

Changes in Financial Environment and the Stability of Korean Banks

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Abstract

These days, changes in the financial environment tend to increase the possibility of a financial crisis. This paper analyzes factors affecting individual banks' asset soundness, profitability, capital adequacy and liquidity in Korea, using Korean banks' annual panel data from 1999 to 2004. Korean banks' financial data show that herd behavior among Korean banks may have increased. It would thus be desirable for the policy authority to keep a more careful watch over banks' behavior. The results of SUR estimations show bank stability to have been negatively affected by increases in asset size and in the proportion of retail business conducted, but positively affected by business diversification, governance transparency and greater length of maturity of deposits. The effects on banks' stability of an increase in the overnight call rate seem ambiguous, as it has a negative impact on bank profitability, a positive impact on bank liquidity, and no significant effects on either the capital adequacy or asset soundness of banks. The estimation results also imply that as a bank becomes larger in asset size, less transparent in governance structure, and less diversified in its business lines, its stability tends to deteriorate more severely when the overnight call rate rises.

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I. Introduction

In recent years, though price stability, a major goal of central banks, has been maintained, financial stability seems to have deteriorated due to the instability of asset prices and the increase in fund outflows. In reality, inflation has been stabilized as efforts for price stability have been buttressed through the improvement of central bank independence and the introduction of inflation targeting systems in many countries that experienced high inflation in the 1970s and 1980s. Low interest rates could have been maintained owing to the stabilization of general price levels. However, the prolonged low interest rate trend has played a role in raising the instability of asset prices. Meanwhile, financial liberalization and internationalization were promoted from the 1980s to improve the efficiency of fund allocation. However, they are seen as having given rise to side effects such as the intensification of competition among financial institutions, the expansion of risk-seeking behavior and the increase in the financial system's vulnerability to external shocks.

Since financial intermediation weakens and the effectiveness of monetary policy declines when the financial system is unstable, the central bank needs to maintain the stability of financial system. In particular, the recent decline in the effectiveness of monetary policy is very likely to be related to¹⁾ the instability of the financial system. Therefore, the central bank should pay considerable attention not only to price stability, but also to financial stability

Financial stability refers to a state in which the function of financial intermediation works smoothly through the stability of financial institutions, financial markets and financial infrastructure, which together make up the financial system. The stability of an individual financial institution can be achieved in general when it maintains asset soundness, capital adequacy, liquidity, profitability and stability of internal management. In other words, the stability of a financial institution can be sustained in the following cases: where the financial institution ① holds asset with low insolvency risk (asset soundness), ② can raise emergency funds smoothly (liquidity), ③ has the capacity to generate profits (profitability), ④ operates internal controls and management systems properly (management stability), and ⑤ holds sufficient capital to absorb losses generated by various risks²⁾ (capital adequacy).

Financial market stability signifies a state in which there is little likelihood of

1) For example, an expansionary monetary policy is unlikely to have any substantial effect when banks are burdened by the need to raise capital adequacy ratios and to set aside provisions against bad debts.

financial market price variables³⁾ fluctuating violently in the short term in response to changes in economic fundamentals. When the fluctuations of financial market prices are estranged from movements of economic fundamentals, adverse side effects can occur: ① the likelihood of financial instability such as a credit crunch increases with the heightened risk of an abrupt and dramatic adjustment of financial market prices, and ② financial transactions decline and transaction costs increase as the uncertainty of price variables rises due to the unpredictability of their future economic variables.

Financial infrastructure stability indicates the effective operation of market discipline and the public financial safety net, and the stability of the payment and settlement system and other financial systems. The stability of financial systems includes the protection of creditor's rights and the interests of users of financial services and the guarantee of fair transactions among financial institutions.

Financial stability ultimately works to support the stability of real economic activities by enabling the function of financial intermediation to operate smoothly in the direct and indirect financial markets. For example, if financial institutions overemphasize their stability exclusively, the financial intermediation function contracts and thereby real economic growth can slow down with, in consequence, financial stability coming under threat in the long run. From this point of view, it seems necessary to find the optimal policy mix because there can be the likelihood of a negative relationship between the stability of financial institutions and the efficiency of financial intermediation in the short term.

There are not many research papers that undertake a comprehensive analysis of the determinants of the state of a bank's management. Research concerning the determinants of bank profitability has been conducted sporadically at home and abroad. Among existing studies that analyze the determinants of profitability using the panel data of banks are those of Angbaxo (1997), Pasiourasa and Kosmidou (2007) abroad, and that of Jung (2001) in Korea. The current paper parts company from the existing research in that it considers the problem of endogeneity between profitability as a dependent variable and bank-specific explanatory variable, the likelihood of correlation between residuals in the

2) As for the risks financial institutions confront, there are credit risk following counterparty's default, market risk generated by fluctuations of price variables in the financial market such as interest rate, exchange rate, stock price, liquidity risk selling assets at a cheap price because of emergency fund, and operation risk by lack of internal control.

3) These include stock price, real estate price, exchange rate, market interest rate, etc.

equation by type of bank and four key bank management indexes including profitability.

The financial authority assesses the management stability of individual financial institution using evaluation indexes such as CAMELS or CAEL. However, while these indexes help gauge the state of financial institution stability at the present time, they are unable to give sufficient information as to how this may change in the future. The financial authority needs to be able to respond to the likelihood of management instability at an early stage, through forecasting how these indexes concerning financial institution's management stability will change in the future. This is because turning round a situation of management instability will involve considerable costs once it has actually come about. Meanwhile, there is almost no model⁴⁾ either in Korea or internationally, which can forecast systematically evaluation indexes concerning the stability of individual financial institution. In this respect, the empirical analysis model in this research is expected to provide some help for the forecasting of evaluation indexes regarding management stability.

The effect of changes in the policy rate and market interest rates on bank profitability is one of the major interests of the monetary policy authority and financial institutions. In previous empirical analyses such as Flannery (1981), and Hanweck and Kilcollin (1984), changes in profitability caused by an economic upturn were not divided from changes in profitability caused by interest rate fluctuations. However, we attempt to conduct an empirical analysis separating out the effect of these factors in this research. While previous researchers have conducted empirical analysis without considering the effect of change in a bank's characteristics on its profitability and the likelihood of correlation between the residuals of equations by type of bank, the present paper takes account of these effects.

The research sets out to examine what effects the recently-changed economic environment has on the stability of banks' management, e.g., profitability. In Chapter II, we develop the argument concerning the factors having an effect on the stability of financial institutions. In Chapter III, empirical analysis is carried out on the determinants of management stability. Chapter IV attempts to find policy arrangements for the consolidation of bank stability.

4) The SCOR model of FDIC in the U.S. derives the bankruptcy probability of financial institutions from the CAMELS score of the present time.

II. Discussion on the factors affecting the stability of financial institution

1. Changes in interest rate levels

As a low interest rate trend was maintained in several countries from 2001 onwards, the dramatic rise in asset price functioned as a factor impeding financial stability. As the level of inflation remained low owing to improvements in labor productivity, the increase in the supply of low-price manufactured goods from developing countries and the efforts of the monetary authority for price stability in individual countries, the low interest rate stance was maintained. In addition, the increase in savings for retirement⁵⁾ thanks to longer life expectancy and population ageing, and the rise in liquidity due to growth in corporate profitability also acted to maintain low interest rates. From 2006, though, the policy rate shifted to an upward trend in several countries because of concern over inflation. If the level of interest rates decreases, asset prices and especially those of stocks and real estate rise dramatically, which opens up the possibility of their detracting from financial market stability. Asset prices can be assumed as the current discount value of future profit flows that the assets yield. A slight change in interest rates can bring about a dramatic change in asset prices through this relationship. Especially when interest rate levels become lower, the volatility of asset prices caused by a one percentage point change in the interest rate increases further.⁶⁾ In reality, as asset prices rose dramatically in recent years within a short term in conjunction with the persistent low interest rate trend, the likelihood of bubble formation in asset prices increases and financial instability grows. Meanwhile, as the borrowing of funds in order to pursue asset investment expands, the malign side effects on the financial system are likely to rise when the asset price bubble bursts.

Although a drop in interest rates can give rise to an asset price bubble and thereby heighten financial market instability, it can have a positive or negative effect on the stability of financial institution according to their management behavior. The major channels through which a change in policy rates has an impact on management indicators of financial institutions' stability are as follows. First, a change in the policy rate can affect the profitability of financial

5) If the future working-age population decreases due to a decline in the birth rate, the scale of the accumulation of current financial assets needed to maintain a certain standard of consumption in the future increases as price rises through a reduction in total supply.

6) Refer to Appendix 1 for the detailed procedure.

institutions due to the maturity mismatch among their assets and liabilities. That is, when the maturity of deposits at financial institutions is shorter than that of their loan assets, net interest margin decreases and thereby profitability declines as their deposit interest rates rise faster than their loan interest rate when there is an increase in the policy rate⁷⁾. In contrast, when the maturity of deposits at financial institutions is longer than that of their loan assets, profitability increases as their loan interest rates rise faster than their deposit interest rate when there is a hike in the policy rate. Meanwhile, if market rates rise in addition to the rise in the policy rate, their existing low-interest-rate deposits are withdrawn prior to maturity and are likely to be converted into high-interest-rate deposits. Moreover, if market rates fall, existing high-interest-rate loans are redeemed prior to maturity and are likely to be converted into new low-interest-rate loans. Therefore, if midterm withdrawal of deposits (midterm loan redemptions) expands when there is a hike(reduction) in interest rates even when the maturity of deposits at a financial institution is longer(shorter) than the maturity of its loans, its deposit(loan) interest rates also rise(fall) fast and thereby its profitability may not be improved⁸⁾. Depositors can comparatively easily convert their previous deposits into those at other financial institutions or other financial products.⁹⁾ The likelihood of midterm withdrawal of deposits is seen higher than that of midterm loan redemption due to borrowers' difficulty¹⁰⁾ in converting existing loans into those of other financial institutions or other loan products. Second, a rise(drop) in the policy rate reduces(increases) the price of assets such as bonds, stocks, and real estate that financial institutions hold by way of rising(falling) market rates, which can give rise to capital losses(gains) and a decline(rise) in their net asset value. Third, a rise(drop) in the overnight call rate, which is currently the policy rate, pushes up (lowers) financial institutions' fund-raising costs much faster than does their profit on the operation of their funds and it can consequently have a negative(positive) effect on their

7) In this case, maturity means interest rate maturity. For example, although maturity date of loan principal is set up more than 1 year, the interest rate maturity can be considered 3 months if loan interest rate is renewed every 3 months.

8) The scale of midterm withdrawals and midterm loan redemptions is expected to differ according to the penalty charge for midterm withdrawal of deposit, the penalty charge for early loan redemption prior to maturity and the range of interest rate fluctuations.

9) In this case, depositors are required only to pay a charge for midterm withdrawal.

10) In this case, borrowers may have to bear an additional burden apart from charges for redemption prior to maturity. That is, when a small firm that has conducted transactions with Bank A in the past applies for a new loan from Bank B, this will not be easy since Bank B unlike Bank A lacks adequate information about the firm. In addition, even when the firm refinances with Bank A by converting its existing loan into a new loan, the conversion can be problematic since credit screening still needs to be conducted.

profitability in the short run. In other words, a rise in interest rates in the call market, whose function is to resolve financial institutions' temporary shortages of liquidity, increases the necessity for financial institutions to secure liquid funds and thereby drive up their cost of funds. In fact, when the correlations between the overnight call rate and the interest rates paid or charged by deposit-taking banks are calculated using data on deposit banks in Korea, the rank order runs CD interest rate, bank deposit interest rate and loan interest rate, indicating that the deposit interest rate responds more sensitively than the loan interest rate¹¹⁾ to changes in the overnight call rate. Fourth, as existing borrowers' burden in servicing payments of principal and interest on the loan grows following the rise in the policy rate and market rates, the loan delinquency and default rates also rise, which can lead to an increase in financial institutions' bad loans. This is known to act as a factor in reducing the asset soundness and profitability of financial institutions (Blejer et al.(2002)). Fifth, if the policy rate changes, financial institutions can adjust their asset portfolios. That is, considering that the credit standing of households or firms applying for new loans is lowered when interest rates rise, financial institutions may show a tendency to offer new loans primarily to borrowers with good credit ratings by conducting credit screening more rigorously when interest rates rise (Lockett(1970), Silverman(1973), and Harris (1973))¹²⁾. In this case, financial institutions may suffer some deterioration of their asset soundness in the short run due to existing loans turning sour, but bad loans are not likely to rise considerably in the long run. However, their profitability is highly likely to decline as credit is now supplied mainly to sectors with good credit ratings such as government and public bonds and large companies. Sixth, if central banks absorb market liquidity by raising policy rates, the net profit of financial institutions can decline as the volume of their disposable assets is reduced. Since net profit and asset size decline at the same time, this scenario seems unlikely to have a substantial effect on the stability of financial institutions in the short run. To sum up the channels mentioned so far, where the maturity of deposits at financial institutions is longer than that of their loans and there is little likelihood of midterm withdrawal of deposits, rise in interest rates can improve profitability, but where this is not the case, a rise in interest rates is very likely to weaken profitability.

The effect of interest rate change on profitability and stability of financial

11) Looking at the coefficients with the call rate using the data from January 2001 to April 2006, those of the CD interest rate, bank deposit interest rate and loan interest rate are found to be 0.94, 0.84 and 0.80, respectively.

12) Lockett (1970) and Silverman (1973) both demonstrate this relationship through a theoretical model, and Harris(1973) does so through empirical analysis.

institutions is one of the major interests of financial institutions and the monetary authority. Flannery(1981) argued that financial stability can be impaired by worsened profitability when interest rates rise because banks tend to raise funds in the short term and extend loans for the long term. He demonstrated through an empirical analysis using data from large banks that these banks hedge interest rate risk well. Meanwhile, Hanweck and Kilcollin (1984) argued that small banks respond more efficiently to interest rate risk according to an empirical analysis showing that the profitability of small banks improves more than that of large banks when interest rates rise. In general, a rise in interest rates, as Hanweck and Kilcollin (1984) also mentioned, can appear in conjunction with the improvement of economic conditions. Therefore, there is a possibility that the improvement in bank profitability when interest rates are on a rising trend is affected by the decrease in bad loans, and by the increase in loan demand and deposit supply. The two previous research papers did not separate out the effect of an economic boom on profitability from the effect of an interest rate change. The empirical analysis presented in this paper attempts to separate out the effects of these factors. In addition, Hong and Kim (2004) forecasted by examining the interest rate sensitivity gap¹³⁾ and duration gap¹⁴⁾ of domestic banks in 2003 that a rise in interest rates raises net interest margin and net asset value since the maturity of bank debt is longer than that of assets. Using data on banks' assets, debt maturity structure, and bonds as of the end of 2005, Financial System Stability Department of the BOK forecasted (2006) that a rise in interest rates would raise the net interest margin of domestic banks but reduce the value of its portfolio and thus the net effect of a rise in interest rates on net asset value would be neutral. However, there is a possibility that the positive effect of an interest rate rise on the profitability and net asset value of financial institutions may not be as large as presented in the results of these existing analyses insofar as no consideration is given to the possibility that depositors may make midterm withdrawals of existing low-interest-rate deposits halfway and shifting into high-interest-rate deposits, or that the value of banks' stock and real estate holdings may decline. Moreover, the previous studies focused on changes in the profitability of financial institutions through the first and the second channels mentioned above. We cannot, however, exclude the possibility that a rise in

13) The interest rate sensitivity gap of specific maturity is calculated by 「interest-rate sensitive asset - interest-rate sensitive debt」 of the maturity, and it means the disparity in size of between asset and debt by interest rate maturity.

14) It is the maturity computed by taking weighted average based on the current value of future net flow of funds, representing the changes of net asset value in a financial institution following changes in interest rates.

interest rates plays a role in reducing financial institutions' profitability and their net asset value when we take into account the other channels from the third to the sixth. In Chapter IV we examine through empirical analysis, after controlling for various factors, the effect of changes in the policy rate on the profitability of financial institutions.

2. Liberalization of the movement of internal and external financial assets, and increase in inflows of foreign capital.

Although the inflow of foreign capital, prompted by the opening and partial deregulation of the domestic capital market, has contributed to domestic economic progress through the development of financial industry, a rapid outflow of foreign capital can give rise to adverse side-effects such as a credit crunch. Where funds allocation is achieved efficiently in the course of the liberalization of cross-border capital loans, positive effects such as the easing of domestic credit restrictions and the smoother operation of the financial system can also be expected. On the other hand, if the economy of the home country turns unstable or interest rates abroad rise, domestic capital flows out of the home country while foreign capital is clogged, possibly bringing about sharp falls in asset prices and a credit crunch in the home country¹⁵⁾.

In tandem with the development of the internet and electronic payment systems, the velocity and scale of capital flows are increasing, and accordingly there is an increased likelihood of financial instability in forms such as the greatly heightened volatility of the host-country's asset prices, exchange rates and interest rates. Especially in the case of a small open economy, the malign side effects can be that much greater since internal and external shocks may generate large-scale capital outflows.

Although the influx of long-term investment funds such as foreign pension funds can act as a factor strengthening domestic financial market stability, the inflow of speculative capital such as hedge funds with a focus on short-term deals can make for turmoil in the domestic financial market. Foreign funds that invested in firms with high intrinsic value for the long term are expected to contribute to the efficiency of domestic funds allocation and financial market stability. In contrast, if speculative funds enter an industry with high external effects seeking the maximization of short-term profits for shareholders, there is the possibility of the national economy suffering serious damage.

15) For example, the outflow of funds following the interest rate rise in the U.S. functioned as one of the reasons for triggering the Mexico's financial crisis in 1994.

While the entry of foreign financial institutions to the domestic market can play a role in improving the stability of the domestic financial system through the introduction of sophisticated financial techniques and stable fund-raising from the parent institution, it can also be a factor serving to aggravate potential financial instability due to the strong likelihood of a noncooperative attitude on the part of foreign financial institutions in the domestic policy authority's efforts to bring about financial stability. Apart from this, if foreign banks concentrate their efforts on expanding household loans, side effects are likely to arise such as excessive rises in domestic real estate prices and a decline in the supply of funds to firms, which is seen to exercise a negative influence on financial stability and financial intermediation.

3. Structural change in the financial industry

The structural changes in the financial industry, such as financial institutions' expansion of scale and scope and the extension of their overseas networks can improve financial stability by strengthening the basis for financial institutions' profits but, conversely it may act as a factor detracting from financial stability by giving rise to organizational complexity and moral hazard. If there are synergy effects in terms of portfolio diversification, cost reduction and profit generation, their profitability and the stability of their profits can be increased. On the other hand, financial instability can increase as managers' oversight and control of front office operations staff becomes more difficult and the supervisory authority also confronts increasing obstacles in supervising financial institutions. Moreover, since it is in practice very difficult for troubled large financial institutions to be forced to exit through bankruptcy, the supervisory institution is likely to be lenient in its supervision of them (Too big to fail). Moral hazard then arise if large financial institutions come to expect an easy-going regulatory regime. Besides this, in the case of financial companies belonging to an interlinked financial group, there is a great danger that the insolvency of any one of them may spread to embrace the other companies and subsidiaries within the financial group. That is, in the case of interlinked financial groups¹⁶⁾, side effects such as a rise in leverage can occur due to internal transactions taking advantage of regulatory disparities between financial jurisdictions, interlocking capital stakes and payment guarantees between the financial institutions within the

16) In Korea, financial conglomerates take the form of financial holding companies (Woori, Shinhan, Hana), parent-subsidiary (Kookmin), foreign-affiliated financial groups (CitiKorea, SC First bank) and business conglomerates (Samsung, Dongbu), etc.

financial group, and capital contributions to subsidiaries that are liabilities of the parent company.

4. Intensified competition among financial institutions

As competition among financial institutions intensifies in conjunction with financial liberalization¹⁷⁾ by way of the easing of financial regulations, the profitability of financial institutions declines and, at the same time, there is a greater opportunity for investment in high-risk, high yielding assets. Meanwhile, a decrease in the number of banks in the financial market (higher degree of concentration) does not necessarily bring about a weakening of competition among banks. Although the intensified competition among financial institutions can function as a destabilizing factor in the short run, it can contribute to the stable growth in the financial sector in the long run if improvements in financial services and the strengthening of financial intermediation are realized through the development of new financial products. In this context, the financial supervisory authority must supervise and oversee the financial markets to avoid the occurrence of potentially destructive competition and unfair market practices.

5. Increase in management short-termism and herding behavior

As financial institutions increasingly tend to emphasize shareholders' profits, behavior focusing on short-term profit maximization rather than on strengthening the foundation for stable profits is apt to heighten the instability of the financial system. In other words, as the time horizon of management activities in financial institutions becomes limited to the short-term and financial institutions increasingly tend to respond sensitively to temporary external shocks, the likelihood of a credit crunch and the instability of financial market price variables grows. The reinforcement of the pro-cyclicality of financial institution loans is also related with the short-termism¹⁸⁾ of management behavior. Managements that stress short-term performance are unlikely to cooperate readily with a policy authority endeavoring to preserve the stability of the domestic financial system and strengthen financial intermediation. This is because there is little incentive for managers focusing on short-term performance to cooperate with the authority though their cooperation with the

17) Financial liberalization having been promoted on a full-scale since the 1980s in developed countries is based on the recognition that excessive regulations on financial industry after the Great Depression hampered efficiency of fund allocation.

18) If financial institutions reduce (expand) credits in anticipation of a recession (boom) during a boom (recession), the scale of their total credits will not fluctuate severely.

efforts of the policy authority may be helpful for strengthening the long-term foundation for profits.

Similarly, the shortening of banks management time horizon seems to be attributable to the fact that banks' business operations have become increasingly complex and sophisticated and the influence of external shareholders on their management has been heightened. To put it another way, as the management of financial institutions becomes more complex and more sophisticated, external shareholders are hard put to evaluate management capabilities and therefore the practice of assessing management competence on the basis of short-term performance becomes widespread¹⁹⁾. In addition, as the share ownership of financial institutions becomes dispersed, foreigners' equity participation rises and the influence of outside shareholders on management increases, short-term results are considered to be more important.

Another factor acting to detract from financial stability is that massive portfolio shifts have taken place and the volatility of financial asset prices has expanded greatly in response to recent reiterated instances of herding behavior on the part of financial institutions and depositors. This herding behavior occurs due to information asymmetries among economic players, the increasing market dominance of specific financial companies, a rise in investment behavior stressing technological factors rather than intrinsic value, managers' lack of information and the moral hazard of financial institutions. Examining this in greater detail, first, when some economic agents are known to hold excellent information or to have secured a sufficient degree of market dominance to affect price variables in the financial market, it may well be a rational choice from the perspective of other economic agents to follow them. Next, in the case of investors emphasizing temporary changes in prices rather than changes in intrinsic value, sales are made at a loss at a specific price level upon a fall in asset prices, and their investment behavior is based on chart analysis²⁰⁾, which can expand the volatility of asset prices.

When managers do not have enough information to evaluate the ability of employees, managers tend to evaluate employees on the basis of their rivals' performance. Considering this, employees attempt to reduce differences in performance between their own company and its rivals by imitating their

19) When outsider shareholders do not have appropriate information to assess the managerial competence and future profitability of financial institutions, making evaluations on the basis of short-term performance can be an alternative policy. Anglo-Saxon countries that put shareholder value above all else tend to place most importance on short-term performance.

20) Selling at a loss enlarges the scale of the decline when prices fall and, if investors depend on chart analysis, price volatility is heightened since investment decisions are made on the basis of a single item of information.

behavior, resulting in the emergence of herding behavior. Lastly, herding behavior can become more widespread where the managers of financial companies expect the policy authority to bail them out or come to their aid if the management of all financial companies deteriorates in a recession due to excessive lending undertaken during an economic boom.

6. Rise in uncertainty of corporate profits

The riskiness of financial institutions' loan has increased in line with the heightened uncertainty of corporate profits following the currency crisis. In other words, the uncertainty of corporate profits has grown as the competition among firms has become more intense in line with globalization and the rise in the weight of the infocommunication industry with its short product life-cycles. In addition, the volatility of domestic firms' profit has increased due to the rise in the ratio of fixed operating expenses to operating expenses²¹⁾ and in the weight of small businesses in manufacturing companies.

Apart from this, as conglomerates that are able to raise funds in the capital market avoid borrowing to reduce the chances of bankruptcy as the probability of bankruptcy rises due to heightened uncertainty of profits, domestic financial institutions expand their transactions with the borrowers with comparatively low credit ratings such as small and medium sized enterprises. Meanwhile, the tendency of foreign-affiliated financial institutions to offer loans primarily to borrowers having good credit ratings (cherry-picking) also acts to bring about an expansion of domestic financial institutions' transactions with borrowers having low credit ratings.

7. Shortening of the maturity structure of financial institution deposits

Financial instability has deepened due to the increase in short-term liquid funds while the maturity of financial institutions' deposits has shortened owing to depositors' preference for short-term financial assets.

As the financial institutions face increasing liquidity risk due to the expansion of their short-term liabilities, they supply fund for the short term to resolve the maturity mismatch between their assets and liabilities, which would appear to be bringing about a deterioration in financial stability from firms' perspective.

21) Using the DB of Korea credit rating company in actuality, the trend in standard deviation of ROA volatility in listed companies over the five years being examined, and it turns out 7.14('99) → 11.27('02) → 12.07('04), indicating that volatility of profits increases.

Moreover, the instability of interest rates, exchange rates and asset prices is assessed to be on the rise since short-term funds can move swiftly and dramatically between financial and real asset markets.

This shortening of financial institutions' deposit maturities seems attributable to the increase in the future uncertainty of household incomes and to households' lack of confidence in future price and financial stability. In other words, as the instability of household income increases, households prefer financial assets offering high liquidity and stability, resulting in the expansion of short-term deposits. In addition, while long-term market interest rates remain at a low level, depositors are observed to be avoiding long-term financial assets due to anticipations of higher interest rates in the wake of future price rises and financial instability.

8. Development of new financial products such as financial derivatives

Recent product innovation has raised the likelihood of financial institutions' over-exposure to risk. In general, new financial products act to disperse risk to counter a variety of situations that may arise. However, the purchasers of such new financial products tend to face a higher risk of loss as the seller has usually superior information to them concerning the probability of specific events occurring with respect to these products. In accordance with the change in circumstances, financial supervisory agencies increasingly need to analyze the effects of new financial products on financial stability, and to identify steps to address their impact. Notably, when regulations concerning the permissible range of financial products are converted to a negative-list system, it would seem ever more vital for the supervisory authority to prepare preemptive regulatory measures by predicting the side effects of financial products that may be sold in the financial markets in future.

III. Empirical analysis of determinants of banks' management stability

Considering that the banking sector has played the most significant role for the stability of financial system, this paper conducts an empirical analysis focusing on the banking industry. For this, the paper ① examines the trend of

management indexes regarding bank stability and the degree of their divergence among banks, and ② carries out a regression analysis as to whether the major factors presented in Chapter II have a significant effect on bank stability.

1. Analysis of management indexes

Looking at the trend of management indexes regarding bank stability and how they differ from bank to bank, the stability of individual financial institutions is found to have improved, but the likelihood of herding behavior among financial institutions seems to have increased. In general, the management stability of financial institutions can be measured by capital adequacy, asset quality, earnings and liquidity. In this paper, the following proxy variables are used for each evaluation item for measuring management stability.²²⁾

Evaluation items	Proxy variable	Calculation method
Capital adequacy	Capital adequacy ratio	BIS capital adequacy/risk weighted assets
Asset quality	Delinquent loan ratio	Delinquent loans/total loans
Earnings	ROE	Net income/owner's
Liquidity	Korean won liquidity ratio	Korean won 「assets/liabilities」 maturing in three months or less

Looking at the recent trend of each evaluation item for commercial banks, all items show the improving trend(refer to Table 2). Considering that the diversity of major bank management indexes is on the decline, the risk of insolvency of specific banks seems likely to be reduced by improving the stability of those banks that fall below the management stability yardstick (Table 3).

22) In the same way that the supervisory authority uses bank evaluation methods on the basis of CAEL and CAMELS, assessing each item with multiple management indexes enables us to judge the management condition of banks more accurately. In fact, however, it is difficult to obtain the data for each numeric index, as well as to judge what weight to give a management index in advance and to assess each item. Since there is a very close correlation between most of the management indexes for each evaluation item, it seems that there are no substantial differences between the results of econometric analysis using the representative index for each item and those using multiple management indexes for that item.

Table 2 Trend of Major Management Indexes in Commercial Banks

	1999	2000	2001	2002	2003	2004
Capital adequacy ratio	10.83	10.53	10.81	10.56	10.52	11.42
Delinquency loan ratio	7.08	4.37	2.58	2.53	2.52	2.24
ROE	23.13	-11.90	15.88	11.67	2.16	17.96
Korean won liquidity ratio	108.0	114.5	101.8	111.6	110.0	116.3

Table 3 Diversity of Management Indexes among Banks¹⁾

	1999	2000	2001	2002	2003	2004
Capital adequacy ratio	1.820	1.218	0.917	0.977	0.874	0.985
Delinquency loan ratio	1.573	2.163	0.681	0.776	0.739	0.540
Non-performing loan ratio	3.301	3.291	1.584	0.855	0.877	0.504
ROE	86.437	53.070	13.083	12.427	18.931	8.189
ROA	1.469	1.763	0.576	0.547	0.756	0.481
Korean won liquidity ratio	10.477	11.279	10.637	6.597	5.277	7.486
Deposit-loan ratio	9.668	9.279	10.442	9.532	8.867	9.927
Ratio of SME loans	14.150	15.563	16.981	14.054	14.110	14.915

Notes : 1) Diversity is measured by standard deviation and derived by using the formula of $Std(FM_{1,t}, FM_{2,t}, \dots, FM_{n,t})$, where $FM_{i,t}$ denotes management index of bank i in year t

Table 4 Annual Volatility of Management Indexes¹⁾

	1999	2000	2001	2002	2003	2004
Capital adequacy ratio	1.086	0.352	0.289	0.110	0.222	0.252
Delinquent loan ratio	2.477	1.255	0.763	0.200	0.360	0.404

Notes : 1) Volatility is derived using standard deviation of quarterly indexes. Other indexes are not expressed due to the difficulty of acquiring quarterly data.

Examining the annual volatility of the capital adequacy ratio and the delinquent loan ratio in commercial banks, it seems necessary for policy authorities to ease the annual cyclic variation of management indexes as the annual volatility shows an increasing trend since 2002 (Table 4). Looking at the disparity of the volatility of changes in management indexes among banks (Table 5), diversity is seen to have decreased. Considering the increasing tendency for bank management indexes to change in a similar direction, many banks are highly likely to be insolvent at the same time in the event of external shocks due to herding behavior in choosing similar management strategies and asset structures.

Table 5 Diversity of Changes in Management Indexes Among Banks¹⁾

	2000	2001	2002	2003	2004
Capital adequacy ratio	1.764	0.992	1.196	0.518	0.759
Delinquent loan ratio	2.004	1.665	0.444	0.333	0.609
Coverage ratio	3.165	3.380	1.539	0.468	0.667
ROE	97.781	61.216	16.017	11.650	16.405
ROA	2.238	1.997	0.759	0.533	0.573
Korean won liquidity ratio	11.474	12.030	7.438	6.623	7.242
Deposit-loan ratio	8.793	5.528	6.945	4.861	5.653
Ratio of SME loans	5.351	5.315	4.768	2.158	2.502

Notes : 1) Diversity is derived using the formula of $Std(FM_{1,t} - FM_{1,t-1}, FM_{2,t} - FM_{2,t-1}, \dots, FM_{N,t} - FM_{N,t-1})$, where $FM_{i,t}$ represents management index of bank i in year t .

2. Regression analysis

A. Factors affecting the stability of financial institutions

In order to investigate how bank stability is affected by bank-specific variables, monetary policy variables and macro economic indexes, this paper conducts a regression analysis based on the theoretical discussion in Chapter II,

Table 6 Explanatory Variables Used in Empirical Analysis

Explanatory variables	Proxy variables	Mean	Standard deviation
Degree of consolidation	Individual bank assets/total bank assets	7.14	6.95
Degree of diversification	Ratio of fee income to total income	73.14	22.87
Foreigners' influence	Foreign shareholding ratio	27.32	26.92
Governance transparency	Number of outside directors	8.26	5.78
Ratio of retail sales	Number of domestic and overseas branches/total asset ratio	0.104	0.049
Credibility of financial institution	Ratio of short-term savings	49.74	8.96
Macro economic indicators	Degree of competition between banks ¹⁾	2.06	0.30
	Call rate	4.40	0.52
	Exchange rate	1,195.5	88.78
	GDP growth rate	6.08	2.42

Notes : 1) Given that, when competition among banks deepens, there are a decline in interest margin that considers default ratio and a fall in profit, the degree of competition among banks is derived from the differences between deposit banks' "loan interest rate×(1-default ratio) - bank deposit interest rate".

using estimation equations. The dependent variables used are the capital adequacy ratio, delinquent loan ratio, ROA, and Korean won liquidity ratio, which demonstrate the management stability of financial institutions. For the explanatory variables included in common in estimating dependent variables, the following variables are used to reflect the factors presented in Chapter II .

Table 7 Correlation Coefficients Between Explanatory Variables

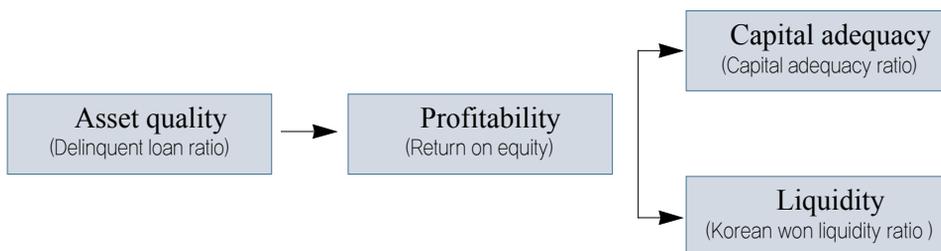
	Ratio of asset size	Ratio of interest income	Foreign shareholders' equity	Number of outside directors	Number of branches/total assets	Ratio of short-term savings	Degree of competition between banks	Call rate	Exchange rate	GDP growth rate
Ratio of asset size	1.00	-0.19	0.42	0.47	-0.68	-0.21	0.00	0.00	0.00	0.00
Ratio of interest income		1.00	0.03	-0.13	0.16	-0.25	-0.11	-0.35	-0.08	-0.34
Weight of foreign share ownership			1.00	0.35	-0.56	-0.49	0.04	-0.41	-0.31	-0.26
Number of outside directors				1.00	-0.37	0.05	-0.02	0.28	0.06	0.25
Number of branches/total assets					1.00	0.39	-0.04	0.25	0.14	0.18
Ratio of short-term saving						1.00	0.10	0.71	0.43	0.44
Degree of competition between banks							1.00	-0.17	-0.29	-0.15
Call rate								1.00	0.60	0.68
Exchange rate									1.00	-0.07

When the correlation between explanatory variables in the estimation equation is high, the problem of multi-collinearity can arise, meaning that the significances of the estimated coefficients may not be accurate. According to the result of measuring the correlations between explanatory variables, they are seen to be not high in general (Table 7), indicating that the likelihood of multi-collinearity is low.

The target banks are 14 commercial banks: Chohung, Woori, SC First, Korea Exchange, Kookmin, Shinhan, Hanmi, Hana, Daegu, Pusan, Kwangju, Jeju, Jeonbuk, and Kyongnam Banks. The period of analysis is from 1999 to 2004 and

annual data is used. Merging and merged banks are considered as a single bank. Meanwhile, when non-performing loans of banks decrease, the return on loan assets increases and profitability promptly rises, but the channel whereby profitability exercises an influence on the bad loan ratio is still seen to be weak. In addition, if profitability rises, internal reserves come into play, the capital adequacy ratio increases in line with this, and the capacity to expand liquid assets with low earnings increases, but the net effect on earnings of an increase in the capital adequacy ratio and liquidity appears uncertain since it runs via various channels.²³⁾ Consequently, when we examine the correlations between indexes relating to stability we find that transmission channels exist whereby asset quality has an effect on profitability, and profitability in turn influences capital adequacy and liquidity²⁴⁾. Therefore, the delinquent loan ratio is included as an explanatory variable when profitability is used as the dependent variable, and profitability is included as the explanatory variable when the capital adequacy ratio and liquidity are used as dependent variables.

Each explanatory variable used in the estimation equation can have a different effect in line with the choice of dependent variables. When the delinquent loan ratio, ROE, capital adequacy ratio and Korean won liquidity ratio are used as dependent variables, the expected signs of explanatory variables are as follows.



23) When the capital adequacy ratio of a bank rises, there is an increased tendency for shareholders to prefer safe assets, which may bring about a decline in profitability. In contrast, when the confidence of depositors grows due to a rise in the capital adequacy ratio, the growing confidence effectively increase profitability since financing costs decrease. Moreover, when liquidity rises, there are increased holdings of low-yielding short-term assets, which reduces profitability while, at the same time, allowing the bank to respond promptly to investment opportunities that arise, and thereby brings about an increase in profitability by reducing the cost of raising funds when these are urgently needed.

24) Banks have been analyzed to share these patterns of management behavior (refer to 'Development report on Management Analysis Skills'(February 1998), prepared by Financial System Stability Department, Bank of Korea).

Table 8 Expected Signs of Explanatory Variables in Estimation Equation of Asset Quality

explanatory variables	Anticipatory effect on delinquent loan ratio	Expected sign
Assets/total bank assets	Where information generation capacity is large due to economies-of-scale effect	(-)
	Where there is a small information generation capacity due to the low ratio of 'relationship lending' in big banks	(+)
Interest income/total revenue	Where high risk lending is reduced owing to the improved profitability following the progress of diversification (low weight of interest income)	(+)
	Where the ratio of high risk lending rises as the stability of profits increases due to diversification	(-)
Foreign shareholding ratio	Foreigners have tendency to prefer safe assets	(-)
Number of outside directors	Management transparency improves asset soundness	(-)
Number of branches/total assets	Asset soundness is low where there is a high ratio of retail business	(+)
Short-term deposits/total deposits	Likelihood of non-performing assets decreases when the short-term asset management ratio is high due to large proportion of short-term deposits	(-)
Call rate	When the call rate changes, different effects arise depending on each bank's asset portfolio preferences	(+/-)
GDP growth rate	Improvement of the real economy enhances asset soundness	(-)
Interest margin	Easing of competition (increase in interest margin) enhances asset soundness	(-)
Exchange rate	Rise in exchange rate improves asset soundness via increase in firms' profits	(-)

Table 9 Expected Sign of Explanatory Variables in Estimation Equation of Earnings

	Anticipatory effect on return on equity	Expected sign
Assets/total bank assets	Where there are economies of scale effects	(+)
	Where there are no economies of scale effects or big banks prefer safe assets	(-)
Interest income/total revenue	Diversification (low ratio of interest income) creates synergy effects and improves profitability	(-)
Foreign shareholding ratio	Management behavior of foreigners emphasizing earnings	(+)
Number of outside director	Improvement of management transparency enhances profitability	(+)
Number of branches/total assets	When the ratio of retail business is high, profitability can be low	(-)
Short-term deposits/total deposits	When the capacity to take long-term deposits is low, profitability is low	(-)
Delinquent loan ratio	A rise in the delinquent loan ratio worsens profitability	(-)
Call rate	Refer to the first paragraph of Chapter II	(+/-)
GDP growth rate	Improvement of the real economy increases profitability	(+)
Interest margin	Easing of competition (increase in interest margin) improves profitability	(+)
Exchange rate	A rise in the exchange rate improves profitability by way of an increase in firms' profits	(+)

Table 10 Expected Sign of Explanatory Variables in Estimation Equation of Capital Adequacy

	Anticipated effect on capital adequacy ratio	Expected sign
Assets/total bank assets	Where the cost of equity capital declines as bank gets bigger	(+)
	Where the stability of loan assets is high in large banks or they are seen as "too big to fail"	(-)
Interest income/total revenue	When diversification (low ratio of interest income) raises bank stability, equity capital can be low	(+)
Foreign shareholding ratio	Where foreigners prefer high capital adequacy	(+)
	Where foreigners show short-termism in management behavior	(-)
Number of outside directors	Improvement of management transparency enhances capital adequacy	(+)
Number of branch/total asset	When the ratio of retail business is high, the capital adequacy ratio can be raised in consideration of high earnings volatility	(+)
Short-term deposits/total deposits	When the capacity for taking long-term deposits is low, the cost of issuing subordinated debt is also high and capital adequacy ratio declines	(-)
Profitability	Increasing profitability improves the capacity for expanding equity capital	(+)
Call rate	A rise in the call rate is likely to increase the cost of equity capital	(-)
GDP growth rate	Improvement of the real economy reduces the cost of equity capital through increasing stock price	(+)
Interest margin	Easing of competition (expansion of interest margin) improves the capacity to increase equity capital through the rise in banks' market capitalization	(+)
Exchange rate	As the stability of bank loan assets increases due to a rise in exchange rate(depreciation of the Korean won), the need to raise capital adequacy declines	(-)

Table 11 Expected Sign of Explanatory Variables in Estimation Equation of Liquidity

	Anticipated effect on Korean won liquidity ratio	Expected sign
Assets/total bank assets	In the case of big banks, the necessity of securing liquidity is relatively not big as the cost of financing emergency fund is low	(-)
Interest income/total revenue	Since diversification (low ratio of interest income) is high, liquid assets are secured to invest immediately when there are investment opportunities	(-)
Foreign shareholding rate	Necessity of securing liquidity is low since the borrowing of emergency funds are easily acquired from overseas parent banks	(-)
Number of outside directors	As governance transparency is higher, liquidity is fully secured	(+)
Number of branches/total assets	As the ratio of retail sale is high, liquidity ratio is kept low since the likelihood of temporary demand for large-scale funds is low	(-)
Short-term deposits/total deposits	When the ratio of short-term deposits is high, the necessity of securing liquidity increases	(+)
Profitability	When profitability is high, liquidity can be kept high	(+)
Call rate	When the call rate increases, the opportunity costs of holding liquidity rise	(-)
	When the call rate rises, the need to secure emergency funds in advance grows	(+)
GDP growth rate	When the real economy picks up, banks' short-term liabilities, i.e., M1, rises and the liquidity ratio (short-term assets/short-term liabilities) declines	(-)
Interest margin	Easing of competition (widening of interest margin) reduces the need to secure liquidity	(-)
Exchange rate	A rise in the exchange rate reduces the liquidity ratio by increasing households and firms' liquidity holdings(short-term liabilities of financial institutions)	(-)

Considering the low accuracy of the estimated coefficient and the risk that significance is higher than in actuality when dependent variables affect explanatory variables,²⁵⁾ bank-specific explanatory variables lagged one year behind the dependent variables are used in the estimations. While the influence of monetary policy variables or macroeconomic variables on the bank management indicators is large, the effect of the bank management indicators on the monetary policy index or macroeconomic variables is expected to be low. Therefore, this paper uses monetary policy variables and macroeconomic variables, which do not lag behind dependent variables. Reckoning with the possibility that the correlation between residuals of estimation equation for a bank and those for another bank is large due to possible omission of explanatory variables, this paper employs Seemingly Unrelated Regression(SUR). Since SUR takes into account the existence of correlation between residuals in the estimation equation for a bank and those for another bank, the significance of the estimated coefficients can be derived more accurately in that the estimation is conducted considering the effects of other factors on dependent variables, which are not included in the estimation equation of each bank, and those of the included explanatory variables as well. Moreover, when lagged dependent variables are included in explanatory variables, the correlation between the variables and error term is highly likely to exist and thereby the estimate of explanatory variables has a possibility of bias. Considering this, the lagged dependent variables are employed as the explanatory variables²⁶⁾.

Considering these factors, estimation equations are set up in equations (1) to (4). Since the following equations are estimated using SUR, correlation between residuals of the estimation equation for a bank and that for another bank exist and $E[\varepsilon_{i,t} \varepsilon_{j,t}] \neq 0$ is established. Assuming that there is no correlation among residuals, $\varepsilon_{i,t}^{AS}$, $\varepsilon_{i,t}^{RE}$, $\varepsilon_{i,t}^{CA}$, $\varepsilon_{i,t}^{LR}$ in the following estimation equations, each equation is estimated independently:

$$AS_{i,t} = \alpha + \sum_{j=1}^n \beta_{(j)} BC_{(j)i,t-1} + \sum_{j=1}^m \gamma_{(j)} MV_{(j)t} + \varepsilon_{i,t}^{AS} \quad (1)$$

$$RE_{i,t} = \alpha + \sum_{j=1}^n \beta_{(j)} BC_{(j)i,t-1} + \delta AS_{i,t}^* + \sum_{j=1}^m \gamma_{(j)} MV_{(j)t} + \varepsilon_{i,t}^{RE} \quad (2)$$

$$CA_{i,t} = \alpha + \sum_{j=1}^n \beta_{(j)} BC_{(j)i,t-1} + \delta RE_{i,t}^* + \sum_{j=1}^m \gamma_{(j)} MV_{(j)t} + \varepsilon_{i,t}^{CA} \quad (3)$$

$$LR_{i,t} = \alpha + \sum_{j=1}^n \beta_{(j)} BC_{(j)i,t-1} + \delta RE_{i,t}^* + \sum_{j=1}^m \gamma_{(j)} MV_{(j)t} + \varepsilon_{i,t}^{LR} \quad (4)$$

25) To resolve this, we conducted the estimation using panel GMM of utilizing the lagged explanatory variables as instrumental variables, but it was difficult to generate significant results.

26) For details, refer to Cho et al (2004), pp.54-55.

* where AS denotes asset soundness, RE return on earnings, CA capital adequacy, LR liquidity, $BC_{(j)}$ bank-specific characteristics in the j th, $MV_{(j)}$ macro variable in the j th.

The correlation between $AS_{i,t}$ and $BC_{(j),t-1}$, and that between $AS_{i,t}$ and $MV_{(j)t}$ can be high. In estimation equation (2), $AS_{i,t}^*$, the residual of the equation estimating $AS_{i,t}$ with $BC_{(j),t-1}$ and $MV_{(j)t}$ is used as the explanatory variable instead of $AS_{i,t}$ to resolve this problem. The correlation between $RE_{i,t}$ and $BC_{(j),t-1}$ and that between $RE_{i,t}$ and $MV_{(j)t}$ can be also high. In a similar manner, $RE_{i,t}^*$, the residual of the equation estimating $RE_{i,t}$ with $BC_{(j),t-1}$ and $MV_{(j)t}$, is used as explanatory variable in estimation equations (3) and (4).

Obtained through these procedures, the result of empirical analysis on the effects of bank-specific characteristics and macroeconomic variables on bank stability is as follows. Asset soundness appears high when asset size is small and the ratio of retail sales and the overnight call rate are low (see Table 12). In other words, since banks with relatively small asset size have a high ratio of loans utilizing not only open information, e.g., financial statements but also unique information that only the relevant bank holds concerning borrowers, the amount of bad loans in these banks seems smaller. And banks with a low ratio of retail sales have few credits to small proprietors and the self-employed and therefore the ratio of delinquent loans is low. In addition, although a cut in the call rate appears to be effective in reducing banks' bad loans, by lowering the probability of default through the reduction of loan interest rates and stimulating the real economy, its significance is not seen to be high. Explanatory power is also seen as comparatively good in the empirical analysis conducted using only the explanatory variables (asset size, ratio of branch numbers and call rate) that are significant in the above estimation results. (Refer to <Appendix 2>)

Table 12 Estimation Result of Asset Quality (Estimation Equation(1))

Dependent variable	Explanatory variable	Estimated value	Standard error	t-value	$R^2 / \overline{R^2}$
Delinquent loan ratio	constant term	3,277	3,359	0.976	0.49/0.41
	assets _{t-1} /total bank assets _{t-1}	6.122**	2,435	2.514	
	interest income _{t-1} /total revenue _{t-1}	0.109	0.112	0.979	
	foreign shareholding rate _{t-1}	0.076	0.667	0.114	
	number of outside directors _{t-1}	-0.038	0.026	-1.428	
	number of branches _{t-1} /total assets _{t-1}	1,531***	0.370	4.135	
	short-term deposits _{t-1} /total deposits _{t-1}	-2.913	2,157	-1.350	
	call rate _t	1.817*	0.953	1.906	
	GDP growth rate _t	-0.095	0.134	-0.710	
	interest margin _t	-1.517	1,174	-1.292	
	exchange rate _t	-0.005	0,004	-1.151	

Note : ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 13 Estimation Result of ROE(Estimation Equation (2))

Dependent variable	Explanatory variable	Estimated value	Standard error	t-value	$R^2 / \overline{R^2}$
Return on equity (ROE)	constant term	-137,325***	3,359	-40.878	0.40/0.29
	asset _{t-1} /total bank asset _{t-1}	-27,777***	2,435	-11,409	
	interest income _{t-1} /total revenue _{t-1}	-2,933***	0,112	-26,273	
	foreign shareholding rate _{t-1}	2,958***	0,667	4,435	
	number of outside directors _{t-1}	0,065**	0,026	2,475	
	number of branches _{t-1} /total assets _{t-1}	-7,116***	0,370	-19,225	
	short-term deposit _{t-1} /total deposit _{t-1}	-36,392***	2,157	-16,869	
	delinquent loan ratio _t	-8,764***	0,128	-68,393	
	call rate _t	-28,543***	0,953	-29,943	
	GDP growth rate _t	6,286***	0,134	47,044	
	interest margin _t	71,175***	1,174	60,626	
exchange rate _t	0,098***	0,004	24,137		

Note : ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Earnings turn out high as bank size is small, universal banking ratio, foreign shareholding ratio and governance transparency are high, retail sales ratio, short-term deposit ratio and delinquent loan ratio are low, economic growth rate and exchange rate are high, and competition between banks and call rate are low (Table 13). In other words, during the analysis period(1999~2004), while consolidation among banks does not produce synergy effects of raising bank's ROE, diversification seems to assist in buttressing the profit foundation. In the meantime, the fact that there have not been improvements in profitability in Korea for a certain length of time after banks' consolidation seems attributable to the difficulties of organizational convergence between the acquiring and the acquired banks, and to that the consolidation is conducted for the purpose of increasing asset size and market dominance rather than of improving efficiency. However, if the consolidated banks improve efficiency through profit-oriented management in future, the synergy effects of consolidation are expected to emerge. Furthermore, reflecting on the empirical analysis in Table 13, banks with high wholesale banking ratios have outstanding profit generation capacity based on superior financial techniques relative to banks focusing on retail sales, and banks with high short-term deposit ratios seem to make low profits due to the difficulties in the long-term and stable operation of their funds. ROE of banks increases via a decline in the interest costs of financing at a low call rate,

Table 14 Estimation Result of Capital Adequacy (Estimation Equation (3))

Dependent variable	Explanatory variable	Estimated value	Standard error	t-value	R^2/\bar{R}^2
Capital adequacy ratio	constant term	10.114***	3.359	3.011	0.36/0.24
	assets _{t-1} /total bank assets _{t-1}	-4.653**	2.435	-1.911	
	interest income _{t-1} /total revenue _{t-1}	-0.053	0.112	-0.477	
	foreign shareholding rate _{t-1}	0.837	0.667	1.255	
	number of outside directors _{t-1}	0.053**	0.026	2.017	
	number of office _{t-1} /total asset _{t-1}	0.185	0.370	0.500	
	short-term deposits _{t-1} /total deposits _{t-1}	-0.489	2.157	-0.227	
	profitability _t	0.015***	0.005	3.225	
	call rate _t	-0.131	0.953	-0.137	
	GDP growth rate _t	0.089	0.134	0.668	
	interest margin _t	1.033	1.174	0.880	
exchange rate _t	-0.001	0.004	-0.290		

Note : ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

and the profitability of banks improves due to an increase in corporate profits following export growth at a high exchange rate(weak Korea won).

Capital adequacy as measured by the BIS capital adequacy ratio turns out high when asset size is small, and management transparency and earnings are high (refer to Table 14). If there is an expectation of a bank being "too big to fail" with regard to banks with large-scale assets, the capital adequacy ratio of big banks can be lower than that of small banks.²⁷⁾ Carrying out additional empirical analysis using the variables (asset size, number of outside directors and ROE) that turn out significant in the above estimation equation and call rate as explanatory variables, estimated coefficients turn out significant and overall explanatory power is satisfactory.(Appendix 2)

Table 15 Estimation Result of Liquidity (Estimation Equation(4))

Dependent variable	Explanatory variable	Estimated value	Standard error	t-value	R ² /R ² _̄
Liquidity ratio in Won	constant term	200.715***	3.359	59.748	0.46/0.36
	assets _{t-1} /total bank assets _{t-1}	-57.078***	2.435	-23.444	
	Interest income _{t-1} /total revenue _{t-1}	-0.242**	0.112	-2.170	
	foreign shareholding ratio _{t-1}	-13.535***	0.667	-20.297	
	number of outside directors _{t-1}	0.149***	0.026	5.650	
	number of branches _{t-1} /total assets _{t-1}	-10.315***	0.370	-27.869	
	short-term deposits _{t-1} /total deposits _{t-1}	2.996	2.157	1.389	
	profitability _t	0.017***	0.005	3.694	
	call rate _t	8.441***	0.953	8.855	
	GDP growth rate _t	0.000	0.134	0.001	
	interest margin _t	-3.213***	1.174	-2.737	
exchange rate _t	-0.084***	0.004	-20.770		

Note : ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

27) It is not essential for big banks to maintain a high capital adequacy ratio when they have a high proportion of safe assets, but in reality the proportion of safe assets in big banks is not found to be high compared to small banks. In other words, the empirical analysis indicates that a bank's asset size does not have significant relationship with the Γ (government and public bonds+monetary stabilization bonds)/loan amount_t, Γ (government and public bond+monetary stabilization bonds)/total marketable securities_t, and Γ credit loans/total loans_t. (For empirical analysis, refer to Appendix 3)

Liquidity turns out high with bank size small, ratio of diversification and governance transparency high, retail sales ratio and foreign shareholding ratio low, profitability high, call rate and degree of competition between banks high and exchange rate low.(Table 15) This result implies that the cost of financing emergency funds is generally higher for small banks compared to big banks due to their lower credit standing, and banks with various investment opportunities owing to diversification and wholesale business can hold liquid assets on a large scale in order to invest immediately when investment opportunities arise that are expected to make profits. The foreign-affiliated banks with a high ratio of foreign shareholders(high foreign capital participation ratio) can easily borrow emergency funds from overseas parent company and therefore the necessity of securing large-scale low yielding liquid assets having low profitability seems small. In addition, since financing costs are high and banks are likely to confront difficulties in borrowing from other banks as the call rate and degree of competition between banks become higher, in preparation for this likelihood, banks are expected to step up efforts for securing liquidity. The above estimation results are summarized in Table 16.

Table 16 Summary of Estimation Results (Estimation Equations (1)~(4))

Dependent variable Explanatory variable	Asset quality	Earnings	Capital adequacy	Liquidity
Total asset size	⊖	⊖	⊖	⊖
Degree of diversification		⊕		⊕
Foreign shareholding ratio		⊕		⊖
Governance transparency		⊕	⊕	⊕
Ratio of retail	⊖	⊖		⊖
Ratio of short-term deposits		⊖		
Asset Soundness	-	⊕	-	-
Profitability		-	⊕	⊕
Call rate		⊖		⊕
GDP growth rate		⊕		
Won-dollar exchange rate		⊕		⊖
Degree of competition between banks		⊖		⊕

Note : ⊕ and ⊖ indicate that the explanatory variable has a positive or negative effect on the dependent variable at the 5% significance level. - indicates that the explanatory variable is not included.

B. Influence of overnight call rate change on financial stability and relationship with bank characteristics

In order to examine whether the influence of the monetary policy variable on the management stability of financial institutions differs depending on characteristics of financial institutions, the additional empirical analysis is carried out. The previous empirical analysis analyzes the effects of each explanatory variable on the stability of financial institutions. This section conducts the empirical analysis using the monetary policy variable and financial institution-specific variables as explanatory variables to analyze influence of financial institution characteristics on the impact of monetary policy on the stability of financial institutions.²⁸⁾ Considering this, estimation equations (1) to (4) are changed into equations (5) to (8), respectively.

$$AS_{i,t} = \alpha + (\beta_0 + \sum_{j=1}^n \beta_{(j)} BC_{(j),i,t-1}) \times Call_t + \sum_{j=1}^l \gamma_{(j)} MV_{(j)}^*_{i,t} + \varepsilon_{i,t}^{AS} \quad (5)$$

$$RE_{i,t} = \alpha + (\beta_0 + \sum_{j=1}^n \beta_{(j)} BC_{(j),i,t-1} + \delta AS_{i,t}^*) \times Call_t + \sum_{j=1}^l \gamma_{(j)} MV_{(j)}^*_{i,t} + \varepsilon_{i,t}^{RE} \quad (6)$$

$$CA_{i,t} = \alpha + (\beta_0 + \sum_{j=1}^n \beta_{(j)} BC_{(j),i,t-1} + \delta RE_{i,t}^*) \times Call_t + \sum_{j=1}^l \gamma_{(j)} MV_{(j)}^*_{i,t} + \varepsilon_{i,t}^{CA} \quad (7)$$

$$LR_{i,t} = \alpha + (\beta_0 + \sum_{j=1}^n \beta_{(j)} BC_{(j),i,t-1} + \delta RE_{i,t}^*) \times Call_t + \sum_{j=1}^l \gamma_{(j)} MV_{(j)}^*_{i,t} + \varepsilon_{i,t}^{LR} \quad (8)$$

* where $MV_{(j)}^*$ denotes a macroeconomic variable in the j th apart from call rate, and $MV_{(j)}$ is a macroeconomic variable in the j th including call rate.

In equations (5) to (8), the term in parenthesis denotes the effect of an overnight call rate rise on the bank stability index. When $\beta_{(j)}$ and δ turn out significant, bank characteristics have an influence on this effect. The correlation between $AS_{i,t} \times Call_t$ and other explanatory variables, such as $BC_{(j),i,t-1} \times Call_t$ and $MV_{(j)}^*_{i,t}$, in estimation equation (6), and the correlation between $RE_{i,t} \times Call_t$ and other explanatory variables in estimation equations (7) and (8) can be high. To resolve this problem, the residual of the equation estimating $AS_{i,t}$ with $BC_{(j),i,t-1} \times Call_t$ and $MV_{(j)}^*_{i,t}$ is used instead of $AS_{i,t}$ in estimation equation (6). In a similar manner, the residual of the equation estimating $RE_{i,t}$ with $BC_{(j),i,t-1} \times Call_t$ and $MV_{(j)}^*_{i,t}$ is used instead of $RE_{i,t}$ in estimation equations (7) and (8).

The results of empirical analysis as to whether the effects of change in monetary policy variable (call rate) on bank stability differ by bank's characteristic are as follows. Asset soundness is analyzed as deteriorating further

28) The estimation equation is structured referring to the model of Cetorelli and Gambera (2001) using the products of variables as explanatory variables in panel analysis.

when overnight call rate rises if asset size is big and the retail sales ratio is high.²⁹⁾(see Table 17) If the overnight call rate increases, profitability is seen to worsen further when bank size³⁰⁾ becomes larger, the diversification ratio³¹⁾, foreign shareholding ratio and governance transparency are low, and the retail sales ratio, short-term deposit ratio³²⁾ and delinquent loan ratio are high.(see Table 18) Capital adequacy is seen to decline further in accordance with a call rate rise when governance transparency and profitability are low.(refer to Table 19). Liquidity is analyzed as worsening further if the overnight call rate increases when bank size is big, the diversification ratio and governance

Table 17 Estimation Result of Asset Soundness(Estimation Equation(5))

Dependent variable	Explanatory variable	Estimated value	Standard error	R ² /R ²
Delinquent loan ratio	constant term	4.094	3.514	0.51/0.43
	(assets _{t-1} /total bank assets _{t-1}) × call rate _t	1.351**	0.561	
	(interest income _{t-1} /total revenue _{t-1}) × call rate _t	0.025	0.024	
	(foreign shareholding ratio _{t-1}) × call rate _t	-0.002	0.155	
	(number of outside directors _{t-1}) × call rate _t	-0.007	0.006	
	(number of branches _{t-1} /total assets _{t-1}) × call rate _t	0.355***	0.084	
	(short-term deposits _{t-1} /total deposits _{t-1}) × call rate _t	-0.625	0.481	
	call rate _t	1.677	1.024	
	GDP growth rate _t	-0.104	0.132	
	interest margin _t	-1.583	1.173	
exchange rate _t	-0.005	0.004		

Note : ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

- 29) Since, relative to small banks, big banks have a low proportion of relationship lending that can easily secure information on firms, the proportion of bad loans grows larger. Banks with high retail sales ratios have a high proportion of loans in the low profitability sector and thereby non-performing loans are likely to expand considerably upon a rise in interest rate.
- 30) Big banks having a higher proportion of transaction lending than relationship lending find it difficult to raise loan interest rates due to a concern over customer churning following an increase in the call rate and financing costs. As a result of this, profitability seems to deteriorate further.
- 31) When financing cost rises in response to a call rate increase, banks highly dependent on interest income acquired through interest margin(banks having low degree of diversification) appear likely to see a greater deterioration in their profitability.
- 32) Banks with a high proportion of retail sales seem to have difficulties in alleviating the decline of profitability caused by an interest rate rise due to their high ratio of fixed costs. If the short-term deposit ratio is higher, total deposit interest payments increases further when market interest rates rise, indicating that the interest costs of these banks also appear to rise.

transparency are low, the retail sales ratio and foreign shareholding ratio are high and profitability is low.(Table 20) Meanwhile, explanatory power is also satisfactory in the empirical analysis using explanatory variables that turn out significant in the estimation results of equations (5) and (7).(Appendix 4)

Table 18 Estimation Result of Earnings (Estimation Equation(6))

Dependent variable	Explanatory variable	Estimated value	Standard error	$R^2/\overline{R^2}$
Return on Equity	constant term	-137.651***	3.359	0.41/0.30
	$(\text{assets}_{t-1}/\text{total bank assets}_{t-1}) \times \text{call rate}_t$	-26.128***	2.435	
	$(\text{interest income}_{t-1}/\text{total revenue}_{t-1}) \times \text{call rate}_t$	-2.988***	0.112	
	$(\text{foreign shareholding ratio}_{t-1}) \times \text{call rate}_t$	3.258***	0.667	
	$(\text{number of outside directors}_{t-1}) \times \text{call rate}_t$	0.052**	0.026	
	$(\text{number of branches}_{t-1}/\text{total assets}_{t-1}) \times \text{call rate}_t$	-7.467***	0.370	
	$(\text{short-term deposits}_{t-1}/\text{total deposit}_{t-1}) \times \text{call rate}_t$	-34.619***	2.157	
	$(\text{delinquent loan ratio}_t) \times \text{call rate}_t$	-8.769***	0.130	
	call rate _t	-28.478***	0.953	
	GDP growth rate _t	6.264***	0.134	
	interest margin _t	71.181***	1.174	
exchange rate _t	0.097***	0.004		

Note : ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 19 Estimation Result of Capital Adequacy (Estimation Equation(7))

Dependent variable	Explanatory variable	Estimated value	Standard error	$R^2/\overline{R^2}$
Capital adequacy ratio	constant term	10.304***	3.514	0.37/0.25
	$(\text{assets}_{t-1}/\text{total bank assets}_{t-1}) \times \text{call rate}_t$	-1.080*	0.561	
	$(\text{interest income}_{t-1}/\text{total revenue}_{t-1}) \times \text{call rate}_t$	-0.011	0.024	
	$(\text{foreign shareholding ratio}_{t-1}) \times \text{call rate}_t$	0.218	0.155	
	$(\text{number of outside directors}_{t-1}) \times \text{call rate}_t$	0.011**	0.006	
	$(\text{number of branches}_{t-1}/\text{total assets}_{t-1}) \times \text{call rate}_t$	0.050	0.084	
	$(\text{short-term deposits}_{t-1}/\text{total deposits}_{t-1}) \times \text{call rate}_t$	-0.076	0.481	
	$(\text{ROEt}) \times \text{call rate}_t$	0.015***	0.005	
	call rate _t	-0.187	1.024	
	GDP growth rate _t	0.088	0.132	
	interest margin _t	1.055	1.173	
exchange rate _t	-0.001	0.004		

Note : ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 20 Estimation Result of Liquidity (Estimation Equation(8))

Dependent variable	Explanatory variable	Estimate	Standard error	R ² /R ² _{adj}
Liquidity ratio in Won	constant term	184.797***	3.514	0.46/0.36
	(assets _{t-1} /total bank assets _{t-1}) × call rate _t	-12.863***	0.561	
	(interest income _{t-1} /total revenue _{t-1}) × call rate _t	-0.055**	0.024	
	(foreign shareholding ratio _{t-1}) × call rate _t	-3.137***	0.155	
	(number of outside directors _{t-1}) × call rate _t	0.032***	0.006	
	(number of branch _{t-1} /total asset _{t-1}) × call rate _t	-2.404***	0.084	
	(short-term deposits _{t-1} /total deposits _{t-1}) × call rate _t	0.883*	0.481	
	(profitability) × call rate _t	0.020***	0.005	
	call rate _t	11.848***	1.024	
	GDP growth rate _t	-0.008	0.132	
	interest margin _t	-3.264***	1.173	
exchange rate _t	-0.083***	0.004		

Note : ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 21 Summary of Extent to which a Call Rate Rise Deteriorates the Management Indicators (Estimation Equation (5)~(8))

Management stability index Bank-specific variable	Asset quality	Earnings	Capital adequacy	Liquidity
Total asset size	↑	↑		↑
Degree of diversification		↓		↓
Foreign shareholding ratio		↓		↑
Governance transparency		↓	↓	↓
Ratio of retail	↑	↑		↑
Ratio of short-term deposits		↑		
Asset quality	-	↓	-	-
Profitability		-	↓	↓

Note : ↑(↓) indicates that a call rate rise has a substantially negative effect on the management index concerning stability as a bank-specific variable is large(small). - means that the variable is not used as an explanatory variable. Influence is defined based on the 5% significance level.

IV. Conclusions and implications

This paper attempts to find implications for improving the stability of banks on the basis of the empirical analysis of panel data using a SUR estimation method. Looking at the simple statistical analysis of bank management indicators, we firstly note that the comovement of indicators across banks has increased. As the herd-like behavior of financial institutions rises, the necessity of policy responding to external shocks increases because risk in the overall financial system is highly likely to rise under an external shock.³³⁾ The herd behavior of financial institutions arises due to the information disparity among economic players, rise in market dominance of some financial companies, increase in investment behavior emphasizing technological factors rather than a firm's intrinsic value, managers' lack of information, and the moral hazard of financial institutions.³⁴⁾ Therefore, the financial authorities, e.g., the Bank of Korea, need to induce a moderation of these factors. That is, controls are necessary to heighten the transparency of public information regarding policy implementation and to ensure that the market dominance of a few financial institutions does not rise excessively. In addition, it is crucial to induce the improvement of investors' analytical ability through providing support for improvement of the financial infrastructure, for example, strengthening the function of credit rating organizations and the cultivation of human resources specializing in finance, and to make managers or major shareholders more liable when financial institutions are subject to management risk so that moral hazard does not arise. Herd-like behavior is likely to destabilize the financial system by way of the expansion of economic fluctuations in the course of the business cycle and therefore the policy authority needs to place greater emphasis on counter-cyclical monetary policy.

Examining the empirical analysis in this paper using panel data, bank consolidation has not had a positive impact on the improvement of financial institutions' stability. The consolidation of banks seems to have been undertaken to raise asset size or market dominance rather than to improve profitability, and mergers and acquisitions have not been conducted in conformity with market principles as well. Reflecting on this, the policy authority should take a more

33) When individual financial institutions have various management strategies and portfolios, some financial institutions may have a problem of insolvency, but the risk of insolvency for financial institutions as a whole is likely to be very low. However, if financial institutions have similar management strategies and portfolios, the risk of insolvency of financial institutions as a whole is likely to be high.

34) For details, refer to Chapter II

cautious approach by allowing mergers and acquisitions to go through only after strict examination of the possibility of the enhancements achieved through M&As between big banks. Furthermore, the policy authority should devise policy measures for raising the management stability of big banks in consideration of the importance of big banks for the financial system.

Unlike bank consolidation, diversification and governance transparency improvement have contributed to the enhancement of stability, the expansion of diversification via financial holding companies and the reform of the governance structure should be constantly induced.³⁵⁾ Since the rise in banks' retail sales ratio is analyzed as having hindered stability through the deterioration of asset soundness and profitability, it is desirable for financial institutions to constrain excessive competition for increasing their branch networks but to focus on profitability.³⁶⁾ Lastly, a short-term maturity structure of funds in financial institutions turns out to impede financial stability and, therefore, the policy authorities should act to encourage a long-term maturity structure by correcting distortions in the term structure of interest rates and stabilizing asset prices.

Although an interest rate rise effectively reduces bank profitability and improves liquidity during the analysis period in the empirical analysis, it is not found to have a significant effect on asset soundness and capital adequacy. In this light, an interest rate rise does not seem to have a strongly marked influence on banks' stability. According to the empirical analysis as to how banks are affected by a change in interest rates in terms of stability when the overnight call rate rises, banks with bigger total asset size and market share, banks with lower degree of diversification and governance transparency, and banks with higher retail sales ratio tend to suffer more greatly from decline in their stability. Taking into account the recent trend of a rise in bank's diversification and governance transparency, this result implies the possibility that a rise in the interest rate may have a positive effect on bank stability in the future. The result of empirical analysis in this paper that the profitability of big banks deteriorates relatively more than that of small banks when interest rates rise is consistent with the empirical analysis of Hanweck and Kilcollin(1984).³⁷⁾ Bearing the empirical analysis in this paper in mind, when the call rate is adjusted upward, it seems

35) When the Aggregate Credit Ceiling is allocated by BOK, plans for expanding BOK loan size seem to be scrutinized for commercial banks with high management transparency.

36) Given the recent trend in the development of information and communications technology, it seems more efficient for the improvement of profitability for banks to narrow the distance from customers in virtual space by expanding internet and phone banking.

37) Flannery(1981) argued that the profitability of big banks is not substantially influenced by an interest rate rise, but the empirical analysis in this paper shows a different result.

crucial for the policy authority to strengthen its monitoring regarding management stability for big banks, banks with a low degree of diversification and governance transparency, and banks with a high retail sales ratio.³⁸⁾

38) Examining the correlation, big banks with large-scale assets do not necessarily have a high degree of diversification and management transparency. Therefore, supervision taking into account the characteristics of each bank seems feasible. During the analysis period, the correlation coefficient between 「the individual bank asset size/total bank assets」 ratio and 「the interest income/total revenue」 ratio and the correlation coefficient between 「the individual bank asset size/total bank assets」 ratio and the number of outside directors are found to be -0.19 and 0.47, respectively.

[Appendix 1] Effects of interest rate change on asset price

AP denotes asset price, D earnings the asset generates every term, and r market interest rate. AP can be expressed in a simple formula as following;

$$AP = \sum_{j=1}^{\infty} \frac{D}{(1+r)^j} = \frac{D}{r}$$

The change in asset price to a change in 1 percent point of interest rate can be computed as follows;

$$\frac{\partial AP}{\partial r} = (-1) \times \sum_{t=1}^{\infty} \frac{Dt}{(1+r)^{t+1}} = (-1) \frac{D}{r^2}$$

From the two relations, the volatility ratio of asset price at a change in interest rate can be expressed as $\frac{\partial AP}{\partial r} / AP = -\frac{1}{r}$, which indicates that the volatility

ratio of asset price is also high when the level of interest rate is low. In other words, when interest rate level is 6%, an interest rate rise(drop) by 1% point causes a decline(rise) in asset price by 16.7%, but when interest rate level is 3%, a decline(rise) in interest rate by 1% point triggers a rise(decline) in asset price by 33.3%. Meanwhile, interest rate rise(fall) slows down(accelerates) economic activities and consequently it can decrease(increase) stock dividend and income gain on real estate. In the same way, when D , gains that asset produces decreases(increases) as interest rate rises(falls), a change in asset price by interest rate fluctuation is expected to be much bigger than $-\frac{1}{r}$.

[Appendix 2]**Estimation Result of Asset Soundness**

Dependent variable	Explanatory variable	Estimated value	Standard error	t-value	$R^2/\overline{R^2}$
Delinquent loan ratio	constant term	-3.628***	1.054	-3.441	0.36/0.33
	asset _{t-1} /total bank asset _{t-1}	4.760**	2.332	2.041	
	number of branch _{t-1} /total asset _{t-1}	1.380***	0.342	4.031	
	call rate _t	0.951***	0.248	3.835	

Note : ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Estimation Result of Capital Adequacy

Dependent variable	Explanatory variable	Estimated value	Standard error	t-value	$R^2/\overline{R^2}$
Capital adequacy ratio	constant term	13.140***	1.054	12.461	0.32/0.28
	asset _{t-1} /total bank asset _{t-1}	-4.656**	1.927	-2.417	
	number of outside director _{t-1}	0.065***	0.024	2.770	
	profitability _t	0.015***	0.005	3.225	
	call rate _t	-0.574**	0.250	-2.291	

Note : ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

* Since the above result is derived after the estimation excluding various controlling variables, the coefficient estimate of call rate can not be seen to represent the direct effect of call rate change.

[Appendix 3] Relationship between bank size and ratio of safe asset

To investigate whether there is a significant relationship between asset size and safe asset ratio of bank, the two-variable panel analysis using panel data employed in this paper is conducted as follows:

$$SAR_{i,t} = \alpha + \beta ASR_{i,t} + e_{i,t}$$

In the equation, $SAR_{i,t}$ denotes safe asset ratio, and $ASR_{i,t}$ represents 「individual bank asset/total bank asset」 ratio. As for the safe asset ratio, the ratio of (government and public bond+monetary stabilization bond)/loan amount, (government and public bond+monetary stabilization bond)/total marketable securities, and credit loan/total loan are used. Looking at the estimation result shown in the below table, the estimate of coefficient does not turn out significant and therefore banks with large asset size cannot be seen to have a high proportion of safe asset.

Estimation Result of coefficient				
Estimation methodology	Dependent variable	beta	t-value	Significance level
SUR	(government and public bond+monetary stabilization bond)/loan amount	-0.385	-0.249	0.802
	(government and public bond+monetary stabilization bond)/total marketable securities)	-0.170	-0.109	0.912
	credit loan/total loan	-0.066	-0.042	0.965

[Appendix 4]**Estimation Result of Capital Adequacy (Estimation Equation(5))**

Dependent variable	Explanatory variable	Estimated value	Standard error	$R^2 / \overline{R^2}$
Delinquent loan ratio	constant term	-1.783*	1.069	0.38/0.35
	$(\text{asset}_{t-1} / \text{total bank asset}_{t-1}) \times \text{call rate}_t$	1.075**	0.539	
	$(\text{number of branch}_{t-1} / \text{total aset}_{t-1}) \times \text{call rate}_t$	0.332***	0.078	
	call rate _t	0.508*	0.299	

Note : ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Estimation Result of Capital Adequacy (Estimation Equation(7))

Dependent variable	Explanatory variable	Estimated value	Standard error	$R^2 / \overline{R^2}$
Capital adequacy ratio	constant term	13.306***	1.076	0.32/0.28
	$(\text{asset}_{t-1} / \text{total bank asset}_{t-1}) \times \text{call rate}_t$	-1.105**	0.446	
	$(\text{number of outside director}_{t-1}) \times \text{call rate}_t$	0.014***	0.005	
	profitability _t	0.015***	0.005	
	call rate _t	-0.603**	0.261	

Note : ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

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