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Regulatory reforms and moral hazard in Korean banking

Abstract

Using the panel data of Korean banks before and after the regulation of banking industry was reformed in the late 1997-1998, we examined whether the tendencies of the banks with greater financial and operational leverages to take on more risk became weaker for the post-reform period. Moral hazard hypotheses predict that the banks with greater financial leverage (lower capital ratio) and higher operational leverage would have greater risk-taking incentives. But during tightened regulation, such behavior would result in higher explicit, implicit costs and increased supervisory attention. We hypothesized, therefore, if the regulation was effective, those tendencies would be weaker after reform. We found very strong and consistent evidences supporting the hypothesis. The risk-taking incentives associated with both financial leverage and operational leverage were significantly weaker after reform. That is, the causality relationship between capital ratio and risk-taking became significantly less negative; the relationship between fixed-asset ratio and risk-taking became significantly less positive after reform. Moreover, the reduced risk-taking incentives of those banks resulted in less profitable performance than safer banks after reform.

Keywords: Korean banking industry, bank regulation, moral hazard, risk taking, deposit insurance.
JEL Classification: G21.

Introduction

It is generally understood that the market discipline of high risk-high cost relationship does not work effectively for the banking industry. Deposit insurance system backed up by the government enables banks to undertake excessively risky strategies by insulating the major creditors or depositors of banks against decrease in bank asset values. Depositors view insured deposits as riskless, and therefore, they would not require higher risk-premiums for the bank's greater risk-taking. The moral-hazard of banks could be even worse if the deposit insurance system is a fixed-rate one. Since the deposit insurance premiums do not vary with the bank risk, banks do not pay any higher cost or penalty for greater risk-taking. Many researchers agree that the moral hazard associated with deposit insurance (especially fixed-rate one) played a major role in the failures of banking industry. In addition to the explicit protection of banking industry by deposit insurance system, implicit 'forbearance policy' practiced by the bank regulators is attributed to be another reason for the banking industry's moral hazard. It would give insolvent banks great incentives to seek excessively risky strategies or to try gamble to get out of bankruptcy, letting insolvent banks remain open without being closed at the appropriate time[1]. Moreover, as pointed out by Saunders, Strock and Travlos (1990), and Cebenoyan, Cooperman and Register (1999), banks could have greater incentives and ability to increase risk during the periods of deregulation relative to periods of regulation.

The risk-taking incentives associated with deposit insurance system, significant deregulations in terms of bank activity, interest rates and the reorganization of financial industries between the early and mid 1990s, and the implicit forbearance policy regarding bank closure are attributed to be some of the main reasons for the failure and crisis of the Korean banking industry around 1997. To restructure the banking industry and to achieve its soundness, Korean government made several regulatory reforms. The regulatory reforms legislated with the Core Principles for Effective Banking Supervision of December 1997 focus on discouraging the banks from taking high risk. These included the transformation of total deposit insurance system into partial deposit insurance system, the implementation of Prompt Corrective Actions, more tightened BIS (Bank for International Settlement) capital standards, and a modest step toward risk-based deposit insurance system, etc. Among these reform clauses, the BIS capital standard was the core one. If the banks do not reach the recommended BIS capital standards, their behaviors were restricted significantly and they are required to provide new management plan to raise their capital ratio, and if this was not satisfied, they became the target of acquisition by other healthier banks or even bank closure by the regulator was possible. Nine banks out of total twenty-six failed between 1998 and 1999 mainly through the resolution method of P&A (purchase and assumption).

The purpose of this study is to investigate empirically whether the regulatory reform of the Korean banking industry beginning in the late 1997 was effective in reducing the risk-taking incentives of banks. Examining the effectiveness of the changes or introduction of new economic regulations and policies would be very important to derive policy implications to make the economic system and

This work was supported by Ewha Womans University research grant of 2007.
[1] Refer to Benston, Eisenbeis, Horvitz, Kane and Kaufman (1986) for a thorough discussion and references to many studies about the role of deposit insurance to induce moral hazard behavior of banks.

environment, which is in our case financial industry, sounder and healthier. By examining the effectiveness of the regulatory changes in Korean banking industry, we try not only to derive some policy implications for the Korean banking industry, but also to make some methodological contribution to test the moral hazard behavior of banking industry. Empirically, it might be impossible to test directly whether the behavior of banks became safer and sounder due to introduction of new regulations. Instead, we take an indirect approach. Specifically, we compare the associations between bank risk-taking and the driving variables that were previously found to play an important role for bank risk-taking between pre- (1994-1997) and post- (1998-2005) reform periods. If reform has been effective, the associations (the causality relationships) between the variables measuring risk taking and the driving variables for risk taking would be significantly weaker for the period after reform. Moral hazard hypotheses predict that the banks with greater financial leverage (lower capital ratio) and greater operational leverage would have greater risk-taking incentives. But during tightened regulation, such behavior would result in higher explicit, implicit costs and increased supervisory attention. We hypothesized, therefore, if the regulation was effective, those tendencies would be weaker after reform. From the panel data of Korean banks before and after the regulation of banking industry was reformed in the late 1997, we found very strong and consistent evidences supporting the hypothesis. The risk-taking incentives associated with both financial leverage and operational leverage were significantly weaker after reform. That is, the causality relationship between capital ratio and risk-taking became significantly less negative; the relationship between fixed-asset ratio and risk-taking became significantly less positive after reform. Moreover, the reduced risk-taking incentives of those banks resulted in less profitable performance than safer banks after reform.

In the next section, we describe the sample of banks, giving summary statistics. In section 2, we describe the hypotheses to be tested and the regression model used to test them. In section 3, we present the empirical results and in the last section offer concluding remarks.

1. Sample and data

We use the balance sheet data of Korean banks to test our hypotheses. The data were obtained from the Statistics of Bank Management from 1994 to 2005 issued by the Korean Financial Supervisory Service. The balance sheet data for each bank include the sizes of asset, capital, loans, investment securities, deposit, and fixed asset.

The sample consists of all the commercial banks in Korea: 24 banks in 1994, 25 banks in 1995 and 1996, 26 banks in 1997, 20 banks in 1998, 17 banks in 1999 and 2000, 15 banks in 2001, and 14 banks from 2002 to 2005. The summary statistics of all the variables used in our analysis are presented in Table 1. Capital-to-asset ratio averages 4.5%, ranging from -6.2% to 14.15%. The average loan-to-asset ratio is 45.7%. The average ratio of investment securities to total asset is 31.2%, ranging from 14% to 53.1%. The average operational leverage measured by the ratio of fixed asset to total asset is 50.77%, ranging from -147.6% to 2,442.9%. The bank asset size ranges from 980 billion won to 214,821 billion won, averaging 32,573 billion won. The size of bank deposit ranges from 841 billion won to 206,470 billion won, averaging 31,188 billion won.

Table 1. Sample descriptive statistics

	Mean	Median	Standard deviation	Min	Max
Capital-to-asset	0.0449	0.0418	0.221	-0.0619	0.1415
Loan-to-asset	0.4573	0.4464	0.0782	0.2721	0.6910
Investment securities-to-asset	0.3127	0.3132	0.0709	0.1408	0.5314
Fixed asset-to-capital	0.5077	0.312	1.7259	-1.476	24.429
Asset	325,735	174,205	380,176	9,803	2,148,219
Deposit	311,887	165,698	362,385	8,416	2,064,074

Note: This table shows the sample descriptive statistics for the sample banks for the period of 1994-2005.

2. Testable hypotheses, testing models, and correlation test

As hypothesized above, if reform has been effective, the associations between the variables measuring risk taking and the driving variables for risk taking would be significantly weaker for the periods after reform. To examine how the risk-taking incentives of banks are changed after reform, we estimate the following pooled time-series/cross-sectional regression equation,

where the reform dummy interaction variable D takes the value of 0 before the pre-reform period (1994-1997) and the value of 1 afterwards (1998-2005).

$$(\text{Risk})_{i,t} = \beta_0 + \beta_1(\text{Financial leverage})_{i,t} + \\ + \beta_2 D\times(\text{Financial leverage})_{i,t} + \\ + \beta_3 (\text{Operational leverage})_{i,t} + \\ + \beta_4 D\times(\text{Operational leverage})_{i,t} + \varepsilon_{i,t}. \quad (1)$$

Risk for each individual bank i is proxied by alternative balance sheet risk measures. The first one is the ratio of loans to total asset. The higher the loan-to-asset ratio is, the greater the degree is to which the bank's performance is exposed to future economic fluctuation. Loans are considered to be risky asset and are given higher risk weight at the calculation of risk-adjusted asset and BIS capital ratio. Moreover, the risky and largest portion of the assets in the sample banks' portfolios are loans to businesses, and the risk of these loans largely depends on the economy. Thus, other things being equal, higher loan-to-asset ratio is believed to represent higher risk-taking incentives[1]. The second one is the ratio of investment securities to total asset[2]. Investment securities are generally considered to be safer than loans, and generally are given lower risk weight at the calculation of risk-adjusted asset and BIS capital ratio[3]. Thus, other things being equal, higher investment securities-to-asset ratio is believed to represent lower risk-taking incentives. The third one is the size of the bank deposit and the fourth one is the size of asset. It is well known that banking industry may be one of the easiest sectors that can increase the firm's asset size by attracting more deposits giving more incentives to depositors such as higher deposit interest rates. Many researchers point out the implication of too-big-to-fail policy and proxy bank risk taking by the size of asset or deposit. It is generally believed by investors and even bankers that regulators will not allow the failures of larger banks in general because of potential damage to the economy. In the event of insolvency, the deposit insurance system would bail them out, and no depositors or creditors would take a loss. This policy is generally known as the 'too-big-to-fail' doctrine. Then larger banks would have greater risk-taking incentives. Thus, other things being equal, greater size of deposit or asset is believed to represent higher risk-taking incentives[4].

As for the explanatory variables for risk taking, we use two leverage variables: financial leverage and operational leverage[5]. Financial leverage is measured by the ratio of capital to total asset[6]. It is generally agreed that the lower the capital-to-asset ratio of a bank is, the riskier it is, because of both leverage effect and the moral-hazard-incentives of stockholder associated with limited liability. Limited liability gives both bank stockholders and managers an incentive to expropriate wealth from depositors and deposit insurance fund by increasing risk. Furthermore, the bank with a high capital-to-asset ratio has obviously a lower possibility of bankruptcy when the bank asset value declines. Thus, other things being equal, the bank with a lower capital-to-asset ratio is believed to have greater risk-taking incentives and to be riskier[7]. The other explanatory variable is operational leverage. Operational leverage is measured by the ratio of fixed asset to total asset. Many researchers such as Mandelker and Rheeargue (1984), and Saunders, Strock and Travlos (1990) argue that operational leverage acts in an analogous fashion to financial leverage in increasing firm risk.

We test the null hypothesis of no change in the relations between bank risk taking and explanatory variables after reform by examining the sign and statistical significance of the coefficients β_2 and β_4 on the reform dummy interaction variables for each dependent variable. The relations between bank risk taking and the explanatory variables for the pre-reform period are estimated by the slope coefficients β_1 and β_3. It would be difficult to predict intuitively what relations there would be among these variables for the

[1] Gunther and Robinson (1990) find a significantly negative relationship between capital growth rate and loan growth rate, interpreting this result as a negative relationship between capital adequacy and risk-taking.

[2] The studies employing loan ratio and the ratio of investment securities include Gunther and Robinson (1990), Gorton and Roden (1995), etc.

[3] In the risk weight of BIS capital ratio, loans and common stock are assigned the highest 100% risk weight. In our sample, the average ratio of common stock to total investment securities is 8%. Thus, the investment securities in our sample mainly consist of the safer securities than risky common stock. Thus, we believe that, on average, the group of investment securities can be considered to be safer than loans.

[4] Demsetz and Strahan (1997) find that larger banks use their better diversification advantage of asset composition to operate with lower capital ratio and pursue riskier strategies, with greater concentrations of consumer and industry loans. Akhavein, Berger and Humphrey (1997) find that a major motivation for bank mergers is the profit enhancements expected from larger banks' riskier strategies. See, also, O'Hara and Shaw (1990); Saunders, Strock and Travlos (1990).

[5] In terms of causality relationship, both directions might be possible. That is, for example, financial leverage or capital ratio could affect the risk-taking behavior of banks, and also, could be affected by the risk-taking behavior. However, instead of examining the causality direction, we follow one of the widely agreed concepts in finance literature that capital ratio is one of the very important driving variables for the banks' risk-taking behavior associated with the moral hazard incentives of stockholders, etc.

[6] We employ only non-BIS capital ratio as the explanatory variable for risk-taking because of data availability. However, BIS capital ratio and the proportion of risk-adjusted assets to total assets could be also very appropriate variables to represent the risk-taking behavior of banks.

[7] Demsetz and Strahan (1997) find a contemporaneously significantly negative relationship between capital-to-asset ratio and risk-taking measured by the standard deviation of stock returns. McKenzie, Cole and Brown (1992) find that low capital thrifts undertake projects with low net present value to increase risk measured by the variance of the return.

pre-reform period. If banks pursed perverse risky strategies before reform as predicted by moral hazard hypotheses, β_1 would be significantly negative and β_3 would be significantly positive for the dependent variable of, for example, loan-to-asset ratio.

Regarding the effectiveness of the reform, our hypotheses about the sign and statistical significance for the coefficients β_2 and β_4 for the dependent variable of loan-to-asset ratio are as follows. If the regulatory reform is effective in reducing the risk-taking incentives of banks, the relation between capital-to-asset ratio and risk-taking would be less strongly negative. After reform, more severe regulatory oversight would be imposed on the banks with lower capital ratio, and therefore, those banks should improve their risk status by reducing loan ratio. Therefore, compared to pre-reform period, the slope coefficient between capital ratio and loan ratio after reform should be less strongly negative (more positive). Similarly, compared to pre-reform periods, the slope coefficient between operational leverage and loan ratio after reform should be less strongly positive (more negative). Therefore, we hypothesize that

Hypotheses: $\beta_2 > 0$ and $\beta_4 < 0$, for loan-to-asset ratio.

Similarly, we hypothesize as follows for the other dependent variables,

Hypotheses: $\beta_2 < 0$ and $\beta_4 > 0$, for investment securities-to-asset ratio.

Hypotheses: $\beta_2 > 0$ and $\beta_4 < 0$, for the size of deposit.

Hypotheses: $\beta_2 > 0$ and $\beta_4 < 0$, for the size of asset.

Table 2 presents Pearson correlation coefficients among the risk characteristics variables for the pre- and post-reform periods. The first number is the correlation for the pre-reform period and the second is the correlation for the post-reform period. The results in Table 2 show that, compared to pre-reform period, the capital-to-asset ratio had a more positive (or less negative) correlation with fixed-asset ratio (from -0.32*** to -0.24***), loan-to-asset ratio (from 0.046 to 0.48*), deposit size and asset size (from -0.5*** to -0.25) after reform. It had a more negative correlation with the investment securities-to-asset ratio (from -0.16*** to -0.35***). The table shows that fixed asset-to-asset ratio had a more negative correlation with loan-to-asset ratio, deposits, asset size, and a more positive correlation with investment securities-to-asset ratio after reform. Also, the positive correlation between loan-to-asset ratio and deposits, asset size became weaker after reform. All of these results (11 out of total 14 correlations ignoring the correlation between deposit size and asset size) show that the pre-reform associations of the higher risk-characteristic variables became weaker after reform, and may be some evidences for the effectiveness of the reform in reducing the risk-taking incentives of banks.

Table 2. Correlations

	Capital-to-asset	Fixed asset-to-capital	Loan-to-asset	Investment securities-to-asset	Deposit	Asset
Capital-to-asset	1	-0.32*** -0.24***	0.046 0.48*	-0.16* -0.35***	-0.50*** -0.25	-0.50*** -0.25
Fixed asset-to-capital		1	0.27*** -0.09	-0.26*** 0.03	0.23* -0.05	0.23* -0.05
Loan-to-asset			1	-0.76*** -0.82***	0.33*** 0.25***	0.33*** 0.25***
Investment securities-to-asset				1	-0.18* -0.34***	-0.19* -0.34***
Deposit					1	0.99*** 0.99***
Asset						1

Notes: This table shows the Pearson correlations among the risk-characteristic variables for the sample banks. The first number is the correlation for the pre-reform period (1994-1997); the second in the correlation for the post-reform period (1998-2005). One, two, or three asterisks indicate statistical significance at the 10, 5, or 1% significance level, respectively.

3. Empirical results for regression analysis

3.1. Results for risk-taking incentives. The results for the regression analysis when the loan-to-asset ratio is used as the dependent variable are presented in Table 3. We begin by noting the coefficients for the pre-reform period. The slope coefficients are significantly positive on both capital-to-asset ratio (β_1) and fixed asset-to-asset ratio (β_3) for the pre-reform period. Therefore, the moral hazard associated with low capital did not exist for the pre-reform period, while that existed with respect to high operational leverage. Perhaps some capital-related regulations introduced since the late 1980s such as the BIS capital standards have been effective in moderating risk-taking in low-capital banks.

We now turn to tests of the hypotheses. We hypothesized that, if reform is effective in reducing the risk-taking incentives, the coefficients on the interaction terms D×(Financial leverage) would be positive, and the coefficient on D×(Operational leverage) would be negative. Table 3 shows that, consistent with our hypotheses, the coefficients on D×(Financial leverage) is significantly positive, and that on D×(Operational leverage) is significantly negative. After banking regulations are tightened, more severe regulatory oversight would be imposed on the bank with lower capital ratio and higher fixed asset ratio either in the form of explicit or implicit cost. Therefore, such banks would not be able to increase loan ratio as much as they did when regulations were loose but try to improve their risk status by reducing loan ratio (or increasing loan ratio less than before), indicating that the reform was effective in reducing the risk-taking incentives of these banks.

Table 3. Regression results for loan-to-asset ratio

$$(\text{Loan-to-asset})_{i,t} = \beta_0 + \beta_1(\text{Financial leverage})_{i,t} + \\ + \beta_2 D\times(\text{Financial leverage})_{i,t} + \beta_3(\text{Operational leverage})_{i,t} + \beta_4 D\times(\text{Operational leverage})_{i,t} + \varepsilon_{i,t}$$

	Coefficient	t-value	p-value
Constant	0.3851 ***	30.72	1.57×10^{-81}
Financial leverage	0.3459 *	1.69	0.09283
D×Financial leverage	2.1456 ***	8.92	1.82×10^{-16}
Operational leverage	0.0009 ***	3.05	0.00261
D×Operational leverage	-0.00086 ***	-3.04	0.00263
Adjusted R^2	0.28		
Number of observations	225		
Standard error of regression	0.0661		
F-statistic	23.2532 ***		

Notes: This table shows the panel regression results for the dependent variable of loan-to-asset ratio. One, two, or three asterisks indicate statistical significance at the 10, 5, or 1% significance level, respectively.

The results for the regression analysis when the investment securities-to-asset ratio is used as the dependent variable are presented in Table 4. The slope coefficient is significantly negative on capital-to-asset ratio (β_1) for the pre-reform period. Therefore, the moral hazard associated with low capital did not exist in terms of holding lower ratio of investment securities for the pre-reform period. However, the coefficient on operational leverage (β_3) is significantly negative for the pre-reform period. Therefore, there existed the moral hazard associated with high operational leverage. Table 4 shows that, consistent with our hypotheses, the coefficient on D×(Financial leverage) is significantly negative, and that on D×(Operational leverage) is significantly positive. After banking regulations are tightened, more severe regulatory oversight would be imposed on the bank with lower capital ratio and higher fixed asset ratio either in the form of explicit or implicit cost. Therefore, such banks would have to change their asset composition toward safer one by raising the holding ratio of relatively safe assets such as investment securities.

Table 4. Regression results for investment securities-to-asset ratio

$$(\text{Investment securities-to-asset})_{i,t} = \beta_0 + \beta_1(\text{Financial leverage})_{i,t} + \beta_2 D\times(\text{Financial leverage})_{i,t} + \\ + \beta_3(\text{Operational leverage})_{i,t} + \beta_4 D\times(\text{Operational leverage})_{i,t} + \varepsilon_{i,t}$$

	Coefficient	t-value	p-value
Constant	0.3728 ***	30.40	1.01×10^{-80}
Financial leverage	-0.4004 **	-1.99	0.05
D×Financial leverage	-1.4989 ***	-6.37	1.07×10^{-9}
Operational leverage	-0.00075 ***	-2.69	0.0076
D×Operational leverage	0.00072 ***	2.62	0.0009
Adjusted R^2	0.17		
Number of observations	225		
Standard error of regression	0.0647		
F-statistic	12.20 ***		

Notes: This table shows the panel regression results for the dependent variable of investment securities-to-asset ratio. One, two, or three asterisks indicate statistical significance at the 10, 5, or 1% significance level, respectively.

The results for the regression analysis when the size of deposit (asset) is used as the dependent variable are presented in Table 5 (6). The slope coefficient is significantly negative on capital-to-asset ratio (β_1) for the pre-reform period, indicating that the moral hazard associated with low capital existed in terms of increasing the sizes of deposit and asset, for the pre-reform period. The slope coefficient is positive on fixed asset-to-asset ratio (β_3) though it is not statistically significant at 10% significance level, for the pre-reform period. Therefore, though it is not strong, the banks with higher operational leverage seemed to have had some incentives to increase the size of deposit and asset. Regarding the effectiveness of the reform, Tables 5 and 6 show that, consistent with our hypotheses, the coefficient on D×(Financial leverage) is significantly positive. The sign on D×(Operational leverage) is negative as hypothesized, but it is not statistically significant. After banking regulations are tightened, more severe regulatory oversight would be imposed on the bank with lower capital. Therefore, such banks would not be able to increase the size of deposit as much as they did when regulations were loose.

Table 5. Regression results for the size of deposit

$$(\text{Deposit})_{i,t} = \beta_0 + \beta_1(\text{Financial leverage})_{i,t} + \\ + \beta_2 D\times(\text{Financial leverage})_{i,t} + \beta_3(\text{Operational} \\ +\text{leverage})_{i,t} + \beta_4 D\times(\text{Operational leverage})_{i,t} + \varepsilon_{i,t}$$

	Coefficient	t-value	p-value
Constant	2.26×10^5 ***	3.64	0.00033
Financial leverage	$-2{,}06\times10^6$ *	-2.03	0.0435
D×Financial leverage	7.45×10^6 ***	6.23	2.24×10^{-9}
Operational leverage	1,593.5	1.13	0.26
D×Operational leverage	-1,605.7	-1.15	0.25
Adjusted R^2	0.17		
Number of observations	225		
Standard error of regression	328,851		
F-statistic	13.00 ***		

Notes: This table shows the panel regression results for the dependent variable of the size of deposit. One, two, or three asterisks indicate statistical significance at the 10, 5, or 1% significance level, respectively.

Table 6. Regression results for the size of asset

$$(\text{Asset})_{i,t} = \beta_0 + \beta_1(\text{Financial leverage})_{i,t} + \\ + \beta_2 D\times(\text{Financial leverage})_{i,t} + \beta_3(\text{Operational} \\ \text{leverage})_{i,t} + \beta_4 D\times(\text{Operational leverage})_{i,t} + \varepsilon_{i,t}$$

	Coefficient	t-value	p-value
Constant	2.3×10^5 ***	3.52	0.00051
Financial leverage	-2.04×10^6 **	-1.91	0.0568
D×Financial leverage	7.8×10^6 ***	6.27	1.79×10^{-9}
Operational leverage	1,655.2	1.12	0.26
D×Operational leverage	-1,674.1	-1.14	0.25
Adjusted R^2	0.18		
Number of observations	225		
Standard error of regression	344,759		
F-statistic	13.09 ***		

Notes: This table shows the panel regression results for the dependent variable of the size of asset. One, two, or three asterisks indicate statistical significance at the 10, 5, or 1% significance level, respectively.

3.2. Results for profitability. To examine how the relations between the bank's profitability and risk characteristics are changed after the regulatory reform, we estimate the following panel regression equation, where ROA (return on asset) is used as the measure of the bank's profitability. The reform dummy variable D is defined the same as before.

$$(ROA)_{i,t} = \beta_0 + \beta_1(\text{Financial leverage})_{i,t} + \\ + \beta_2 D\times(\text{Financial leverage})_{i,t} + \\ + \beta_3(\text{Operational leverage})_{i,t} + \\ + \beta_4 D\times(\text{Operational leverage})_{i,t} + \varepsilon_{i,t}. \quad (2)$$

As shown in Table 7, the coefficient on $D\times$(Financial leverage) is significantly positive and the sign on $D\times$(Operational leverage) is negative though it is not significant at less than 10% significance level. Thus, the safer the bank, the greater the profitability of the bank was after reform. These results, combined with the findings in the previous sections, are intuitively appealing. After tightened regulation, riskier banks such as the ones with lower capital ratio and greater fixed-asset ratio would be more closely monitored by the regulator, and therefore, they had to change their operating structures and business strategies toward less risky (as shown in the previous sections). This reduced risk-taking behavior resulted in less profitable performance than safer banks after reform.

Table 7. Regression results for the profitability

$$(ROA)_{i,t} = \beta_0 + \beta_1(\text{Financial leverage})_{i,t} + \\ + \beta_2 D\times(\text{Financial leverage})_{i,t} + \beta_3(\text{Operational} \\ \text{leverage})_{i,t} + \beta_4 D\times(\text{Operational leverage})_{i,t} + \varepsilon_{i,t}$$

	Coefficient	t-value	p-value
Constant	-2,7778***	-8.69	8.09×10^{-16}
Financial leverage	42.2355***	8.08	4.1×10^{-14}
D×Financial leverage	25.1497 ***	4.13	5.73×10^{-5}
Operational leverage	0.0068	0.94	0.35
D×Operational leverage	-0.0095	-1.32	0.18
Adjusted R^2	0.35		
Number of observations	225		
Standard error of regression	1.68		
F-statistic	31.39 ***		

Notes: This table shows the panel regression results for the profitability. One, two, or three asterisks indicate statistical significance at the 10, 5, or 1% significance level, respectively.

Concluding comments

Using the panel data of Korean banks before and after the regulation of banking industry was reformed in the late 1997-1998, we examined whether the tendencies of the banks with greater financial and operational leverages to take on more risk became weaker for the post-reform period. Moral hazard hypotheses predict that the banks with greater financial leverage (lower capital ratio) and higher operational leverage would have greater risk-taking incentives. But during tightened regulation, such behavior would result in higher explicit, implicit costs and increased supervisory attention. We hypothesized, therefore, if the regulation was effective, those tendencies would be weaker after reform. We found very strong and consistent evidences supporting the hypothesis. The risk-taking incentives associated with both financial leverage and operational

leverage were significantly weaker after reform. That is, the causality relationship between capital ratio and risk-taking became significantly less negative; the relationship between fixed-asset ratio and risk-taking became significantly less positive after reform. Moreover, the reduced risk-taking incentives of those banks resulted in less profitable performance than safer banks after reform.

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