

# An Empirical Study on the Determinants of the Cost of Financial Intermediation in the Korean Banking Industry

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## *Abstract*

*This paper examines the determinants of the cost of financial intermediation using Korean bank data from 1992 through 2004.*

*I find strong evidence that the diversification of banking activities decreases the cost, indicating that pursuing it is a desirable direction not only for a bank's profit maximization but for effective financial intermediation in the economy. Unlike the theoretical expectation, bank size and bank concentration do not seem to affect the cost of financial intermediation. The bank size, however, seems to have become a critical factor since the financial crisis in 1997, though the sign is ambiguous.*

*The credit risk turns out to adversely affect the cost, suggesting that an improvement in credit-rating skills is required for effective financial intermediation. The equity ratio is analyzed as not affecting the cost, raising doubt as to the existence of market discipline through deposit interest rates in the Korean banking industry.*

*Meanwhile interest rate risk shows a positive sign, but it is insignificant. Since banks, however, are becoming more sensitive to the volatility of interest rates, the monetary authorities should seek to minimize it while implementing monetary policy.*

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**Key Words :** cost of financial intermediation, bank size, diversification of banking activities, market concentration, market discipline

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## I. Introduction

Financial intermediation(henceforth 'FI') provides borrowers with loans financed by deposits funneled from the public, based on the monitoring and information production function of a bank, which is the bank's traditional operation(Fama, 1985). Many existing studies support the contention that banks contribute to the growth of an economy by providing funds appropriately to various industries(King and Levine, 1993; Petersen and Rajan, 1994; Jayaratne and Strahan, 1996; Demirgüç-Kunt and Maksimovic, 1998; Rajan and Zingales, 1998; Wurgler, 2000; Beck, Levine, and Loayza, 2000).

Recently, there has been concern that banks' intermediation function in Korea is becoming weakened as the economic environment grows unstable. Considering the importance of the banking industry in the economy, and the fact that traditional deposit and loan operations still make up the greatest part of banking activity in Korea, a much broader study on this topic is required. Since the existing literature, however, has focused on the functional and structural aspects of FI, and the relationship between FI and economic growth, it is very difficult to find studies on the determinants of the cost of FI. Consequently, this paper is extremely worthwhile in that it offers very useful implications to the banking authorities.

This paper sets out to analyze the determinants of the cost of FI using Korean bank data. It especially focuses on such factors as diversification of banking activities, banks' growing concern about size and bank concentration, which have become major issues in recent years.

The rest of the paper continues as follows. Chapter II surveys existing theoretical and empirical studies regarding the cost of FI. Chapter III defines the cost of FI and shows its recent trends. Chapter IV describes the data and variables used in the empirical analysis. Chapter V explains the empirical results, and the final chapter, chapter VI, concludes the paper with some policy implications.

## II. Literature Review

### 1. Dealership Model

In their seminal paper, Ho and Saunders(1981) describes a bank as a risk-averse dealer acting as an intermediary between the demanders and suppliers of funds. In their model, since deposit supplies tend to arrive at different times from loan demands, the bank faces the problem of either a surplus or a shortage of funds. The existence of the short-term money market resolves the problem in their model. A bank can invest or borrow the funds in the money market at the short-term risk-free rate  $r$ . Because of the assumed long-term maturity of deposits and loans and uncertainty over transaction arrivals, the bank will face an interest-rate risk<sup>1)</sup> whenever it holds an unmatched portfolio of deposits and loans. The bank will require a positive fee as the price of providing immediacy of depository and/or loan service in face of the risk. The model indicates that the optimal net interest margin<sup>2)</sup> depends on four factors: (i) market power<sup>3)</sup>, (ii) the degree of bank risk aversion, (iii) the average size of bank transactions, and (iv) interest-rate risk.

$$s = \frac{1}{2} + \frac{1}{2}R \hat{Q} \quad (1)$$

$s$  : pure margin

$\frac{1}{2}$  : the parameter describing the banking market structure

$R$  : the bank's coefficient of absolute risk aversion

$Q$  : the size of bank transactions

$\hat{Q}$  : the variance of interest rates

Applying (1) to the data on 53 major US commercial banks from the fourth quarter of 1976 through the fourth quarter of 1979, they find that the results are

- 1) When a deposit arrives first, the bank invests the funds in the short-term money market at rate  $r$ . If  $r$  falls below the deposit interest rate  $r_D$  at the end of the period, the bank will face a problem that it cannot fully pay the interest to its customer. Similarly, when a loan arrives first, the bank borrows the funds in the short-term money market at rate  $r$  and makes loans at the loan interest rate  $r_L$ . If  $r$  rises above  $r_L$  at the end of the period, the bank will face a problem of not fully paying the interest to the funds borrowed in the money market.
- 2) They claim that the margin tends to exist in highly competitive banking markets as long as transactions uncertainty is present, terming the margin a pure spread.
- 3) Since  $\frac{1}{2}$  is the intercept of deposit(loan) arrival function and  $\frac{1}{2}$  is its slope, large  $\frac{1}{2}$  implies that a bank faces relatively inelastic deposits(loans) against margin, which enables it to exercise monopoly power. See Ho and Saunders(1981), Angbazo(1997) for more details and the derivation of (1).

consistent with the theory. They additionally find that smaller banks have a larger NIM than bigger banks. They explain that it is because the smaller banks, which operate in less competitive local markets, are able to exploit regional monopoly positions.

McShane and Sharpe(1985) use a modified version of Ho and Saunders(1981) to conduct empirical tests of the spreads of six Australian trading banks. They find that, overall, the results are consistent with existing theories. They also find that the shift from the business sector to the individual sector for loan and deposit business is associated with increased bank interest margins. They explain that this is because the personal sector lending of trading banks involves greater risk.

Allen(1988) extends the Ho and Saunders model to consider loan heterogeneity and finds that the net interest margin may be reduced due to the substitution effect of different loan products. In his model, there are two classes of loans, types  $m$  and  $n$ . If the interest margin of loan  $n$  decreases, then the sales of loan  $m$  will fall, causing the interest rates of loan to decrease. Accordingly the net interest margin of loan  $m$  decreases, and this result depends on the sensitivity of the sales of loan  $m$  to the change in loan  $n$ 's margin.<sup>4)</sup>

Angbazo(1997) extends Ho and Saunders(1981) to include default risk, and analyzes 286 US commercial banks over the period 1989-1993. He finds that the net interest margin increases with credit risk because banks need compensation for the risk as theories suggest. In addition, he finds that off-balance sheet activities increases bank's risk and lead to higher net interest margin.

Saunders and Schumacher(2000) analyze seven OECD countries between 1988 and 1995 using the Ho and Saunders model. They find that the monopoly power and interest-rate risk have significant positive effects on bank NIMs, and implicit interest payments have the largest positive effect among other factors.<sup>5)</sup> Capital-to-asset ratio is also found to have a significant positive impact. They argue that equity capital usually decreases a bank's profitability and banks try to compensate for it with a high net interest margin. The most recent study in this line is Maudos and Guevara(2004), in which they take banks' operating costs into account and use Lerner index as a direct measure of the degree of

4) The arrival functions of deposit and loan are  $(a) = -a$ ,  $(b_m) = -b_m + \delta_m b_n$ ,  $(b_n) = -b_n + \delta_n b_m$ , respectively, where  $a$  is a deposit interest margin,  $b_i (i = m, n)$  is loan interest margin, and  $\delta_i (i = m, n)$  is a coefficient representing cross elasticity.

5) Pure margin is the constant estimated in the first step where the cost of FI is regressed on other factors. In step two, the pure margin is regressed on the market structure variable and the variability of interest rates.

6) They argue that since the high management quality enables firms to finance at low rates, ceteris paribus, the bank's net interest margin increases. The negative sign is because they measured management quality as 「expense/revenue」.

competition. They apply it to a five EU country panel and conclude that operating costs and market power have positive effects while the quality of management has a negative effect.<sup>6)</sup>

## 2. Firm-Theoretic Model

The first study analyzing the cost of FI using a firm-theoretic approach is Zarruk(1989). Using an industrial organization approach where the bank is a kind of industrial enterprise, he derives the functional forms of deposit and loan interest rate within the framework of profit maximization. He performs comparative static analyses to each function to conclude that the equity ratio has a negative effect on the cost of FI while the volatility of deposits and degree of risk aversion have negative effects. In addition, deposit(loan)-related expenses and deposit insurance premium prove to have ambiguous effects.

Zarruk and Madura(1992) study an optimal net interest margin in an environment where capital regulation and deposit insurance exist. They find that the optimal net interest margin decreases with either capital requirement or deposit insurance premium when credit risk exists. This is because the bank invests its funds in the loan market providing higher profit with higher risk, instead in the inter-bank market, to meet the requirement. If the loan is relatively price-elastic, the bank may increase the amount of loans by decreasing the loan interest rate, causing the net interest margin to decrease. They argue that deposit insurance premiums can be explained in the same manner.

Wong 's(1997) analysis claims to show that the optimal net interest margin increases with market power, operating expenses<sup>7)</sup>, credit risk, and interest-rate risk in an environment where both interest-rate risk and credit risk exist. Additionally, he argues that the relationship between inter-bank market rate and net interest margin is dependent upon banks ' positions determined in the inter-bank market.

## 3. Others

Unlike above two approaches, Demirgüç-Kunt, Laeven, and Levine(2003) empirically examine the effects of bank regulations, market structure, and national institutions on banks ' net interest margins. Using data on over 1,400 banks across 72 countries, they find that tighter regulations on bank entry and

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7) An increase in operating expenses leads to a rise in the marginal administrative cost of loans, which induces the bank to increase loan interest rates to compensate for the costs.

bank activities boost the cost of FI. They find that market concentration is positively associated with net interest margins, but its significance diminishes when regulatory impediments to competition are added in the analysis, meaning that market concentration results from various regulatory policies. In addition, institutional factors, such as protection of property rights and the degree of economic freedom, turn out to be significant in determining the cost of FI.

Table 1 summarizes the various determinants explained so far and also illustrates other factors determining the cost of FI, which are not explained in this chapter but in the original studies.

		Theoretic Determinants	Results of Empirical Analysis
dealership model	Ho and Saunders (1981)	HS, implicit interest payments(+), reserve requirements(+), credit risk (+).	quarterly data on 53 US commercial banks (1976. 4/4 ~ 1979. 4/4). reserve requirements (+, x), credit risk(+, x), degree of risk aversion (/), size of transactions(/).
	McShane and Sharpe(1985)	HS, proportion of personal sector business(+), proportion of non-interest bearing deposits to total deposits(+).	annual data on 8 Australian trading banks (1962~1981). proportion of non-interest bearing deposits to total deposits(-, x).
	Allen(1988)	HS, interest margin of an alternative loan product(+).	-
	Angbazo (1997)	HS, credit risk(+), reserve requirements(+), implicit interest payments(+), equity capital(+), liquidity risk(+), management quality (+), branch regulation(-), off-balance sheet transactions(+).	annual data on 286 US commercial banks (1989 ~ 1993). implicit interest payments(-, x), branch regulation(-, x).
	Saunders and Schumacher (2000)	HS, implicit interest payments(+), reserve requirements(+), equity capital(+).	annual data(1985 ~ 1988) on 614 banks from 7 countries (Germany, Spain, France, U.K., Italy, Switzerland, US). size of transactions(/), degree of risk aversion(/).
	Maudos and Guevara (2004)	HS, operation expense(+), credit risk(+), implicit interest payments(+), reserve requirements(+), management quality(+).	annual data(1993~2000) on 1,826 banks from 5 countries(Germany, France, U.K., Italy, Spain) reserve requirements(+, x).
firm theoretic model	Zarruk(1989)	degree of risk aversion(-), equity capital(+), variability of deposits(-), deposit insurance premium(+/-), deposits(loans) management expense (+/-).	-
	Zarruk and Madura(1992)	equity capital(-), credit risk(-), deposit insurance premium(-).	-
	Wong (1997)	market power(+), operating costs(+), credit risk(+), interest-rate risk(+), equity capital(-), degree of risk aversion(+), inter-bank market rate (+/-).	-

Others	Demirgüç-Kunt, Laeven, and Levine (2003)	-	annual data(1995~1999) on 1,400 banks from 72 countries. bank size(-), liquidity risk(+), equity capital(+), government ownership(+), entry barrier(+), market power (+), non-interest revenue(-), reserve requirements(+), bank concentration(+), inflation(+), banking freedom(-), economic growth(-), stock market development(-).
<p>Notes : 1) HS denotes factors derived in Ho and Saunders(1981) : market power(+), interest rate risk(+), degree of risk aversion(+), and size of transactions(+).</p> <p>2) (+), (-), and (+/-) mean a positive effect, a negative effect, and indeterminate, respectively. (+, x) means positive but insignificant, similarly (-, x) means negative but insignificant. (/) means that a factor is considered in the theoretical analysis, but excluded in the empirical analysis. Factors not addressed in the empirical analysis are consistent with the theory and significant.</p> <p>3) I tried to use unified terms in the theoretical analysis. For instance, credit risk in Zarruk and Madura(1992) is an alternative expression of asset quality, which has a negative relationship with credit risk.</p>			

### III. The Cost of FI

#### 1. Definition<sup>8)</sup>

The cost of FI can be simply defined as costs accruing while financial intermediation service is provided, though the costs are diversified.

One may narrowly define the cost of FI as costs that a bank generates while providing FI service. One may also define it broadly as costs that an economy pays for FI services that the banking industry provides.

As this study examines the determinants of the cost of FI to draw some implications from the macroeconomic aspect, the broad definition is preferred.

Banks usually determine the loan interest rate by adding a spread to the prime rate, which is the sum of operating costs, net margin, and deposit interest rate.<sup>9)</sup>

$$r_L = r_D + c + m + sp. \quad (2)$$

( $r_L$  : Loan interest rate,  $r_D$  : Deposit interest rate,  $c$  : Operating costs,  $m$  : Net margin,  $sp$  : Spread)

By the broad view, the cost of FI can be expressed like follows.

$$\text{The cost of FI} = r_L - r_D = c + m + sp. \quad (3)$$

8) This part is largely indebted to Kim(1996).

9) In banking business, operating expenses and net margin are sometimes classified as the spread.

## 2. Trends

There are many indices measuring the cost of FI, and in this study we will use "interest rate difference over total assets" (hereafter 'IRDTA') as an adequate proxy variable for the cost.<sup>10)</sup>

IRDTA can be calculated as followings.

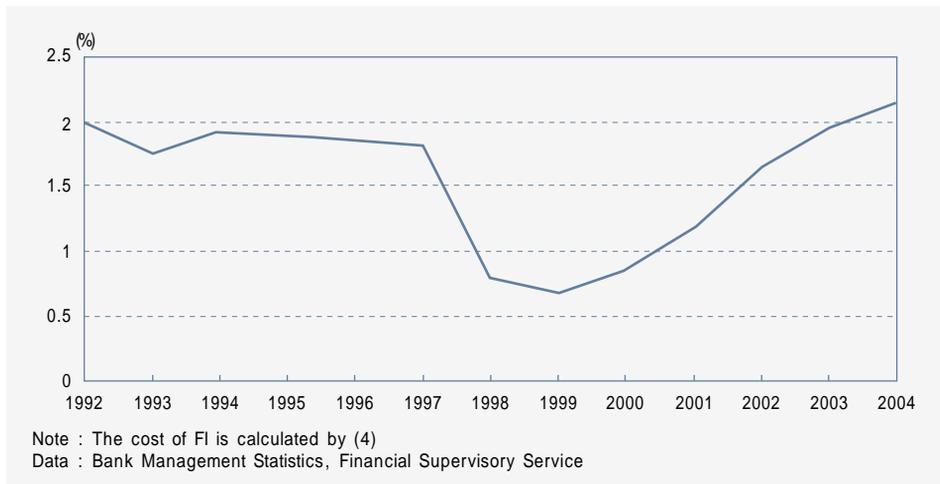
$$\text{IRDTA} = \frac{(\text{Loan-related Revenues} - \text{Deposit-related Expenses})}{\text{Total Assets}} \quad (4)$$

The trend of the cost of FI, measured by IRDTA, between 1992 and 2004 shows a big change around the banking crisis in 1997 (See Figure 1). The cost of FI moved within a narrow band of 1.5~2.0% from 1992 through 1997 except for a relatively big decrease in 1993. This was because interest rates could not move freely in the market because they were not completely liberalized during the period.<sup>11)</sup>

It plummeted in 1998 right after the crisis and continued to decrease in 1999. The sharp drop in 1998 reflects the situation when the interest revenue of the

Figure 1

Trends of OF the Cost of FI



10) For details about the indicators of the cost of FI, refer to Kim(1996).

11) Looking at the separate data of loan and deposit interest rates, one may find that they moved within very narrow bands.

12) In 2004, Korean banks decreased deposit interest rates immediately after the BOK lowered the call rate, which provoked public criticism that the banks were pursuing excessive interest margin.

banking industry shrank greatly due to a series of corporate defaults. In other words, the decline of the cost of FI at that time did not result from the improvement of bank efficiency, but from an unexpected economic crisis.

The cost of FI reversed its trend in 2000 and returned to the pre-crisis level in 2003. Since 2004 it has been gradually increasing.<sup>12)</sup> The upward trend of the cost of FI in the 2000s may be related with the change in the competitiveness of the banking industry after the closure of five commercial banks in 1998 and successive M&A activity thereafter.

## IV. Estimation of the Determinants of the Cost of FI

### 1. Data

The major source of data for this study is bank management statistics from the FSS(Financial Supervisory Service). Some macro data are from the BOK(Bank of Korea), NSO(National Statistical Office), and Korea Securities Dealers Association.<sup>13)</sup> The sample period is from 1992 to 2004 and annual data are used.<sup>14)</sup> The number of total banks included in the analysis is 27, but the number varies annually because there were several mergers and closures during the sample period.<sup>15)</sup>

### 2. Variables

The determinants of the cost of FI in banking industry in existing studies can be classified into two groups; namely, bank-specific factors and macroeconomic factors.

The bank-specific factors are bank size(McShane and Sharpe, 1985), non-interest revenue(Demirgüç-Kunt *et al.*, 2003), equity ratio(Angbazo, 1997), credit risk(Maudos and Guevara, 2004), market power(Ho and Saunders, 1981), degree of risk aversion(Angbazo, 1997), implicit interest payments(Saunders

13) For the descriptive statistics of data, see Appendix 2.

14) The sample period begins from 1992 mainly due to data availability.

15) Banks in the analysis include only commercial banks(national banks+local banks). Since specialised banks, such as KDB, IBK, KEXIM, National Agricultural Cooperative Federation, and National Federation of Fisheries Cooperatives have different objectives and financing methods, in addition to their short data period, they were excluded from the analysis. Woori, Kyungnam, and Gwangju bank in Woori Financial Holding Company and Shinhan and Chohung bank in Shinhan Financial Holding Company were regarded as individual banks. The details of banks included in the analysis are shown in Appendix 1.

and Schumacher, 2000), management quality(Maudos and Guevara, 2004), etc.<sup>16)</sup>

Macroeconomic factors are degree of bank concentration(Demirgüç-Kunt *et al.*, 2003), interest rate risk(Ho and Saunders, 1980), reserve requirements(Angbazo, 1997), economic growth · inflation · degree of capital market development(Demirgüç-Kunt *et al.*, 2003), entry barriers such as branch regulation, etc.

This paper particularly focuses on bank size, non-interest revenue, bank concentration, as they have been main banking issues in Korea. I also include interest-rate risk, credit risk, equity ratio, and degree of capital market development to control for other aspects of the banking industry.<sup>17)</sup>

### **A. The Cost of FI(NIM, Dependent Variable)**

I use IRDTA as the dependent variable throughout the analyses. IRDTA is calculated as interest revenues minus interest expenses divided by average total assets. Interest revenues and interest expenses in IRDTA are loan-related interest and deposit-related interest, respectively. This is to focus on the traditional banking activities of deposits and loans, and those in the trust account section of banking activity are excluded.

The cost of FI calculated like this, however, may be subject to the *ex post* aggravation of asset quality shown in Figure 1<sup>18)</sup>, which may be incorporated into indicators representing bank soundness. In order to resolve this, I add bad loans(BL), a representative indicator of bank soundness, in the analysis. For the possible endogeneity of BL, I use the lagged variable of BL.

### **B. Bank Size(SZ)**

One of the global trends in banking industry is the pursuit of enlarged size, which may result from the general idea that a large bank is usually more competitive than a small bank. Greiber and Herz(2002) argue that German banks in 1990 benefited from M&A and reduced a large amount of the expenses resulting from inefficient operation.<sup>19)</sup> Demirgüç-Kunt *et al.*(2003) empirically analyze 1,400 banks in 72 countries to conclude that bank size may negatively

16) Operating expense is very closely related to the cost of FI, but it has not been considered as an explanatory variable in most existing studies as it is an alternative proxy for the cost of FI (see Table 1). Demirgüç-Kunt *et al.*(2003) argue that similar results are found when they use it as an alternative dependent variable.

17) In a preliminary test, 「individual bank's assets/total banks' assets」 was used as a proxy for market power. But it was excluded in the final test because it had such a high correlation(0.858) with bank size variable, while it had very low significance.

18) For more rigorous analysis, it is necessary to control the fact, though most existing studies do not mention it.

19) There is no consensus on the existence of economies of scale in the banking industry. Humphrey(1990) argues

affect the cost of FI.

This study does not comment on the existence of scale economies in the banking industry as it does not estimate a bank's cost function. Based on the results from Demirgüç-Kunt *et al.*(2003), I just expect that the size may negatively affect the cost of FI.

Bank size is denoted by average total assets as in existing studies. Table 2 shows that the average total assets of banks in 1992 amounted to 6 trillion won, but this rose to 51 trillion won in 2004, nine times the amount in 1992. I believe that this is strong evidence on the trend to maximise size within the Korean banking industry. The huge increase between 1997 and 1999 may reflect the situation in which several banks were involved in M&A in the period, resulting in a decrease in the number of total banks.

Table 2 Trends of Bank Size

	(unit ; trillion won, %)												
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Size	5.64	6.00	7.06	9.02	10.77	14.26	18.88	24.81	29.14	31.26	40.59	47.94	51.02
Increase rate	-	6.4	17.7	27.8	19.4	32.4	32.4	31.4	17.5	7.3	29.8	18.1	6.4

Notes : 1) Size is the average of bank assets.

2) Rate of increase is over the previous year.

Data : Bank Management Statistics, Financial Supervisory Service.

### C. Revenues from Non-Traditional Activities(Fee)

Recently, banks have been earning revenues from diverse activities such as, securities trading, insurance, credit cards, etc. Demirgüç-Kunt *et al.*(2003) analyse that increase in the "revenue from non-traditional activities"(henceforth 'RNTA') may decrease the cost of FI by lowering the burden imposed on the traditional deposit-loan business. For instance, a bank with a great amount of revenues from fee business may pursue low net interest margin, because it can still achieve its target profit. Accepting this argument, Fee is expected to have a negative sign.

In the analysis, Fee is computed by RNTA divided by total assets. RNTA here includes securities-related income, credit card-related income, and fee income. If

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that it is because there are so many differences in the models, variables, functional forms, and sample periods used by individual studies

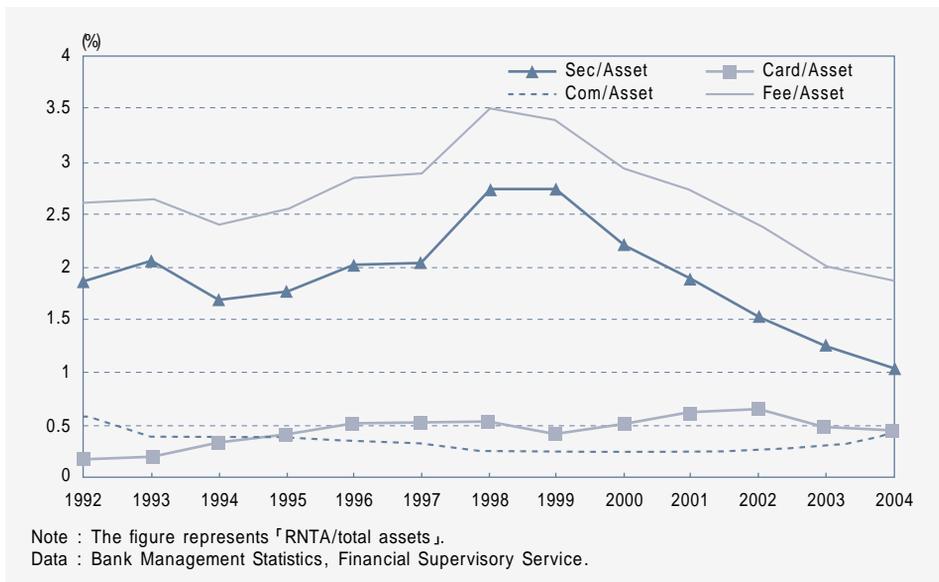
the rate increases, we may interpret it as the progress of diversification in banking activities.

In Figure 2, 「RNTA/Total assets」 has been decreasing since 1999, which is because revenue from securities trading declined greatly due to the downturn of the securities market resulting from the economic crisis in 1999 and the burst of the high-tech startup bubble afterwards. That is, the decrease of 「RNTA/total assets」 is mainly due to the decrease of 「securities-related income/total assets」. Meanwhile, 「credit card-related income/total assets」 (Card/Assets) has begun to decrease since the bursting of the credit card bubble in 2003.

On the other hand, there may exist an endogeneity between Fee and the cost of FI. As was argued above, the expansion of RNTA may allow the traditional loan-deposit business to earn less revenue, but reversely the expansion of traditional loan-deposit business may cause the non-traditional activities to earn less revenue. Considering this, I used a lagged variable when estimating the model.

Figure 2

Trends of RNTA



#### D. Bank Concentration(HH)

There is no consensus on the effect of bank concentration on the efficiency of FI (Demirgüç-Kunt *et al.*, 2003). This is because the concept of concentration is

very hard to interpret. According to existing studies, concentration reflects various regulations restricting competition<sup>20)</sup>, efficient structure of an organization, and market power of a bank, etc. A group of studies argues that banks in a highly concentrated market have high operation costs, high loan interest rates and low deposit interest rates.<sup>21)</sup> Other studies argue that net interest margin is lower in a highly concentrated market than in a less concentrated market.<sup>22)</sup>

This study does not analyze the causes of bank concentration to focus on its effect on the cost of FI.

Among various measures of bank concentration, I use HHI(Herfindahl-Hirschman Index) in the analysis.<sup>23)</sup> When there are  $n$  banks in the economy, the HHI can be calculated as follows.

$$HHI = \sum_{i=1}^n S_i^2. \tag{5}$$

In (5),  $i$  and  $S_i$  denote bank  $i$ , its market share, respectively. The market share here refers to the total asset of an individual bank divided by the sum of total assets of all banks.

Looking at Table 3, it is found that the degree of bank concentration gradually decreased before the crisis in 1997, but it reversed its pattern in 2001 and 2002. The number has been decreasing little by little since 2003.<sup>24)</sup>

Table 3

Trends of Market Concentration

1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
947.9	916.4	867.1	775.7	759.5	708.6	774.5	950.6	938.2	1,137.4	1,438.5	1,388.4	1,350.3

Notes : Numbers are the Herfindahl-Hirschman Indexes computed according to (5)  
 Data : Bank Management Statistics, Financial Supervisory Service.

20) Saunders and Schumacher(2000) argue that as the banking industry becomes less competitive, the bank NIMs increase. They analyze data on seven countries over the period of 1988~1995, and find that the US, where the installation of bank branches across states was restricted, has a larger interest margin than other OECD countries.

21) Berger and Hannan(1989, 1998), Hannan and Berger(1991), Neumark and Sharpe(1992), etc.

22) Rajan and Peterson(1995), Smirlock(1985), Graddy and Kyle(1979), etc.

23) Demirgüç-Kunt *et al.*(2003) basically employ CR3(the share of three largest banks' assets in the total assets of all banks in the economy) and CR5(the share of the five largest banks' assets in the total assets of all banks in the economy). In addition, they use three major banks' assets divided by the sum of assets of three major savings banks, cooperative banks, and non-bank credit institutions in a broader sense. They also use the share of the top five banks' deposits in total deposits in the economy to show the robustness of the results.

24) The Herfindahl-Hirschman Index may have numbers between 0 and 10,000. The US Department of Justice

### **E. Equity Ratio(Equity)**

Since banks with high equity ratios are able to finance funds at low interest rates because they are considered as having a low probability of bankruptcy(Demirgüç-Kunt *et al.*, 2003), *ceteris paribus*, they may have higher net interest margin than banks with a low equity ratio. Meanwhile, since the cost of equity capital is usually higher than that of debt, a bank may require a higher net interest margin to compensate for this(Saunders and Schumacher, 2000). According to these arguments, the equity ratio is expected to have a positive effect on the cost of FI.

In the empirical analysis, the equity ratio was computed by the ratio of equity capital to total assets in a bank's B/S. Since the current year's net profit is a component of equity capital in the B/S, there exists reverse causality between the cost of FI and the equity ratio. Considering this, I use a lagged variable of equity ratio in the analysis.

### **F. Interest Rate Risk(Bond)**

When interest rate risk is predicted during the lending period, banks tend to incorporate it by way of a certain amount of premium(Ho and Saunders, 1981; McShane and Sharpe, 1985; Allen, 1988; Angbazo, 1997; Wong, 1997; Saunders and Schumacher, 2000; Maudos and Guevara, 2004), which may increase the net interest margin.

In this study, I used the variance of yield on 3 year corporate bonds(A+) as a proxy for the interest rate risk.

### **G. Credit Risk(Loans)**

A higher net interest margin is expected for firms having lower credit ratings as banks usually apply credit spreads based on firms' credit ratings(Ho and Saunders, 1981; Angbazo, 1997; Wong, 1997; Maudos and Guevara, 2004). On the other hand, Zarruk and Madura(1992) argue that credit risk has a negative relationship with net interest margin. In their model, the variance of a bank's profit is an increasing function of the loan interest rate and increase of credit risk causes the variance of a bank's profit to rise. As a result, a risk-averse bank may decrease its loan interest rate to reduce the variance of its profit. Since their argument, however, has not been verified empirically, in this study I expect (+) sign on the coefficient of credit risk according to more empirically verified

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terms a market having HHI below 1,000 a 'competitive market', one between 1,000 and 1,800 a 'moderately concentrated market' and one over 1,800 a 'severely concentrated market'. According to this criterion, the banking industry in Korea is not very highly concentrated.

arguments.

In the empirical analysis, the proxy variable for credit risk is the ratio of loans to total assets used in Maudos and Guevara(2004)<sup>25)</sup> According to their argument, loans are risky assets and the rate of loans to total assets may reflect well the credit risk that a bank faces.

### **H. Degree of Financial Market Development(FD), etc.**

In an economy where financial markets are highly developed, banks compete with other financial institutions, which leads to the decrease of net interest margin (Demirgüç-Kunt *et al.*, 2003). Considering this, I include the degree of financial market development in the analysis, which is computed by  $\frac{\text{the amount of stocks traded in the market} + \text{the amount of bonds traded in the market}}{\text{nominal GDP}}$ . In addition, since the loan to deposit ratio may reflect the strategy of a bank and affect the cost of FI, I include  $\frac{\text{average amount of loans}}{\text{average amount of deposits}}$  in the analysis to control for this.<sup>26)</sup>

Finally, I include a dummy variable(Dum\_Crisis) to consider the impact of the economic crisis in Nov. 1997. Dum\_Crisis has a value of 1 in 1998, and 0 in other years. In addition to this, I also estimate models for pre- and post-crisis periods separately to figure out the changes in the determinants of the cost of FI after the crisis.

Table 4 explains variables, the computation, and expected signs in the analysis.

25) Loan loss reserve is also used as a proxy for credit risk, but I think it measures *ex post* credit risk as loan loss reserve is set-aside at the end of fiscal year. Ho and Saunders(1981) and Angbazo(1997) use the ratio of loan loss reserve to loans to measure credit risk and find that it is not significant. In this study, I also used the ratio, but found the result was not significant and the coefficient had a negative sign which was contrary to our initial expectation.

26) Considering that overall economic conditions may affect banks' net interest margins, I attempted to use the dishonored bill ratio and real GDP growth rate in the analysis. However, the dishonored bill ratio was insignificant though the sign was correct, and GDP growth rate was not only insignificant but had unexpected sign. Meanwhile, net interest margin, the dependent variable of the analysis, was used as a financial depth indicator in Kings and Levine(1993). Following the argument that financial development contributes to economic growth, it is possible that the GDP variable may have simultaneity or endogeneity with the dependent variable. In order to resolve this, the lagged variable of GDP was added in the analysis, but there was no difference in the results. Consequently, the dishonored bill ratio and GDP growth rate were excluded from the final analysis. According to an existing theory, countries with high inflation usually have an under-developed financial system, resulting in high net interest margins(Boyd, Levine and Smith, 2001; Huybens and Smith, 1999). In addition, inflation affects net interest margin through the change in the real financing cost of borrowers and real expected rate of return for lenders. Taking these facts into account, I included inflation in the initial analysis, but found that it was insignificant in all models. So it was excluded from the final analysis.

Table 4 Details of Variables

	Meaning	Computation	Expected sign
NIM	the cost of FI	(interest revenue - interest expense) / average total assets	dependent variable
BL	bad loans	bad loans/total assets	-
SZ	bank size	log(average total assets)	-
Fee	the share of RNTA	RNTA/average total assets	-
HH	bank concentration	log(Herfindahl-Hirschman index)	+/-
Equity	equity capital	equity capital/average total assets	+
Bond	interest-rate risk	the variance of daily yield on 3- year corporate bonds	+
Loan	credit risk	average loan/average total asset	+
FD	stock market development	total amount of securities traded /GDP	-
LDR	loan-to-deposit rate	average loans/average deposits	+/-
Dum_Crisis	dummy for the foreign exchange crisis	1 in 1998, 0 in others	-

Notes : 1) Interest revenue is loan interest, and interest expense is deposit interest  
 2) RNTA = securities-related income + credit card-related income + other fee income  
 3) loans = loans in local or foreign currencies + domestic import usance bills + advances for customers  
 4) Expected sign is the sign that the coefficient of each variable is expected to have. +/- means that the expected sign can be either + or - .

Table 5 Correlations between Explanatory Variables

	BL	SZ	Fee	HH	Equity	Bond	Loan	FD	LDR	Dum_Crisis
BL	1.000									
SZ	-0.188	1.000								
Fee	0.271	-0.422	1.000							
HH	-0.212	0.388	-0.349	1.000						
Equity	-0.116	-0.410	0.114	-0.541	1.000					
Bond	0.341	-0.089	0.310	-0.500	0.053	1.000				
Loan	-0.367	0.310	-0.620	0.214	0.095	-0.121	1.000			
FD	0.119	0.264	0.008	0.573	-0.449	-0.409	-0.141	1.000		
LDR	-0.429	0.069	-0.235	0.295	0.201	-0.342	0.512	-0.009	1.000	
Dum_Crisis	0.269	-0.042	0.315	-0.270	-0.066	0.823	-0.179	-0.249	-0.336	1.000

On the other hand, in Table 5 are the relations of various explanatory variables explained so far. The reason that Bond and Dum\_Crisis have such a high correlation is the high-interest rate policy mandated by the IMF during the crisis period, when interest rate volatility was very high.

Since other variables are not so closely correlated with one another, the

possibility of multicollinearity does not seem to exist.

### 3. The Econometric Model

I formulate a panel regression model to account for the sample heterogeneity.<sup>27)</sup> After estimating fixed effects and random effects model, I perform Hausman and Bruesch-Pagan LM tests to report only appropriate results.<sup>28)</sup>

$$NIM_{it} = \alpha_i + \beta_1 BL_{it-1} + \beta_2 SZ_{it} + \beta_3 Fee_{it-1} + \beta_4 HH_{it} + \beta_5 Equity_{it-1} + b_1 A_{it} + b_2 B_{it} + \epsilon_{it}, \epsilon_{it} \sim N(0, \sigma^2) \quad (6)$$

As explained before, *NIM* is the cost of FI measured by IRDTA, *BL* is the soundness of bank assets, *SZ* is the bank size, *Fee* is the portion of RNTA, *HH* is Herfindahl-Hirschman Index, and *Equity* is equity ratio. *A* denotes a vector of bank-specific variables, such as credit risk(Loan), loan to deposit rate(LDR), and *B* refers to a vector of macroeconomic variables, such as interest-rate risk(Bond), degree of financial market development, and a dummy variable(Dum\_Crisis). Accordingly,  $b_1, b_2$  are coefficient vectors corresponding to vector *A* and *B*.

The empirical study starts from the analysis of whole period(1992~2004) and later analyzes the pre-crisis period(1992~1997), post-crisis period(1998~2004), respectively.<sup>29)</sup>

## V. Empirical Results

Table 6 shows the results of the analysis for the whole period. The overall results are somewhat different from those of the existing studies for commercial banks in the US or other countries.

BL has expected (-) signs in all models, which are significant, indicating that unexpected deterioration of asset quality decreases the revenue from the deposit-loan business.

SZ shows positive relationships in most models and is significant at 1% in I-3. This result is inconsistent with Demirgüç-Kunt *et al.*(2003), but consistent with

27) The data processing was performed by STATA(ver. 8.2).

28) The model selection criterion is in Appendix 3.

29) Strictly speaking, the beginning of the sample period is not necessarily 1992 because of many lagged and missing variables. For the notational convenience, however, 1992 is used in the analysis.

other studies (McShane and Sharpe, 1985; Angbazo, 1997; Maudos and Guevara, 2004). The evidence, however, does not seem strong, as it is insignificant in most models.<sup>30)</sup>

On the other hand, Fee has expected (-) signs in most models and is significant at 1%, which is consistent with the existing results (Demirgüç-Kunt *et al.*, 2003). Fee was first measured by  $\lceil \text{RNTA}/\text{total asset} \rceil$  (Fee1), but I also used  $\lceil \text{RNTA}/\text{total revenue} \rceil$  to verify the robustness of the results.

Meanwhile, bank concentration (HH) has negative signs in most models and is significant at 5% in model I-1. But the evidence seems very weak because it is not significant in most models, suggesting that more profound study is needed in the future to figure out exactly how bank concentration affects the cost of FI. When I used alternative measures of bank concentration, such as CR3 and CR5, the results were mostly the same. In fact, the correlation coefficients between these variables and HH were 0.9919 and 0.9786, respectively.

In most models, Equity has unexpected negative signs and is not significant.<sup>31)</sup> This runs counter to the argument that a bank with high equity ratio can finance at low cost and thus enjoy a high net interest margin (Demirgüç-Kunt *et al.*, 2003), or that a bank should pursue high net interest margin to compensate for the high cost of equity capital (Saunders and Schumacher, 2000). According to Demirgüç-Kunt *et al.* (2003), the lack of significance of Equity means that depositors do not discriminate between the soundness of assets across banks.

Interest rate risk (Bond) has expected positive signs, but is not significant in most models, which is inconsistent with the existing results of dealership model (Ho and Saunders, 1981). The results were almost the same when I used the variance of daily CD (91 days) and Call (overnight) rates.

Loan proxying the credit risk has expected (+) signs in all models at the 1% significant level, which is consistent with the results of Angbazo (1997), Maudos and Guevara (2004). Meanwhile, the loans provided for SME (small and medium enterprises) are considered as riskier, so I add the rate of SME loans to total loans in the analysis to reflect this. The ratio of SME loans to total loans (Loan2) shows two positive signs and are significant at 1% in one of them. Loan2 here is measured by  $\lceil \text{average SME loans}/\text{average bank loans} \rceil$ , where bank loans do not include inter-bank loans.

30) Total loans were used to measure bank size as this study was about the net interest margin from traditional activity of bank intermediation, but the results proved to be almost the same as before except that the significance decreased a little. The correlation coefficient between total assets and total loans in the sample period was 0.9821, meaning that the movement of these variables were very similar.

31) Instead of Equity, the BIS-based ratio of equity capital was attempted, but it turned out to be inappropriate because there was inconsistency in the series of some banks.

Table 6 Estimation Results I

Sample period : 1992 - 2004				
	I - 1	I - 2	I - 3	I - 4
BL(- 1)	-0.041*** (0.001)	-0.034*** (0.007)	-0.042*** (0.002)	-0.048*** (0.002)
SZ	-0.065 (0.633)	-0.001 (0.997)	0.399*** (0.002)	0.391 (0.178)
Fee1(- 1)	-0.363*** (0.000)		-0.523*** (0.000)	
Fee2(- 1)		-0.038*** (0.000)		-0.051*** (0.000)
HH	-1.532*** (0.009)	-0.109 (0.863)	-0.790 (0.192)	0.699 (0.432)
Equity(- 1)	-0.017 (0.269)	-0.022 (0.178)	0.0001 (0.993)	-0.016 (0.389)
Bond	0.006 (0.517)	0.007 (0.460)	0.017 (0.116)	0.013 (0.274)
Loan1	4.038*** (0.000)	4.075*** (0.000)		
Loan2			0.013*** (0.000)	0.005 (0.536)
FD	-0.040 (0.645)	-0.246*** (0.004)	-0.071 (0.447)	-0.356*** (0.000)
LDR	0.019*** (0.000)	0.016*** (0.000)	0.023*** (0.000)	0.020*** (0.000)
Dum_Crisis	-0.451** (0.014)	-0.585*** (0.002)	-0.622*** (0.003)	-0.726*** (0.002)
Constant	4.142** (0.017)	-0.203 (0.905)	1.097 (0.586)	-1.948 (0.452)
R <sup>2</sup>	0.740	0.737	0.680	0.680
No. of obs. (group)	182(27)	182(27)	180(27)	180(27)
Breusch - Pagan	35.41*** (0.000)	35.83*** (0.000)	7.33*** (0.007)	2.61 (0.106)
Hausman	14.83 (0.138)	17.14* (0.071)	13.64 (0.190)	19.28** (0.037)

Notes : 1) \*, \*\*, \*\*\* denote significance level of 10%, 5%, 1%, respectively and numbers in ( ) are p values.

2) The null hypothesis of Breusch Pagan is 'No random effects', and that of Hausman is 'No relationship between random effects and independent variables'.

3) Fee1 denotes 'RNTA/total asset', and Fee2 denotes 'RNTA/total revenue'.

4) Loan1 denotes the ratio of total loans to total assets, and Loan 2 denotes the ratio of SME loans to total loans.

5) (- 1) denotes the lagged variable.

While credit risk proves to be very significant in most models, interest rate risk(Bond) is insignificant in most models. This implies that the cost of FI is

more deeply related to credit risk than interest rate risk. This may be because a bank can easily consider a firm's credit risk when determining the loan interest rate, while it is hard for the bank to consider interest rate risk.<sup>32)</sup>

And FD has unexpected signs and is significant at 1% in half of the models, which reflects the idea that the development of the capital market raises the degree of competition and finally decreases the cost of FI.

On the other hand, LDR has significant (+) signs in most models. Since LDR may reflect mixed situations, such as a bank's business strategy or the structures of deposit and loan markets, it is very difficult to find out the possible reasons why it has a positive sign. I will put off conjecturing the reason till I estimate the models for before and after the crisis.

Finally, the dummy variable for the economic crisis (Dum\_Crisis) shows significant negative signs, indicating that the cost of FI decreased sharply during the crisis.

Meanwhile, unlike most existing studies, Demirgüç-Kunt *et al.*(2003) employ loans instead of total assets arguing that the loans may be a better measure of the cost of FI from the viewpoint of traditional loan-deposit operations. Following the argument, I re-estimated the panel regression model using average loans as an alternative proxy for the cost of FI. The results are shown in Table 7, which is almost the same as those in Table 6. Overall the fitness is a little lower and the variables proxying for credit risk(Loan1, Loan2) become less significant than before.

From the results of two estimations, one may find that Fee significantly decreases the cost of FI while there is no evidence that bank size and concentration affect it. And it is also found that credit risk is regarded as very important while interest rate risk is not.

Meanwhile, as we saw in Figure 1, the cost of FI changed greatly after the crisis in 1997. Before the crisis, it moved within a narrow range, but it has been increasing gradually after a big decrease right after the crisis. This indicates that the determinants of the cost of FI have changed greatly since the crisis.

Table 8 shows the estimation results for the pre-crisis period, which have lower  $R^2$  compared to the whole period, and lower explanatory power for each variable.

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32) It is shown that no term for interest rate risk is found in equation (2). It is surveyed that banks do not consider interest rate risk in their spread when determining loan interest rate. Instead, banks usually make floating rate loans, which helps them reflect interest rate risk by adjusting the prime rate.

Table 7

## Estimation Results II

Sample period : 1992 - 2004				
	II-1	II-2	II-3	II-4
BL(-1)	-0.082*** (0.004)	-0.067** (0.020)	-0.080*** (0.010)	-0.065** (0.042)
SZ	-0.081 (0.796)	0.069 (0.836)	-0.072 (0.901)	0.215 (0.718)
Fee1(-1)	-0.875*** (0.000)		-0.831*** (0.000)	
Fee2(-1)		-0.084*** (0.000)		-0.083*** (0.000)
HH	-2.886** (0.026)	0.302 (0.832)	-0.981 (0.587)	2.081 (0.258)
Equity(-1)	-0.022 (0.529)	-0.029 (0.426)	0.001 (0.970)	-0.002 (0.956)
Bond	0.012 (0.565)	0.013 (0.547)	0.026 (0.289)	0.028 (0.270)
Loan1	1.732 (0.318)	2.325 (0.200)		
Loan2			0.018 (0.253)	0.020 (0.225)
FD	-0.162 (0.393)	-0.638*** (0.001)	-0.211 (0.281)	-0.666*** (0.001)
LDR	0.037*** (0.000)	0.032*** (0.000)	0.037*** (0.000)	0.034*** (0.000)
Dum_Crisis	-1.001** (0.014)	-1.270*** (0.003)	-1.163** (0.011)	-1.435*** (0.003)
Constant	10.984*** (0.004)	1.631 (0.669)	4.943 (0.368)	-4.595 (0.390)
R <sup>2</sup>	0.626	0.606	0.621	0.598
No. of obs. (group)	182(27)	182(27)	180(27)	180(27)
Breusch-Pagan	43.71*** (0.000)	43.36*** (0.000)	4.35** (0.037)	3.62* (0.057)
Hausman	9.51 (0.484)	13.14 (0.216)	60.87*** (0.000)	26.94*** (0.003)

Notes : The dependent variable is the number that uses the average loan as a denominator. Others are the same as before.

SZ, Equity, Bond, FD are insignificant and have ambiguous signs. Fee has expected signs, but is not significant. Only credit risk and LDR maintain explanatory power, but the sign of credit risk is ambiguous.

In conclusion, the estimation results for the pre-crisis period differ greatly from those for the whole period, indicating there has been a big change in the

Table 8

## Estimation Results I II

Sample period : Pre-Crisis (1992-1997)				
	III-1	III-2	III-3	III-4
BL(-1)	-0.135 (0.509)	-0.125 (0.545)	-0.304 (0.293)	-0.243 (0.400)
SZ	1.588 (0.423)	1.612 (0.415)	-1.134 (0.964)	-0.291 (0.929)
Fee1(-1)	-0.100 (0.525)		-0.208 (0.370)	
Fee2(-1)		-0.011 (0.548)		-0.039 (0.158)
Equity(-1)	-0.063 (0.178)	-0.062 (0.182)	0.045 (0.434)	0.028 (0.620)
Bond	-0.015 (0.541)	-0.015 (0.540)	0.022 (0.554)	0.023 (0.527)
Loan1	12.31*** (0.000)	12.13*** (0.000)		
Loan2			-0.025 (0.401)	-0.026 (0.306)
FD	0.076 (0.988)	0.496 (0.922)	-1.571 (0.832)	-0.702 (0.923)
LDR	0.021** (0.040)	0.021** (0.038)	0.046*** (0.001)	0.043*** (0.002)
Constant	-12.39 (0.241)	-12.51 (0.236)	1.191 (0.940)	2.642 (0.864)
R <sup>2</sup>	0.669	0.669	0.390	0.410
No. of obs. (Group)	74(25)	74(25)	69(25)	69(25)

Notes : 1) Fixed-effects models, which have higher R<sup>2</sup> than their random-effects counterparts, are selected in all cases, because the Hausman test was not feasible, which made the selection criterion in Appendix 3 irrelevant.

2) HH was excluded because of multicollinearity.

3) Others are the same as in Table 6.

determinants of the cost of FI. Consequently, it is highly possible that the panel regression in Table 8 is missing some important determinants. Though we need to work more on this in a future study, I think it will be very difficult because the determinants might be some unmeasurable factors. In the early 1990s when financial liberalization was not complete, interest rates were not freely determined in the market. Exogenous power such as the government's intervention in the market may have greatly affected interest rates, and in turn the cost of FI.

On the other hand, the results for the post-crisis period are in Table 9.

The most striking change is found in bank size(SZ). SZ is very significant in

all models, which is different from the results for whole period. However, it has (+) signs in two models, while it has (-) in another two. This ambiguity does not allow us to conclude that bank size affects the cost of FI either positively or negatively. One thing evident, however, is that bank size became an important determinant after the economic crisis. Fee1, Fee2 turn out to have significant explanatory power continuously in the analysis for the post-crisis period. Meanwhile, contrary to the expectation, bank concentration(HH) turns out not to have any explanatory power. This implies that the degree of monopoly power is not in such a range as to affect the cost of FI in the domestic banking industry, which we discussed before.

Equity ratio, on the other hand, has a significant sign in IV-2, but is insignificant in most models. According to Demirgüç-Kunt *et al.*(2003), this implies a lack of market discipline. This result contradicts the general idea that people have discriminated between the soundness of banks since the economic crisis. It can be explained in two ways. Firstly, it is possible that depositors exercised market discipline via the size of deposits not by deposit interest rates. Jeon and Oh(2000), and Park(2002) find that market discipline existed even before the economic crisis. However, they find a significant sign when they employ the increase rate of deposits as a dependent variable, while they find much lower significance when they use the deposit interest rate as an alternative dependent variable(Park, 2002). This indicates that the market discipline was performed via the size of deposits not by deposit interest rates. That is, a sound bank with good asset quality may have received more deposits at the same deposit interest rates rather than it received deposits at lower interest rates. According to this conjecture, we may interpret that the equity ratio has not affected the cost of FI measured by IRDTA. Based on this result, we may envisage the possibility that depositors have continued to exercise market discipline via the size of deposits since the crisis. Secondly, we may think of the possibility of moral hazard by the participants in the deposit market. As is widely known, deposit insurance tends to make depositors less careful about bank soundness. This tendency might have been more serious when there was a total-amount deposit insurance guarantee from 1998 to 2000, which is partly verified by Jeon and Oh(2000), and Park(2002).

Table 9

## Estimation Results IV

Sample period : Post-Crisis (1998 - 2004)				
	IV-1	IV-2	IV-3	IV-4
BL(-1)	0.008 (0.648)	0.019 (0.299)	-0.043*** (0.007)	-0.038* (0.064)
SZ	-2.048*** (0.002)	-1.766*** (0.006)	0.418** (0.023)	1.290** (0.014)
Fee1(-1)	-0.317*** (0.001)		-0.575*** (0.000)	
Fee2(-1)		-0.027*** (0.007)		-0.037*** (0.003)
HH	0.849 (0.381)	1.481 (0.142)	-0.445 (0.636)	0.414 (0.738)
Equity(-1)	-0.031 (0.300)	-0.050* (0.096)	0.011 (0.734)	-0.054 (0.143)
Bond	-0.013 (0.374)	-0.013 (0.285)	-0.014 (0.275)	-0.0001 (0.993)
Loan1	9.638*** (0.000)	10.04*** (0.000)		
Loan2			0.010* (0.054)	-0.004 (0.720)
FD	-0.032 (0.757)	-0.159 (0.175)	-0.041 (0.740)	-0.153 (0.296)
LDR	0.003 (0.560)	0.002 (0.697)	0.018*** (0.000)	0.011* (0.056)
Constant	4.842 (0.109)	1.621 (0.563)	0.554 (0.863)	-5.117 (0.158)
R <sup>2</sup>	0.765	0.754	0.629	0.624
No. of obs. (group)	111(22)	111(22)	111(22)	111(22)
Breusch - Pagan	8.45*** (0.003)	9.92*** (0.001)	4.63** (0.031)	1.30 (0.254)
Hausman	30.22*** (0.000)	75.78*** (0.000)	8.81 (0.455)	17.40** (0.043)

Note : The same as in Table 6

Bond proves to be still insignificant in most models, meaning that interest rate risk has not affected loan interest rates even after the crisis. Credit risk(Loan1, Loan2) is significant in most models, and FD, the degree of capital market development, is mostly insignificant.

Meanwhile, the ratio of loans to deposits(LDR) is less significant than in the pre-crisis period, which can be explained as follows, though they may not be exact. In the pre-crisis period when the liberalization of interest rates was still under progress, interest rate competition was not fierce and the market was

dominated by providers. Under this situation, the IRDTA could increase with LDR. After the crisis, however, since the market was dominated by demanders and interest rate competition began to be fierce, it has been very difficult for the banks to increase interest rates while maintaining their loan market share. Consequently, the cost of FI measured by IRDTA could not increase with the LDR.

The estimation results explained so far can be summarized as follows.

Firstly, for the entire period, the most important determinants of the cost of FI in the Korean banking industry are RNTA(Fee), credit risk(Loan1, Loan 2), and loans to deposits ratio(LDR). Bank size and bank concentration prove not to affect the cost of FI.

Secondly, for the pre-crisis period, the results are greatly different from those for the entire period. The overall explanatory power of the model and the significance of individual variables are lower than those for the entire period, indicating that there was a great change in the determinants of the cost of FI between the pre-crisis period and the post-crisis period. We may conjecture that there were certain unmeasurable factors that affected the cost of FI before the crisis. On the other hand, credit risk and LDR turn out to have almost the same results as those for the entire period.

Finally, for the post-crisis period, RNTA and credit risk have the same significance as those for the entire period. Bank concentration still has low explanatory power, but the importance of bank size as a determinant of the cost of FI has increased very much. The sign, however, proves to be ambiguous, which requires further analysis in the future.

## VI. Concluding Remarks and Implications

Analyzing the Korean bank data, it turns out that the results are significantly different from existing studies for foreign banks.<sup>33)</sup>

First of all, I can not find strong evidence that bank size affects the cost of FI for the entire sample period, but find it has become important since the crisis. This suggests that banking authorities need to monitor banks' efforts to increase their size through M&A. The direction, however, is not clear in the study, which

33) This result may come from the difference in variable selection and estimation method. For instance, in existing theories, asset quality(BL) used to adjust net interest margin in this analysis, and the endogeneity of explanatory variables were not considered. The loan to deposit ratio(LDR) is also considered for the first time in this analysis.

requires further elaboration in the future.

RNTA turns out to have a significant negative effect on the cost of FI. Korea has a less-developed non-bank financial market than countries having a market-based system like the US. Banks still play a great role in the financial market, and the weight of traditional deposit-loan operations among banking activities is greater than that in developed countries. This makes the FI of the banking sector the greatest factor affecting firms' investment behavior. In this regard, banks' efforts to diversify their business area should be exerted continuously from the viewpoint of profitability as well as of efficient financial intermediation in the economy. The banking authorities ought to produce relevant new policies for the progress of diversification in banking activities.

On the other hand, the bank concentration turns out not to affect the cost of FI not only in the pre-crisis period but in post-crisis period. I conjecture that this is because the degree of bank concentration in Korea is not serious enough to affect the cost of FI. However, since it seems that the degree of bank concentration is becoming greater, banking authorities need to pay more attention to the banking industry from a macroeconomic perspective.<sup>34)</sup>

The equity ratio turns out not to affect the cost of FI either way. According to an existing study(Demirgüç-Kunt *et al.*, 2003), this indicates that depositors do not discriminate bank soundness via deposit interest rates. Though there is some evidence from studies for Korean banks(Park, 2002), further study about the exercise of market discipline by depositors is needed to ascertain whether it did strengthen after the crisis.

Interest rate risk has a positive sign, but is insignificant in most models. This means that interest rate risk cannot be an important factor affecting the cost of FI. However, since many interest raterelated financial products have been introduced in the market recently, implying that the sensitivity of a bank towards the market interest rate is increasing, the monetary authorities need to pay continuous attention to minimize the variability of a bank's interest rate.

Credit risk, unlike interest rate risk, shows a positive sign in all models, suggesting that a bank's ability to assess customer's credit risk correctly is a way to activate the bank's FI.<sup>35)</sup>

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34) Lee and Lee(2004) analyze that the competitiveness of banking industry decreased due to the rise in the market concentration after the crisis. For the details, see Lee and Lee(2004).

35) Banks tend to evaluate newly established companies and SMEs as having high credit risk. Accordingly, they require high loan interest rates from the firms, even though they have projects with good prospects. If those firms are unable to afford the high interest rates, financial intermediation does not occur, resulting in the squandering of national resources. If banks could provide loans at low interest rates in this instance through the improvement of their credit rating skills, it would result in favorable macroeconomic consequences.

Meanwhile, financial market development turns out to have a negative effect on the cost of FI for the entire period. It, however, has nothing to do with the cost of FI for the post-crisis period.

As I pointed out at the beginning, it is very hard to find existing papers studying the determinants of the cost of FI in Korea. I think there may be many points in this study that someone may not agree to. For instance, this study does not find out satisfactorily factors affecting the cost of FI in the pre-crisis period, while it does for the post-crisis period.

Finally, there still exists a suspicion about the appropriateness of certain variables such as credit risk.<sup>36)</sup> Future studies need to be undertaken in such a way to resolve the problems cited, using various data and regressors as in other studies in the US, etc.

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36) One referee suggested that a more appropriate proxy variable for the credit risk is needed, pointing out that the credit risk variable used in the analysis does not accurately measure the credit risk of loan asset, and the simple loan ratio has a high correlation with the cost of FI measured by IRDTA. However, I could not consider his comments in the analysis because of time shortage and data availability.

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## Appendix

### 1. Banks Included in the Analysis

Year	No.	Bank Name
1992	23	1,2,4,5,6,7,10,11,12,13,14,15,16,18,19,20,21,22,23,24,25,26,27
1993	24	1,2,4,5,6,7,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27
1994	24	1,2,4,5,6,7,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27
1995	24	1,2,4,5,6,7,8,10,11,12,13,14,15,17,18,19,20,21,22,23,24,25,26,27
1996	25	1,2,4,5,6,7,8,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27
1997	26	1,2,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27
1998	21	1,2,4,5,6,7,8,9,10,11,15,16,17,18,19,21,22,24,25,26,27
1999	17	1,3,4,6,7,8,9,10,11,15,17,18,19,21,22,24,26
2000	17	1,3,4,6,7,8,9,10,11,15,17,18,19,21,22,24,26
2001	15	1,3,4,6,7,8,10,11,15,18,19,21,22,24,26
2002	14	1,3,4,7,8,10,11,15,18,19,21,22,24,26
2003	14	1,3,4,7,8,10,11,15,18,19,21,22,24,26
2004	14	1,3,4,7,8,10,11,15,18,19,21,22,24,26

Note : Numbers denote corresponding banks below. Hanvit bank(1999~2001) is denoted by Woori bank.

1: Chohung, 2: Commercial, 3: Woori, 4: First 5: Hanil, 6: Seoul,  
7: Foreign Exchange, 8: Kookmin, 9: Housing, 10: Shinhan, 11: Hanmi,  
12: Donghwa, 13: Dongnam, 14: Daedong, 15: Hana, 16: Boram, 17: Pyunghwa,  
18: Daegu, 19: Pusan, 20: Chungcheong, 21: Kwangju, 22: Jeju, 23: Kyungki,  
24: Jeonbuk, 25: Gangwon, 26: Kyongnam, 27: Chungbuk

### 2. Descriptive Statistics of Sample

Variables	No.	Average	Maximum	Minimum	S.D.
NIM1	183	1.49	3.46	-2.77	0.92
NIM2	183	2.69	5.91	-7.47	1.76
BL	183	2.71	19.50	0.10	3.66
SZ	183	4.80	6.11	0.99	0.63
Fee1	183	2.76	6.82	1.21	0.85
Fee2	183	33.27	64.07	14.50	7.40
HH	183	2.97	3.16	2.85	0.11
Equity	183	7.22	21.37	0.89	2.99
Bond	183	4.32	20.42	0.05	7.06
Loan1	183	0.53	0.73	0.29	0.07
Loan2	183	53.15	90.00	6.30	16.87
FD	183	0.82	2.19	0.32	0.56
LDR	183	73.91	137.83	38.87	15.87
Dum_Crisis	183	0.12	1.00	0.00	0.32

Note : NIM1 is based on total asset, NIM2 is based on total loan

### 23. Fixed-effects Model vs. Random-effects Model

The discrimination of fixed-effects model vs. random-effects model comes from the difference of viewpoint about heterogeneity across groups. In (6),  $\epsilon_{it}$  can be viewed either as group-specific constant (fixed-effects model) or as group-specific disturbance (random-effects model).<sup>37)</sup> Which type of model to use depends on the following test.

Breusch and Pagan developed LM (Lagrange Multiplier) test based on the following estimator of OLS residual.

$$LM = \frac{nT}{2(T-1)} \left[ \frac{\sum_{i=1}^n (Te_i)^2}{\sum_{i=1}^n \sum_{t=1}^T e_{it}^2} - 1 \right]^2 \quad (7)$$

(7) is known to have chi-square distribution with degree of freedom 1 under the null hypothesis of no random effects. If the estimate is greater than the critical value, the null hypothesis is rejected for the existence of random effects. However, since random effects, denoting group specific disturbance, may have correlation with other regressors, another test developed by Hausman is conducted to consider this. This test is based on the fact that both OLS and GLS have consistency under the null hypothesis of no correlation between random effects and regressors.<sup>38)</sup> That is, there should be no systematic difference between the two estimates under the null hypothesis. Hausman estimator is described as follows.

$$W = x^2[K] = [b - \hat{\beta}]^t \hat{\Sigma}^{-1} [b - \hat{\beta}]. \quad (8)$$

In (8),  $b$  denotes an OLS estimate,  $\hat{\beta}$  denotes a GLS estimate, and  $\hat{\Sigma}$  denotes covariance matrix of  $(b - \hat{\beta})$ .  $W$  has an asymptotic chi-square distribution with degree of freedom  $K$ . If the estimate is less than the critical value, one may conclude that there is no correlation between random effects and regressors. Finally, one may say that random effects model is preferred in this case. This test procedure was utilized in chapter IV and only the selected models were reported.<sup>39)</sup>

37) Unlike  $\epsilon_{it}$ , the disturbance term is unique in each group irrespective of  $t$ .

38) For more detail, refer to Green(2000).

39) The problem occurs when both tests reject the null hypotheses at the same significance level. There is no consensus on this point, but in this study I chose random effects model whenever p value of Breusch and Pagan is less than or equal to that of Hausman. Otherwise, fixed effects model were chosen.