{dt}$, $\frac{dP_I^*}{dn_n}$, *and* $\frac{dP_I^*}{d\sigma_P}$ *decreases in* β*.*

Proof: See the Appendix.

2.3. Testable Hypotheses

Making use of the three Propositions and the regulatory change in August 2003, testable hypotheses can be formulated. First of all, note that the replacement of the market making obligation by the put-back option can be interpreted by decrease in β, since the regulatory change reduced underwriter's extent of obligation and the risk of overpricing. Combining Proposition 1 and Proposition 3 yields a testable hypothesis in relation to the volatility of post IPO price and underpricing, consisting of two predictions: the first prediction is due to

Proposition 1 and the second due to Proposition 3.

HP 1: (1) *Before the regulatory change in August 2003, expected volatility of post IPO share price* σ_P *is positively related to underpricing; (2) After the regulatory change, the magnitude of the relationship decreases.*

Proposition 3 produces two additional testable hypotheses for the relationships between (t, n_n) and underpricing in the context of the regulatory change in August 2003, which I state as HP 2 and HP3.

HP 2: *After the regulatory change in August 2003, the magnitude of the relationship between the ratio of liquidity investors* t and underpricing becomes smaller relative to the before the change.

HP 3: *After the regulatory change in August 2003, the magnitude of the relationship between the ratio of newly issued shares* n_n and underpricing becomes smaller relative to the before the change.

The final hypothesis stems from the fact that the put-back option was only provided to retail investors. Under the market making regulation, price support by the underwriter was extended to both institutional and retail investors. The regulatory change in 2003 changed this by confining the protection from price risk to the group of retail investors. So, after the regulatory change in 2003, a higher retail distribution rate began implying higher expected cost for the underwriter from overpricing. This, in turn, was likely to lead to increase in underwriter's effort to lower the IPO price. My model does not entail particular implications on the relationship between the retail distribution ratio and underpricing before the regulatory change in 2003. However, there are some reasons to conjecture that before the regulatory change, retail allocations rates are positively related to underpricing[9]. Assuming this, my model predicts that larger degree of underpricing would have been associated with higher retail distribution rates after 2003 in comparison to before 2003[10], which yields the final hypothesis.

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[9] Previous works (Habib and Ljungqvist 2001, Ljungqvist and Wilhelm 2003) suggest reasons to conjecture that retail allocation rates are negatively related with underpricing before Oct 2003. I discuss this in more detail in Section 4.2.

[10] To see this formally, it is sufficient to note that after the regulatory change, higher retail allocation rates can be interpreted as higher β.

HP 4: *Assuming that retail allocation rates were positively related with underpricing before the regulatory change in August 203, the magnitude of the relationship decreased after the regulatory change.*

3. Data and Regression Methodology

3.1. Data Sources

Empirical work of the paper uses a sample of IPOs floated on Kosdaq between April 2001 and May 2007. All the variables used in the analysis except stock prices and firm characteristics are collected from either Prospectus or Reports of IPO, which are available through the DART system operated by the Financial Supervisory Services (FSS). Stock prices information including Kosdaq Market Index and Kosdaq Industry indices is from the KSRI data base. Firm characteristics information such as firm age, sales amount and KSIC code is from the KIS value system.

During the sample period 531 firms were listed. I lost 21 companies for which some of regression variables were unavailable, and excluded one outlier firm that increased their capital at the IPO more than four times[11]. The final sample consists of 509 firms. The regulatory change in August 2003 began taking effect on market practices from October 2003. Of the total 509 firms, 304 firms were listed before October 2003 and the remaining 205 firms afterward.

3.2. Variable Definitions and Regression Equation Specifications

The dependent variable in the regression equation is the IPO return. Due to the 15 percent band regulation on daily price fluctuation, the first day return estimated from the IPO price to the first-day closing price may not be an accurate measure of the underpricing return in Korean markets. To alleviate the problem, I use short run trading day returns as well as the first day return, denoted by F(t) and computed by $\mathrm{F(t)} = \frac{\mathrm{P(t)}}{\mathrm{P(0)}} - 1$ where $\mathrm{P(t)}$ = the t-th trading day closing price from the listing, $\mathrm{P(0)}$ = IPO price. In addition, I also use cumulative abnormal return (CAR) as a measure for the IPO return, which is defined as $\mathrm{CAR(t)} = \sum_{s=1}^{s=t}[\left(\frac{\mathrm{P(s)}}{\mathrm{P(s-1)}}\right) - \left(\frac{\mathrm{M(s)}}{\mathrm{M(s-1)}}\right)]$ where $\mathrm{P(s)}$ = the s-th trading day closing price from the listing, $\mathrm{P(0)}$ = IPO price, $\mathrm{M(s)}$ = the s-th trading day market index (Kosdaq index) and $\mathrm{M(0)}$ = the market index one trading day before the listing. For both F(t) and CAR(t), I report regression

[11] Other than the excluded firm, the ratio of new issues to existing stocks is less than one for the rest of IPO firms.

results for the trading day of 1, 5, 15, and 25.

The specification of the regressors of interest, mentioned in the hypotheses, is determined closely following the theoretical model: the new issue rate $n_n = N_n/N_0$ (New Issue); the expected volatility of the post IPO price as the standard deviation of the daily Kosdaq industry index sample consisting of 140 days to 20 days prior to listing date (IND_STD); the tradable share rate t as the ratio of not locked-up stocks to the total existing stocks (Tradable); the retail distribution rate as the ratio of newly offered equities to retail investors out of the total new floating (RetailDist). Throughout the sample period, there existed a floor restriction on the retail distribution rate as documented in Table 1. The floor had been fifteen percent until March 2004, and twenty since then. To address the data change due to the regulatory revision, I normalize retail distribution rates by dividing them by their corresponding floor rates.

In addition to the four regressors, to control for possible impacts of ex-ante uncertainty on IPO returns as in Rock (1986), I include two firm characteristics variables experimented in previous empirical works (Ritter 1984, 1991): firm age at floatation (Age) and offer size (OfferSize). Age is the number of months between the floatation date and the founding date of an issuing firm. Offer size is computed by multiplying the IPO price and the number of newly offered shares. Considering Habib and Ljungqvist (1998)'s criticism that the offer size can be negatively related with the IPO return even when holding risk constant, I also use sales (SALES) amount in the year prior to the IPO instead of the offer size. For Age, Offer Size and SALES, I use log transformed values in regression.

To control for possible 'certification' effects by intermediaries noted by Megginson and Weiss (1991), Booth and Smith (1986), and Carter and Manaster (1990), I include the venture capital-backing dummy (VC dummy) and prestigious underwriter dummy (UNDERWRITER dummy). The VC dummy indicates if a firm was financially backed by venture capitalists before the listing. 'VC dummy =1' indicates that at least 1% of the firm's shares prior to the IPO was held by a venture capitalist. The prestigious UNDERWRITER dummy was constructed by identifying underwriters with above 5 % IPO market share in terms of the number of IPOs during the sample period. Among the total 29 underwriters that had been active during the sample period, 6 were identified. Altogether the six underwriters handled 278 IPOs, which explains about 55 percent of the total IPOs in the sample.

Also to control for the partial-adjustment phenomena documented by Hanley (1993) and generally considered consistent with Benveniste and Spindt (1989)'s information revelation theory, I include a variable UPDATE, which equals the percentage adjustment between the midpoint of the indicative price range suggested by an underwriter for a book building and the final offer price. To allow for possible asymmetry in price revision (Lowry and Schwert

2002), I estimate the effect of positive revisions (Positive UPDATE) on underpricing separately.

To control for the possibility of “hot” market or cyclicality in the IPO market (Ritter 1984, Ibbotson, Sindelar and Ritter 1994) I include year dummies, and to address the existence of positive serial correlation in the IPO return series (Loughran and Ritter 2002, Lowry and Schwert 2002), I include a most recent lagged IPO return variable in regression equations. Finally, I include an industry dummy representing KSIC digit code 20 to control the industry effect (see Table 2 below and related discussion).

3.3. Descriptive Statistics

Table 2 reports yearly and industry distribution of IPOs for the sample period. The number of IPOs had been higher in 2001 and 2002 hovering around 140 each year, then more than halved to 50 or 60. IPO firms are concentrated in the KSIC two digit code 20 industry, high-tech manufacturing sector. Figure 1 reports yearly mean CARs for the sample firms. IPO returns measured by yearly mean CARs for trading days ranging from 1 to 30 are found to be positive. Yearly mean CARs are statistically significantly different from zero except some CARs of 2004, confirming the existence of “underpricing”.

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Table 2

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Figure 1: Yearly Distribution of IPO Returns: Mean CARs

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Table 3 summarizes descriptive statistics of variables used in regression analyses. The median issuer is a young company between 7 and 8 years old, with the sales amount of about 18.6 and 27.0 billion Korean Won respectively for each subsample. The median amount raised at the IPO is 6.2 billion Korean Won in the earlier sample and 8.2 billion Korean Won in the later. In each variable, averages exceed medians, indicating positive skewness. About 60 to 70 percent of IPO firms are backed by VCs respectively for each subsample, and about 50 to 60 percent are handled by prestigious underwriters.

While the sales amount of a median firm grew by almost 50 percent from the former period to the latter, IPO proceeds across the two periods registered merely 30 percent increase. This is reflected in the smaller New Issue rate of the latter period. In contrast, the median ratio of tradable shares to existing share increased from 29 percent to 40 percent after the

regulatory change. Retail distribution is less active in the latter period, indicated by the decrease in the mean. Both for the median and the mean firm, adjustment from the indicative prices is minimal, which is consistent with the US pattern. However, small standard deviation (0.14) of the UPDATE variable contrasts with the US pattern, which, according to Habib and Ljungqvist (2001), is reported to be 20.08 for the sample of IPOs on NASDAQ from 1991 to 1995. It suggests that price adjustment reflecting learning during the book building phase occurred, if any, in a smaller scale at the Kosdaq market.

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TABLE 3: Descriptive Statistics

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4. Results

4.1. Main Regression Results

For each subsample, I run two sets of regressions, one using CAR(1), CAR(5), CAR(15) and CAR(25) as independent variables, and the other F(1), F(5), F(15) and F(25) instead. Across eight regressions altogether, explanatory variables are maintained fixed. For a variable representing the size, in addition to the sales amount the offer size is also experimented. I only report estimates for the regressions using the sales amount as the results using the offer size variable are almost identical[12]. Also I do not report estimates of the coefficients to the industry dummy, year dummies and lagged IPO return to save the space.

As results are qualitatively similar, I discuss regression results focusing on F(1), F(5), F(15) and F(25) which are presented in Panel A and B of Table 4. In each subsample, the coefficient estimates are stable across all four regressions. The explanatory power of the regressions is higher in the later subsample with adjustedR^2 being 21-33 percent, compared to 12-21 percent in the earlier. The coefficients of interest display the changes in magnitudes as predicted by the hypotheses. Consistent with HP 1, the ex-ante price volatility of an issuing stock measured by IND STD had been positively related to underpricing before Oct 2003 significant at 5 percent significance level, but became insignificant afterward. Estimates for the ratio of tradable shares are also in line with HP 2. None of the estimates in Panel A are significant, indicating that the explanatory power of TRADABLE for IPO returns is not different from zero before Oct 2003. The change after Oct 2003 is dramatic: TRADABLE is estimated to be inversely related to underpricing and the statistical significance is clear.

[12] The regression results can be obtained from the author upon request.

Results for NEW ISSUE are supportive HP3 as well. In the earlier sample, estimates of the coefficients for NEW ISSUE are negative but generally insignificant. In the later sample, as predicted by HP3 estimates are larger in absolute terms and significantly negative although the statistical significance is weaker for longer-term returns. Finally, consistent with HP 4, the coefficient to the retail distribution rate is found to have been inversely related to underpricing before Oct 2003, but estimated statistically not different from zero after Oct 2003.

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TABLE 4: Regression Results

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Ex-ante uncertainty variables represented by the age of an issuing firm and the sales amount show weak results. The relation of the age to underpricng is estimated insignificant in both subsamples across different specification regression models. The sales amount is inversely related to underpricing but only significant for the first day return.

Both venture capital backing dummy and prestigious underwriter dummy are uniformly found to have no explanatory power for underpricing, questioning the certification role of the intermediaries at the IPO. Nonetheless, it is interesting to observe that estimates of the coefficients to the VC dummy and UNDERWRTIER dummy change the sign over the time. Before Oct 2003, both variables are estimated to have positive relationships with IPO returns albeit with marginal statistical significance. Estimates change sign to negative in the later sample and the statistical significance increases slightly. Apparently, prestigious underwriters and venture capitalists acted to increase underpricing before the regulatory change in Oct 2003 contradicting the certification hypothesis (Carter and Manaster, 1990; Meggins and Weiss 1991), and to decrease since then. One conjecture in view of the hypotheses of this paper would be that when overpricing risk was high, prestigious underwriters bargained more successfully to protect their interests, resulting in more underpricing; later as the opportunity cost of overpricing decreases due to the regulatory change, their behavior became more aligned with issuer's interests. Verifying the conjecture is left as future research agenda.

It is also notable that the estimated relationship of the UPDATE with underpricing displays a clear change over the time. In the earlier sample, revisions of IPO prices are positively related with underpricing, but no asymmetry exists between negative and positive revisions inconsistent with the empirical pattern documented by Lowry and Schwert (2002) for the US market. In contrast, in the later sample after the regulatory change in Oct 2003, only positive

revisions are related with underpricing and the magnitude is much larger, now similar to the findings of the US literature. Whether this indicates that the book building phase began producing information which was not available before the filing and portion of underpricing was started to be used in compensating institutional investors providing the information need further investigation.

4.2. Robustness Check

(1) Estimation of the Pooled Sample

In main regression analyses, I regressed separately for each sample. I formed hypotheses based on the assumption that data generating processes underwent a structural change as a result of the institutional change in August 2003, and put up the hypotheses for empirical testing. Hence, it is natural to suppose that statistical characteristics including variances of disturbance terms also differ across the two samples. Given that variances of disturbance terms differ, pooling the observations and estimating the regression equations using the whole sample will result in a biased estimate of disturbance variances, which in turn will lead to incorrect inference on parameter estimates (See, e.g. Green 1993, Ch.8). Advantage of pooling the observations across two periods is that efficiency if there is no change in statistical characteristics of disturbance terms throughout the sample. When applying the F-test for the hypothesis that disturbance variances are equal across the two samples, the obtained p-value is 0.2: maybe difficult to reject if without the prior information but low enough to reject with the prior assumption of the hypotheses. Anyways, for a reference I present the results of the pooling regression in Table 5. As expected significance becomes weak for some variables such as NEW ISSUE and RETAIL. Still, it can be confirmed that overall results are consistent with the predictions of hypotheses.

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Table 5

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(2) Valuation and Uncertainty

In explaining the substantial increase in IPO returns during the “Dot-com bubble” in the US, the empirical pattern of the positive relation of the “overhang” with IPO returns seized researchers’ attention (Bradley and Jordan 2002, Loughran and Ritter 2003), as the positive relation gained statistical significance during the Dot-com bubble, while had been weaker

before the bubble. In the literature, overhang is defined as a ratio of retained shares to the newly issued shares, which is, by definition, inversely related to the “New Issue rate”. Hence, the negative relation between the New issue rate and underpricing may be considered a mirror image of the positive relation between the overhang and underpricing.

Loughran and Ritter (2003) propose that the relationship between the two variables should be understood in light of the combination of information asymmetry and changing market sentiment. They assume that market sentiment changes over time and, thus, there is a period when the market willingly places higher values on a certain category of firms. They further assume that high valuations are correlated with greater information asymmetry regarding valuation, though they do not provide a justification for why. If the firm has a fixed amount of IPO proceeds in mind, the relative size of the floating will be smaller for highly valued firms due to market sentiments: in other words, for highly valued firms the overhang (New Issue rate) will be larger (smaller). Given the assumed correlation between uncertainty and valuation, it gives rise to the positive (negative) relation between the overhang (New issue rate) and IPO returns. Loughran and Ritter (2003) argue that the Dot-com bubble period was a high valuation time for a certain category of firms. The firms issued relatively small amount of new shares at the IPO, but due to greater valuation uncertainty concurrently experienced high underpricing. As a supporting evidence for the argument, they present that during the bubble period, IPO proceeds were generally larger relative to the firm size measured by sales volume (high valuation period); IPO proceeds remained constant across new issue rates (fixed proceeds); positive price revisions for low new issue rate-firms were larger (larger uncertainty and IPO return).

It is doubtful that Loughran and Ritter (2003)’s argument can be extended to the empirical pattern documented in this paper. To be consistent with their model, one needs an implausible assumption that post 2003 was a high valuation period when a certain category of firms were highly valued by market. Table 1 shows, however, that IPOs in the first two years of 2001 and 2002 were more frequent than during the rest of the sample period. The period of “hot” market, if existed at all, corresponds to the earlier sample rather than the latter.

As another evidence against applying Loughran and Ritter’s (2003) argument for the regression results in Table 4, Table 6 presents IPO proceeds, sales volume and positive revisions of IPO prices of a median firm for the two groups sorted by the New issue rate. Two samples are formed for each sub period, ‘Low’ new issue rate and ‘High’ new issue rate firms. Low rate firms are with new issue rates of lowest 30 percent category; High with new issue rates of highest 30 percent. Table 6 compares means of the Low and High new issue rate firm-samples for each sub period. All the patterns are in contrast to the US documented

in Loughran and Ritter (2003), IPO proceeds is rather constant during the earlier period, not in the later when the negative relation between the New issue rate and underpricing is found. Overall IPO proceeds relative to the sales volume is not larger in the later period. No clear difference in the magnitude of positive price revisions between the high and the low New issue rate firms can be found.

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Table 6

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(3) Behavioral Bubble due to Overconfidence

Hong, Scheinkman and Xiong (2005) develop a model that generates the negative relationship between tradable shares and speculative bubbles. Again their motivation is on explaining episodes like the Dot.com bubble in the late nineties in the US. In the model, investors have heterogeneous beliefs due to overconfidence. The bubble's size depends on tradable shares because a larger tradable means that it takes a greater divergence in opinion in the future for an investor to resell the shares, which means a less valuable resale option today. If interpreting the bubble as high IPO returns, their model may appear to have a potential to explain the negative correlation between the ratio of tradable shares and the IPO return reported in this paper.

However, relevancy of Hong, Scheinkman and Xiong (2005)'s model for the sample of this paper is limited. Their model cannot explain why there is a change in the relationship between tradable shares and IPO returns around the regulatory change in 2003, particularly why the negative correlation is only observed in the latter subsample. To explain the change in view of the behavioral bubble argument, similar to the high valuation case by Loughran and Ritter (2003), one has to claim that prior to late 2003 was a stagnant or normal period, and the post 2003 a bubble period when investors' overconfidence prevailed in market, which is counterfactual.

(4) Allocation among Retail Investors, Directed Share Program and Institutional Investors

On the relation between retail allocation rates and underpricing, there are two notable prior empirical works. Ljungqvist and Wilhelm (2003) report that a positive relation exists between participation rates in directed share program (DSP) and underpricing, which, they interpret, is due to issuing firm's utilizing the program as a compensation mechanism for insiders. Aggarwal, Prabhala and Puri (2002) show that the ratio of the shares distributed to

institutional investors to the total number of new shares has positive relationship with underpricing, which they relate to the information revelation theory. Assuming that the reported empirical patterns also exist in the Kosdaq market, alternative explanation for the change in the relation between retail allocation rates and underpricing can be formulated. Since the distribution rate to institutional investors had been fixed at 65 percent (see Table 1) until April 2004, Aggarwal, Prabhala and Puri (2002)'s finding has no implication for the earlier sample period. During the period, higher retail ratios were matched exactly by lower DSP participation rates and vice versa. For the later sample, higher retail ratios can be matched by either lower institutional allocation rates or DSP participation rates. Though prior empirical works predict that both of them will take impacts on underpricing in the same direction (positive), magnitude of the effect on underpricing can differ between the two. Then, the weakening in the negative relation of the retail allocation rate with underpricing may be explained without invoking the opportunity cost argument.

Formalizing the speculation, when Ljungqvist and Wilhelm's (2003) finding of the positive relation between DSP rates and underpricing holds and institutional allocation rates are fixed at 65 percent, allocation of IPO shares to investors can be described by the following two equations where X denotes all other explanatory variables for underpricing and ε an error term.

$$\mathrm{RetailDist} = 35 - \mathrm{DSP} \qquad (4.1)$$

$$\mathrm{Underpricing} = \alpha + \beta \cdot \mathrm{X} + \theta \cdot \mathrm{DSP} + \varepsilon \qquad (4.2)$$

Inserting the identity relation of (4.1) into (4.2) yields the negative relation between retail allocation rates and underpricing consistent with the regression results reported in Table 4. fter institutional allocation rates started to vary, allowing for Aggarwal, Prabhala and Puri's (2002) argument that more institutional allocation leads to more underpricing, the system of equations describing allocation and underpricing needs to be rewritten as follows, where $\mathrm{InstDIst}$ denotes institutional investors allocation rates and δ an error term.

$$\mathrm{RetailDist} = 100 - (\mathrm{DSP} + \mathrm{InstDIst}) \qquad (4.3)$$

$$\mathrm{Underpricing} = \alpha + \beta \cdot \mathrm{X} + \theta \cdot \mathrm{DSP} + \gamma \cdot \mathrm{InstDist} + \delta \qquad (4.4)$$

Comparing the system of (4.3) and (4.4) with (4.1) and (4.2), it reveals that regressing underpricing on retail allocation rates will produce different estimates across the two samples because of the change in the system of allocation, not necessarily because of the change in underwriters' opportunity cost for distributing more shares to retail investors as put

forwarded by HP4[13].

To check the plausibility of the speculation, I run a regression including DSP participation rates and institutional rates as explanatory variables instead of retail allocation rates for the later sample. Table 7reports the results. The speculation expects the estimate of the coefficient to DSP to be positive and significant. The obtained result is inconsistent with the speculation. DSP is estimated insignificant. Institutional rates are significant but with a negative sign inconsistent with Aggarwal, Prabhala and Puri (2002). An interpretation for the result, however, can be advanced in light of HP 4. Larger institutional allocation rates imply lesser retail allocation, which means lower (higher) opportunity cost of overpricing (underpricing) for an underwriter in the presence of the put-back option obligation. Hence, the opportunity cost channel may predict a negative relation between institutional allocation rates and underpricing.

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Table 7

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5. Conclusion

In this paper, I examine the importance of opportunity cost of underpricing to agents in understanding dynamics of underpricing at the Kosdaq market. I present a simple model and identify parameters that can affect either underwriter's or issuer's opportunity cost of underpricing. In the model, same parameters can be related to both agents' opportunity costs, which prevent easy empirical identification in a homogeneous environment. Making use of the regulatory change that took differential impacts on underwirtier's and issuer's cost, I formulate four hypotheses for testing and find the empirical results supportive of the hypotheses.

The results of the paper suggest that a same variable may enter an IPO return regression equation with different magnitudes and even with different signs depending on exgoneous environment that dictates agents' endogenous decisions. Hence, it cautions that deterministic views on agents' role in the IPO process can be naïve, as, for example, the certification theories envisage. Underwriters' and Venture Capitalists' behavioral patterns in the IPO process may be state-contingent. Whether they act to mitigate information

[13] Given the system, regressing underpricing on the retail allocation rate is tantamount to imposing a wrong restriction that θ is equal to γ.

asymmetry and reduce the extent of underpricing cannot be told without knowing the incentive structure they are subject to. To fully understand their behavior, therefore, it is crucial to identify the specific environment surrounding them and clarify their incentive structures for underpricing.

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Appendix 1: Proof of Proposition2

To show that the sign of $\frac{dP_I^*}{dt}$ is indeterminate, notice that

$$\frac{dP_I^*}{dt} = \frac{\partial e_i^*}{\partial t} \cdot \frac{\partial P_I}{\partial e_i} + \frac{\partial e_u^*}{\partial t} \cdot \frac{\partial P_I}{\partial e_u} \qquad (A1)$$

By the assumption on the functional form of P_I, I have that $\frac{\partial P_I}{\partial e_i} > 0 \; and \; \frac{\partial P_I}{\partial e_u} < 0$. To determine signs of $\frac{\partial e_i^*}{\partial t}$ and $\frac{\partial e_u^*}{\partial t}$, I apply the standard comparative static analysis tool with respect to t. Taking total differentials of the system of equation (1.2) and (1.4), and expressing them in a matrix form, I obtain

$$\begin{bmatrix} H_{11} & 0 \\ 0 & H_{22} \end{bmatrix} \begin{bmatrix} \frac{\partial e_u^*}{\partial t} \\ \frac{\partial e_i^*}{\partial t} \end{bmatrix} = \begin{bmatrix} \beta \cdot n_n \cdot \frac{\partial P_I}{\partial e_u} \cdot \frac{\partial F(P_I)}{\partial t} \\ -\frac{\partial P_I}{\partial e_i} \cdot \frac{1}{1+n_n} \end{bmatrix} \qquad (A2)$$

, where $H_{11} = (f - \beta \cdot F(P_I) - \beta \cdot P_I) \cdot n_n \cdot \frac{\partial^2 P_I}{\partial e_u^2} - C''(e_u)$ and $H_{22} = \frac{n_n + t}{1+n_n} - C''(e_i)$

Solving (A2) by Cramer's rule, it is obtained that

$$\frac{\partial e_u^*}{\partial t} = \frac{1}{H_{11} \cdot H_{22}} \cdot \left[\beta \cdot n_n \cdot \frac{\partial P_I}{\partial e_u} \cdot \frac{\partial F(P_I)}{\partial t} \cdot H_{22} \right] \qquad (A3)$$

$$\frac{\partial e_i^*}{\partial t} = \frac{1}{H_{11} \cdot H_{22}} \cdot \left[-\frac{\partial P_I}{\partial e_i} \cdot \frac{1}{1+n_n} \cdot H_{11} \right] \qquad (A4)$$

Notice that each H_{11} and H_{22} is the second order condition of maximization for the underwriter and the issuer respectively, and so negative. Therefore, both $\frac{\partial e_i^*}{\partial t}$ and $\frac{\partial e_u^*}{\partial t}$ are positive. Then, the first term in equation (A1) is positive, but the second term in equation (A1) is negative. Hence, depending on relative magnitude of the two terms, the sign of $\frac{dP_I^*}{dt}$ can be either positive or negative. By the same procedure, it can be shown that the sign of $\frac{dP_I^*}{dn_n}$ is also indeterminate, which proves Proposition 2.

Appendix 2: Proof of Proposition3

For any given two β_1, β_2 $(\beta_1 > \beta_2)$, denote the corresponding $\frac{dP_I^*}{dt}$ as $\frac{dP_I^*}{dt}(\beta_1)$ and $\frac{dP_I^*}{dt}(\beta_2)$. I need to show that $\frac{dP_I^*}{dt}(\beta_1) > \frac{dP_I^*}{dt}(\beta_2)$. From (A3) and (A4), it can be observed that $\frac{\partial e_u^*}{\partial t}$ increases in β while $\frac{\partial e_i^*}{\partial t}$ is not a function of β. Hence, the first term in equation (A1) is constant with respect to β. So, the following relationship holds.

$$\frac{dP_I^*}{dt}(\beta_1) - \frac{dP_I^*}{dt}(\beta_2) = \frac{\partial P_I}{\partial e_u} \cdot \left[\frac{\partial e_u^*}{\partial t}(\beta_1) - \frac{\partial e_u^*}{\partial t}(\beta_2) \right] \qquad (A5)$$

Since $\frac{\partial e_u^*}{\partial t}$ increases in β and $\frac{\partial P_I}{\partial e_u}$ is negative, (A5) is negative. Analogously it can be also shown that $\frac{dP_I^*}{dn_n}$ *and* $\frac{dP_I^*}{d\sigma_P}$ decrease in β.

Table 1. Regulatory Environment for IPOs at the Kosdaq Market (2000 June ~ 2007 June)

Revision Date	2000.6	2000.12	2002.7	2003.8	2004.3	2004.9	2005.3	2007.6
IPO price	Underwriter and Issuer decide the IPO price within ±10% of the weighted average price obtained through the book-building process, where weights are assigned by a predetermined rule.	Underwriter and Issuer decide the IPO price within ±30% of the weighted average price obtained through the book-building process, where weights are assigned by a predetermined rule.	Deregulated, but the previous practice continued					
IPO Share Allocation	Institutional Investors: at least 45%, de facto fixed at 65% Retail Investors: at least 15% Directed Share Program (DSP): at most 20%				Institutional : at least 45%; Retail: at least 20% DSP: at most 20%	Institutional : at least 30% Retail: at least 20% DSP: at most 20%		Retail: at least 20% DSP: at most 20%
Market Making	Support at 80% of the IPO price at least for two months	Support at 80% of the IPO price at least for a month	Support at 90% of the IPO price at least for a month	Provide “put-back option” only to retail investors				Deregulated
Daily Price Change Limit	Within ±12% from the previous trading day closing price						Within ± 15% from the previous trading day closing price	

Source: Various versions of “Rule on Underwriting of Securities”, Korea Securities Dealers Association.

Table 2. Yearly and Industrial Distribution of IPO Firms
This table documents yearly and industry composition of IPOs from April 2001 to May 2007. Industry classification is based on KSIC two digit codes. KSIC codes 20 to 29, which the largest population of IPOs belong to, include semi-conductor(262), electronic parts manufacturing(261), and communication and broadcasting equipment manufacturing(264). KSIC 50 to 59, which the second largest belong to, include software development(582).

KSIC Code	Number of IPOs							
	2001	2002	2003	2004	2005	2006	2007	Total
Below 20	2	8	1	3	0	2	0	16
20-29	80	68	45	29	51	33	14	320
30-39	5	3	4	3	3	2	2	22
40-49	10	16	2	2	2	1	0	33
50-59	20	28	6	4	8	10	0	76
60-69	9	10	7	5	2	3	1	37
70-79	4	10	2	0	3	1	0	20
80-99	2	2	1	1	0	1	0	7
Total	132	145	68	47	69	53	17	531

Figure 1. Yearly Distribution of IPO Returns
This figure documents IPO returns measured by CARs. Mean of CARs are computed for yearly sample of IPOs from April 2001 to May 2007. They are all significant at 1 percent level except CARs for 2004. For the year of 2004, CAR(5), CAR(30) are significant at 5 percent level; CAR(10), CAR(15), CAR(25) significant at 10 percent level; but, CAR(20) insignificant at standard significance levels.

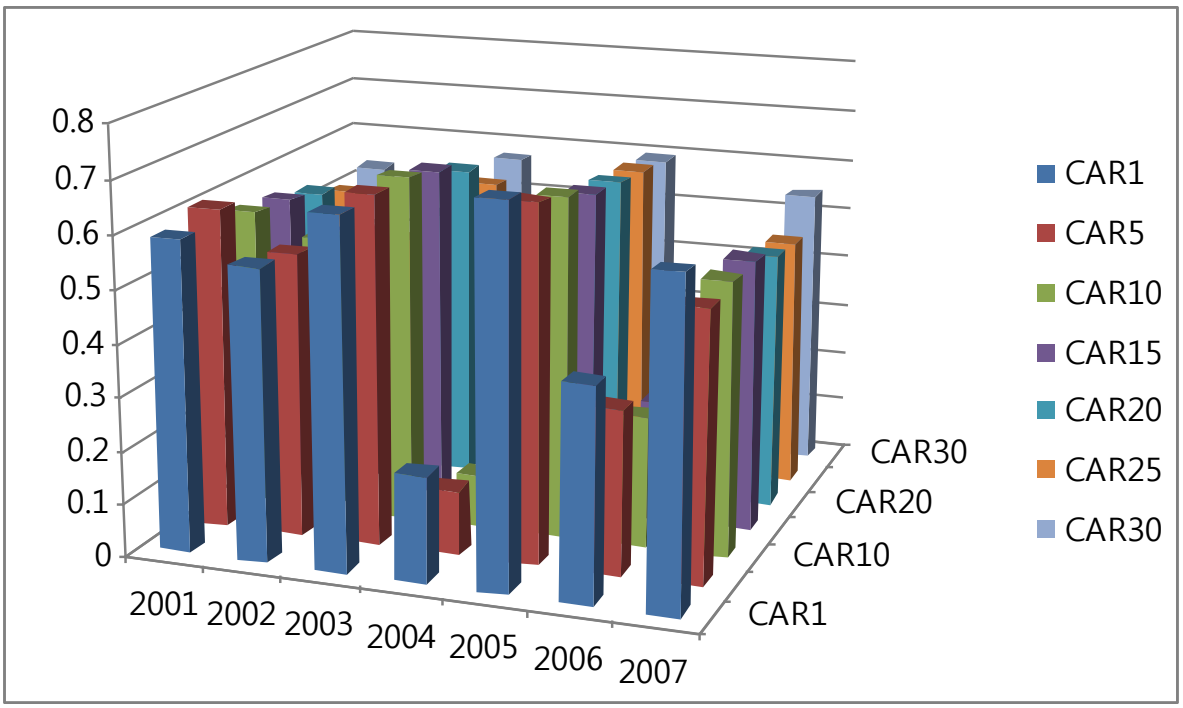

Table 3. Descriptive Statistics of Regression Variables

The table presents mean, median and standard deviation (STD) of each series of variables. Age is the number of months between the floatation date and the founding date of an issuing firm. Offer size is the product of the IPO price and the number of newly offered shares. Sales is the sales amount in the year prior to the IPO. UPDATE is the percentage adjustment between the midpoint of the indicative price range suggested by an underwriter for a book building and the final offer price. New Issue is the ratio of the number of newly issued shares to the number of existing shares. TRADABLE is the ratio of the number of non locked-up shares to the number of existing shares. RETAIL is the 'normalized' ratio of newly issued shares to retail investors to the total new floating, where normalization is made by dividing the raw ratio by fifteen for the observations before March 2004 and twenty afterward. VC dummy is a dummy variable indicating that at least 1% of the firm's shares prior to the IPO was held by a venture capitalist. UNDERWRITER dummy is a dummy variable indicating underwriters with above 5 % IPO market share in terms of the number of IPOs during the sample period. F(t) is a return between t-th trading day closing price from the listing and the IPO price. CAR(t) is a cumulative abnormal return for the period of t-trading days after the listing, using the Kosdaq index for computing market return.

	2001.4-2003.9			**2003.10-2007.5**			**2001.4-2007.5**		
	Mean	Median	STD	Mean	Median	STD	Mean	Median	STD
AGE	9.62	7.54	6.79	8.90	6.92	5.57	9.34	7.08	6.34
Offer Size(billion)	8.17	6.15	7.61	1160	819	1000	9.52	6.81	8.79
SALES(billion)	31.80	18.60	43.40	3950	2700	3640	34.80	21.50	40.90
UPDATE	-0.00	0.00	0.15	-0.05	-0.04	0.13	-0.02	-0.02	0.14
NEW ISSUE	0.39	0.43	0.08	0.32	0.29	0.10	0.36	0.43	0.09
TRADABLE	0.30	0.29	0.18	0.38	0.40	0.19	0.33	0.33	0.19
RETAIL	1.32	1.00	0.48	1.11	1.00	0.22	1.24	1.00	0.41
IND STD	0.03	0.03	0.01	0.02	0.02	0.00	0.02	0.03	0.01
CAR(1)	0.58	0.58	0.43	0.49	0.41	0.46	0.55	0.49	0.44
CAR(5)	0.59	0.57	0.51	0.43	0.33	0.54	0.52	0.43	0.52
CAR(15)	0.56	0.50	0.52	0.38	0.27	0.53	0.49	0.39	0.53
CAR(25)	0.48	0.44	0.53	0.36	0.27	0.55	0.44	0.37	0.54
F(1)	0.55	0.53	0.47	0.48	0.40	0.48	0.52	0.47	0.47
F(5)	0.58	0.44	0.68	0.42	0.23	0.70	0.52	0.33	0.69
F(15)	0.53	0.35	0.77	0.36	0.19	0.69	0.47	0.26	0.75
F(25)	0.41	0.23	0.75	0.34	0.13	0.80	0.38	0.17	0.77
# of VC Dummy =1	176			145			321		
# of Und Dummy=1	154			128			282		
Number of Firms	322			206			528		

Table 4. IPO Return Regressions – Estimation with Divided Samples

Regression models for IPO returns in the Kosdaq market from April 2001 to May 2007:

$$\text{IPO return} = \alpha + \beta_1 \cdot \text{LOGAGE} + \beta_2 \cdot \text{LOGSALES} + \beta_3 \cdot \text{UPDATE} + \beta_4 \cdot \text{UPDATE POSI} + \beta_5 \cdot \text{NEWISSUE} + \beta_6 \cdot \text{TRADABLE} + \beta_7 \cdot \text{RETAIL} + \beta_8 \cdot \text{INDSTD} + \beta_9 \cdot \text{UNDERWRITER} + \beta_{10} \cdot \text{VC} + \varepsilon$$

LOGAGE, LOGSALES are log transformed values of AGE and SALES defined in Table 3. UPDATE POSI is UPDATE when it is positive and zero otherwise. Other variables are defined in Table 3. Year dummy for each year, industry dummy indicating the industry of KSIC code from 20 to 29 where IPOs are concentrated, and lagged IPO return are also included in regression models, but estimates for the coefficients not reported below. Models are estimated separately for the two sub-periods divided before and after October 2003. Panel A contains estimates for the sample before Oct 2003 and Panel B after. Panel A and B use F(t) for IPO returns while Panel C and D use CAR(t). The t-statistics use standard OLS standard errors.

	Panel A : Before 2003.10				Panel B : After 2003.10			
	Dependent Variable				Dependent Variable			
	F(1)	F(5)	F(15)	F(25)	F(1)	F(5)	F(15)	F(25)
C	1.45 ** (2.38)	0.24 (0.27)	-0.12 (-0.11)	-1.42 (-1.36)	3.33 *** (3.68)	2.51 * (1.78)	0.68 (0.48)	1.83 (1.12)
LOGAGE	0.05 (1.15)	0.11 (1.56)	0.14 (1.58)	0.14 * (1.74)	0.02 (0.27)	0.01 (0.14)	0.02 (0.15)	-0.03 (-0.21)
LOGSALES	-0.04 * (-1.91)	-0.01 (-0.43)	-0.00 (-0.00)	0.04 (1.01)	-0.09 ** (-2.50)	-0.05 (-0.97)	0.01 (0.22)	-0.03 (-0.50)
UPDATE	0.29 (0.91)	0.39 (0.82)	0.47 (0.83)	0.52 (0.96)	0.02 (0.06)	-1.00 * (-1.89)	-1.05 * (-1.97)	-0.96 (-1.56)
UPDATE_POSI	0.01 (0.03)	0.48 (0.57)	0.12 (0.12)	-0.03 (0.03)	1.27 (1.46)	4.75 ** (3.52)	5.29 *** (3.87)	5.34 *** (3.41)
NEW ISSUE	-0.64 * (-1.73)	-0.19 (-0.33)	-0.52 (-0.79)	-0.15 (-0.24)	-1.23 *** (-3.28)	-1.78 *** (-3.04)	-0.91 (-1.54)	-0.63 (-0.94)
TRADABLE	0.04 (0.27)	0.18 (0.85)	0.24 (0.94)	0.23 (0.94)	-0.70 *** (-4.02)	-0.88 *** (-3.26)	-0.53 * (-1.93)	-0.56 * (-1.79)
RETAIL	-0.23 *** (-4.47)	-0.25 *** (-3.30)	-0.24 *** (-2.60)	-0.21 ** (-2.48)	-0.05 (-0.37)	0.20 (0.92)	0.14 (0.63)	-0.07 (-0.29)
IND STD	10.34 ** (2.2)	17.70 ** (2.45)	19.43 ** (2.27)	19.81 ** (2.43)	-1.37 (-0.20)	-3.09 (-0.29)	-14.88 (-1.40)	-10.73 (-0.88)
Underwriter	0.03 (0.61)	0.04 (0.58)	0.04 (0.43)	0.00 (0.00)	-0.06 (-1.01)	-0.13 (-1.36)	-0.11 (-1.18)	-0.04 (-0.36)
VC	0.07 (1.16)	0.08 (0.93)	0.09 (0.80)	0.13 (1.27)	-0.12 (-1.62)	-0.18 (-1.62)	-0.17 (-1.48)	-0.16 (-1.23)
Adjusted R-squared	0.21	0.17	0.10	0.12	0.33	0.22	0.20	0.21
Number of Firms	304	304	304	304	205	205	205	205

	Panel C: Before 2003.10				Panel D : After 2003.10			
	Dependent Variable				Dependent Variable			
	CAR(1)	CAR(5)	CAR(15)	CAR(25)	CAR(1)	CAR(5)	CAR(15)	CAR(25)
C	1.68 *** (3.10)	1.06 (1.61)	0.81 (1.16)	0.16 (0.22)	3.11 *** (3.59)	2.62 ** (2.51)	1.51 (1.41)	2.14 * (1.92)
LOGAGE	0.03 (0.69)	0.06 (1.22)	0.06 (1.11)	0.07 (1.24)	-0.03 (-0.52)	-0.04 (-0.45)	-0.03 (-0.43)	-0.07 (-0.86)
LOGSALES	-0.05 ** (-2.52)	-0.04 (-1.46)	-0.03 (-0.94)	0 (-0.15)	-0.08 ** (-2.39)	-0.06 (-0.76)	-0.02 (-0.51)	-0.04 (-1.02)
UPDATE	0.39 (1.38)	0.53 (1.56)	0.52 (1.42)	0.59 (1.60)	0.21 (0.64)	-0.3 (-0.76)	-0.36 (-0.90)	-0.27 (-0.64)
UPDATE_POSI	-0.22 (-0.45)	-0.14 (-0.23)	-0.14 (-0.21)	-0.29 (-0.44)	0.92 (1.11)	2.79 *** (2.79)	3.21 *** (3.12)	2.98 *** (2.79)
NEW ISSUE	-0.49 (-1.48)	-0.36 (-0.91)	-0.49 (-1.15)	-0.26 (-0.62)	-0.84 ** (-2.35)	-1.08 ** (-2.42)	-0.71 (-1.60)	-0.58 (-1.26)
TRADABLE	0.02 (0.13)	0.12 (0.81)	0.12 (0.77)	0.14 (0.86)	-0.70 *** (-4.25)	-0.79 *** (-3.95)	-0.62 *** (-3.03)	-0.57 *** (-2.69)
RETAIL	-0.17*** (-3.66)	-0.18 *** (-3.25)	-0.17 *** (-2.90)	-0.19 *** (-3.18)	-0.05 (-0.38)	0.08 (0.48)	0.09 (0.54)	-0.02 (-0.10)
IND STD	7.29 * (1.73)	11.33 ** (2.20)	11.92 ** (2.17)	12.34 ** (2.23)	2.54 (0.40)	-1.40 (-0.18)	-5.42 (-0.67)	-4.89 (-0.59)
Underwriter	0.05 (1.11)	0.05 (0.99)	0.05 (0.85)	0.03 (0.44)	-0.09 (-1.50)	-0.11 (-1.53)	-0.11 (-1.53)	-0.08 (-1.04)
VC	0.03 (0.62)	0.04 (0.58)	0.02 (0.32)	0.06 (0.83)	-0.09 (-1.35)	-0.13 (-1.50)	-0.13 (-1.55)	-0.12 (-1.33)
Adjusted R-squared	0.23	0.23	0.17	0.18	0.32	0.28	0.24	0.22
Number of Firms	304	304	304	304	205	205	205	205

Table 5. IPO Return Regressions –Estimation with the Whole Sample

Regression models for IPO returns in the Kosdaq market from April 2001 to May 2007:

$$\begin{aligned}\text{IPO return} = {} & \alpha + \beta_1 \cdot \text{LOGAGE} + \beta_2 \cdot \text{LOGSALES} + \beta_3 \cdot \text{UPDATE} + \beta_4 \cdot \text{UPDATE POSI} + \beta_5 \\ & \cdot \text{NEWISSUE} + \beta_6 \cdot \text{TRADABLE} + \beta_7 \cdot \text{RETAIL} + \beta_8 \cdot \text{INDSTD} + \beta_9 \\ & \cdot \text{UNDERWRITER} + \beta_{10} \cdot \text{VC} + \gamma_1 \cdot \text{AFTER2003Oct} + \gamma_2 \cdot \text{AFTER2003Oct} \\ & \cdot \text{LOGAGE} + \gamma_3 \cdot \text{AFTER2003Oct} \cdot \text{LOGSALES} + \gamma_4 \cdot \text{AFTER2003Oct} \cdot \text{UPDATE} \\ & + \gamma_5 \cdot \text{AFTER2003Oct} \cdot \text{UPDATE POSI} + \gamma_6 \cdot \text{AFTER2003Oct} \cdot \text{NEWISSUE} + \gamma_7 \\ & \cdot \text{AFTER2003Oct} \cdot \text{TRADABLE} + \gamma_8 \cdot \text{AFTER2003Oct} \cdot \text{RETAIL} + \gamma_9 \\ & \cdot \text{AFTER2003Oct} \cdot \text{INDSTD} + \gamma_{10} \cdot \text{AFTER2003Oct} \cdot \text{UNDERWRITER} + \gamma_{11} \\ & \cdot \text{AFTER2003Oct} \cdot \text{VC} + \varepsilon\end{aligned}$$

AFTER2003Oct is a dummy variable taking one when an IPO is listed after Oct 2003, otherwise zero. LOGAGE, LOGSALES are log transformed values of AGE and SALES defined in Table 3. UPDATE POSI is UPDATE when it is positive and zero otherwise. Other variables are defined in Table 3. Year dummy for each year, industry dummy indicating the industry of KSIC code from 20 to 29 where IPOs are concentrated, and lagged IPO return are also included in regression models, but estimates for the coefficients not reported below. Panel A contains estimates of β while Panel B contains estimates of γ. The t-statistics use standard OLS standard errors.

	Panel A: Before Oct 2003 (Estimates of β)				Panel B: After Oct 2003 (Estimates of γ)			
	Dependent Variable				Dependent Variable			
	F(1)	F(5)	F(15)	F(25)	F(1)	F(5)	F(15)	F(25)
C	1.45 **	0.24	-0.12	-1.42	1.68	1.90	0.48	2.95
	(2.44)	(0.27)	(-0.12)	(-1.36)	(1.52)	(1.12)	(0.25)	(1.53)
LOGAGE	0.05	0.11	0.14*	0.14*	-0.04	-0.10	-0.12	-0.17
	(1.17)	(1.58)	(1.69)	(1.74)	(-0.43)	(-0.75)	(-0.82)	(-1.14)
LOGSALES	-0.04 *	-0.01	-0.00	0.04	-0.04	-0.04	0.01	-0.07
	(-1.94)	(-0.43)	(-0.00)	(1.01)	(-1.02)	(-0.58)	(0.16)	(-0.96)
UPDATE	0.29	0.39	0.47	0.52	-0.27	-1.39	-1.52*	-1.48*
	(0.93)	(0.83)	(0.89)	(0.96)	(-0.57)	(-1.95)	(-1.89)	(-1.81)
UPDATE_POSI	0.01	0.48	0.12	-0.03	1.25	4.26***	5.17 ***	5.37 ***
	(0.03)	(0.57)	(0.13)	(-0.03)	(1.19)	(2.65)	(2.86)	(2.92)
NEW ISSUE	-0.64*	-0.19	-0.52	-0.15	-0.59	-1.60**	-0.39	-0.48
	(-1.77)	(-0.34)	(-0.85)	(-0.24)	(-1.12)	(-1.97)	(-0.43)	(-0.52)
TRADABLE	-0.04	0.18	0.24	0.23	-0.66 ***	-1.06 ***	-0.76 **	-0.79 **
	(-0.27)	(0.86)	(1.00)	(0.94)	(-2.91)	(-3.07)	(-1.97)	(-1.99)
RETAIL	-0.23***	-0.25 ***	-0.24***	-0.21**	0.17	0.46*	0.38	0.14
	(-4.56)	(-3.34)	(-2.78)	(-2.48)	(1.10)	(1.91)	(1.40)	(0.52)
IND STD	10.34**	17.70**	19.43**	19.81**	-11.72	-20.80	-34.31**	-30.54**
	(2.25)	(2.47)	(2.43)	(2.44)	(-1.39)	(-1.61)	(-2.37)	(-2.08)
Underwriter	0.03	0.04	0.04	0.00	-0.09	-0.17	-0.15	-0.04
	(0.62)	(0.59)	(0.46)	(0.00)	(-1.15)	(-1.41)	(-1.11)	(-0.29)
VC	0.07	0.08	0.09	0.13	-0.19**	-0.27*	-0.25	-0.29*
	(1.19)	(0.94)	(0.86)	(1.28)	(-1.97)	(-1.84)	(-1.56)	(-1.75)
Adjusted R-squared	0.31	0.25	0.20	0.21	0.31	0.25	0.20	0.21
Number of Firms	509	509	509	509	509	509	509	509

Table 6. Comparison of Medians between High and Low New Issue Rate IPO Firms
Two samples are formed for the period before Oct 2003 and the period after by the magnitude of NEW ISSUE rates. All the firms are ordered by NEW ISSUE rates. 'Low' sample consists of firms with NEW ISSUE rates falling in the lowest 30 percent range. 'HIGH' sample consists of firms with NEW ISSUE rates falling in the highest 30 percent range. Medians of Offer Size and positive Update are computed for each sample.

Mean	Before Oct 2003	After Oct 2003
New Issue Rate (%)		
Low	26.4	25
High	44	43
Offer Size (billion Won)		
Low	6.0	7.2
High	5.7	9.0
Sales (billion Won)		
Low	16.6	26.4
High	18.5	31.3
Positive Update (%)		
Low	3.14	1.78
High	2.14	1.56

Table 7. IPO Return Regressions – Alternative Specification for Allocation of IPO Shares
Regression models for IPO returns in the Kosdaq market from October 2003 to May 2007:

$$\text{IPO return} = \alpha + \beta_1 \cdot \text{LOGAGE} + \beta_2 \cdot \text{LOGSALES} + \beta_3 \cdot \text{UPDATE} + \beta_4 \cdot \text{UPDATE POSI} + \beta_5 \cdot \text{NEWISSUE} + \beta_6 \cdot \text{TRADABLE} + \beta_7 \cdot \text{DSP} + \beta_8 \cdot \text{INSTOTUTIONAL} + \beta_9 \cdot \text{INDSTD} + \beta_{10} \cdot \text{UNDERWRITER} + \beta_{11} \cdot \text{VC} + \varepsilon$$

DSP is allocation rate to the direct share program. INSTITUTIONAL stands for allocation rate to institutional investors. LOGAGE, LOGSALES are log transformed values of AGE and SALES defined in Table 3. UPDATE POSI is UPDATE when it is positive and zero otherwise. Other variables are defined in Table 3. Year dummy for each year, industry dummy indicating the industry of KSIC code from 20 to 29 where IPOs are concentrated, and lagged IPO return are also included in regression models, but estimates for the coefficients not reported below. The t-statistics use standard OLS standard errors.

	Dependent Variable			
	F(1)	F(5)	F(15)	F(25)
C	3.85 *** (3.58)	4.37 *** (3.39)	3.15 ** (2.38)	3.51 ** (2.58)
LOGAGE	-0.04 (-0.64)	-0.05 (-0.59)	-0.05 (-0.58)	-0.09 (-1.06)
LOGSALES	-0.09 *** (-2.67)	-0.07 * (-1.84)	-0.04 (-0.86)	-0.07 (-1.51)
UPDATE	0.2 (0.63)	-0.27 (-0.71)	-0.34 (-0.85)	-0.26 (-0.63)
UPDATE POSI	0.86 (1.04)	2.67 *** (2.71)	3.09 *** (3.03)	2.83 *** (2.70)
NEW ISSUE	-0.84 ** (-2.33)	-1.03 ** (-2.40)	-0.68 (-1.54)	-0.52 (-1.13)
TRADABLE	-0.73 *** (-4.40)	-0.83 *** (-4.16)	-0.66 *** (-3.23)	-0.63 *** (-2.99)
DSP	0.00 (0.24)	-0.00 (-0.54)	-0.00 (-0.37)	0.00 (0.52)
INSTITUTIONAL	-0.01 (-1.06)	-0.02 * (-1.90)	-0.02 * (-1.67)	-0.01 (-1.38)
IND STD	1.89 (0.29)	-2.3 (-0.30)	-6.13 (-0.77)	-5.49 (-0.67)
Underwriter	-0.08 (-1.35)	-0.10 (-1.39)	-0.10 (-1.37)	-0.06 (-0.76)
VC	-0.09 (-1.28)	-0.12 (-1.49)	-0.13 (-1.54)	-0.11 (-1.26)
Adjusted R-squared	0.33	0.29	0.25	0.25
Number of Firms	205	205	205	205