# The Relaxation of Financing Constraints by the Initial Public Offering of Small Manufacturing Firms

*Juseong Kim*

ABSTRACT. Capital market imperfections, such as information asymmetry, increase the cost of external funds compared to that of internal funds. This phenomenon creates financing constraints limiting the availability of external funds and making corporate investment excessively sensitive to cash flow. This study analyzes the effect of financing constraints on the investment by comparing the financial behavior of Korean firms before and after their stocks are newly listed on a stock exchange. The results show that the sensitivity of investment to cash flow will be higher during the period before initial public offering (IPO) than after IPO. In particular, the effect of financing constraints relaxation by IPO is more prominent in small than in large manufacturing firms.

## 1. Introduction

Modigliani-Miller's (1958) "irrelevance theorem" suggests that in a perfect capital market, a firm's value is independent of its capital structure. In such case, a firm's investment activities are independent of its financing activities.

However, recent studies on the capital market have considered the existence of market imperfections such as information asymmetry, and showed that a firm's investment may be affected by its financial factors. For example, Stiglitz and Weiss (1981), Myers and Majluf (1984) proved that in the presence of information asymmetry, external funds financing is constrained if insiders in a firm have private information on an investment project that is not shared by outsiders.

In the presence of information asymmetry, external funds can not be a perfect substitute for internal funds and external funds are available only at a premium. So, the cost of external funds becomes higher than the opportunity cost of internal funds. If differences in cost between internal funds and external funds exist, firms prefer internal funds in financing their investment projects. Consequently, their investment expenditures are affected by the availability of internal cash flow and become excessively sensitive to it.

Financing constraint refers to the situation where good investment projects that would be undertaken if there were sufficient internal funds, get cancelled because the availability of external funds is limited due to the imperfection factors in the capital market and the cost of external funds is higher than that of internal funds. In other words, it refers to the situation where investment is affected by the size of internal funds, because of the wedge between the costs of internal and external funds.

The purpose of this study is to analyze empirically the impact of financing constraints on the investment of small manufacturing firms (SMFs) in Korea by comparing it with that of large manufacturing firms (LMFs). In doing so, this study offers a new approach that can overcome the problems of the previous empirical studies of financing constraints.

In Korea, the availability of external funds is not only limited by information asymmetry but also by other institutional factors, thereby creating much severer financing constraints for Korean SMFs than for large domestic firms, not to speak of firms in other advanced nations.[1] In this context, the importance of this study can be further emphasized.

Until now, most empirical studies on financing constraints have classified firms according to some

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*Technology Policy Sect., ETRI,*
*161 Kajong-Dong, Yusong-Gu,*
*Taejon, 305–350, S. Korea*
*E-mail: juskim@mail.etri.re.kr*

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prior criteria for information asymmetry and focused their attention on whether there is any significant difference in the sensitivity of investment to internal cash flow across groups of firms.[2] For example, Fazzari, Hubbard and Petersen (1988) used dividend payout ratio as the prior criterion for information asymmetry when classifying firms into groups. In general, mature firms which are well-informed pay high dividends, while rapidly growing firms which are young and relatively less-informed pay low dividends, making the investments in low-dividend paying firms more sensitive to internal cash flow than in high-dividend paying firms. Fazzari, Hubbard and Petersen tried to find out whether there were differences in the sensitivity of investment to cash flow across firm groups by classifying firms into 3 groups; a high-dividend paying group, a medium-dividend paying group and a low-dividend paying group. However, their analysis had a problem in that the dividend payout ratio, used as the prior criterion for information asymmetry, is endogenously determined within the firms.[3]

To overcome this problem, a different approach using more exogenous criteria, such as firm size or membership in industrial group as prior criterion for information asymmetry, have been suggested.[4] However, the empirical studies using this approach also have their own limits. They didn't consider other unknown systematic factors besides financing constraints that may cause the differences in the sensitivity of investment to cash flow between the groups of firms. They assumed that there is no reasonable justification that the cash flow in the more financially constrained firms reflects the future profitability of investment more closely than in less financially constrained firms. However, the practical justification of this assumption is not clear. For example, the cash flow of rapidly growing firms is likely to reflect future investment opportunities better than that of mature firms. As it is almost impossible to control the expected future profitability of investment with a poor proxy variable for investment opportunity such as Tobin's q, the group of growing firms may show a higher investment-cash flow sensitivity than the group of mature firms, even without the existence of financing constraints.

This study tries to eliminate the problems of previous empirical studies by comparing the financing behavior of firms before and after their stocks are newly listed in an organized stock exchange. Initial public offering (IPO) is an exogenous event, and at the same time, a pure financial event that helps relieve financing constraints by reducing information asymmetry problems. So, IPO does not affect the future investment opportunities of firms. This study focuses on the change in the sensitivity of investment to cash flow between the periods before and after IPO. It has the advantage of analyzing more clearly than other previous studies the existence of financing constraints or the impact of financing constraints on corporate investment.[5]

In section 2, four research hypotheses are suggested. The models and methodology for empirical analysis are explained in section 3. The structure of data, classification of the groups of firms, descriptive statistics of data and empirical results from the analyses are presented subsequently in section 4, while section 5 contains the conclusions of this study.

## 2. Research hypotheses

In an imperfect capital market, newly borrowing firms will be faced with severer financing constraints than mature firms which have had successful business experiences for a long time. If the capital market is perfect, both newly borrowing firms and mature firms raise funds by paying risk-adjusted interest rates on an equal basis. But, in the presence of information asymmetry, this logic does not hold true due to the following reasons. First, lenders generally obtain more information from mature firms since they have more time and experience to learn about mature firms. Second, mature firms can build continuous relationships with lenders based on mutual trust which will help alleviate information problems. This can arise because intertemporal contracts can provide more flexibility to lenders when they establish incentive schemes to prevent borrowing firms from behaving opportunistically. Stiglitz and Weiss (1981) show that lenders can use the threat of reducing future loans to improve borrowers' present behavior.

If this reasoning is applied, financing constraints will have more impact on the investment

decisions of SMFs than those of LMFs, which are largely composed of mature firms. In addition, informational scale economy can occur in lending to LMFs depending on the amount of fixed cost associated with collecting information on borrowers by the lenders. For these reasons, SMFs are more financially constrained than LMFs. Therefore, it can be construed that the sensitivity of investment to cash flow is higher for SMFs. Consequently, the following hypothesis can be put forward:

**Hypothesis 1:** In the presence of information asymmetry, the investment expenditures of SMFs will be more sensitive to cash flow than those of LMFs.

Unlike the previous empirical studies, this study uses listing of the stocks of a firm on a stock exchange as a prior classification criterion in assessing the degree of financing constraints. IPO can contribute to relaxing the financing constraints faced by firms in the following ways.[6]

First, IPO allows firms to overcome the borrowing constraint caused by information asymmetry. A major benefit of the IPO is that firms can gain access to financial sources other than banks. In the presence of information asymmetry, a firm which needs large external funds may face higher interest rates or even credit rationing. The issuance of external equity by going public can relieve financing constraints, allowing the firm to obtain external funds on a large scale.

Second, IPO improves the bargaining power of firms with banks through diversification of external financing sources in the capital market. Another potential problem with bank loans besides credit rationing is that banks can exclusively extract rents from the privileged information about credit worthiness of their customers. IPO allows firms to gain access to the stock market and disseminate information to the general investors, thereby, eliciting competition among lenders. This in turn ensures firms to finance their investment projects with external funds at a lower cost of capital.

Third, IPO allows trading of stocks on an organized stock exchange instead of relying on private trading. Therefore, with the IPO, firms can increase the liquidity of their stocks. The stocks of unlisted firms can be traded only through informal searching for a counterpart at a considerable cost. On the other hand, being traded at an organized exchange, the stocks of listed firms have better features, especially for small shareholders who want to trade their stocks on short notice. Since IPO allows shareholders to trade their stocks in a more cost-effective way in transaction cost, it can increase the liquidity of stocks, and thereby, increases the value of them.

Fourth, IPO provides a managerial discipline device, both by creating the danger of hostile takeovers and by enabling to relate stock price to managerial incentives. In other words, since IPO provides additional devices to monitor managers, it reduces agency problems between shareholders and managers. The threat of takeover by potential raiders can be a source of managerial discipline created by the market. In addition, the shareholders of listed firms can improve compensation schemes for their managers by indexing their salaries to the stock price or by offering them stock options.

Fifth, IPO can act as an advertisement for a firm and can enhance the investors' awareness of the firm. Since most investors simply ignore the existence of certain firms, they are likely to hold portfolios which contain only a small fraction of the available securities. To these investors, the listing of stocks on a stock exchange acts as an advertisement for the firm, helping them overcome this problem.

Listed firms also have a considerably lower degree of information asymmetry than unlisted firms because listed firms have an obligation to disclose the informations that affect their financial status to interest groups immediately. Furthermore, they are continuously analyzed by firm analyst groups, such as institutional investors, and the results of the analysis are often made public.[7] Consequently, the degree of financing constraints that listed firms face is lower than those of unlisted firms.

Since IPO can relieve financing constraints for the reasons described above, it can be said that financing constraints of listed firms caused by capital market frictions are lower than that of unlisted firms. Therefore, it is possible to assert the following hypothesis:

**Hypothesis 2:** In the presence of information

asymmetry, investment expenditures of unlisted firms will be more sensitive to internal cash flow than those of listed firms.

Hypothesis 2 can be tested more powerfully by comparing the investment-cash flow sensitivities during the period before IPO and after IPO when the stocks of firms are newly listed on a stock exchange. That is, for the same firm, financing constraints during the periods before and after going public will be different. Therefore, there will be a difference in the sensitivity of investment to cash flow between periods before and after going public. So, it is possible to hypothesize as follows:

**Hypothesis 3:** For IPO firms, the sensitivity of investment to cash flow will be higher during the period before IPO than after IPO.

Unlike the approach used in previous empirical studies which analyzes the cross-sectional difference in the sensitivity of investment to cash flow across groups of heterogeneous firms, this hypothesis analyzes the serial difference in the sensitivity after a specific financial event called IPO. This creates lots of advantages in that it can eliminate the problems found in previous empirical studies by directly dealing with a pure financing constraints effect after almost perfectly controlling a real effect, such as investment opportunity.[8]

Finally, as suggested in Schaller (1993), Mills, Morling and Tease's (1995) previous empirical studies, when large firms are less financially constrained than small firms, the effects of financing constraints relaxation by the IPO will be different between the groups of firms. That is, since large firms are less financially constrained from the beginning, the effects of financing constraints relaxation by the IPO on them will be lower than on small firms that are more financially constrained. Thus,

**Hypothesis 4:** The reduction in the sensitivity of investment to cash flow resulting from IPO will be higher for small IPO firms than large IPO firms.

## 3. Model and empirical methods

This study applies the panel data analysis technique that is widely used these days for statistical analysis. The advantages of using panel data sets are as follows:

First, the use of panel data makes it possible to produce more reliable parameter estimates, and enables to specify and test more sophisticated models through the increased number of observations. Second, panel data sets may alleviate the problem of multicollinearity. Third, these data sets enables to identify and measure effects that are simply not detectable in pure cross section or pure time series data. Finally, the use of panel data may eliminate or reduce estimation bias because it is possible to control for latent variables by introducing individual or time effects. In this study, typical panel data analysis like the fixed effects model (covariance model) and the random effects model (error component model) are used.[9]

The model for empirical analysis slightly modifies Devereux and Schiantarelli's (1989) investment model, according to the hypotheses to be tested.[10] For regression analysis, all variables are divided by the capital stock K at the beginning of the period to reduce heteroscedasticity. The reduced-form investment model for empirical analysis is as follows:

$$\left(\frac{I}{K}\right)_{jt} = \alpha_j + \alpha_t + \beta_S\left(\frac{S}{K}\right)_{jt} + \beta_{CF}\left(\frac{CF}{K}\right)_{jt} + \beta_{LD}\left(\frac{\Delta LD}{K}\right)_{jt} + \beta_{WC}\left(\frac{\Delta WC}{K}\right)_{jt} + u_{jt} \quad (1)$$

$I$ = fixed asset investment
$S$ = sales
$CF$ = cash flow
$\Delta WC$ = increase in working capital
$\Delta LD$ = increase in long-term debt
$K$ = stock of fixed assets at the beginning of the period

In this model, $\alpha_j$ and $\alpha_t$ represent individual firm effects and time effects respectively, in either the fixed effects model or the random effects model.

For the endogeneity test which examines the existence of any correlation between error terms $u_{jt}$ and independent variables $X_{jt}$, a Hausman test is conducted on both models. The null hypothesis, $H_0$ for the Hausman test on endogeneity, is $E(u_{jt}|X_{jt}) = 0$. The regression coefficients of the

fixed effects model ($\beta_F$), whether $H_0$ is true or not, are always consistent. On the other hand, the regression coefficients of the random effects model ($\beta_R$) are BLUE under $H_0$, consistent and efficient asymptotically. However, if $H_0$ is not true, $\beta_R$ is not consistent. So, if $H_0$ is rejected, the fixed effects model is favored over the random effects model despite its low efficiency. Test statistics for the endogeneity test are shown in (2), where $\widehat{\ }$ means estimate. Under $H_0$, *plim* $\widehat{q_1} = 0$ and $\text{cov}(\widehat{q_1}, \widehat{\beta_R}) = 0$ hold good.

$$m_1 = \widehat{q_1}'[\text{var}(\widehat{q_1})]^{-1}\widehat{q_1} \sim \chi_k^2, \qquad (2)$$

$k$: the dimension of slope vector $\beta$

$\widehat{q_1} = \widehat{\beta_F} - \widehat{\beta_R}$

$\text{var}(\widehat{q_1}) = \text{var}(\widehat{\beta_F}) - \text{var}(\widehat{\beta_R})$

In order to analyze the difference in regression coefficients between the groups of firms, interactive dummy variables are added into the basic model (1). For example, in order to analyze any changes in the sensitivity of investment to cash flow during the periods before and after IPO, interactive dummy variables are added to the variables at the right hand side in the basic model (1). The model specification for this purpose is as follows:

$$\left(\frac{I}{K}\right)_{jt} = \alpha_j + \alpha_t + (\beta_1 + \gamma_1 D_{jt})\left(\frac{CF}{K}\right)_{jt} + (\beta_2 + \gamma_2 D_{jt})\left(\frac{S}{K}\right)_{jt} + (\beta_3 + \gamma_3 D_{jt})\left(\frac{\Delta LD}{K}\right)_{jt} + (\beta_4 + \gamma_4 D_{jt})\left(\frac{\Delta WC}{K}\right)_{jt} + u_{jt} \qquad (3)$$

The difference between (1) and (3) lies in the addition of the interactive dummy variable $D_{jt}$, which is 1 after and 0 before IPO. $\gamma$ represents the changes in regression coefficients after IPO. If $\gamma_1$ shows a statistically significant negative value, one can argue that there exist the effects of financing constraints relaxation by the IPO. Regression model (3) will also be used to test the various hypotheses in this study.

However, to test hypothesis 2 concerning the difference in cash flow coefficients between listed and unlisted firms, it is impractical to use interactive dummy variables because the data with different periods of time are used for each group. So, after the regression analysis for each group of firms, the *t*-test statistic (4) is applied. In this case, it is necessary to assume that error terms are independent between the two groups.

$$\frac{\beta_h - \beta_l}{[S(\beta_h)^2 + S(\beta_l)^2]^{1/2}} \sim t(n_h + n_l + 2k - 2) \qquad (4)$$

In this test statistic, $\beta_h$ and $\beta_l$ represent the regression coefficients of unlisted firms ($h$) which are less financially constrained, and those of listed firms ($l$) which are more financially constrained, respectively. $S(\beta)^2$ represents the sum of squares of standard errors for the regression coefficient. $n_h$ and $n_l$ represent the number of observations in each group, and $k$ represents the number of explanatory variables in the regression equation.

## 4. Data and empirical results

### 4.1. *Panel data and descriptive statistics*

*Structure of panel data*

The data used for empirical analysis are taken from KIS-LINE DB of Korea Investors' Service Inc.[11] For listed firms, 9-year data of 215 manufacturing firms from 1985 to 1993 are used, and for unlisted firms, 5-year data of 190 manufacturing firms from 1989 to 1993 are used. In the case of unlisted firms, the period of time for analysis can not but be shortened when compared with listed firms because of the difficulty in gathering data.

Variables for the analysis include fixed assets investment, cash flow, sales, working capital and long-term debt. For the stock of fixed asset (KIS-LINE classification No. 11-4000), the sum of tangible and assets is used. The investment in fixed assets representing the increase in the stock of fixed assets (KIS-LINE classification No. 14-5200), is the sum of increases in land, buildings and buildings in process, machinery and intangible fixed assets.

For cash flow, the sum of depreciation expense and net profit is used. This estimate for cash flow was also used by Blundell, Bond, Devereux and Schiantarelli (1992), Fazzari and Petersen (1993). Here, depreciation expense is the sum of depreciation expense in tangible assets (KIS-LINE classification No. 14-1021) and depreciation expense in intangible assets (KIS-LINE classifi-

cation No. 14-1022); and net income is net profit after tax (KIS-LINE classification No. 12-9000).

For sales, net sales (KIS-LINE classification No. 12-1000) is used. Working capital is defined as "liquid assets – liquid liabilities", and the increase/decrease in working capital is defined as the difference between the working capital at the end of the period and that at the beginning of the period (KIS-LINE classification No. 14-8000). For the increase in long-term debt, the increase in long-term debt in the statement of changes in financial position (KIS-LINE classification No. 14-1420) is used.

*Classification of the groups of firms*

In classifying firms by their size, 66 listed firms that recorded average annual sales of 300 billion won or more from 1985 to 1993 are classified as LMFs group, and 57 listed firms that recorded average annual sales of 50 billion won or less are classified as SMFs group. For a clearer test of the hypothesis, firms in the intermediate range are excluded from the analysis.[12] As the proxy variable for firm size, either total equity or total assets may be used; but, in this study, total sales amount is chosen as classification criteria, since it is most frequently used when assessing the market share of a firm in an industry.[13]

To estimate the change in the effect of financing constraints on investment between the period before and after IPO, data from 69 manufacturing firms whose stocks were newly listed in 1988 are taken. Among these 69 firms, 35 firms with 9-year average annual sales of 35 billion won or more are classified as LMFs group, and the remaining 34 firms are classified as SMFs group.

*Summary of descriptive statistics*

A summary of descriptive statistics on variables in the regression analysis of listed and unlisted firms is shown in Table I. The summary of listed firms also includes descriptive statistics of LMFs and SMFs.

Descriptive statistics of the variables for the 69 firms that went public in 1988 for 9 years, during the periods before IPO and after IPO are shown in Table II.

## 4.2. *Empirical results*

*Test of the investment model*

First, in order to determine the proper econometric model for panel data analysis, variance components due to individual firm effects ($\sigma_j^2$) and time effects ($\sigma_t^2$) should be estimated. In the case of listed firms, $\sigma_j^2$ is 181.384 (*F*-value: 8.76, *p*-value: 0.00) and $\sigma_t^2$ is 2.113 (*F*-value: 1.92, *p*-value: 0.06), while the variance components due to error terms ($\sigma_\varepsilon^2$) is 144.847 and the total variance is

TABLE I
Summary of descriptive statistics on listed and unlisted firms

| Variables | Listed firms | | | Unlisted firms |
|---|---|---|---|---|
| | All firms | LMFs | SMFs | |
| $I_t/K_{t-1}$ | 0.484<br>(1.331) | 0.433<br>(0.625) | 0.485<br>(0.359) | 0.701<br>(6.103) |
| $C_t/K_{t-1}$ | 0.247<br>(0.430) | 0.248<br>(0.165) | 0.245<br>(0.727) | 0.203<br>(1.104) |
| $S_t/K_{t-1}$ | 4.190<br>(3.129) | 4.084<br>(3.503) | 4.108<br>(2.677) | 5.759<br>(15.950) |
| $\Delta LD_t/K_{t-1}$ | 0.118<br>(0.237) | 0.103<br>(0.150) | 0.135<br>(0.271) | 0.299<br>(1.705) |
| $\Delta WC_t/K_{t-1}$ | 0.047<br>(0.727) | 0.008<br>(0.304) | 0.061<br>(1.197) | –0.120<br>(5.038) |

[a] *I* is fixed asset investment, *S* is sales, *CF* is cash flow, $\Delta WC$ is the increase in working capital, $\Delta LD$ is the increase in long-term debt and $K_{t-1}$ is the stock of fixed assets at the beginning of the period *t*.
[b] The standard errors of the mean appear in parentheses.

TABLE II
Summary of descriptive statistics on variables of newly listed firms in 1988

| Variables | Entire period | Before IPO | After IPO |
|---|---|---|---|
| $I_t/K_{t-1}$ | 0.432<br>(0.350) | 0.457<br>(0.615) | 0.412<br>(0.359) |
| $C_t/K_{t-1}$ | 0.311<br>(0.328) | 0.406<br>(0.216) | 0.207<br>(0.326) |
| $S_t/K_{t-1}$ | 4.950<br>(3.504) | 6.537<br>(4.315) | 3.657<br>(2.150) |
| $\Delta LD_t/K_{t-1}$ | 0.142<br>(0.212) | 0.433<br>(0.931) | 0.112<br>(0.137) |
| $\Delta WC_t/K_{t-1}$ | 0.131<br>(0.689) | 0.065<br>(0.572) | 0.037<br>(0.446) |

[a] All variables are as defined in Table I, note a.
[b] The standard errors of the mean appear in parentheses.

328.345. $\sigma_j^2$ accounts for 55.24% of the total variance, while $\sigma_t^2$ accounts for 0.64% of the total variance. The *F*-test shows that $\sigma_t^2$ is different from 0 only at a significance level of 10%. A similar trend is found for unlisted firms. $\sigma_j^2$ is 1,046.658 (*F*-value: 1.72, *p*-value: 0.00) and $\sigma_t^2$ is 45.138 (*F*-value: 4.67, *p*-value: 0.00), while $\sigma_\varepsilon^2$ is 1,824.517 and the total variance is 2,916.312. $\sigma_j^2$ accounts for 35.89% of the total variance, while $\sigma_t^2$ accounts for only 1.54% of the total variance. For unlisted firms, the *F*-test shows that the variance component due to individual firm effect or time effect is significantly different from 0; but since the variance component due to time effect is relatively small, an investment model thatcovers only individual firm effect will be used in this study.

To test for endogeneity, a Hausman test is conducted to find out the relationship between error terms $u_{jt}$ and independent variables $X_{jt}$. In the case of listed firms, the $\chi^2$-value is 19.61 for LMFs and 20.95 for SMFs, so, they are statistically significant. Since the null hypothesis $H_0$, $E(u_{jt}|X_{jt}) = 0$ is unacceptable, it would be better to use fixed effect estimates rather than random effect estimates. If endogeneity is present, only the estimates from the fixed effects model remain consistent. But in asymptotic cases, which is common in panel data, the efficiency of the random effect estimates is higher than that of the fixed effect estimates. So, in this study, the results from both the fixed effects model and the random effects model will be presented.

*Results of hypotheses testing*

The main point of hypothesis 1 is that in the presence of information asymmetry, the investment expenditures of SMFs will be more sensitive to cash flow than those of LMFs. To satisfy this hypothesis, the cash flow coefficient of SMFs should be statistically significantly larger than that of LMFs.

As seen in Table III, the cash flow coefficient of listed SMFs in the fixed effects model and the random effects model are 0.5412 and 0.5399 respectively, which are considerably larger than that of LMFs 0.2422 and 0.2934. The regression model with interactive dummy variables to find out the difference in coefficients between SMFs and LMFs shows that the *t*-value of the interactive dummy variable for the cash flow coefficient is 1.99 for SMFs (*p*-value: 0.04). The difference in the coefficient between the groups is statistically significant at 5% significance level.[14]

This result suggests that for the listed firms that have spent considerable time after IPO, firm size can be the prior criterion for market imperfection factors, such as information asymmetry, and that transaction costs and information asymmetry may differ significantly according to firm size.

Hypothesis 2 suggests that the degree of financing constraints in listed firms is lower than in unlisted firms, and therefore, the sensitivity of investment to cash flow for listed firms should be lower than for unlisted firms. In order for this hypothesis to be satisfied, the cash flow coefficient in the group of unlisted firms has to be significantly larger than in the group of listed firms.

It is difficult to compare the coefficient for listed firms with that for unlisted firms because of the different time periods (for listed firms, the period of time is 9 years, whereas for unlisted firms, 5 years). As shown in Table IV, the cash flow coefficient for listed firms in the fixed effects model is 0.5366, and 0.5398 in the random effects model, while the cash flow coefficients for unlisted firms are 0.7976 and 0.9299 respectively. This result shows a higher cash flow coefficient for unlisted firms than for listed firms.

The *t*-value of the difference in the coefficient

TABLE III
Effects of financing constraints on investments based on firm size

| Independent variables | LMFs (66 firms) | | SMFs (57 firms) | |
|---|---|---|---|---|
| | Fixed effects model | Random effects model | Fixed effects model | Random effects model |
| $CF_t/K_{t-1}$ | 0.2422<br>(1.59, 0.01) | 0.2934<br>(1.91, 0.00) | 0.5412<br>(11.85, 0.00) | 0.5399<br>(11.19, 0.00) |
| $S_t/K_{t-1}$ | 0.0205<br>(1.78, 0.07) | 0.0142<br>(1.32, 0.18) | 0.0783<br>(4.86, 0.00) | 0.0757<br>(4.67, 0.00) |
| $\Delta LD_t/K_{t-1}$ | 0.3576<br>(2.96, 0.00) | 0.3779<br>(2.99, 0.00) | 0.1642<br>(1.36, 0.17) | 0.1605<br>(1.27, 0.20) |
| $\Delta WC_t/K_{t-1}$ | –0.2196<br>(–4.06, 0.00) | –0.2298<br>(–4.07, 0.00) | –0.1053<br>(–3.60, 0.00) | –0.1032<br>(–3.36, 0.00) |
| $R^2$ | 0.0711 | 0.1262 | 0.2816 | 0.2886 |

[a] The dependent variable is the fixed investment-capital ratio ($I_t/K_{t-1}$). All variables are as defined in Table I, note a.
[b] *t*-values and *p*-values are in parentheses.
[c] The individual firm effects in fixed effects model are not reported.

TABLE IV
Effects of financing constraints relaxation by the IPO

| Independent variables | Listed firms (215 firms) | | Unlisted firms (190 firms) | |
|---|---|---|---|---|
| | Fixed effects model | Random effects model | Fixed effects model | Random effects model |
| $CF_t/K_{t-1}$ | 0.5366<br>(14.56, 0.00) | 0.5398<br>(13.82, 0.00) | 0.7976<br>(9.87, 0.00) | 0.9229<br>(10.67, 0.00) |
| $S_t/K_{t-1}$ | 0.0495<br>(5.97, 0.00) | 0.0475<br>(5.59, 0.00) | 0.0212<br>(3.35, 0.00) | 0.0178<br>(2.62, 0.00) |
| $\Delta LD_t/K_{t-1}$ | 0.2729<br>(4.38, 0.00) | 0.2801<br>(4.24, 0.00) | 0.0524<br>(1.02, 0.30) | 0.0120<br>(0.21, 0.82) |
| $\Delta WC_t/K_{t-1}$ | –0.1205<br>(–5.71 0.00) | –0.1213<br>(–5.42, 0.00) | –1.0480<br>(–66.18, 0.00) | –1.0345<br>(–64.02, 0.00) |
| $R^2$ | 0.4406 | 0.4496 | 0.9219 | 0.9232 |

[a] The dependent variable is the fixed investment-capital ratio ($I_t/K_{t-1}$). All variables are as defined in Table I, note a.
[b] *t*-values and *p*-values are in parentheses.
[c] The individual firm effects in fixed effects model are not reported.

between the groups is 4.824, which is statistically significant. This difference might be caused by lower information asymmetry in listed firms than in unlisted firms as explained in section 2. Thus, the results concerning hypothesis 2 show more clearly that financing constraints are caused by information asymmetry than the previous results for hypothesis 1.

The point of hypothesis 3 is that even in the same firm, the degrees of information asymmetry before IPO and after IPO may differ, so the sensitivity of investment to cash flow is higher during the period prior to IPO than after IPO. In order for this hypothesis to be satisfied, the cash flow coefficient during the period before IPO has to be significantly larger than the one during the period after IPO.

The test results on hypothesis 3 are shown in Table V. To analyze the effects of IPO on financing constraints more clearly, the data for the 69 manufacturing firms newly listed in 1988, after excluding the data of year 1988, are used for the

TABLE V
Difference in financing constraints between the periods before and after IPO

| Independent variables | Fixed effects model | | Random effects model | |
|---|---|---|---|---|
| | Before IPO | After IPO | Before IPO | After IPO |
| $CF_t/K_{t-1}$ | 1.1113<br>(4.99, 0.00) | 0.2904<br>(8.87, 0.00) | 0.8758<br>(5.31, 0.00) | 0.3921<br>(6.76, 0.00) |
| $S_t/K_{t-1}$ | 0.0460<br>(3.70, 0.00) | 0.1197<br>(6.99, 0.00) | 0.0185<br>(2.08, 0.03) | 0.0480<br>(5.38, 0.00) |
| $\Delta LD_t/K_{t-1}$ | 0.0312<br>(5.88, 0.36) | 0.8240<br>(6.22, 0.00) | 0.0185<br>(0.54, 0.58) | 0.9047<br>(7.20, 0.00) |
| $\Delta WC_t/K_{t-1}$ | –0.7063<br>(–14.64, 0.00) | –0.2398<br>(–6.11, 0.00) | –0.7687<br>(–14.53, 0.00) | –0.3067<br>(–7.73, 0.00) |
| $R^2$ | 0.7941 | 0.4978 | 0.7955 | 0.6326 |

[a] The dependent variable is the fixed investment-capital ratio ($I_t/K_{t-1}$). All variables are as defined in Table V, note a.
[b] *t*-values and *p*-values are in parentheses.
[c] The individual firm effects in fixed effects model are not reported.

analysis in the fixed effects model. Results show that the cash flow coefficient prior to IPO is 1.1113, whereas the cash flow coefficient after IPO reduces drastically to 0.2904. To analyze the difference in cash flow coefficient between two periods, interactive dummy variable are used. The results show that the *t*-value is –4.55 (*p*-value: 0.00), which means that the difference is statistically significant.[15]

Finally, the main point of hypothesis 4 is as follows: the effects of financing constraints relaxation by the IPO in LMFs are lower than in SMFs; and therefore, the change in the sensitivity of investment to cash flow due to the IPO will be lower in LMFs. To prove this hypothesis true, the decrease in the cash flow coefficient of SMFs due to the IPO should be statistically significantly larger than that of LMFs. If the change in the sensitivity of investment to cash flow due to the IPO of SMFs is significantly different from 0, while that of LMFs is not significantly different, hypothesis 4 can be accepted.

The results on hypothesis 4 are shown in Table VI. To test the difference in the change in cash flow coefficient between LMFs and SMFs due to the IPO, a regression model with interactive dummy variables is used. In the case of LMFs, the t-value of the interactive dummy variables for cash flow coefficient is –1.62 (*p*-value: 0.12). This means that there is no statistically significant

TABLE VI
Difference in the effect of financing constraints relaxation by the IPO between LMFs and SMFs

| Independent variables | LMFs (35 firms) | SMFs (34 firms) |
|---|---|---|
| $CF_t/K_{t-1}$ | 0.7722<br>(4.50, 0.00) | 1.1300<br>(4.87, 0.00) |
| DUMCF | –0.2866<br>(–1.18, 0.12) | –0.8598<br>(–3.63, 0.00) |
| $S_t/K_{t-1}$ | 0.0341<br>(2.97, 0.00) | 0.0180<br>(1.35, 0.17) |
| DUMS | 0.0229<br>(1.75, 0.08) | 0.0770<br>(4.45, 0.00) |
| $\Delta LD_t/K_{t-1}$ | 0.4464<br>(3.00, 0.00) | 0.4067<br>(1.99, 0.04) |
| DUMLD | 0.9933<br>(5.28, 0.00) | 0.5546<br>(2.11, 0.03) |
| $\Delta WC_t/K_{t-1}$ | –0.5426<br>(–7.21, 0.00) | –0.8035<br>(–10.13, 0.00) |
| DUMWC | 0.2206<br>(2.49, 0.01) | 0.6208<br>(6.86, 0.00) |
| $R^2$ | 0.6823 | 0.5823 |

[a] The dependent variable is the fixed investment-capital ratio ($I_t/K_{t-1}$). All variables are as defined in Table I, note a. DUMCF, DUMS, DUMLD, DUMWC represent interactive dummy variable for each independent variable respectively.
[b] *t*-values and *p*-values are in parentheses.
[c] The individual firm effects in the fixed effects model are not reported.

difference even at the 10% significance level. In the case of SMFs, the *t*-value is –3.63 (*p*-value: 0.00), which means there is a statistically significant difference in cash flow coefficients between the two groups. So, in general, the effect of financing constraints relaxation by the IPO is more prominent in SMFs, which had initially faced severer financing constraints than LMFs before IPO.

## 5. Conclusions

Capital market imperfections, such as information asymmetry, increase the cost of external funds compared with that of internal funds. This creates financing constraints that limit the availability of external funds, and makes investment excessively sensitive to cash flow. This study has analyzed the effect of financing constraints on corporate investment by introducing a new approach that overcomes the problems discovered in previous empirical studies.

At first, this study analyzes the effect of financing constraints on investment by classifying firms into two groups based on their size, the method employed in previous empirical studies. As expected, the test results show that the sensitivity of fixed investment to cash flow in SMFs is higher than that in LMFs. Therefore, it can be said that the degree of financing constraints faced by firms varies depending on their size.

Previous empirical studies emphasized the difference between the groups of firms since cash flow could be a proxy for future investment opportunities; however, they had limits in that they did not consider unknown systematic factors other than financing constraints that could cause differences in the sensitivity of fixed investment to cash flow between groups of firms. This study has tried to solve this problem by using a method that compares the financial behaviors of firms before and after their stocks are listed in a stock exchange. The results show that the cash flow coefficient for unlisted firms is higher than that for listed firms; and the cash flow coefficient for a firm before IPO is higher than after IPO. Especially, the effects of financing constraints relaxation by the IPO are more prominent in SMFs than in LMFs. This result implies that, in order to maximize the economic effect of the IPO, government's policy should be geared to emphasizing the IPO of small firms that are financially sound.

The limits of this study and the direction for future researches may be summarized as follows.

First, due to the problems in obtaining corporate financial data, the period of time for the analysis have to be limited to 9 years for listed firms and 5 years for unlisted firms. If longer time series data are available, various econometric techniques, such as the dynamic linear model and the intertemporal difference estimator in the Hausman test, which deals with measurement error problems more accurately, may be employed.

Second, more meaningful results may be derived by expanding the scope of research from corporate to industry level and by comparing an industry group that is likely to be more financially constrained, with another industry group that is likely to be less financially constrained.

At last, this study emphasizes the existence of financing constraints caused by capital market imperfection factors such as information asymmetry. Since the existence of financing constraints has been proved empirically, the analysis of the sources of financing constraints should be pursued in future studies. In this case, finding out the sources of financing constraints and determining proper proxy variables for each source of financing constraints will be the core issues.

## Notes

[1] The institutional factors limiting availability of external funds in Korea are as follows:

For instance, in the case of external financing from bank, following practices are prevalent.

First, as a voluntary credit rationing, lending banks require deposits or loan amounts, partly or in whole, to be placed in them, or require provision of adequate collateral to secure credit, since it is quite difficult for them to sort out reliable customers solely by their independent appraisal. Second, as a compulsory credit rationing, there are such institutional factors as government intervention through interest regulations, a dual interest rate structure resulting from the gap between practical market-based interest rates and official interest rates set by the monetary policy authorities, a credit control system in which distorted political support is given to large-sized firms and export-oriented manufacturing firms, while restricting the supply of loans to small and medium-sized enterprises and firms operating mainly for domestic demand.

External financing through issuing new shares is also limited by regulations governing new shares and arbitrary

government adjustment of IPO timing through consideration of stock market circumstances.

[2] This approach is referred to as a split-sample approach since it classifies firms by assuming the existence of firm heterogeneity in financing constraints. On the other hand, the representative firm approach refers to one interpreting excessive sensitivity of investment to cash flow, after controlling the expected future profitability of investment as a signal of the existence of financing constraints. The representative firm approach has problems in that it is difficult to select appropriate variables that represent investment opportunities. In this case, internal cash flow may reflect a future investment profitability that cannot be controlled by the proxy variables for an investment opportunity (Generally, Tobin's q is used as the proxy variable); and as a result, the effect of financing constraints can be overestimated. For the previous study which applied the representative firm approach, see Fazzari and Athey (1987).

[3] For detailed explanation, see Blinder (1988).

[4] Bond rating (Whited, 1992), maturity of firms, dispersion of ownership (Schaller, 1993) and membership in an industrial group (Hoshi et al., 1991) are some of the criteria that previous empirical studies used as the indicators of differences in information asymmetry across firms.

[5] In Korea, Korea Stock Committee (KSC) which takes charge of Korean stock exchange limits IPOs very strictly, in due consideration of stock price fluctuations, especially relating to the Korea Composite Stock Price Index (KOSPI). For this reason, IPO of a firm is determined by concurrent stock market conditions (environmental factors) rather than by the company's financial status or management performance. It is not unusual for some companies to wait 2 ~ 3 years before obtaining the permission for IPO, albeit fulfilling all specified requirements. For example, Korea Telecom (KT), the largest telecommunication operator in Korea, fulfilled all the requirements for the IPO; but its IPO has been postponed for over 4 years by the government, for fear of the consequential shock to the stock market which has been on a downward trend. Therefore, it is reasonable to view the IPO in Korea as an exogenous event, rather than as an endogenous event whose occurrence can be determined by internal factors within a firm.

[6] For the benefits and costs of IPO, see Pagano M., F. Panetta and L. Zingales(1995).

[7] For example, according to the Korean stock exchange law, the stock exchange can request listed firms to confirm or deny on the rumors related to them, and can also request disclosure of important information, if any, that is not made public, in case of frequent changes in stock prices and trade volumes. The important information, that is not made public, refers to the information on firms that is likely to affect investors' decision making and is not released to the general public. Listed firms should disclose the information without delay, unless the disclosure is impossible due to government regulations, natural disaster or other uncontrollable reasons.

[8] Since a firm's IPO is a pure financial event, it is quite plausible to assume that no changes in investment opportunities are caused by the IPO.

[9] The difference between the fixed effects model and the random effects model is that in the fixed effects model, dummy variables are used to represent individual firm effects and time effects, while in the random effects model, both effects are introduced into the model through variance components in error terms. See Matyas and Sevestre (1992) and Maddala (1993).

[10] For the derivation of (1), see Devereux and Schiantarelli's (1989) Appendix. Similar model to (1) were also used by Fazzari and Petersen (1993) and Carpenter (1994). However, instead of q model, sales accelerator model is used in this study because it is difficult to estimate Tobin's q for unlisted firms.

[11] For further details of these financial statements, refer to "KIS-LINE users' manual (1994)". KIS-LINE is an on-line, real-time strategy information system operated by Korea Investors Service Inc., a representative Korean credit rating company, similar to Moody's or Standard and Poors. This system represents the largest data bank in Korea dealing with overall data on the economy, finance, industry and the corporate sector. The corporate finance DB of the system, in particular, features the longest time series accounting data on Korean listed and unlisted firms. Although more detailed data (e.g., to which industries individual firms belong) should be supplmented with respect to individual firms, its accounting data is credited as most reliable in Korea. So, this DB is most frequently used by scholars for the studies regarding corporate finance in Korea.

[12] In this study medium-range firms has been excluded from the analysis, considering possible intertemporary changes in the financing constraints faced by these firms. Analysis of these firms shows that the cash flow coefficient representing financing constraint effects is 0.5127 (*t*-value: 3.48, *p*-value: 0.00). This estimate is not significantly different from that for LMFs, but is significantly different from that for SMFs. This result shows that financing constraints effects are especially high on SMFs in Korea.

[13] Faroque and Ton-That (1995) also used sales as the criterion for firm size in classifying firms into groups.

[14] For the sake of convenience, only the results based on the fixed effects model will be presented from now on. The results based on the random effects model are not significantly different in interpretation.

[15] Although not shown in the test results, in the case of the 33 firms whose stocks that were newly listed in 1990, the cash flow coefficient before IPO is 1.3653 and 0.5218 after IPO.

## References

Baltagi, B. H., 1995, Econometric Analysis of Panel Data, 1st ed., John Wiley and Sons.

Blinder, A. S., 1988, 'Financing Constraints and Corporate Investment, Comment and Discussion', *Brookings Papers on Economic Activity* **l**, 196–200.

Blundell, R., S. Bond, M. Devereux and F. Schiantarelli, 1992, 'Investment and Tobin q', *Journal of Econometrics* **51**, 233–257.

Carpenter, R. E., 1994, 'Finance Constraints or Free Cash Flow? The Impact of Asymmetric Information on Investment', Emory University Working Paper.

Devereux, M. and F. Schiantarelli, 1989, 'Investment,

Financial Factors and Cash Flow: Evidence from U.K. Panel Data', NBER Working Paper No. 3116.

Faroque, A. and T. Ton-That, 1995, 'Financing Constraintsand Firm Heterogeneity in Investment Behavior: An Application of Non-Nested Tests', *Applied Economics* **27**, 317–326.

Fazzari, S. M. and M. Athey, 1987, 'Asymmetric Information, Financing Constraints, and Investment', *Review of Economics and Statistics*, 481–487.

Fazzari, S. M., R. G. Hubbard and B. C. Petersen, 1988, 'Financing Constraints and Corporate Investment', *Brookings Papers on Economic Activity* **1**, 141–195.

Fazzari, S. M. and B. C. Petersen, 1993, 'Working Capital and Fixed Investment: New Evidence on Financing Constraints', *RAND Journal of Economics* (Autumn), 328–342.

Hoshi, T., A. K. Kashyap and D. Scharfstein, 1991, 'Corporate Structure, Liquidity, and Investment: Evidence from Japanese Industrial Groups', *The Quarterly Journal of Economics*, 33–60.

Kaplan, S. N. and L. Zingales, 1997, 'Do Investment-Cash Flow Sensitivities Provide Useful Measures of Financing Constraints?', *The Quarterly Journal of Economics* **112**, 169–215.

Korea Investors Service Inc., *KIS-LINE User's Manual*, 1994.

Maddala, G. S., 1993, *The Econometrics of the Panel Data* Vol. I, II, Edward Elgar Publishing Co.

Matyas, L. and P. Sevestre (eds.), 1992, *The Econometics of Panel Data – Handbook of Theory and Applications*, Kluwer Academic Publishers.

Modigliani, F. and M. H. Miller, 1958, 'The Cost of Capital, Corporation Finance, and the Theory of Investment', *American Economic Review* **48**, 261–296.

Mills, K., S. Morling and W. Tease, 1995, 'The Influence of Financial Factors on Corporate Investment', *The Austrian Economic Review* (2nd quarter), 50–64.

Myers, S. C. and N. S. Majluf, 1984, 'Corporate Financing and Investment Decisions When Firms Have Information that Investors Do Not', *The Journal of Finance*, 187–221.

Pagano, M, F. Panetta and L. Zingales, 1995, 'Why Do Companies Go Public? An Empirical Analysis', NBER Working Paper #5367.

Schaller, H., 1993, 'Asymmetric Information, Liquidity Constraints, and Canadian Investment', *Canadian Journal of Economics* (August), 552–574.

Stiglitz, J. E. and A. Weiss, 1981, 'Credit Rationing in Markets with Imperfection', *American Economic Review* **71**, 393–410.

Whited, T. M., 1992, 'Debt, Liquidity Constraints, and Corporate Investment: Evidence from Panel Data', *The Journal of Finance* (September), 1425–1460.