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Bank-dependence, Financial Constraints, and Investments: Evidence from Korea*

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Firms are financially constrained because external funds are more costly than internal funds in imperfect financial markets. If banks play a role in alleviating information costs, financial constraints faced by firms decrease with bank dependency. The study finds that investments for firms with higher bank debt ratio respond less sensitively to cash flow using the Korean firm level data. This implies that a close bank relationship improves the accessibility to external funds by firms. The effect of a bank relationship on sensitivity of investment to internal funds is pronounced for large firms and is reinforced after a financial crisis.

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1. INTRODUCTION

As documented by previous research, firms with higher information problems face higher costs for external financing and experience greater financial constraints. The firms with a close bank relationship become less liquidity-constrained if banks play a critical role of mitigating information problems of client firms and consequently resolve financial constraints confronted by firms. However, firms cannot enjoy wide access to capital if bank affiliation imposes nontrivial costs to client firms. Existing empirical studies have yielded mixed results about the effect of bank-firm ties on financial constraints.

This paper investigates whether financial constraints vary systematically with the dependence on bank debt by a firm. Korean firm data is useful in examining the effect of a bank relationship on investments since Korean firms have long relied on bank financing. Although the fraction of bank financing has recently decreased through rapid development of capital markets, Korean firms still finance largely from banks. In 2003, firms financed 41.57% of external funds from domestic banks and non-bank financial intermediaries while they financed 36.46% from domestic capital markets.

Korea has a unique form of bank-firm relationships that link large business groups to one particular bank. The 'principal transactions bank system' was initially devised for the purpose of credit control over business groups in 1982. According to Nam (1996), the roles of the principal transactions bank include handling of credit information and business activities, provision of loans, guidance for improving of capital structure, dealing with troubled firms, restrictions on real estate acquisitions, and investments in new business. Although Korean banks play a limited role in monitoring client firms, the bank-firm relationships can affect the accessibility to credit by a firm.[1)]

[1)] The customer relationship is weaker in Korea than in Japan because the Korean principal transactions bank system was initiated by the need to regulate large firms. Banks do not

This study appraises the role of bank financing in Korea by investigating whether bank relationships play a role of ameliorating the financial constraints of firms. Employing a dataset of 363 firms from 1981-2003, the study estimated various forms of investment equations and investigated whether cash flow sensitivity of investment decreases with the bank debt ratio. The study also examined whether the effect on investment of bank relationship varies across the size and credit market conditions of a firm.

The main empirical findings include that: i) firms with higher bank debt ratio face less severe financial constraints; ii) bank-dependency reduces financial constraints especially for large firms; and iii) the role of banks in reducing information asymmetry problems are more successful after a financial crisis. The findings show that the benefits exceed the costs of bank financing in Korea. Banks play a successful role of easing financial constraints by alleviating information problems.

The paper is organized as follows. Section 2 reviews the main literature on financial theories of investment and the effect of bank-firm relationships on investment. Model specification and estimation methods are described in section 3. In section 4, the study presents the data properties and estimation results. Section 5 contains a brief conclusion.

2. LITERATURE REVIEW

2.1. Cash Flow Sensitivity of Investment

According to Modigliani and Miller (1958) investments by firms solely depend on profit opportunities. However, a growing body of empirical literature has found that investment decisions by a firm are dependent on financial factors such as the availability of internal funds. Since Fazzari,

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have much incentive to monitor the performance of borrowing firms because most loans are accompanied by collateral and cross-guarantees among affiliated firms. See Choi and Lee (2006).

Hubbard and Petersen (1988), most researchers have presented the significant cash flow sensitivity of investment as evidence of financial factors for investments.

Existing literature attributes investment sensitivity to internal funds to imperfections in the financial markets.[2] Myers and Majluf (1984) and Stiglitz and Weiss (1981) demonstrate that the costs of external funds are higher than those of internal funds in the presence of the asymmetry of information between borrowers and lenders. As noted by Jensen and Meckling (1976), external investors tend to require a premium for lending because managers who are not owners may pursue self-interests and not the stockholders interests. Both asymmetric information and the possibility of managerial discretion result in financial constraints rendering firms to rely on internal funds for investments.

A large body of literature has empirically examined whether imperfections in financial markets influence investments by a firm.[3] The methodology of the paper by Fazzari, Hubbard, and Petersen is to examine differences in the sensitivities of investment to cash flow between *a priori* segmented firms. Many studies have found that investments for firms with higher information problems respond more sensitively to changes in cash flow than firms with lower information problems. Various segmenting variables have been employed to identify an unobservable degree of information asymmetry. Frequently employed variables include dividend-payout ratio, group affiliation, firm size, firm age, issuing commercial paper, bond ratings, exchange listing, ownership structure, and country characteristics.

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[2] Stein (2001) reviews the theoretical literature that argues for the information asymmetry as a main reason for the sensitivity of investment to cash flow. Some studies such as Kaplan and Zingales (1997), argue that the observed correlation between investment and internal funds solely reflects free cash flow problems due to managerial discretion.

[3] Schiantarelli (1996) and Hubbard (1998) provide extensive surveys of empirical literature on financial constraint models.

2.2. Bank-firm Ties and Investment

Many studies claim that if banks play a role in mitigating information asymmetries, a close tie between a firm and banks can improve the accessibility to financial markets by a firm.[4] There exist two channels through which bank relationships affect external financing for investment. First, close bank ties can be a signal to outside investors that the firm is in a good financial position. Because banks specialize in screening good borrowers in imperfect financial markets, investors are likely to regard bank-dependent firms as creditworthy borrowers.[5] Second, since banks serve as a delegated monitor of firms, a close bank relationship may result in good corporate governance. Managers have less incentive of discretion under the scrutinized monitoring of banks and bank-dependent firms tend to have less agency problems. Because of the reduction of asymmetric information problems, outside investors require a lower premium for lending for firms with bank loans. Financial constraints confronted by a firm decrease as the firm borrows more from the banks than the public markets.

While banks give benefits to a firm by mitigating adverse selection and agency problems, there may be nontrivial costs associated with bank financing. Besides the direct costs of monitoring, so-called 'hold-up costs' are incurred when a firm relies exclusively on short-term bank borrowings. Rajan (1992) and Sharpe (1990) argue that information acquired by a bank can create an information monopoly problem. Banks are able to impose non-competitive terms upon a client firm through monopoly power.[6] If a firm is perceived to be closely affiliated with a bank, it may be difficult for the

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[4] For example, Petersen and Rajan (1994) show that a bank-borrower relationship positively affects the availability of credit.

[5] Diamond (1991) shows that borrowing from banks may serve as a certification device that facilitates financing in capital markets. A number of empirical studies also find that bank loan announcements result in excess returns of borrowing firms (Boscaljon and Ho, 2005). These findings imply that investors regard an increase in bank loans as a good signal in imperfect financial markets.

[6] Degrysee and van Cyseele (2000) find evidence that contract terms deteriorate with longer duration of the relationship in Europe.

firm to raise external funds elsewhere since public markets may interpret this as a refusal by the bank to extend credit. When these costs exceed the benefits from a close relationship it is expect that financial constraints faced by firms would increase with bank-reliance. The effect of bank-dependence on financial constraints depends on the relative size of benefits and costs of relationship lending.

Several empirical studies have investigated the effects of bank-firm relationships on financial constraints with mixed results. Hoshi, Kashyap, and Scharfstein (1991) find that the cash flow sensitivity of investment for bank-affiliated firms is lower than independent firms in Japan and shows that strong ties help alleviate financial constraints. Recently, McGuire (2003) also ascribes less liquidity-constraints of *keiretsu* firms to the role of the main bank system in Japan. Using Spanish firm data, García-Marco and Ocaňa (1999) present evidence that a firm with a close bank relationship is not financially constrained because banks play a monitoring role. Using Taiwanese firm data, Shen and Wang (2005) also demonstrate that investment is less sensitive to cash flow for firms with strong bank relationships because of the reductions in information asymmetry. Castaňeda (2005) provides evidence from Mexican data that bank ties helped overcome financial bottlenecks of the client firms before the financial crisis. Semenov (2006) also finds that the sensitivity of investment to internal funds is lower in countries with close bank-firm relationships than in countries with arm's length bank-firm relationships. K. Park, R. S. Park, and S. H. Yoon (2007) recently report that a positive effect of cash stock on investment is pronounced for firms with a distant relationship with banks in Korea.

Some studies document a negative effect of a close bank relationship on the accessibility to credit by a firm.[7] Hayashi (2000) finds no evidence of the effect of the main bank system on the differential sensitivity of

[7] This claim is consistent with findings that a close relationship does not improve the performance by a firm. Weinstein and Yafeh (1998) show that Japanese bank-affiliated firms perform worse than independent firms using various profit measures. Agarwal and Elston (2001) also show that bank-affiliation does not enhance the performance of firms in Germany.

investment to liquidity in Japan. Using the US firm data, Houston and James (2001) demonstrate that the sensitivity of investment to cash flow increases with the reliance on bank loans by a firm. Using German firm data, Fohlin (1998) also shows that investment is more sensitive to internal liquidity for bank-dependent firms than unattached firms.

The association between a bank relationship and the financial constraints of a firm depends on the economic institutions and legal systems in each country. This issue should be addressed in the context of country-specific circumstances and institutional features.

3. MODEL SPECIFICATION AND ESTIMATION METHOD

3.1. Model Specification

The standard *Q* model posits that Tobin's *Q* is the only determinant of investment and no financial variable should matter. If the financial market is not perfect because of asymmetric information, the availability of internal funds can affect investments. Many researchers rely on the *Q*-model augmented with financial variables to test for the financial effects on investment.[8)]

This study specifies a financial variable-augmented *Q*-model as follows

$$\left(\frac{I}{K}\right)_{it} = c + \beta_1\left(\frac{I}{K}\right)_{it-1} + \beta_2 Q_{it} + \beta_3\left(\frac{CF}{K}\right)_{it} + f_i + d_t + \varepsilon_{it}, \qquad (1)$$

where f_i is firm-specific effect; d_t is time-specific effect; and ε_{it} is white noise. I represents investment; K capital stock; Q Tobin's Q; and CF cash flow. A test for the existence of financial constraints amounts to a test

8) Following Fazzari, Hubbard, and Petersen (1988), most researchers regress the investment level on *Q*, cash flow and other control variables to test for financial constraints.

for the null hypothesis of $\beta_3 = 0$ in equation (1). If the internal financial status of a firm affects investment then the null hypothesis should be rejected.

To test whether the cash flow sensitivity of investment differs across bank-dependence the study estimated the following equation

$$\left(\frac{I}{K}\right)_{it} = c + \beta_1\left(\frac{I}{K}\right)_{it-1} + \beta_2 Q_{it}\cdot BANK_i + \beta_3\left(\frac{CF}{K}\right)_{it}\cdot BANK_i + \beta_4 Q_{it}\cdot IND_i + \beta_5\left(\frac{CF}{K}\right)_{it}\cdot IND_i + f_i + d_t + \varepsilon_{it}, \quad (2)$$

where *BANK* is a dummy variable for firms with high bank-dependence; and *IND* is a dummy variable for firms with low bank-dependence. The study expects that $\beta_3 > 0$ and $\beta_5 > 0$ in an imperfect financial market. Comparing the values of β_3 and β_5 it is possible to examine whether the effect of cash flow on investment is weaker for firms with low bank-dependence than firms with high bank-dependence.

If the effect of the bank relationships is pronounced for firms with hard-to-valued assets, it is expected that the effects of the bank relationships are stronger for small firms than for large firms. The study defines two dummy variables *SMALL* and *LARGE* that capture small firms and large firms. Including the interaction terms between size dummies and bank-dependence dummies it is then possible to examine whether bank-dependence more strongly affects financial constraints for small firms than large firms. If financial constraints are stronger for small firms than large firms it is expected that β_3 is greater than β_7 and that β_5 is greater than β_9 in equation (3). Furthermore, the study expects that the difference between β_3 and β_5 is larger than the difference between β_7 and β_9 if the effect of bank-dependence on cash flow sensitivity is stronger for small firms.

$$\left(\frac{I}{K}\right)_{it} = c + \beta_1\left(\frac{I}{K}\right)_{it-1} + \beta_2 SMALL_i \cdot BANK_i \cdot Q_{it} + \beta_3 SMALL_i \cdot BANK_i \cdot \left(\frac{CF}{K}\right)_{it} + \beta_4 SMALL_i \cdot IND_i \cdot Q_{it} + \beta_5 SMALL_i \cdot IND_i \cdot \left(\frac{CF}{K}\right)_{it} + \beta_6 LARGE_i \cdot BANK_i \cdot Q_{it} + \beta_7 LARGE_i \cdot BANK_i \cdot \left(\frac{CF}{K}\right)_{it} + \beta_8 LARGE_i \cdot IND_i \cdot Q_{it} + \beta_9 LARGE_i \cdot IND_i \cdot \left(\frac{CF}{K}\right)_{it} + f_i + d_t + \varepsilon_{it}. \quad (3)$$

The study now investigates whether bank-firm relationships more strongly affect the degree of financial constraints after the financial crisis in 1997.[9] Included are two dummy variables of *PRE* and *POST* that capture pre- and post-crisis eras in equation (4).

$$\left(\frac{I}{K}\right)_{it} = c + \beta_1\left(\frac{I}{K}\right)_{it-1} + \beta_2 PRE_t \cdot BANK_i \cdot Q_{it} + \beta_3 PRE_t \cdot BANK_i \cdot \left(\frac{CF}{K}\right)_{it} + \beta_4 PRE_t \cdot IND_i \cdot Q_{it} + \beta_5 PRE_t \cdot IND_i \cdot \left(\frac{CF}{K}\right)_{it} + \beta_6 POST_t \cdot BANK_i \cdot Q_{it} + \beta_7 POST_t \cdot BANK_i \cdot \left(\frac{CF}{K}\right)_{it} + \beta_8 POST_t \cdot IND_i \cdot Q_{it} + \beta_9 POST_t \cdot IND_i \cdot \left(\frac{CF}{K}\right)_{it} + f_i + d_t + \varepsilon_{it}. \quad (4)$$

[9] The financial crisis accelerated wide restructuring process in the banking industry. It is expected that the role of banks in screening good borrowers and monitoring management was reinforced after the financial crisis.

The study expects that β_3 is greater than β_7 and that β_5 is greater than β_9 in equation (4). Furthermore, if the effect of bank-dependence on cash flow sensitivity is stronger after the crisis the difference between β_7 and β_9 should be larger than the difference between β_3 and β_5.

Although the *Q*-model is very simple to implement, it has many limitations.[10] Many researchers employ an Euler model of investment to overcome the disadvantages of the *Q*-model.

This study adopted a very simple model in Forbes (2007) in which an Euler equation is derived from the model of the maximization of the firm value under the assumption that dividends must be non-negative. This assumption implies that external financing is more costly than the internal financing.[11] This also assumes that the marginal product of capital is proportional to sales and that the adjustment cost function is quadratic.[12] Finally, if financial constraints are affected by internal funds like cash flow it is possible to derive the following Euler equation

$$\left(\frac{I}{K}\right)_{it} = c + \beta_1\left(\frac{I}{K}\right)_{it-1} + \beta_2\left(\frac{S}{K}\right)_{it} + \beta_3\left(\frac{CF}{K}\right)_{it} + f_i + d_t + \varepsilon_{it}, \qquad (5)$$

where *S* is sales.

In the presence of financial constraints, β_3 is greater than zero. Similar to equation (2), the study adds two dummy variables *BANK* and *IND* to equation (5) to test for the hypothesis that the financial constraints for firms

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[10] Forbes (2007) points out many weaknesses of the *Q*-model. The average *Q* that most researchers rely on is equal to marginal *Q* under very restrictive assumptions. If *Q* is mis-measured for any reason, then the estimates from the *Q* model can be biased.

[11] This model ignores the possibility of debt financing. As Love (2003) describes, the inclusion of debt financing does not affect the first-order condition for investment. It is possible to have another Euler equation for debt in the model with debt financing. This study does not consider the possibility of debt financing because the optimal debt level is out of the scope of this paper.

[12] This assumption is plausible because, as Gilchrist and Himmelberg (1999) show that if a production function has a Cobb-Douglas form, the marginal product of capital is proportional to sales.

with high bank-dependence is weaker than for firms with low bank-dependence. Two size dummies *SMALL* and *LARGE* are adopted to investigate the effects of firm size on the association between bank reliance and financial constrains. The effect of restructuring in the banking industry after the financial crisis can be investigated using the dummies *PRE* and *POST*.

3.2. Estimation Method

The ordinary least squares (OLS) estimation method for dynamic panel models is likely to result in biased estimates due to endogeneity and heterogeneity problems. The error terms in investment equations capture technology shocks to the profit function and explanatory variables such as sales and cash flow that also depend on technology shocks. Some explanatory variables in the investment equation can be correlated with the error term.[13] The presence of the lagged investment-to-capital ratio as an explanatory variable can bias coefficient estimates from the OLS. Potential differences across firms in the investment behavior can also result in a heterogeneity problem.

Instead of the OLS, recent studies adopt the generalized method of moments (GMM) estimation method for dynamic panel models. The success of the GMM technique mainly depends on the adoption of appropriate instruments and the elimination of unobserved firm effects. The study will carry out the two specification tests developed by Arellano and Bond (1991) to test for the validity of the model. A Sargan test for over-identifying restrictions is used to test for the validity of instruments and a test of serial correlation of error terms that can detect unobserved firm effects.

In a situation where the study fails to eliminate unobserved individual effects in the GMM-level estimation results, it will then apply the GMM-system estimation method developed by Arellano and Bover (1995) that

[13] Hayashi and Inoue (1991) argue that many explanatory variables of investment (such as output and cash flow) depend on the technology shock and are endogenous as well.

combines the regression in difference with the regression in levels. The appropriate instruments for the difference regression lagged right-hand side variables if the following moment conditions are fulfilled.

$$E\left[\left(\frac{I}{K}\right)_{it-s}\Delta\varepsilon_{it}\right]=0, \quad s\geq 2\,; \quad t=3,\,.....,\,T,$$
$$E\,[z_{it-s} \quad \Delta\varepsilon_{it}]=0, \qquad s\geq 2\,; \quad t=3,\,.....,\,T, \tag{6}$$

where z_{it} represents the set of explanatory variables (other than lagged capital-output ratio). The instruments for the regression in levels are the lagged differences of the right-hand side variables under the assumption that the differences of the right-hand side variables are not correlated with the unobserved firm effects. The moment conditions for the level equations are

$$E\left[\Delta\left(\frac{I}{K}\right)_{it-s}(f_i+\varepsilon_{it})\right]=0, \quad s\geq 2\,; \quad t=3,\,.....,\,T,$$
$$E\,[\Delta z_{it-s} \quad (f_i+\varepsilon_{it})]=0, \qquad s\geq 2\,; \quad t=3,\,.....,\,T. \tag{7}$$

4. EMPIRICAL ANALYSIS

4.1. Data and Variables

The study constructed a firm-level panel data set from the *Korea Investors Service-Financial Analysis System* (*KIS-FAS*) database. Applying an appropriate elimination process, the study derived an unbalanced panel data set of the manufacturing firms during 1981-2003.[14] The data set consists of 5,389 observations from 363 firms.

[14] The study eliminated the firms that are listed for less than five years and have non-available values for any relevant variable.

Existing literature employs various methods to define the degree to which a firm relies on bank financing.[15] The study defines bank-dependence based on the ratio of bank debt to total debt. Bank-dependent firms are firms whose bank-debt ratio is high and remaining firms are defined as independent firms. The dummy variable *BANK* has a value of one, if the ratio of bank debt to total debt belongs to the upper quartile and zero, otherwise.[16] In contrast, the value of *IND* is one for firms with a bank-debt ratio belonging to the lower third quartiles and zero, otherwise. To categorize the firm size the study defines two dummy variables: *SMALL* whose

Table 1 Variable Definitions

Abbreviation	Description
K_t	Total assets at the beginning of period t
I_t	Capital expenditure during period t
Q_t	Average Q at the beginning of period t (= $(B_t + E_t) / K_t$)
B_t	Book value of debt at the beginning of period t
E_t	Market value of equity (excluding preferred stocks) at the beginning of period t
CF_t	Cash flow during the period t–1 (= operating profits + depreciation)
S_t	total sales during the period t
$BANK_i$	=1 for bank-dependent firms; =0 for independent firms
IND_i	=1 for independent firms; =0 for bank-dependent firms
$LARGE_i$	=1 for large firms; =0 for small firms
$SMALL_i$	=1 for small firms; =0 for large firms
PRE_t	=1 before financial crisis; =0 after financial crisis
$POST_t$	=1 after financial crisis; =0 before financial crisis

[15] For example: the number of banks in Shen and Wang (2005), *keiretsu* system in Japan in Hoshi, Kashyap, and Scharfstein (1991), loan duration in Ongena and Smith (2001), the percentage of shares owned by a bank in García-Marco and Ocaňa (1999), the placement of bank directors on the board of directors at a firm in Fohlin (1998), and the ratio of loans to total debt and the number of banks in Houston and James (2001).

[16] Even if the study defines bank-dependent firms as firms that belongs to the third quartiles of bank debt ratio similar results are obtained.

value is one for firms with less than 300 employees; and *LARGE* that has a value of one for firms with more than 300 employees. The study also defines two dummies *PRE* and *POST*. The value of *PRE* is one before 1997 and zero after 1998 while that of *POST* is one after 1998 and zero before 1997. The other variables are defined according to conventional methods. The detailed description of relevant variables is presented in table 1.

Table 2 Summary Statistics (1981-2003)

	(*I*/*K*)	*Q*	(*S*/*K*)	(*CF*/*K*)	Bank Debt/ Total Debt	Number of Firms (years)
Total Firms	0.082 (0.096)	1.214 (0.747)	1.073 (0.497)	0.103 (0.084)	0.651 (0.173)	363
Bank-dependent Firms	0.083 (0.095)	1.173 (0.767)	1.088 (0.483)	0.102 (0.082)	0.895 (0.199)	91
Independent Firms	0.081 (0.096)	1.225 (0.741)	1.069 (0.501)	0.103 (0.085)	0.581 (0.272)	272
Mean Difference (*t*-value)	0.002 (0.621)	–0.052** (–2.157)	0.019 (1.207)	–0.001 (–0.982)	0.314*** (45.32)	
Large Firms	0.086 (0.092)	1.232 (0.763)	1.082 (0.496)	0.109 (0.081)	0.631 (0.280)	263
Small Firms	0.066 (0.107)	1.146 (0.684)	1.041 (0.501)	0.079 (0.089)	0.720 (0.309)	100
Mean Difference (*t*-value)	0.02*** (5.992)	0.086*** (3.817)	0.041** (2.564)	0.03*** (10.69)	–0.089*** (–9.222)	
Pre-Crisis	0.105 (0.107)	1.404 (0.815)	1.177 (0.508)	0.119 (0.063)	0.652 (0.246)	(17)
Post-Crisis	0.045 (0.059)	0.901 (0.478)	0.902 (0.428)	0.077 (0.106)	0.646 (0.347)	(6)
Mean Difference (*t*-value)	0.06*** (27.38)	0.503*** (29.46)	0.275*** (21.97)	0.042*** (16.71)	0.006 (0.703)	

Notes: 1) The numbers are mean and standard deviations in parentheses.
2) *** (**) indicates significance at 1% (5%) level. The null hypothesis is that means are the same between groups.

Table 2 provides summary statistics of each variable during 1981-2003. There are significant differences in *Q* and bank debt ratio between bank-dependent and independent firms. Large firms demonstrate higher investment ratios and cash flow ratios than small firms. However, the bank-debt ratio is lower for large firms than small firms because large firms can raise external funds from public markets. The study sees a drastic decrease in investment ratio *Q* and cash flow after crisis. The debt ratio however, does not change significantly after the crisis.

4.2. Estimation Results

Table 3 presents the basic estimation results of equation (1) and (5) for the whole sample period. The study applies the GMM-system estimation techniques

Table 3 Basic Estimation Results

Explanatory Variables	*Q*-Model	Euler Equation
Constant	–0.002 (0.014)	–0.014 (0.015)
$(I/K)_{it-1}$	0.262*** (0.025)	0.274*** (0.024)
Q_{it}	0.017*** (0.005)	–
$(S/K)_{it}$	–	0.037*** (0.010)
$(CF/K)_{it}$	0.156*** (0.042)	0.101** (0.044)
*m*1	0.000***	0.000***
*m*2	0.645	0.576
Sagan Test	0.302	0.174

Notes: 1) The standard errors are in parentheses. *** (**, *) indicates significance at 1% (5%, 10%) level, respectively.

2) Time dummies are included, but not reported.

3) The instruments of difference equations are *t*–2, *t*–3, and *t*–4 lagged variables and the instruments of level equations include Δ *t*–1 differenced lagged variables.

4) The *m*1 and *m*2 are *p*-values of the test for first- and second-order serial correlation of residuals, respectively.

5) Sargan test results present *p*-values of the test for over-identification. Sargan test statistics has asymptotically a chi-square distribution.

using the *t*–2, *t*–3, and *t*–4 lagged right-hand side variables as instruments for difference equations and the difference of *t*–1 right-hand side variables as instruments for level equations.[17)]

Sargan test results for over-identifying restrictions indicate that the instruments adopted are valid. The second-order serial correlation test statistics *m*2 are statistically insignificant, indicating that little unobserved individual effect remains in the GMM-system estimation results.[18)]

For both the *Q*-model and Euler model the coefficients in cash flow are statistically significant at the conventional level, implying that firms are financially constrained. The finding suggests that the availability of internal funds does affect the investment level, contrary to the predictions of Modigliani-Miller. The study also finds persistence in the investment of firms from statistically significant coefficients in the lagged investment-to-capital ratio. As expected Tobin's *Q* and sales ratio have a positive relation with the investment-capital ratio.

The study tests whether the cash flow sensitivity of investment differs across the degree of bank-dependence. Table 4 presents the estimation results of equation (2) for the *Q*-model and the corresponding Euler equation. For both models, the cash flow sensitivity for firms with higher levels of bank-debt ratio is lower and statistically insignificant than for firms with lower levels of bank-debt ratio. Financial constraints faced by firms decrease with bank-dependence. The findings show that the Korean banking system plays a successful role in reducing information asymmetry problems. High bank-debt ratios of a firm do convey a signal that this firm is creditworthy and that banks are monitoring the management well.

The study includes the interaction terms between size dummies and bank-dependence dummies in equation (3) to test whether the size of firms is related to the effect of bank-dependence on cash flow sensitivity of investments. Table 5 shows that small firms are not liquidity-constrained

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17) The GMM-level estimates appear to be biased since unobserved individual effect remains.

18) First-order correlation coefficients in differenced error terms are statistically significant by construction.

Table 4 Bank-Dependence and Investment

Explanatory Variables	*Q*-Model	Euler Equation
Constant	0.001 (0.014)	–0.013 (0.016)
$(I/K)_{it-1}$	0.278*** (0.025)	0.274*** (0.025)
$BANK_i \cdot Q_{it}$	0.021 (0.013)	–
$BANK_i \cdot (S/K)_{it}$	–	0.058** (0.025)
$BANK_i \cdot (CF/K)_{it}$	0.120 (0.122)	0.050 (0.177)
$IND_i \cdot Q_{it}$	0.009* (0.005)	–
$IND_i \cdot (S/K)_{it}$	–	0.030*** (0.011)
$IND_i \cdot (CF/K)_{it}$	0.179*** (0.060)	0.117*** (0.039)
*m*1	0.000***	0.000***
*m*2	0.568	0.590
Sagan Test	0.079	0.265

Notes: 1) The standard errors are in parentheses. *** (**, *) indicates significance at 1% (5%, 10%) level, respectively.
2) Time dummies are included, but not reported.
3) The instruments of difference equations are *t*–2, *t*–3, and *t*–4 lagged variables and the instruments of level equations include Δ *t*–1 differenced lagged variables.
4) The *m*1 and *m*2 are *p*-values of the test for first- and second-order serial correlation of residuals, respectively.
5) Sargan test results present *p*-values of the test for over-identification. Sargan test statistics has asymptotically a chi-square distribution.

regardless of bank reliance.[19] Contrary to expectations, Korean small firms do not appear to have disadvantages in financial markets.[20] For large firms an increase in the bank-debt ratio affects the cash flow coefficient. Only independent large firms are financially constrained. The study speculates that banks play a significant role of mitigating information asymmetry problems for large firms.

[19] It is not surprising that small firms are not financially constrained in Korea. This finding is in line with Laeven (2002), who claims that Korean bank lending policy has favored small and medium enterprises since the end of the 1980s.

[20] The finding that small firms are not liquidity-constrained is also reported in Kadapakka, Kumar, and Riddick (1998) in which they investigate the effects of firm size on cash-flow sensitivity of investment using firm data from six OECD countries.

Table 5 Bank-Dependence and Investment across Firm Sizes

Explanatory Variables	*Q*-Model	Euler Equation
Constant	–0.002 (0.016)	–0.022 (0.017)
$(I/K)_{it-1}$	0.276*** (0.025)	0.277*** (0.025)
$LARGE_i \cdot BANK_i \cdot Q_{it}$	0.027 (0.025)	–
$LARGE_i \cdot BANK_i \cdot (S/K)_{it}$	–	0.085** (0.040)
$LARGE_i \cdot BANK_i \cdot (CF/K)_{it}$	0.181 (0.181)	–0.001 (0.282)
$LARGE_i \cdot IND_i \cdot Q_{it}$	0.012* (0.007)	–
$LARGE_i \cdot IND_i \cdot (S/K)_{it}$	–	0.039*** (0.012)
$LARGE_i \cdot IND_i \cdot (CF/K)_{it}$	0.188** (0.078)	0.095** (0.046)
$SMALL_i \cdot BANK_i \cdot Q_{it}$	0.006 (0.014)	–
$SMALL_i \cdot BANK_i \cdot (S/K)_{it}$	–	0.029 (0.033)
$SMALL_i \cdot BANK_i \cdot (CF/K)_{it}$	–0.019 (0.203)	0.077 (0.235)
$SMALL_i \cdot IND_i \cdot Q_{it}$	–0.012 (0.020)	–
$SMALL_i \cdot IND_i \cdot (S/K)_{it}$	–	0.011 (0.023)
$SMALL_i \cdot IND_i \cdot (CF/K)_{it}$	0.162 (0.186)	0.197 (0.179)
*m*1	0.000***	0.000***
*m*2	0.574	0.571
Sagan Test	0.098	0.360

Notes: 1) The standard errors are in parentheses. *** (**, *) indicates significance at 1% (5%, 10%) level, respectively.
2) Time dummies are included, but not reported.
3) The instruments of difference equations are *t*–2, *t*–3, and *t*–4 lagged variables and the instruments of level equations include Δ *t*–1 differenced lagged variables.
4) The *m*1 and *m*2 are *p*-values of the test for first- and second-order serial correlation of residuals, respectively.
5) Sargan test results present *p*-values of the test for over-identification. Sargan test statistics has asymptotically a chi-square distribution.

The last issue addressed in this paper is whether the role of the bank in reducing information asymmetry problems becomes more important after the financial crisis at the end of 1997. The studies including Choi (2003)

expect that banks play screening and monitoring roles better after crisis because of the wide restructuring process that occurred in the banking industry. Table 6 shows that the investments of bank dependent firms do not

Table 6 Bank-Dependence and Investment during Pre and Post-Crisis

Explanatory Variables	*Q*-Model	Euler Equation
Constant	–0.016 (0.016)	–0.035* (0.018)
$(I/K)_{it-1}$	0.279*** (0.026)	0.278*** (0.025)
$PRE_t \cdot BANK_i \cdot Q_{it}$	0.020* (0.011)	–
$PRE_t \cdot BANK_i \cdot (S/K)_{it}$	–	0.061* (0.037)
$PRE_t \cdot BANK_i \cdot (CF/K)_{it}$	0.105 (0.170)	–0.003 (0.296)
$PRE_t \cdot IND_i \cdot Q_{it}$	0.007 (0.006)	–
$PRE_t \cdot IND_i \cdot (S/K)_{it}$	–	0.031** (0.013)
$PRE_t \cdot IND_i \cdot (CF/K)_{it}$	0.356*** (0.095)	0.259*** (0.100)
$POST_t \cdot BANK_i \cdot Q_{it}$	0.006 (0.012)	–
$POST_t \cdot BANK_i \cdot (S/K)_{it}$	–	0.070*** (0.025)
$POST_t \cdot BANK_i \cdot (CF/K)_{it}$	0.155 (0.163)	–0.004 (0.192)
$POST_t \cdot IND_i \cdot Q_{it}$	0.016 (0.012)	–
$POST_t \cdot IND_i \cdot (S/K)_{it}$	–	0.048** (0.020)
$POST_t \cdot IND_i \cdot (CF/K)_{it}$	0.102** (0.046)	0.036 (0.063)
$m1$	0.000***	0.000***
$m2$	0.536	0.522
Sagan Test	0.088	0.369

Notes: 1) The standard errors are in parentheses. *** (**, *) indicates significance at 1% (5%, 10%) level, respectively.

2) Time dummies are included, but not reported.

3) The instruments of difference equations are t–2, t–3, and t–4 lagged variables and the instruments of level equations include Δ t–1 differenced lagged variables.

4) The $m1$ and $m2$ are p-values of the test for first- and second-order serial correlation of residuals, respectively.

5) Sargan test results present p-values of the test for over-identification. Sargan test statistics has asymptotically a chi-square distribution.

rely on internal funds during both pre- and post-crisis eras. Independent firms are financially constrained during both sample periods and the constraints are relieved significantly after the crisis. This finding suggests that recent changes in the banking industry results in reducing asymmetric information problems.

5. CONCLUDING REMARKS

Much of the existing literature claims that a close bank-firm relationship mitigates information asymmetry problems, thereby reducing the cash flow sensitivity of investment. The study examines whether bank-dependence is systematically related to the cash flow effects on the investments using firm data from Korea. Because firms have relied mainly on bank loans as a source of external funds and the principal transactions bank system has been implemented for the sample period in Korea, the study expected that the bank-debt ratio significantly affects financial constraints faced by firms.

The study found that firms with higher levels of the bank-debt ratio are less constrained in financial markets that show that banks play a role of mitigating information asymmetry in Korea. Firms with more bank loans appear to have less difficulty raising outside funds. This finding can be regarded as another evidence for the role of banks in imperfect financial markets.

REFERENCES

Agarwal, R. and J. A. Elston, "Bank-Firm Relationships, Financing and Firm Performance in Germany," *Economics Letters*, 72, 2001, pp. 225-232.

Arellano, M. and S. R. Bond., "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations," *Review of Economic Studies*, 58, 1991, pp. 277-297.

Arellano, M. and S. R. Bover, "Another Look at the Instrumental Variable Estimation of Error-Components Models," *Journal of Econometrics*, 68, 1995, pp. 29-51.

Boot, A. W. A., "Relationship Banking: What do We Know?," *Journal of Financial Intermediation*, 9, 2000, pp. 7-25.

Boscaljon, B. and C.-C. Ho, "Information Content of Bank Loan Announcements to Asian Corporations during Periods of Economic Uncertainty," *Journal of Banking & Finance*, 29, 2005, pp. 369-389.

Castañeda, G., "Consequences of Firms' Relational Financing in the Aftermath of the 1995 Mexican Banking Crisis," *Journal of Applied Economics*, 8, 2005, pp. 53-79.

Choi, D.-Y. and Y. Lee, "Financial Supervision of Merchant Banking Corporations as a Cause of Korea's Currency Crisis," *Journal of the Korean Economy*, 7, 2006, pp. 77-118.

Choi, G., "Post-Crisis Financial Development in Korea: Implications for Monetary Policy," *Journal of the Korean Economy*, 4, 2003, pp. 29-62.

Degryse, H. and S. Ongena, "Bank Relationships and Firm Profitability," *Financial Management*, 20, 2001, pp. 9-34.

Degryse, H. and P. van Cayseele, "Relationship Lending within a Bank-backed System: Evidence from European Small Business Data," *Journal of Financial Intermediation*, 9, 2000, pp. 90-109.

Diamond, D., "Monitoring and Reputation: the Choice between Bank Loans and Privately Placed Debt," *Journal of Political Economy*, 99, 1991, pp. 689-721.

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

Fohlin, C., "Relationship Banking, Liquidity, and Investment in the German Industrialization," *Journal of Finance*, 53, 1998, pp. 1737-1758.

Forbes, K. J., "One Cost of the Chilean Capital Controls: Increased Financial Constraints for Smaller Trade Firms," *Journal of International*

Economics, 71, 2007, pp. 294-323.

García-Marco, T. and C. Ocaňa, "The Effect of Bank Monitoring on the Investment Behavior of Spanish Firms," *Journal of Banking & Finance*, 23, 1999, pp. 1579-1603.

Gilchrist, S. and C. Himmelberg, "Investment, Fundamentals, and Finance," *NBER Macroeconomics Annual 1998*, 1999, pp. 223-262.

Hayashi, F., "The Main Bank System and Corporate Investment: An Empirical Reassessment," in M. Aoki, and G. Saxonhouse, eds., *Finance*, *Governance*, *and Competitiveness* in Japan, Oxford University Press, 2000, pp. 81-98.

Hayashi, F. and T. Inoue, "The Relation between Firm Growth and Q with Multiple Capital Goods: Theory and Evidence from Panel Data on Japanese Firms." *Econometrica*, 59, 1991, pp. 731-754.

Hoshi, T., A. Kashyap, and D. Scharfstein, "Corporate Structure, Liquidity, and Investment: Evidence from Japanese Industrial Groups," *Quarterly Journal of Economics*, 106, 1991, pp. 3-60.

Houston, J. and C. James, "Do Relationships have Limits? Banking Relationships, Financial Constraints, and Investment," *Journal of Business*, 74, 2001, pp. 347-374.

Hubbard, R. G., "Capital-Market Imperfections and Investment," *Journal of Economic Literature*, 36, 1998, pp. 193-225.

Jensen, M., "Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers," *American Economic Review*, 76, 1986, pp. 323-329.

Jensen, M. and W. Meckling, "Theory of the Firms: Managerial Behavior, Agency Costs, and Ownership Structure," *Journal of Financial Economics*, 1, 1976, pp. 305-360.

Kadapakkam, P.-R., P. C. Kumar, and L. A. Riddick, "The Impact of Cash Flows and Firm Size on Investment: The International Evidence," *Journal of Banking & Finance*, 22, 1998, 293-320.

Kaplan, S. and L. Zingales, "Do Financing Constraints Explain Why Investment is Correlated with Cash Flow?," *Quarterly Journal of Economics*, 112, 1997, pp. 169-215.

Laeven, L., "Financial Constraints on Investments and Credit Policy in Korea," *Journal of Asian Economics*, 13, 2002, pp. 251-269.

Love, I., "Financial Development and Financing Constraints: International Evidence from the Structural Investment Model," *Review of Financial Studies*, 16, 2003, pp. 765-791.

McGuire, P., "Bank Ties and Bond Market Access: Evidence on Investment-Cash Flow Sensitivity in Japan," NBER WP, No. 9644, 2003.

Modigliani, F. and M. H. Miller, "The Cost of Capital, Corporation Finance, and the Theory of Investment," *American Economic Review*, 48, 1958, pp. 261-297.

Myers, S. C. and N. S. Majluf, "Corporate Financing and Investment Decisions when Firms have Information that Investors do not Have," *Journal of Financial Economics*, 13, 1984, pp. 187-221.

Nam, S.-W., "The Principal Transactions Bank System in Korea and a Search for a New Bank-Business Relationship," in T. Ito and A. O. Krueger, eds., *Financial Deregulation and Integration in East Asia*, Chicago University Press, 1996, pp. 277-301.

Park, K., R. S. Park, and S. H. Yoon, "Accessibility to Capital Markets and the Sensitivity of Investment to Cash Flow," *Economic Papers*, 10, 2007, pp. 33-55.

Petersen, M. A. and R. G. Rajan, "The Benefits of Lending Relationships: Evidence from Small Business Data," *Journal of Finance*, 49, 1994, pp. 3-37.

Rajan, R. G., "Insiders and Outsiders: The Choice between Informed and Arm's Length Debt," *Journal of Finance*, 47, 1992, pp. 1367-1400.

Schiantarelli, F., "Financial Constraints and Investment: Methodological Issues and International Evidence," *Oxford Review of Economic Policy*, 12, 1996, pp. 70-89.

Semenov, R., "Financial Systems, Financing Constraints and Investment: Empirical Analysis of OECD Countries," *Applied Economics*, 38, 2006, 1963-1974.

Sharpe, S. A., "Asymmetric Information, Bank Lending, and Implicit

Contracts: A Stylized Model of Consumer Relationships," *Journal of Finance*, 45, 1990, pp. 1069-1087.

Shen, C.-H. and C.-A. Wang, "Does Bank Relationship Matter for a Firm's Investment and Financial Constraints? The Case of Taiwan," *Pacific-Basin Finance Journal*, 13, 2005, pp. 163-184.

Stein, J., "Agency, Information and Corporate Investment," NBER WP, No. 8342, 2001.

Stiglitz, J. and A. Weiss, "Credit Rationing in Markets with Imperfect Information," *American Economic Review*, 71, 1981, pp. 393-410.

Weinstein and Yafeh, "On the Costs of a Bank Centered Financial System: Evidence from the Changing Main Bank Relations in Japan," *Journal of Finance*, 53(2), 1998, pp. 635-672.