



**BOJ**  
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Financial  
system  
FSR report

**Bank of Japan**  
**March 2007**

This report covers the 12 major banks and 111 regional banks.

The 12 major banks comprise Mizuho Bank, The Bank of Tokyo-Mitsubishi UFJ, Sumitomo Mitsui Banking Corporation, Resona Bank, Mizuho Corporate Bank, Saitama Resona Bank, Mitsubishi UFJ Trust and Banking Corporation, Mizuho Trust and Banking Company, The Chuo Mitsui Trust and Banking Company, The Sumitomo Trust and Banking Company, Shinsei Bank, and Aozora Bank. The 111 regional banks comprise the 64 member banks of the Regional Banks Association of Japan and the 47 member banks of the Second Association of Regional Banks, as of the end of September 2006.

In the charts, "I" and "II" represent the first half and second half of the relevant year, respectively.

Unless otherwise stated, this document uses data available as at the end of February 2007.

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Financial Analysis and Research  
Financial Systems and Bank Examination Department, Bank of Japan  
[post.bsdl@boj.or.jp](mailto:post.bsdl@boj.or.jp)

# Financial System Report

Bank of Japan

March 2007

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## Preface

The Bank of Japan has published the *Financial System Report* every summer since 2005 with two primary objectives. The first is to present a comprehensive analysis and assessment of the stability and the functioning of Japan's financial system. The second is to facilitate communication with concerned parties in order to enhance the stability and functioning of the financial system and thereby contribute to the long-term stability of the financial system and the sound development of the economy.

The Bank has decided to publish the *Financial System Report* twice a year, every spring and fall. This aims at further enhancing research activity on the financial system and publishing research results in a more timely manner. This first semiannual issue, the March 2007 issue, assesses the current state of Japan's financial system and analyzes its functioning and robustness. The next issue, which is to be published this fall, is planned to provide a more comprehensive analysis on various issues related to the financial system, including the business strategies of Japanese financial institutions.

In macroprudential research, it is deemed important to appropriately assess the functioning and the robustness of the financial system as a whole. Regarding the functioning of the financial system, it is necessary to assess whether it promotes a more efficient allocation of economic resources, thereby contributing to the sound development of the economy. Regarding its robustness, it is necessary to examine to what extent the financial system is robust to imbalances and vulnerabilities that may impede sustained economic growth. Macroprudential research is also useful in assessing the functioning of the transmission channels of monetary policy.

The Bank is determined to make continued efforts to ensure the stability of Japan's financial system and enhance its functioning. To this end, the Bank will continue to analyze Japan's financial system, publish the results of its research, and take appropriate policy measures.

## **An Assessment of the Current State of Japan's Financial System: An Overview**

1. Japan's financial system as a whole has remained stable. The financial intermediation function of the system has improved, and its robustness against shocks of various types has increased.
2. As for the soundness of Japanese banks, their capital position has improved in terms of both quality and quantity and the total risk borne by banks has been largely restrained. Regarding profitability, high profit levels have been maintained, but they depend to some extent on a one-time factor, i.e., the reversal of allowances for loan losses. Improving profitability remains an important business challenge for banks (Chapter I).
3. The financial intermediation function of Japanese banks has improved with the easing of banks' capital constraints, which has led to an expansion of their risk-taking capacity. The outstanding amount of bank loans has been increasing moderately, and the diversification of borrowers and loan types has been advancing. The efficiency in the resource allocation of bank loan portfolios across industries have also improved. Interest rate margins on loans, however, have kept narrowing (Chapter II).
4. With regard to the inflow of funds to the real estate market, the expansion of loan volumes to the real estate sector by banks has been restrained, while money inflows from investors other than banks have continued. Against this background, the rate of increase in the price index of J-REITs has been accelerating. In order to ensure the sustained stability of the financial system, it is therefore necessary to carefully watch future developments in the real estate market and their effect on the financial system (Chapter II).
5. Although banks' role in financial intermediation has gradually declined, the interdependence between the banking sector and economic activity has become more pronounced since the 1990s. It therefore remains essential to properly analyze the banking sector when assessing the robustness of the financial system as a whole (Chapter III).
6. The robustness of Japan's financial system against changes in interest rates and credit costs has increased. Increases in interest rates are likely to improve banks' profit base in the medium term due to increases in interest earnings despite the adverse impact that a decline in the market value of bond portfolios would have in the short term. Japanese major banks have reduced their credit risks arising from a stress scenario of an unexpected and significant economic downturn, confirming that the quality of their loan portfolios has improved due to the progress in the disposal of nonperforming loans (NPLs) especially to large borrowers (Chapter III).
7. The first priority must be to make every effort to avoid instability in the financial system, since it is extremely costly to the economy to restore stability. It is thus essential to accurately analyze potential imbalances and vulnerabilities of the financial system that may threaten its stability, carefully taking into account the interactions between the financial system and economic activity.

Chart 1: Net Income/Loss

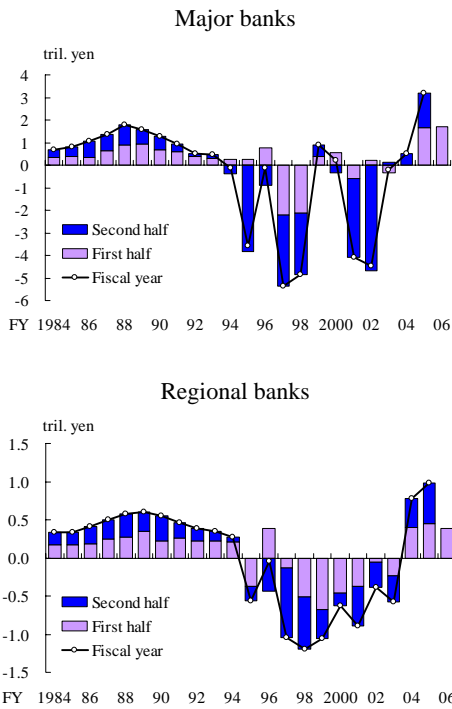
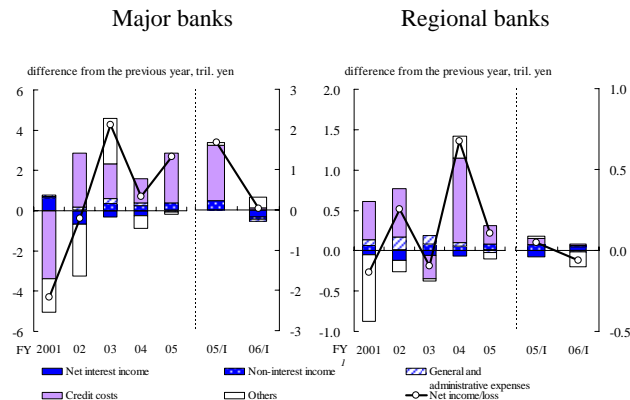
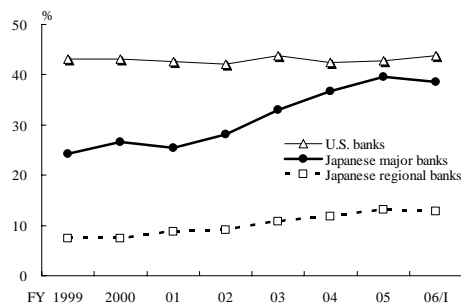


Chart 2: Contributions to Changes in Net Income/Loss



Note: 1. Non-interest income = net fees and commissions + profits on specified transactions + other operating profits - net realized bond-related gains/losses.

Chart 3: Ratios of Non-Interest Income to Gross Operating Profits<sup>1</sup>



Note: 1. Ratio of non-interest income to gross operating profits from core business = non-interest income/(net interest income + non-interest income).

Source: FDIC, "Statistics on Banking."

## I. Business Conditions of Japanese Banks

### A. Increases in Banks' Profits

Banks' profits remained high. The net income of the major banks in the first half of fiscal 2006 (April-September 2006) was slightly higher than in the same period in the previous year, thus marking a record high for two consecutive years (Chart 1). On the other hand, the net income of the regional banks decreased in the first half of fiscal 2006, compared with a year earlier when it marked a record high, but overall levels remained high. These positive results mainly reflect decreases in credit costs as a result, for example, of lower net losses derived from the disposal of NPLs. As will be discussed below, credit costs fell sharply in the past few years and remained low in the first half of fiscal 2006.

As for changes in the components of banks' profits, in the first half of fiscal 2006, the major banks registered decreases both in net interest income and in non-interest income compared with a year earlier (Chart 2). In contrast, at the regional banks, both net interest and non-interest income increased, although the increase was limited. The increase in the ratio of non-interest income to gross operating profits seen in recent years came to a halt, and the ratio remained almost unchanged (Chart 3). Regarding non-interest income from fees and commissions, the rate of increase in income from the sale of investment trusts and private pension policies slowed significantly at the major banks but remained high at the regional banks (Chart 4).

The degree of improvement in banks' profitability can be seen in their ROE based on core profitability (hereafter, core ROE). This is calculated by excluding volatile components such as credit costs, gains/losses on securities, and corporate income tax from net income,

and is used to gauge the change in the trend of their profitability more accurately.

Core ROEs slightly declined at both the major and the regional banks in the first half of fiscal 2006 due to a deceleration in the increase in core profits and an increase in banks' capital (Chart 5). Looking at the core ROE for individual banks, the degree of improvement in profitability varies from bank to bank and many banks have not seen an improvement in profitability when comparing fiscal 2003 and the first half of fiscal 2006 (Chart 6).

This observation suggests that the improvement in banks' core profitability remains an important challenge. It should be noted that in the assessment above, the core ROE for the first half of fiscal 2006 has been annualized by simply doubling the net income of that period. In previous fiscal years, the annualized income in the first half year was not equal to the actual annual income. In addition, doubling the half-year net income exaggerates the effect of temporary factors in the first half of the year.

Chart 4: Contributions to Increase in Fees and Commissions from Operations in Japan

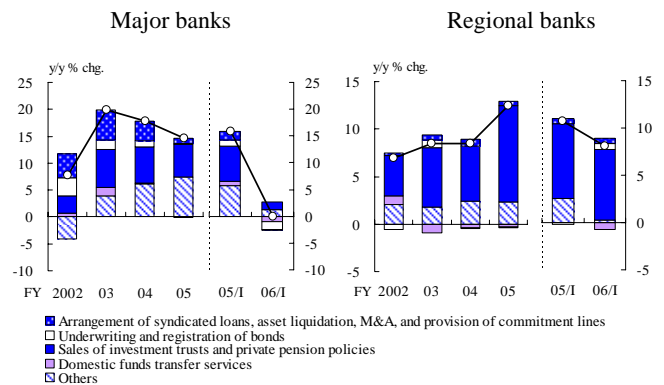
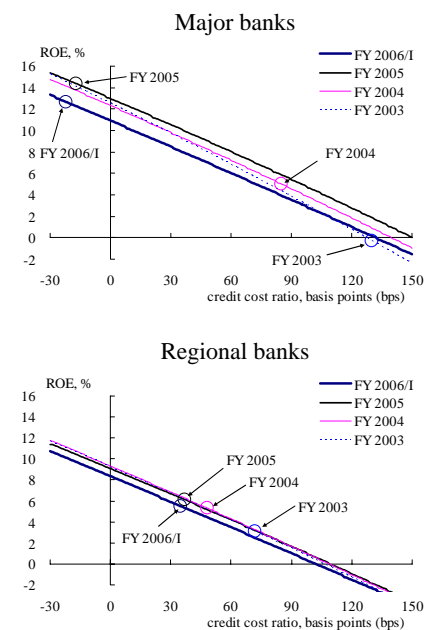
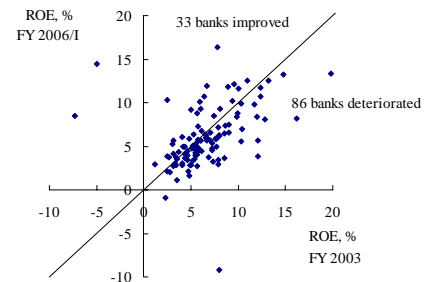


Chart 5: Core ROEs of Banks<sup>1,2,3</sup>



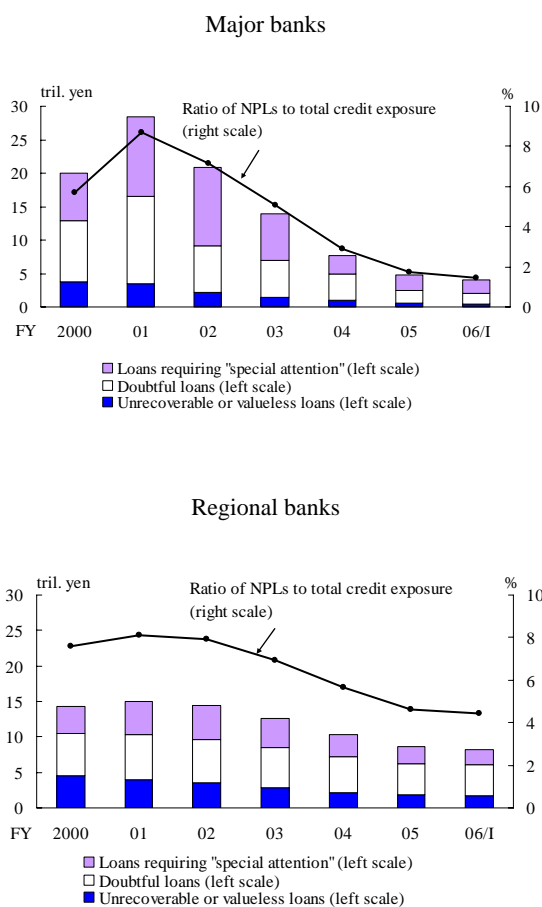
- Notes: 1. Core ROEs are reestimated by excluding volatile components such as credit costs, gains/losses on securities, and corporate income tax. See Hattori, M., J. Ide, and Y. Miyake (2007), "Bank Profits in Japan from the Perspective of ROE Analysis," Bank of Japan Review (forthcoming), for details.  
 2. Figures for the first half of fiscal 2006 are annualized.  
 3. One basis point (bp) = 0.01 percent.

Chart 6: Core ROE for Individual Banks<sup>1,2,3,4</sup>



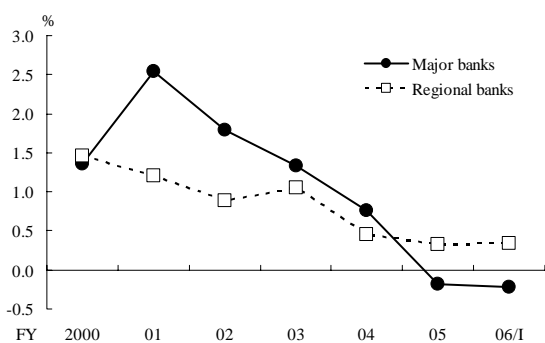
- Notes: 1. Core ROEs are estimated by the same method as in Chart 5.  
 2. Credit cost ratio is assumed to be 30 basis points.  
 3. Two banks do not appear within the scope of the chart.  
 4. Core ROEs of the banks plotted above the 45-degree line improved in the first half of fiscal 2006 compared with those in fiscal 2003.

Chart 7: NPL Ratios<sup>1,2</sup>



Notes: 1. NPLs disclosed under the Financial Reconstruction Law.  
 2. From fiscal 2000 to 2005, the figures include NPLs which are transferred to subsidiary companies for corporate revitalization.

Chart 8: Credit Cost Ratios<sup>1,2,3</sup>



Notes: 1. Credit cost ratio = credit costs/total outstanding loans.  
 2. From fiscal 2000 to 2005, the figures include credit costs of subsidiary companies for corporate revitalization.  
 3. Figures for credit costs in the first half of fiscal 2006 are annualized.

## B. Suppressed Credit Costs

Banks' NPLs have been declining against the background of firms' strong business performance amid the continuing expansion of Japan's economy. The ratio of NPLs to total credit exposure at the major banks declined to 1.5 percent at the end of September 2006, down from a peak of 8.7 percent at the end of fiscal 2001 (Chart 7). The ratio at the regional banks declined to 4.4 percent at the end of September 2006, compared with 8.1 percent at the end of fiscal 2001.

The credit cost ratio (the ratio of credit costs to total outstanding loans) has also been declining. As in fiscal 2005, the ratio at the major banks in the first half of fiscal 2006 was below zero (-0.22 percent); it remained low (0.35 percent) at the regional banks (Chart 8).

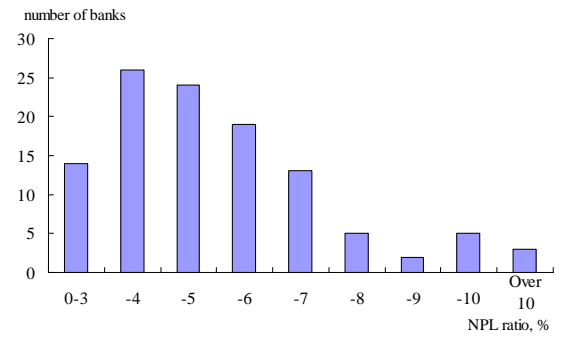
The low credit cost ratios can be attributed to two factors. First, the emergence of new NPLs has been contained. Second, the major banks in particular have posted large reversals of allowances for loan losses as a result of improvements in borrowers' credit quality. It should be noted, however, that the reversals in loan-loss allowances are due to favorable economic conditions and strong business performance, and hence their effect on credit cost ratios is essentially a temporary phenomenon.

The pace of decline in the NPL ratio at the regional banks has been moderate compared with that at the major banks (Chart 7). This appears to be a reflection of the following two factors. First, the pace of recovery of regional economies has been slower than that of metropolitan areas. Second, the attitude of the regional banks toward the disposal of NPLs has been different from that of the major banks. The difference stems from the fact that the regional banks tend to place greater importance on maintaining long-term business relationships with borrowers. With regard to the



regional banks, another notable development is that although the NPL ratios of the regional banks on the whole have been declining, they remain high for some regional banks (Chart 9). These banks need to make further efforts to dispose of NPLs.

Chart 9: NPL Ratios at the Regional Banks<sup>1</sup>



Note: 1. Calculated based on figures at the end of the first half of fiscal 2006.

Chart 10: Overall Gains/Losses on Securities

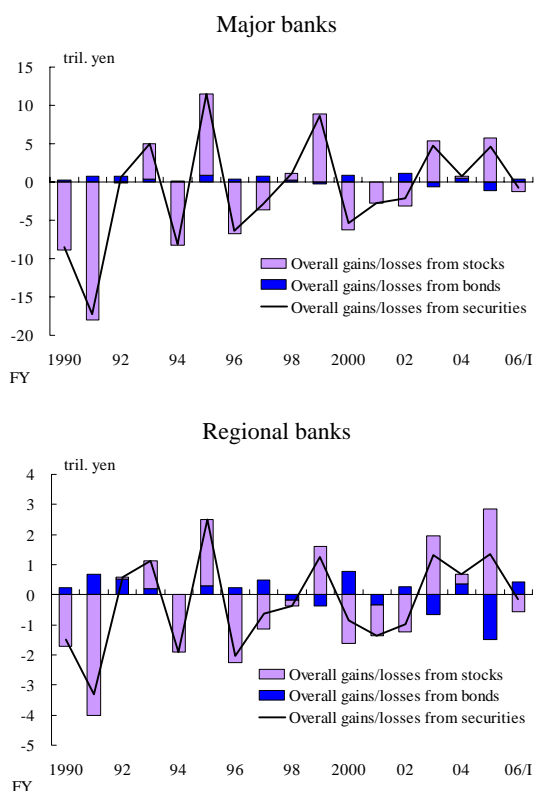
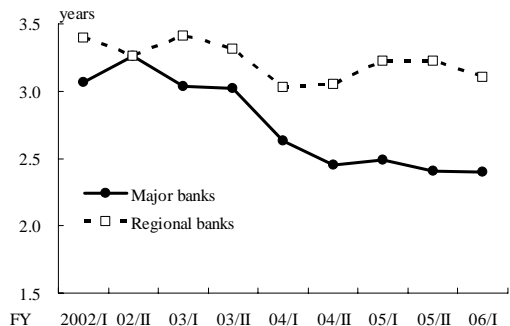
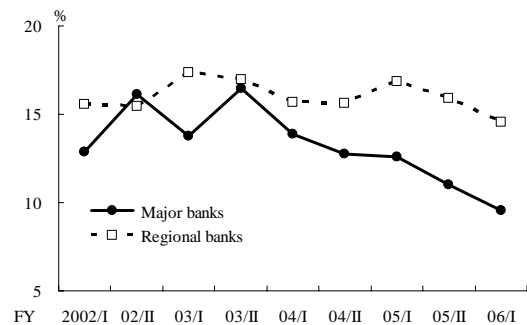


Chart 11: Average Maturity of Banks' Yen-Denominated Bond Portfolios<sup>1</sup>



Note: 1. Estimated by the Bank of Japan.

Chart 12: Ratios of Risks Associated with Banks' Holdings of Yen-Denominated Bonds to Tier I Capital<sup>1,2</sup>



Notes: 1. The risks are estimated based on the assumption that market interest rates increase by 100 basis points on all maturities. 2. Estimated by the Bank of Japan.

### C. Developments in Risk Associated with Bond Holdings and Stockholdings

During the first half of fiscal 2006, both the major and the regional banks recorded slight overall losses on securities, measured by the sum of net realized securities gains/losses and changes in net unrealized securities gains/losses (Chart 10). The losses are mostly explained by overall losses on stockholdings as a result of falling stock prices, while profits on bond holdings made small gains as the rise in long-term interest rates was temporary during that period.

The average maturity of bonds in the portfolios of the major banks has been shortening (Chart 11). The same is true for the regional banks, which had registered a slight increase in previous years.

Against this background, the ratio of risks associated with yen-denominated bond holdings (100 basis point value [bpv]) relative to Tier I capital, or core capital, both at the major and the regional banks has continued to decline further and the ratio of the interest rate risk in bond portfolios relative to Tier I capital has been restrained on the whole (Chart 12).

Meanwhile, banks have increased their holdings of "alternative investments" such as investments in structured products, credit investments, and hedge funds -- financial products that have risk/return profiles different from traditional assets such as straight bonds (Chart 13 [1]). At present, such alternative investments account for only a small share of the total balance of securities investments of the banking sector as a whole (3.4 percent at the major banks and 4.4 percent at the regional banks in the first half of fiscal 2006). There are, however, banks that have invested large amounts in these products relative to their total securities investments (Chart 13 [2]).

Some of these products have complex risk/return

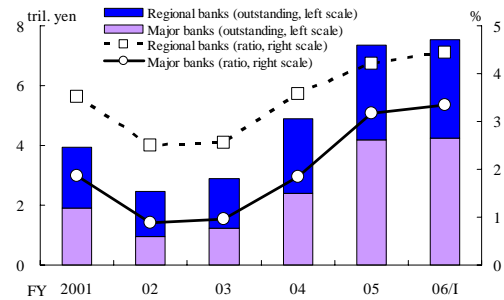
profiles compared to traditional securities. Therefore, understanding and managing the risks associated with such products is an important task for banks.

With respect to price movement risks associated with stockholdings, value-at-risk (VaR) increased due to a rise in stock price volatility, while the amount of banks' stockholdings remained more or less unchanged. Looking at the relative size of the risk vis-à-vis banks' Tier I capital, VaR associated with stockholdings rose to a little less than 50 percent at the major banks and a little more than 30 percent at the regional banks (Charts 14 and 15).

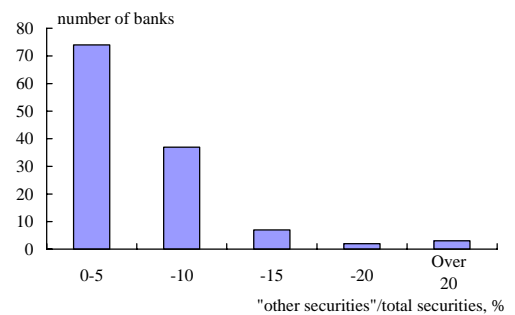
At the same time, although the risk associated with stockholdings has increased, banks' unrealized gains on stockholdings have also increased due to the recovery in stock prices. Looking forward, banks need to manage risks carefully, balancing the benefits of holding stocks and the associated costs.

Chart 13: Alternative Investments: Banks' Investment in "Other Securities"<sup>1</sup>

(1) Amount Outstanding of "Other Securities" and Ratios to Total Securities Outstanding

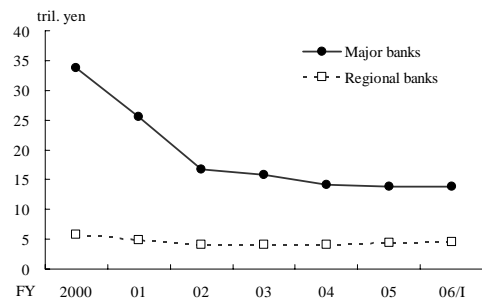


(2) Ratios of the Amount Outstanding of "Other Securities" to Total Securities Outstanding



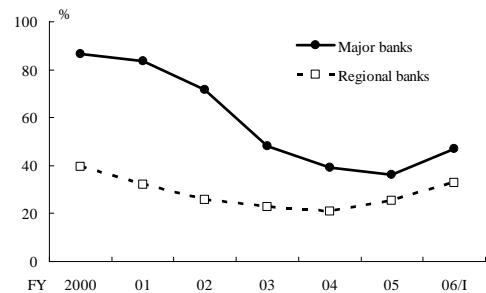
Note: 1. "Other securities" is banks' holdings of securities other than government bonds, corporate bonds, and stocks.

Chart 14: Banks' Stockholdings<sup>1,2</sup>



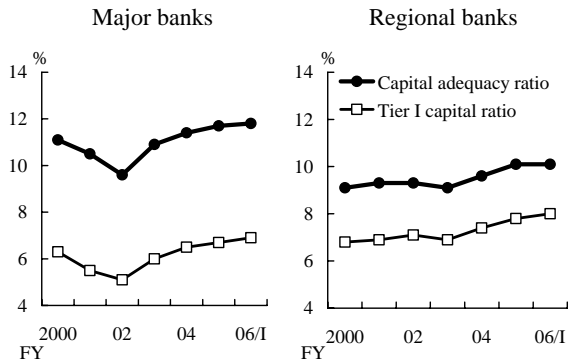
Notes: 1. Figures are based on acquisition prices.  
2. On a consolidated basis.

Chart 15: Ratios of Risks Associated with Banks' Stockholdings to Tier I Capital<sup>1</sup>



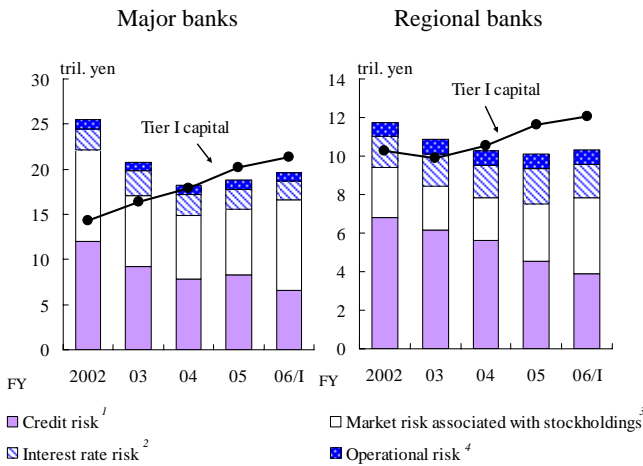
Note: 1. Estimated by the Bank of Japan. As measured by 1-year, 99 percent VaR (using TOPIX as a risk factor).

Chart 16: Capital Adequacy Ratios and Tier I Capital Ratios<sup>1</sup>



Note: 1. On a consolidated basis.

Chart 17: Overall Amount of Risk and Tier I Capital



- Notes: 1. Credit risk is estimated by subtracting expected loss (EL) from the maximum loss (EL + UL) based on the Basel II risk weight formulas with a confidence interval of 99 percent. In the estimation, borrowers classified as requiring "special attention" or below (in terms of credit quality) are considered to be in a state of default.
2. Interest rate risk is limited to yen-denominated bond portfolios and estimated by the same method as in Chart 12.
3. Market risk associated with stockholdings is estimated by the same method as in Chart 15.
4. Operational risk is defined to be 15 percent of gross profits based on the Basel II basic indicator approach.

## D. Easing Constraints on Capital

Banks' capital adequacy ratios at the end of September 2006 remained almost unchanged from their levels at the end of March 2006: a little less than 12 percent at the major banks and around 10 percent at the regional banks (Chart 16). These levels were higher than required by the capital adequacy regulations. At the same time, although Tier I capital ratios both at the major and the regional banks increased, they remained at an average of 6-7 percent at the major banks. Given that many major foreign banks have Tier I capital ratios of over 8 percent, a number of the major banks in Japan are aiming at further enhancing their Tier I capital.

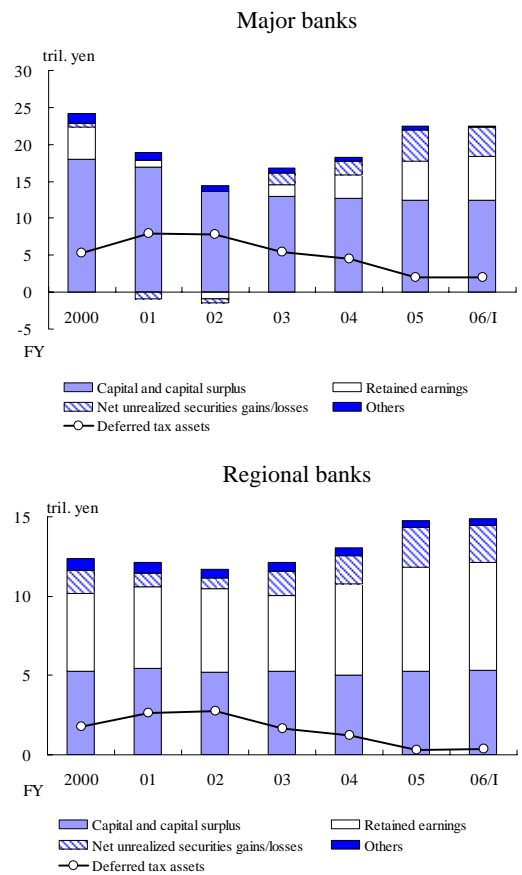
The overall amount of risk in the banking sector relative to banks' combined capital continued to be restrained (Chart 17). Looking at risk by category, market risk associated with stockholdings increased at both the major and the regional banks due to a rise in stock price volatility. In contrast, interest rate risk remained low as a result of the shortened average maturity of banks' bond portfolios. Credit risk continued to decrease as the quality of banks' loan portfolios further improved. Given that, as mentioned above, banks' core capital buffers increased, their risk-taking capacity appears to have been on an increasing trend.

Banks' net assets on the basis of their balance sheets remained almost unchanged at the end of September 2006 when compared with the end of March 2006, both at the major and the regional banks (Chart 18). Looking at the composition of net assets, it is clear that the quality of capital has improved due to a further expansion of both retained earnings and capital procurement despite the decrease in appraisal gains from stockholdings caused by the fall in stock prices. Moreover, although banks' deferred tax assets overall have increased slightly as a result of an upward revision of deferred tax assets at a major bank due to a recovery

in the profit outlook, many banks reduced deferred tax assets while posting strong profits.

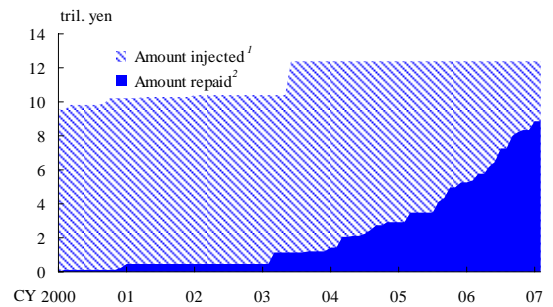
In the situation described above, banks accelerated the repayment of public funds they had received to boost their capital, and three major financial groups in succession fully repaid public funds in fiscal 2006. As a result, about 9 trillion yen, or a little over 70 percent of the total of about 12 trillion yen of public capital injected since 1998, was repaid by the end of December 2006 (Chart 19). As for the means of repayment, given that banks' profits have been stable and they have been able to build up capital, and in order, for example, to avoid the dilution of shares, banks have typically used internal funds to repay the public funds.

Chart 18: Composition of Net Assets<sup>1</sup>



Note: 1. On a nonconsolidated basis.

Chart 19: Repayment of Public Funds

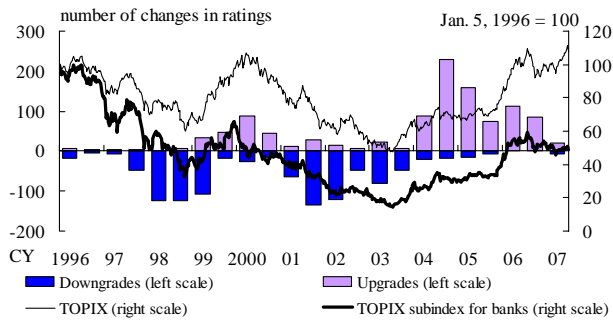


Notes: 1. The sum of public funds injected pursuant to the Early Strengthening Law, the Financial Function Stabilization Law, the Deposit Insurance Law, the Financial Reorganization Promotion Law, and the Financial Functions Strengthening Law.  
2. At face value.

Source: Deposit Insurance Corporation of Japan.

## E. Improvement in the Market's Evaluation of Japan's Financial System

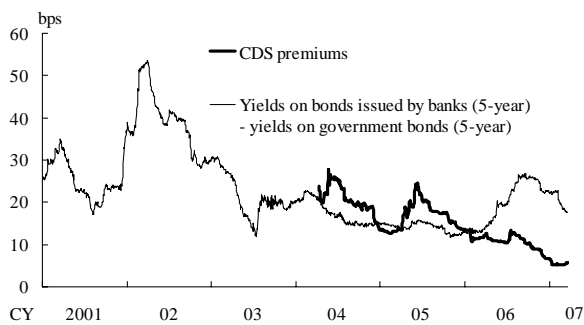
Chart 20: Credit Rating and Prices of Bank Stocks<sup>1</sup>



Note: 1. The number of upgrades and downgrades is the sum of the number of changes in ratings made by the following credit rating agencies: Moody's Investors Service, Standard and Poor's, Fitch Ratings, Rating and Investment Information, and Japan Credit Rating Agency.

Sources: Tokyo Stock Exchange; Bloomberg.

Chart 21: CDS Premiums and Credit Spreads of Three Major Banks<sup>1</sup>



Note: 1. Figures are the simple averages of Mizuho Corporate Bank, The Bank of Tokyo-Mitsubishi UFJ, and Sumitomo Mitsui Banking Corporation.

Sources: Tokyo Financial Exchange; Bloomberg.

Taken together, developments in various indicators of financial markets indicate that the assessment of Japan's financial system overall has continued to improve. However, looking at different markets, some differences emerge. For example, while the prices of bank stocks have recently stagnated, the number of upgrades by credit rating agencies for banks has been exceeding the number of downgrades (Chart 20). Moreover, banks' credit default swap (CDS) premium has remained low, and the credit spread (between yields on bonds issued by banks and on government bonds) has narrowed after widening slightly around the middle of 2006 (Chart 21).

The different assessments of Japan's financial system can be explained by whether market participants focus on stability or profitability. On the one hand, the stability of Japan's financial system has been increasing steadily as a result of overcoming the NPL problem. On the other hand, the large profits banks have registered in recent years, including those in the first half of fiscal 2006, to a great extent are attributable to one-time factors including suppressed credit costs due to the reversals of allowances for loan losses, and further improving profitability remains an important challenge for banks. While the credit ratings and the CDS premium reflect the increasing stability of the financial system, stock prices reflect the stock market's expectations with regard to banks' future profitability.

## II. Developments in Banks' Financial Intermediation Function

### A. Increases in Bank Loans

Banks' lending attitude has been becoming more accommodative as a result of the improvement in borrowers' financial conditions and the easing of banks' capital constraints, which has led to an expansion of their risk-taking capacity (Chart 22). At the same time, as a result of, for example, the rise in raw material prices as well as increased investment reflecting buoyant corporate activity, firms' demand for loans is gradually increasing (Chart 23).

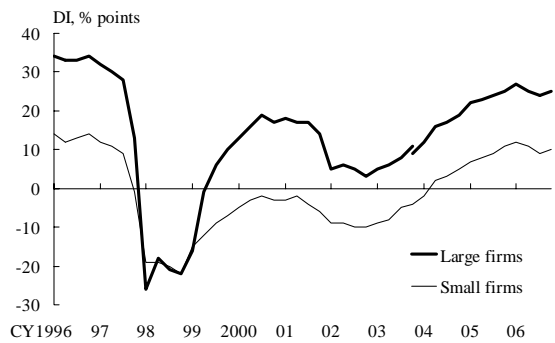
Based on these trends, the year-on-year change in outstanding loans turned positive in 2005 and bank lending has kept rising moderately since then (Chart 24). As for bank loans by type of borrower, the positive contribution of loans to small and medium-sized firms has increased, although the contribution of loans to large firms is still negative. Loans to individuals have also increased, with housing loans as the driving force.

The contrast in the trend of loans extended to large and to small and medium-sized firms is partly the result of the fact that large firms have more ample cash flows than small and medium-sized firms. Moreover, banks have been opening small branches specialized in extending loans to small firms and introducing uncollateralized business loans for small firms.

As for housing loans, which have been the driving force of loans extended to individuals, banks maintained an accommodative lending attitude, offering special discount rates through promotional campaigns (Chart 25). As a result, the ratio of housing loans outstanding to total loans outstanding has continued to rise, albeit at a slower pace (Chart 26).

In recent years, banks have diversified the types of loans

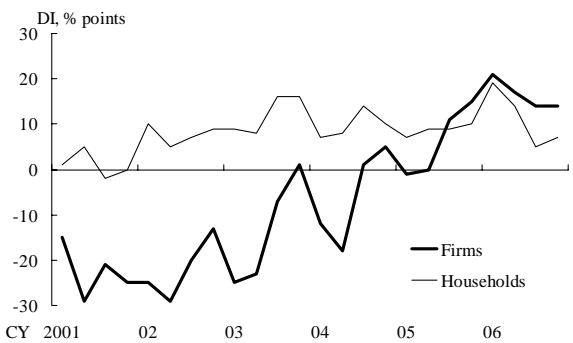
Chart 22: Lending Attitude of Financial Institutions as Perceived by Firms<sup>1</sup>



Note: 1. DI = "accommodative" - "severe."

Source: Bank of Japan, "Tankan -- Short-Term Economic Survey of Enterprises in Japan."

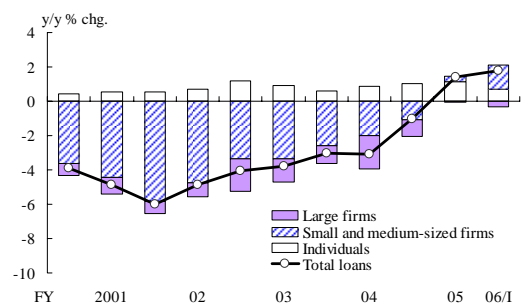
Chart 23: Demand for Loans from Borrowers: Classified by Borrower Type<sup>1</sup>



Note: 1. DI for demand for loans = (percentage of respondents selecting "substantially stronger" + percentage of those selecting "moderately stronger" × 0.5) - (percentage of those selecting "substantially weaker" + percentage of those selecting "moderately weaker" × 0.5).

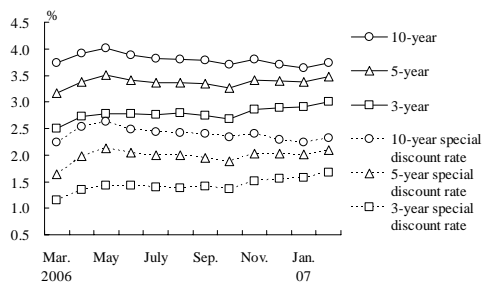
Source: Bank of Japan, "Senior Loan Officer Opinion Survey on Bank Lending Practices at Large Japanese Banks."

Chart 24: Bank Loans Outstanding by Type of Borrower



Source: Bank of Japan, "Loans and Discounts Outstanding by Sector."

Chart 25: Interest Rates on Housing Loans<sup>1,2</sup>

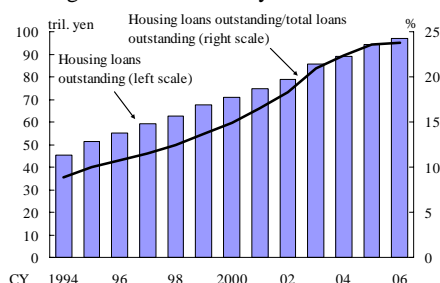


Notes: 1. Figures are calculated by averaging interest rates on housing loans offered by Mizuho Bank, The Bank of Tokyo-Mitsubishi UFJ, Sumitomo Mitsui Banking Corporation, Resona Bank, Mitsubishi UFJ Trust and Banking Corporation, The Chuo Mitsui Trust and Banking Company, and The Sumitomo Trust and Banking Company.

2. Data for interest rates on housing loans are as of the beginning of each month.

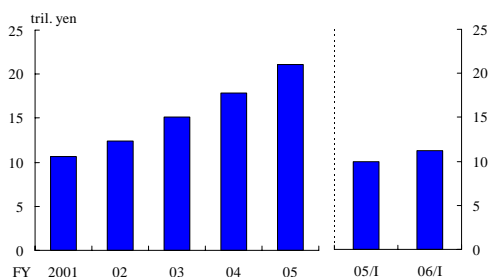
Source: Published accounts.

Chart 26: Housing Loans Extended by Banks



Sources: Bank of Japan, "Loans and Discounts Outstanding by Sector," "Outstanding of Loans (Others)."

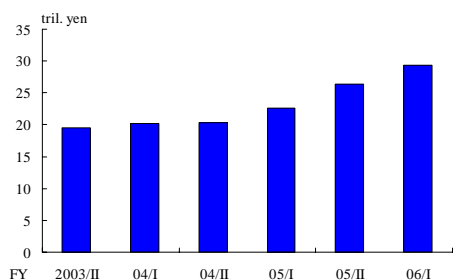
Chart 27: Syndicated Loans Arranged in Japan<sup>1</sup>



Note: 1. The figures for fiscal 2003, 2004, 2005, the first half of fiscal 2005, and the first half of fiscal 2006 were 19.0 trillion yen, 21.6 trillion yen, 25.9 trillion yen, 12.2 trillion yen, and 12.0 trillion yen, respectively, in the Bank of Japan's "Loans Syndicated and Loans Transferred."

Source: Thomson Financial.

Chart 28: Total Loans Outstanding in Overseas Operations<sup>1</sup>



Note: 1. Amount outstanding. The aggregate figure for both the major and the regional banks.

they offer. They have been actively extending loans to individuals and uncollateralized business loans for small firms, both of which were already mentioned, and are also active in the syndicated-loan business, including the arrangement of such loans (Chart 27). Moreover, while demand for funds for project finance and corporate acquisitions increased in an environment where worldwide M&A activity is growing and raw material prices are rising, banks have been actively expanding their overseas lending (Chart 28).



## B. Narrowing of Interest Margins on Loans

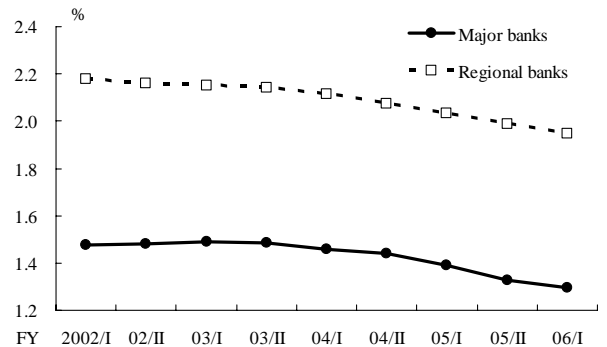
Interest margins on loans continued to narrow (Chart 29). According to the results of a questionnaire survey regarding banks' stance on setting interest margins, there were slightly more banks that widened interest margins than banks that narrowed margins for borrowers with a low credit rating. For borrowers with medium to high credit ratings, the results were the opposite (Chart 30). However, an increasing number of banks are planning to raise margins.

To analyze the factors underlying the narrowing of interest margins, interest margins are divided into interest rate spreads on time deposits (market interest rates minus the interest rates on time deposits) and interest rate spreads on loans (interest rates on loans minus market interest rates).

First, looking at interest rate spreads on time deposits, spreads for all maturities have widened slightly after an end to the zero interest rate environment in July 2006 (Chart 31). However, interest rate spreads on 3-month and 6-month time deposits, which account for a large share in time deposits, have been close to zero due to the fact that many banks have been offering preferential interest rates to new depositors.

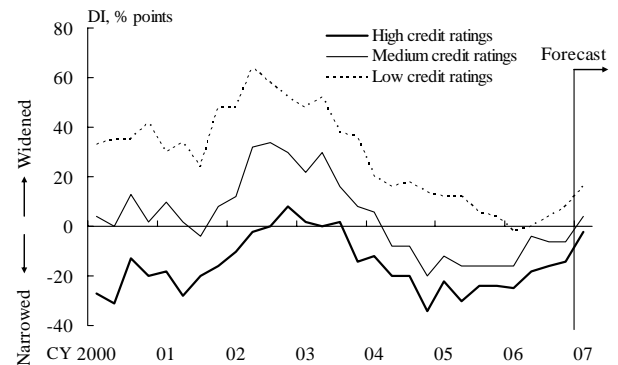
Second, interest rate spreads on loans have been on a narrowing trend. To identify the underlying factors, a multivariate time-series model is used to decompose the changes in interest rate spreads on loans into three factors (Chart 32; see Box 1 for further details). The three factors are (1) long-term changes resulting from changes in the market structure, (2) cyclical changes induced by the business cycle, and (3) short-term changes due to the costs banks incur when changing interest rates. The results suggest that the dominant factor behind the narrowing of the interest rate spreads on loans in the past few years has been the cyclical

Chart 29: Interest Margins on Loans Extended in Domestic Operations<sup>1</sup>



Note: 1. Interest margin on loans (lending margin) = interest rate on lending - interest rate on interest-bearing liabilities.

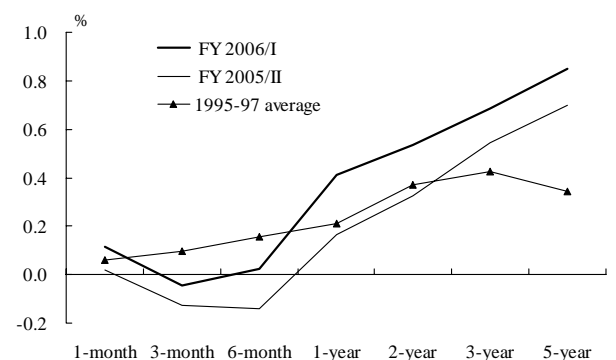
Chart 30: Interest Margins on Loans by Borrowers' Ratings<sup>1</sup>



Note: 1. DI for spread of loan rates = percentage of respondents selecting "widened" - percentage of respondents selecting "narrowed." All responses were given considering lending margins set over the past three months.

Source: Bank of Japan, "Senior Loan Officer Opinion Survey on Bank Lending Practices at Large Japanese Banks."

Chart 31: Interest Rate Spreads on Time Deposits<sup>1,2</sup>

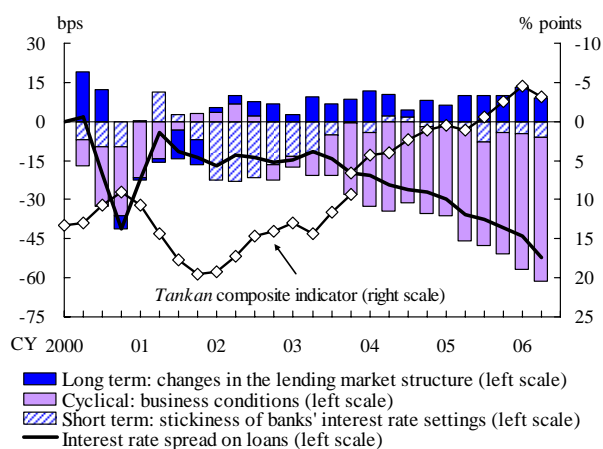


Notes: 1. Interest rate spread on time deposits = market interest rate - time deposit rate.

2. LIBOR data are used for market interest rate for 1-month to 1-year maturity, and the swap rate data for 2-year maturity or more.

Sources: Bank of Japan, "Average Interest Rates on Time Deposits by Term (New Receipts)"; Bloomberg.

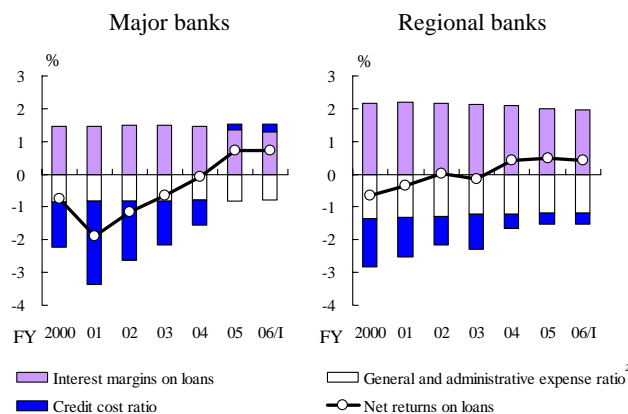
Chart 32: Decomposition of Changes in Interest Rate Spreads on Loans<sup>1, 2, 3</sup>



- Notes: 1. Interest rate spread on loans = average contracted interest rate on new loans and discounts (short-term) - CD interest rate (3-month).  
 2. Figures for interest rate spread on loans are the gap from those in 2000/Q1 (167 basis points).  
 3. See Box 1 for further details.

Sources: Bank of Japan, "Average Contracted Interest Rates on Loans and Discounts," "Average Interest Rates Posted at Financial Institutions by Type of Deposit," and "Takan -- Short-Term Economic Survey of Enterprises in Japan"; Bloomberg.

Chart 33: Net Returns on Loans of Banks<sup>1</sup>



- Notes: 1. Figures for the first half of fiscal 2006 are annualized.  
 2. General and administrative expense ratio = general and administrative expenses/amount outstanding of total interest-earning assets.

changes induced by the business cycle. The continued economic expansion may have exerted downward pressure on interest rate spreads on loans through improving the financial condition of borrowers and stimulating competition among banks that were enjoying improvements in their capital.

In recent years, the profitability of banks' loan business, which, in addition to interest margins, depends on the general and administrative expense ratio and the credit cost ratio, has shown a moderate improvement mainly due to a substantial decline in credit costs (Chart 33). However, the decline in the general and administrative expense ratio has recently been coming to a halt. Moreover, the reversals of allowances for loan losses that are largely responsible for the current low credit cost ratio are only temporary. Thus, it is possible that these two factors may lower the profitability of banks' loan business. Therefore, it is necessary to keep a close watch on the total profitability of banks' loan business, focusing not only on interest margins but also on the general and administrative expense ratio and the credit cost ratio.

### C. The Efficiency of Bank Loan Portfolios

As has been seen so far, banks' capital ratios have been rising, the volume of outstanding loans has started to increase, and new types of loans have also increased. These trends suggest that banks' financial intermediation function has steadily strengthened.

Another criterion to assess the degree of the functioning of financial intermediation is the efficiency of the allocation of banks' lending across industries. From the viewpoint of profit maximization behavior on the part of the banks, the most efficient allocation of bank loans is realized by the maximization of risk-adjusted returns. Thus, in order to examine the efficiency of loan allocation, a benchmark portfolio that maximizes the risk-adjusted return is estimated based on the mean-variance approach. Then the gap between the benchmark and the actual loan portfolios is calculated as an indicator for the efficiency of banks' loan allocation (see Box 2 for the details of the measurement methodology).

The gap between the benchmark and the actual loan portfolios of domestically licensed banks as a whole increased until 1998, then declined sharply until 2003, and has remained more or less unchanged since then (Chart 34). This result indicates that from the viewpoint of the efficiency of bank loan allocation to industries, financial intermediation has improved since the late 1990s and has been functioning well compared with the preceding period.

Next, in order to examine changes in the risk that banks' financial intermediation function may be impaired, the gap between the benchmark and the actual loan portfolios is compared with banks' capital.

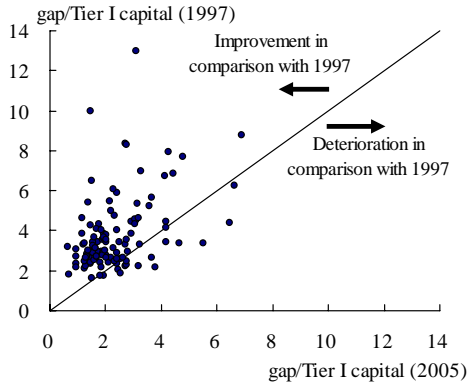
The gap between the benchmark and the actual loan portfolios indicates that there are loans with insufficient returns relative to their risk. Therefore, for individual

Chart 34: Indicator for the Efficiency of Loan Portfolios<sup>1,2</sup>



Notes: 1. Estimated by the Bank of Japan. See Box 2 for details on the estimation method.  
2. To exclude the effects of non-recourse loans to the real estate sector, loan ratios to the real estate sector are assumed to be constant since 2003.

Chart 35: Ratios of the Gap between the Benchmark and the Actual Loan Portfolios to Tier I Capital<sup>1</sup>



Note: 1. The gap between the benchmark and the actual loan portfolios is the indicator for the efficiency of bank loan portfolio multiplied by the amount outstanding of loans. See Box 2 for details on the estimation method.

banks, the larger the gap between the benchmark and the actual loan portfolios, the higher the probability of suffering from NPLs in the future. At the same time, banks' capital assumes the role of a buffer that ensures intertemporal risk smoothing by absorbing losses stemming from firms' poor business performance or bankruptcy during a recession. Therefore, as long as the gap between the benchmark and the actual loan portfolios is covered by banks' capital, the potential imbalance as measured by the gap does not materialize. But once the gap exceeds the banks' capital buffer, the imbalance suddenly materializes and banks' risk smoothing function may be impaired all at once.

The ratio of the gap between the benchmark and the actual loan portfolios to Tier I capital for each bank in 1997, when the financial crisis broke out, and in 2005 indicates that the ratios of almost all banks have improved (Chart 35). This result shows that the capacity of the financial system overall to fulfill its financial intermediation function has increased.

## D. Developments in the Inflow of Funds to the Real Estate Market

In recent years, there has been a diversification in the channels of funding to the real estate sector. In addition to loans from financial institutions, funds from the household sector, the non-financial corporate sector, and the foreign sector have been flowing directly into the real estate market via real estate funds (see Box 3 for details). But banks, mostly major banks, are also actively expanding business in this field, for example, by providing non-recourse loans and assistance in the establishment of real estate funds.

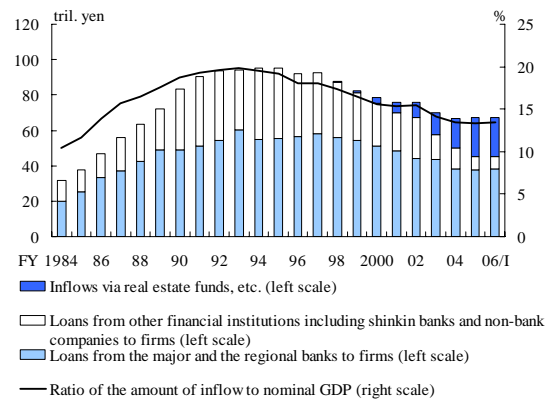
With regard to the recent changes in the inflow of funds to the real estate market, loans from banks have remained almost constant and loans from other institutions, including non-bank companies, have continued to decrease, while the inflow via real estate funds appears to have expanded (Chart 36). As a result, the overall amount of funds flowing into the real estate sector is estimated to have been more or less unchanged at around 65 to 70 trillion yen. This amount is almost the same as that in 1988-89. Moreover, relative to nominal GDP, the level is the same as that in 1986-87.

As for recent developments in banks' loans to the real estate sector, while the total amount outstanding has remained almost unchanged, non-recourse loans, including loans to real estate funds, have kept increasing (Chart 37). As a result, the decline in the outstanding amount of loans to the real estate sector since the mid-1990s came to a halt and outstanding loans have gradually started to increase again.

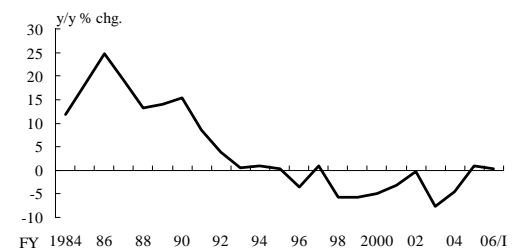
The risks associated with traditional loans to firms in the real estate sector and non-recourse loans are examined below. It should be noted that banks' provision of funds to the real estate market also includes investment in real estate funds, which is classified as

Chart 36: Inflow of Funds to the Real Estate Market<sup>1,2</sup>

### (1) Amount Outstanding

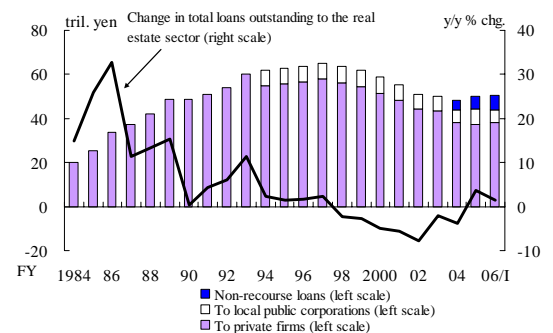


### (2) Year-on-Year Change



Notes: 1. Estimated by the Bank of Japan.  
2. See Box 3 for details on the estimation method.

Chart 37: Banks' Loans to the Real Estate Sector<sup>1,2</sup>



Notes: 1. Estimated by the Bank of Japan.  
2. See Box 3 for details.

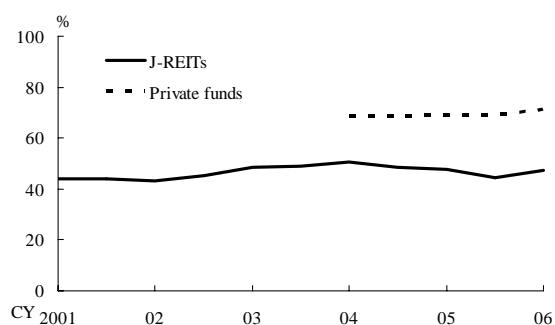
Chart 38: Ratio of Interest-Bearing Liabilities to Assets at Real Estate Firms<sup>1</sup>



Note: 1. Ratio of interest-bearing liabilities to the sum of fixed assets and inventories.

Source: Ministry of Finance, "Financial Statements Statistics of Corporations by Industry."

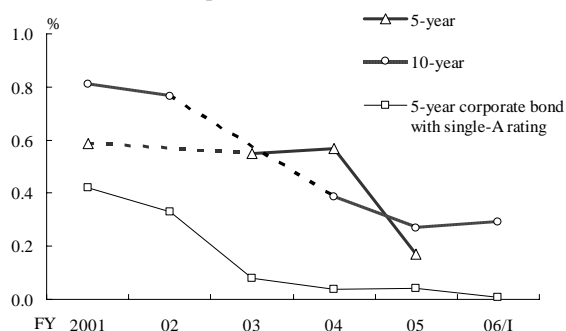
Chart 39: LTV of Real Estate Funds<sup>1,2,3</sup>



- Notes: 1. LTV of J-REITs is the simple average of LTVs registered in their financial statements.  
 2. LTV of private funds is based on a questionnaire from the STB Research Institute.  
 3. Data on private funds cover those which are currently managed in Japan.

Sources: Financial statements of investment corporations; STB Research Institute, "Market Survey Results of Private Placement Real Estate Funds."

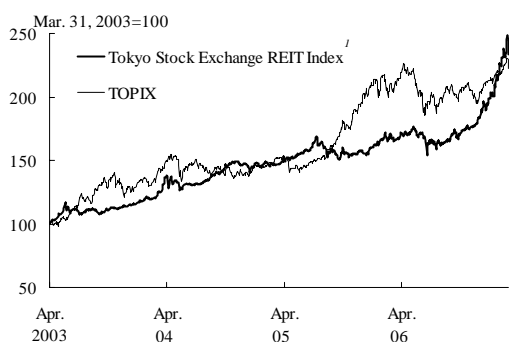
Chart 40: Interest Rate Spreads on Loans to a J-REIT<sup>1,2,3,4</sup>



- Notes: 1. Interest rates on loans to the J-REIT are calculated by averaging those on loans to Nippon Building Fund Inc. weighted by the amount of loans.  
 2. Spreads against swap rate.  
 3. Corporate bond yields are quotations of ratings published by the Japan Securities Dealers Association. The rating is that of Moody's Investors Service.  
 4. The issuer rating for Nippon Building Fund Inc. is A1, assigned by Moody's Investors Service.

Sources: Nippon Building Fund Inc.; Japan Securities Dealers Association.

Chart 41: Price Index of J-REITs



Note: 1. The Tokyo Stock Exchange REIT Index is a capitalization-weighted index based on all REITs listed on the Tokyo Stock Exchange.

Source: Tokyo Stock Exchange.

alternative investment. At this stage, the outstanding amount of such investment in real estate funds is limited.

To begin with, concerning the risks involved in loans to real estate firms, the ratio of outstanding interest-bearing liabilities to the sum of fixed assets and inventories at real estate firms has steadily declined since 1990 until recently following the sharp rise in the late 1980s, suggesting that loans to real estate firms have not reached excessive levels in proportion to the value of real estate holdings of these firms (Chart 38).

Next, as for risks related to non-recourse loans, the loan-to-value (LTV) of J-REITs and private real estate funds has remained at 40 to 50 percent and around 70 percent, respectively, and so far no increase has been observed (Chart 39). The spread on outstanding loans to a J-REIT has, however, narrowed remarkably, although it is a little higher than that on corporate bonds of a similar rating (Chart 40).

With regard to the provision of funds to the real estate market, the above observations suggest that the expansion of loan volumes to the real estate sector by banks has been restrained. At the same time, however, the inflow of funds to the real estate market from investors other than banks has continued. The rate of increase in the price index of J-REITs has been accelerating since the second half of 2006, and market expectations appear to be rising (Chart 41). In order to ensure the continued stability of the financial system, it is therefore necessary to carefully watch future developments in the real estate market and their effect on the financial system.

## Box 1: The Decomposition of Interest Rate Spreads on Loans

Interest rate spreads on loans, i.e., the difference between interest rates on loans and market rates, represent banks' profit margin in their loan business. The size of the spread is mainly affected by changes in the lending market structure, business conditions, and stickiness of banks' interest rate settings.

### 1. Changes in the Lending Market Structure (Long-Term Factor)

The long-term level in interest rate spreads is affected by various structural changes in lending markets. These include opportunities for firms to raise funds through direct access to capital markets as well as deregulatory measures, such as the elimination of government interest rate controls or the removal of the segmentation of business areas and of geographical restrictions on new branch openings.

### 2. Business Conditions (Cyclical Factor)

From borrowers' point of view, the spread represents the external financing premium that they have to pay to obtain funds from banks. In the presence of asymmetric information, it is natural to expect that the premium is strongly affected by borrowers' financial condition (or credit rating). During an economic expansion, borrowers' financial condition tends to improve due to increases in cash flow and/or asset prices. In addition, competition among banks in the lending market tends to intensify due to improvements in the financial condition of banks. Thus, the spread tends to move countercyclically (Chart 1 for Box 1).

### 3. Stickiness of Banks' Interest Rate Settings (Short-Term Factor)

Since banks incur adjustment costs, such as re-negotiation costs, when revising lending rates, they cannot adjust lending rates instantaneously in response to changes in market rates that determine their marginal funding costs. Thus, at least in the short term, changes in the spread and in the market rate tend to be negatively correlated (Chart 2 for Box 1).

Chart 1 for Box 1: Interest Rate Spreads on Loans<sup>1</sup> and Business Conditions

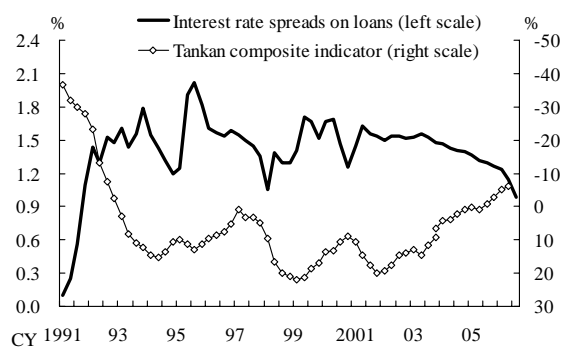
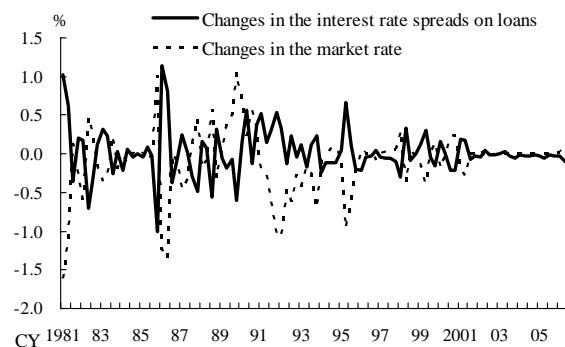


Chart 2 for Box 1: Changes in the Interest Rate Spreads on Loans<sup>1</sup> and Changes in the Market Rate



Note: 1. Interest rate spreads on loans = average contracted interest rate on short-term loans and discounts - 3-month interest rate of CDs.  
Sources: Bank of Japan, "Average Contracted Interest Rates on Loans and Discounts," "Tankan – Short-Term Economic Survey of Enterprises in Japan"; Bloomberg.

Chart 32 in the main text shows the result for the decomposition of the interest rate spread into the above-mentioned three factors using a structural vector autoregression (VAR) model. As identifying restrictions, the following assumptions are used: (1) the spread in the long term remains unaffected by business conditions or by stickiness in banks' lending rates; and (2) the level of the (nominal) market rate is unaffected by business conditions in the long term. The results of the time-series decomposition indicate that the declining trend in the interest rate spread on loans in the past few years is mainly explained by the continued economic expansion.



## Box 2: Indicator for the Efficiency of Bank Loan Portfolios

Among the numerous studies focusing on financial factors underlying Japan's protracted economic stagnation in the 1990s, several have investigated the role of forbearance lending to insolvent firms in the late 1990s (see, for example, Sekine, Kobayashi, and Saita [2003]; and Peek and Rosengren [2005]). These studies regard the provision of additional loans to troubled firms as a distortion in the loan market. But banks kept troubled firms alive not only by providing additional loans but also by forgiving debts and not calling in loans where this would have been warranted from the standpoint of risk-adjusted returns. Moreover, banks did not provide sufficient funds to growing firms, since the increase in NPLs impaired banks' capital and thus lowered their risk-taking capacity. Based on these considerations, Otani, Shiratsuka, and Yamada (2007) estimate the benchmark loan portfolio for each bank that maximizes the risk-adjusted return based on the mean-variance approach and then calculate the gap between this portfolio and the actual portfolio as the indicator for the efficiency of bank loan portfolios.

Concretely, Otani, Shiratsuka, and Yamada (2007) numerically estimate the loan shares by industry for each bank that maximize the ratio of the return to the standard deviation of the whole loan portfolio (a proxy for risk) under the constraint that the loan portfolio can be adjusted only gradually. The benchmark portfolio is calculated as follows:

$$\begin{aligned} & \underset{a_{1,k}, \dots, a_{n,k}}{\text{Max}} \frac{\sum_{i=1}^n a_{i,k} E[X_i]}{\sqrt{\sum_{i=1}^n a_{i,k}^2 \text{Var}[X_i] + 2 \sum_{i=1}^n \sum_{j=i+1}^n a_{i,k} a_{j,k} \text{Cov}[X_i, X_j]}}, \\ & \text{s.t. } \forall i = 1, \dots, n, \quad \tilde{a}_{i,k} / 1.5 \leq a_{i,k} \leq 1.5 \tilde{a}_{i,k}, \quad \sum_{i=1}^n a_{i,k} = 1, \end{aligned}$$

where subscript  $k$  refers to bank  $k$ ,  $X_i$  is a random variable representing the returns from loans to industry  $i$ , and  $a_i$  and  $\tilde{a}_i$  are the loan ratio to industry  $i$  and the average of actual values of the loan ratio to industry  $i$  in the past, respectively. The constraint condition means that the range of adjustments in loans outstanding to each industry is restricted from 1/1.5 times to 1.5 times of actual loan ratios, which takes account of the fact that banks' loan portfolios are adjusted only gradually.

Note that in the estimation the lending rates adjusted by the credit risk from 1985 to 2005 are used as the return on loans. As for lending rates by industry, the hypothetical long-term loan rate by industry calculated from data on long-term debt outstanding, short-term debt outstanding, corporate bonds outstanding, and interest payments, obtained from the "Financial Statements Statistics of Corporations by Industry" published by the Ministry of Finance, is used. For credit risk by industry, the rates of private and legal defaults in each industry, calculated using Teikoku Databanks' "Matrix Data for the Calculation of Probabilities of Default," are used. Covariances are calculated from the standard deviation of lending rates minus credit risk and the coefficients of correlation between stock prices by industry for the period 1985 to 2005.

The indicator for the efficiency of each bank's loan portfolio is estimated by summing up the absolute values of

the gaps between the loan shares in the benchmark and actual portfolios, as shown below. Chart 34 in the main text shows the average of the indicator for the efficiency of each bank's loan portfolio weighted by its outstanding amount of loan.

$$\delta_k = \sum_i |a_{i,k}^* - a_{i,k}|.$$

References:

Otani, Akira, Shigenori Shiratsuka, and Takeshi Yamada, "Distortions in Resource Allocation and Bank Lending: The Malfunction of Financial Intermediation," Bank of Japan Working Paper, Bank of Japan, 2007, *forthcoming*.

Peek, Joe, and Eric S. Rosengren, "Unnatural Selection: Perverse Incentives and the Misallocation of Credit in Japan," *American Economic Review*, 95 (4), 2005, pp. 1144-1166.

Sekine, Toshitaka, Keiichiro Kobayashi, and Yumi Saita, "Forbearance Lending: The Case of Japanese Firms," *Monetary and Economic Studies*, 21 (2), Institute for Monetary and Economic Studies, Bank of Japan, 2003, pp. 69-92.

### Box 3: Estimation of the Inflow of Funds to the Real Estate Market

In addition to traditional loans from financial institutions, the real estate market has in recent years also seen an increase in the inflow of funds from individual investors, from firms, and from abroad via real estate funds. However, statistics that cover the diversified inflow of funds to the real estate market are not available. This box therefore explains how the total inflow of funds to the real estate market is estimated based on publicly available material (Chart for Box 3).

Considered first is the methodology for estimating loans to firms in the real estate sector extended mainly by banks and other financial institutions including *shinkin* banks and non-bank companies. As for statistics on loans from financial institutions to the real estate sector, balance-sheet data from "Financial Statements Statistics of Corporations by Industry" published by the Ministry of Finance, providing information on the outstanding amount of liabilities of firms in the real estate sector are used. Note, however, that in these statistics, firms in the real estate sector do not include special purpose companies (SPCs) and the outstanding amount of liabilities therefore does not include the outstanding amount of non-recourse loans. Data on banks' loans are provided in "Statistics on Loans and Discounts Outstanding by Sector" compiled by the Bank of Japan. These statistics provide information on the overall amount of banks' loans to firms, local public corporations, and non-recourse loans to the real estate sector. These statistics also contain data on the outstanding amount of loans to local public corporation since 1994. Information on real estate non-recourse loans is released, for example, by the Financial Services Agency.

Based on these statistics and publicly available materials, the outstanding amount of loans to firms in the real estate sector by banks and other financial institutions including *shinkin* banks and non-bank companies is estimated as follows:

1. The outstanding amount of loans to firms by banks is estimated by subtracting the outstanding amount of loans to local public corporations and non-recourse loans from the outstanding amount of banks' overall loans to the real estate sector based on "Statistics on Loans and Discounts Outstanding by Sector."
2. The outstanding amount of loans to firms by other financial institutions including *shinkin* banks and non-bank companies is estimated by subtracting the above estimates of loans to firms by banks from the outstanding amount of borrowing from financial institutions in "Financial Statements Statistics of Corporations by Industry."

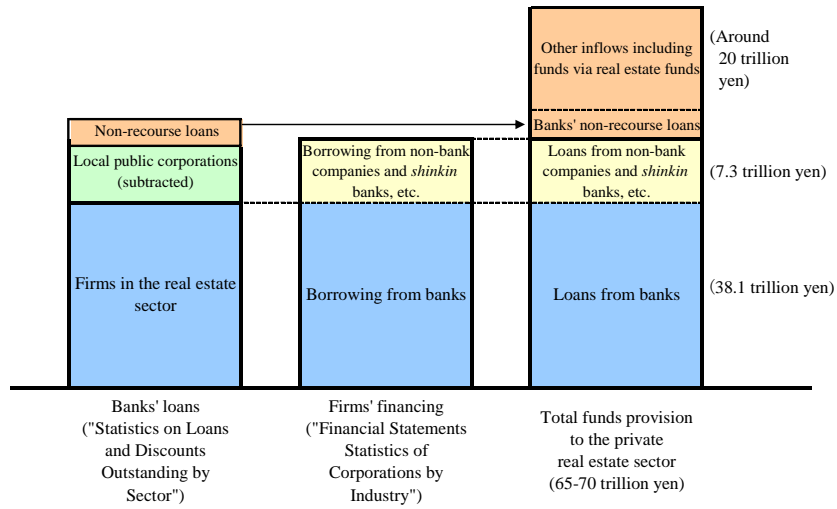
Next, the amount of funds flowing into the real estate market via real estate funds and other channels can be estimated by using the trend in beneficiary rights of trusts issued for the purpose of property securitization.

The annual amount of property securitization is available from "Statistics on Trends in the Achievement of Real Property Securitization," published by the Ministry of Land, Infrastructure and Transport. Based on this, the inflow of funds to the real estate sector via real estate funds and other channels can be estimated as the cumulative amount of property securitization minus the amount of refinancing and transfers.

Finally, the total amount of inflows to the real estate market can be obtained by adding up loans to firms in the

real estate sector from banks and other financial institutions, and the other inflows to the real estate market. Based on these calculations, the total amount of inflows to the real estate market is estimated to have been 65-70 trillion yen at the end of September 2006, as is shown in Chart 36 in the main text.

Chart for Box 3: Inflows to the Real Estate Market<sup>1</sup>



Note: 1. Figures are as of the end of September 2006, except for other inflows, which are as of the end of March 2006.

### III. Robustness of the Financial System

This final chapter focuses on examining to what extent the robustness of Japan's financial system against changes in interest rates and credit costs associated with fluctuations in the economy has increased.

#### A. Interdependence between Economic Activity and the Financial System

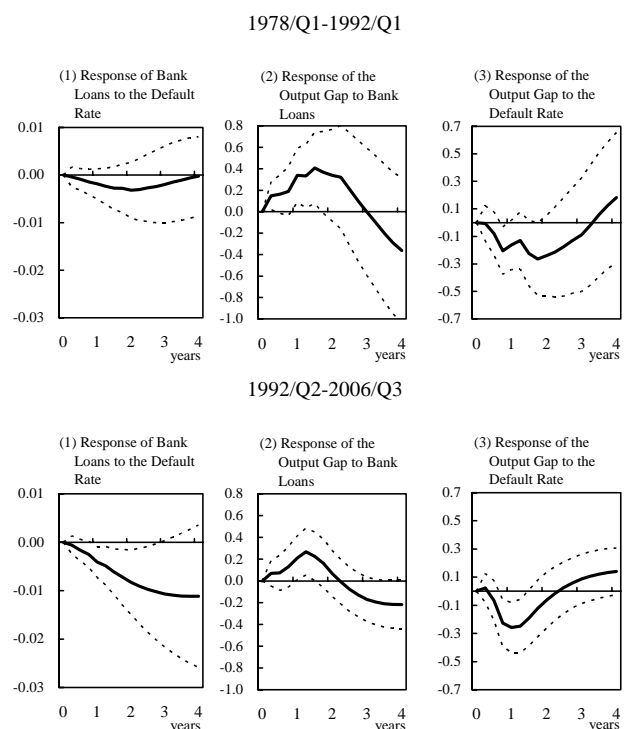
Before assessing the robustness of Japan's financial system, it is helpful to examine the interdependence between the financial system and economic activity using a standard multivariate time-series model. Banks play an important role in corporate financing in Japan, and their functioning and robustness can be assumed to have a significant effect on economic activity (see Box 4 for details).

The analysis uses vector autoregression (VAR) models that include six variables related to economic activity, the financial system, and monetary policy, using data for the period from the first quarter of 1978 to the third quarter of 2006 divided into two subsample periods, one up to the first quarter of 1992 and one from the second quarter of 1992. The VAR models are then estimated for each subsample period to determine the interdependence between the variables by measuring the impulse response (see Box 5 for details).

Chart 42 shows the three impulse responses for each subsample period: the response of bank loans outstanding to the default rate (impulse response [1]); the response of the output gap to bank loans outstanding (impulse response [2]); and the response of the output gap to the default rate (impulse response [3]). The results allow the following conclusions.

The shape of the impulse response of bank loans

Chart 42: Impulse Responses<sup>1,2,3</sup>



- Notes: 1. The dashed lines indicate two standard error bands.  
 2. The VAR model consists of the following six variables: exchange rate, the output gap, CPI, real bank loans outstanding, default rate, and call rate.  
 3. See Box 5 for details.

outstanding to an increase in the default rate (impulse response [1]) in the second subsample period is clearly different from the one in the first subsample period. While an increase in the default rate does not have a significant effect on bank loans outstanding in the first subsample period, it does have a significant negative effect in the second subsample period. This result suggests that, in the second subsample period, increases in the default rate due to exogenous shocks may have had the effect of amplifying movements in economic activity through a decrease in bank loans outstanding.

This interpretation is supported by the impulse response of the output gap to bank loans outstanding (impulse response [2]) and that of the output gap to the default rate (impulse response [3]). Impulse response [2] shows that, in both subsample periods, a change in bank loans causes fluctuations in the output gap: an increase in bank loans outstanding initially pushes the output gap in the direction of excess demand, but the effect reverses after about 3-4 years, leading to insufficient demand. Consequently, an increase in bank loans outstanding amplifies swings in economic activity. The confidence interval is narrower in the second subsample period than in the first subsample period, and the narrower confidence interval in the second subsample period means that the effect amplifying the swings in economic activity is clearer in that subsample period. Moreover, impulse response [3] shows that, in the second subsample period, the negative effect on the output gap of an increase in the default rate becomes more statistically significant. This means that the effect of an increase in the default rate on the output gap in the direction of insufficient demand is more clearly observable in the second subsample period than in the first subsample period.

The analysis thus suggests that, since the 1990s, the interdependence between Japan's bank-centered

financial system and movements in economic activity has become more pronounced. In other words, as shown in the analysis on the efficiency of loan portfolios, banks' ability to play their role in intertemporal risk smoothing declined during the second half of the 1990s as a result of impaired capital condition due to the increase in NPLs. It therefore seems that the banking sector was unable to sufficiently absorb exogenous shocks, causing them to affect economic activity, and the banking sector in fact amplified exogenous shocks rather than absorbing and preventing them from affecting economic activity.

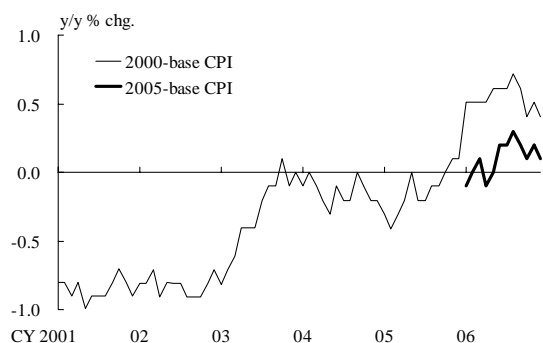
The results of the analysis thus imply that it remains essential to closely monitor the banking sector when assessing the functioning and robustness of the financial system as a whole.

Chart 43: Economic Growth and Prices in Japan

(1) Real GDP Growth Rate



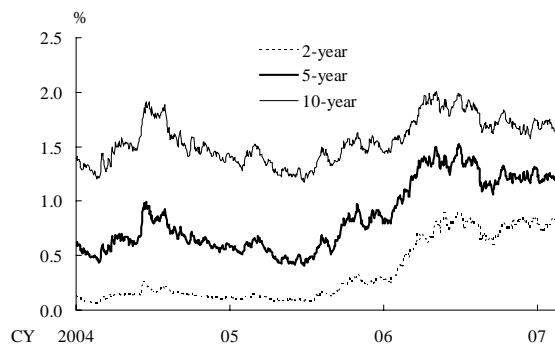
(2) CPI (Excluding Fresh Food)



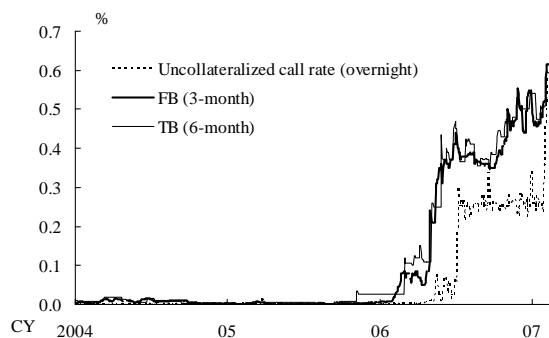
Sources: Cabinet Office, "National Accounts"; Ministry of Internal Affairs and Communications, "Consumer Price Index."

Chart 44: Market Interest Rates

(1) Medium and Long-Term Interest Rates (JGBs)



(2) Short-Term Interest Rates



Sources: Bloomberg; Japan Bond Trading Co., Ltd.; Bank of Japan.

## B. Economic and Financial Developments

Japan's economic and financial developments are summarized below.

Japan's economy has been expanding moderately. Consumer prices (excluding fresh food) have been registering small increases on a year-on-year basis (Chart 43).

Against this background, the Bank of Japan decided to raise the operating target of money market operations (the uncollateralized overnight call rate) from effectively zero percent to around 0.25 percent at the Monetary Policy Meeting held in July 2006 and to around 0.5 percent in February 2007. In response, money market rates rose, while medium and long-term interest rates remained stable, partly due to contained inflation expectations among market participants (Chart 44).

Following a temporary drop toward the middle of 2006, stock prices recovered in the second half of the year, partly reflecting firms' strong business performance (Chart 45). The rate of increase in land prices in major cities, such as the 23 wards of Tokyo, accelerated (Chart 46).

Turning to the outlook for Japan's economy, the economy is likely to continue its moderate expansion with a virtuous circle of production, income, and spending in place. On the price front, it is possible that the rate of change in consumer prices will be around zero in the short run, depending, for example, on developments in the prices of crude oil. From a longer-term perspective, however, consumer prices are likely to increase as a trend, since the utilization of resources such as production capacity and labor is increasing and the economic expansion is expected to continue.



Taking the economic and financial developments mentioned above into account, the sections below will examine to what extent the robustness of the financial system against various shocks has improved by conducting macro stress-testing (see Box 6 for an outline of the macro stress-testing). Two types of stress scenarios are used to analyze the impact on the banking sector: first, an increase in interest rates resulting from an acceleration in economic activity; and second, an increase in default rates due to an economic downturn.

It should be noted that the stress scenarios assumed in the macro stress-testing are aimed at crystallizing the risks to the banking sector and are not considered to be highly probable.

Chart 45: Stock Prices

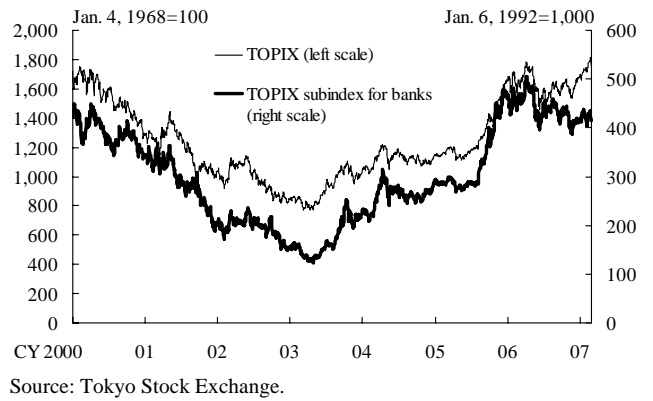
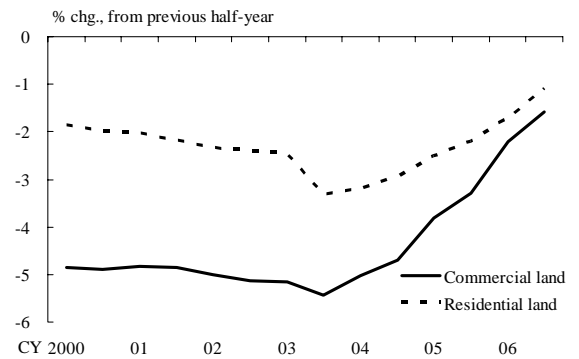
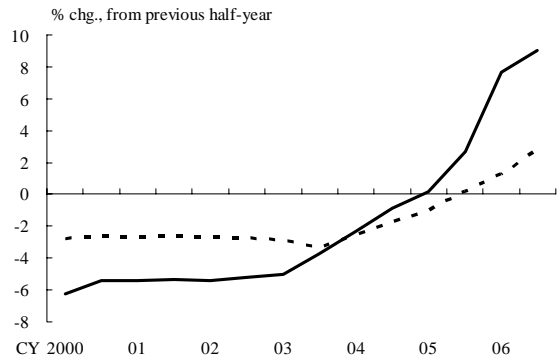


Chart 46: Land Prices<sup>1,2</sup>

(1) All City Areas in Japan



(2) Six Major City Areas



Notes: 1. The Urban Land Price Index is based on surveys conducted at the end of March and September each year.

2. The six major city areas are the 23 wards of Tokyo, Yokohama, Nagoya, Kyoto, Osaka, and Kobe.

Source: Japan Real Estate Institute, "Urban Land Price Index."

Chart 47: Basic Structure of Banks' Income Simulation Model

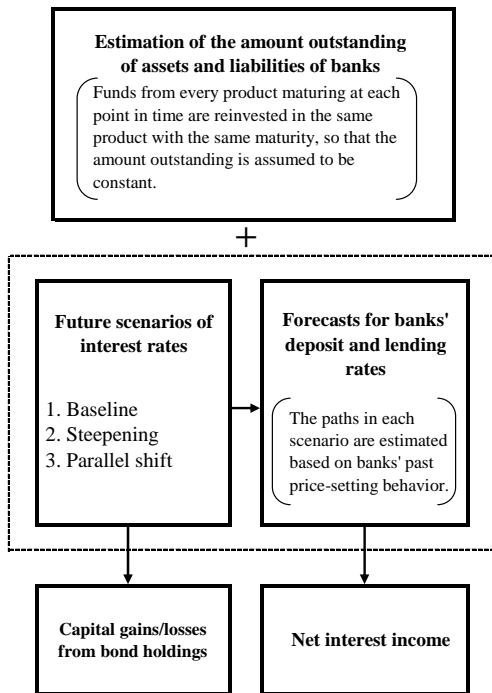
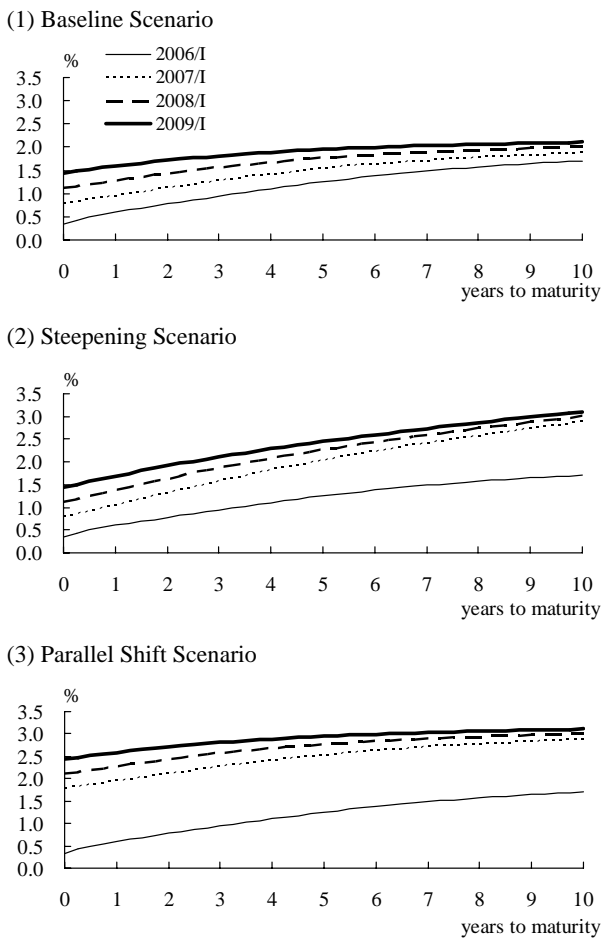


Chart 48: Spot Rate Curves<sup>1</sup>



Note: 1. The construction of these scenarios is provided in Box 7.

### C. The Impact of a Rise in Market Interest Rates on Banks' Net Profits

This section employs a simulation model in order to analyze the impact of rises in market interest rates on the future path of banks' net profits. The model incorporates the actual balance-sheet structure of the major banks and the regional banks at the end of September 2006 as well as their price-setting behavior in the past (see Chart 47 for the basic structure of the model).

First, the maturity structure of assets and liabilities at the end of September 2006 is estimated for both the major and the regional banks. In addition, it is assumed that the funds from every product maturing at each point in time are reinvested in the same product with the same maturity. This means that the maturity structure of banks' balance sheets remains unchanged.

Second, with respect to the future path of market interest rates, three scenarios -- a baseline scenario, a steepening scenario, and a parallel shift scenario -- are considered. The baseline scenario assumes that future short-term interest rates follow the expected path implied by the forward rate curve at the end of September 2006. The steepening scenario assumes that the 10-year spot rate shifts upward compared to the baseline scenario by 1 percentage point over one year and that, for spot rates with time-to-maturity of less than ten years, the shorter the time-to-maturity, the smaller the upward shift. The parallel shift scenario assumes that the spot rate curve itself shifts upward compared to the baseline scenario by 1 percentage point over one year (Chart 48; details of these scenarios are provided in Box 7). It should be noted that the interest rate scenarios here do not necessarily mean that they are likely to materialize. Rather, the purpose is to crystallize the effect on the risks banks are currently exposed to.

Third, banks' interest rate setting behavior for various products is estimated using past values of deposit/lending rates and market rates. In the estimation, the spread between deposit/lending rates and the corresponding market rate for products with a similar maturity is assumed to settle down to its historical average in the long run. One major exception, however, is the assumption regarding the ordinary deposit rate. Based on past observations, the ratio of the ordinary deposit rate to the 1-month LIBOR is assumed to be about 20 percent.

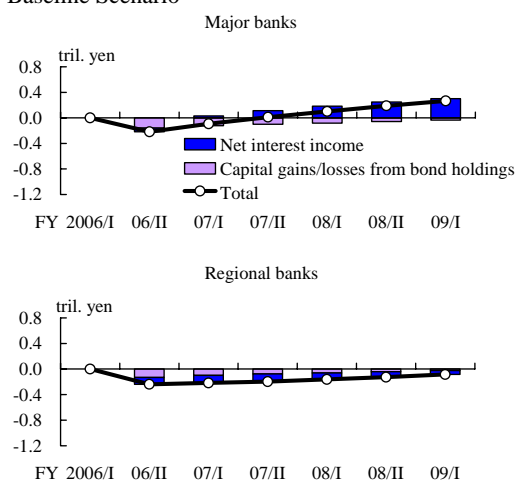
Finally, using the scenarios of future interest rates and the estimation results mentioned above, out-of-sample forecasts for banks' deposit/lending rates are obtained and the future paths of net interest income as well as the net capital gain from bond holdings are calculated (Chart 49).

In the short term, both for the major banks and for the regional banks, a rise in interest rates causes the increase in interest payments on short-term debts such as deposits and market-based financing to exceed that in interest income from lending and bond holdings. Therefore, in every scenario, net interest income for both the major and the regional banks slightly declines compared to the initial level in the first half of fiscal 2006 when net interest income from domestic operations was 1.9 trillion yen for the major banks and 2.1 trillion yen for the regional banks.

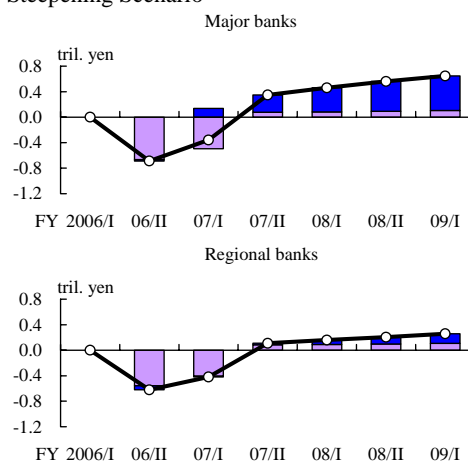
In the medium term, net interest income for the major banks exceeds the initial level at a relatively early stage, while it does not reach the initial level for a while for the regional banks. This is because the maturity of both lending and bonds is longer for the regional banks than for the major banks, and the negative impact of regional banks' past lending and bond investment with low interest rates on their future interest income remains

Chart 49: Impact of Rises in Market Interest Rates on Banks' Net Interest Income and Capital Gains/Losses from Bond Holdings<sup>1,2</sup>

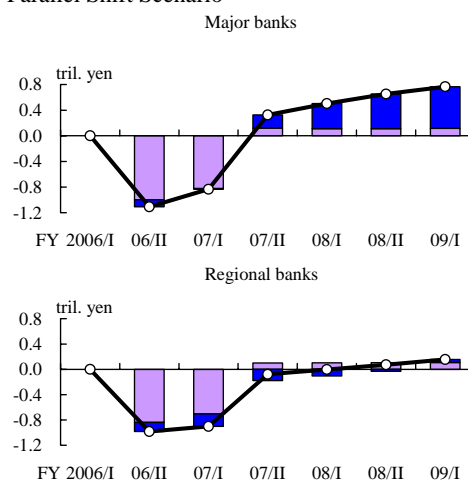
(1) Baseline Scenario



(2) Steepening Scenario



(3) Parallel Shift Scenario



Notes: 1. Estimated by the Bank of Japan. Figures for net interest income are the gap from actual results in the first half of fiscal 2006.  
2. Net interest income from domestic operations in the first half of fiscal 2006 was 1.9 trillion yen for the major banks, and 2.1 trillion yen for the regional banks.

Chart 50: Average Maturities (in Years) of Banks' Assets and Liabilities<sup>1,2</sup>

Major Banks			
Interest-earning assets	1.14	Interest-bearing liabilities	0.56
Loans	0.83	Time deposits	0.95
Bonds	2.40	Corporate bonds	2.16

Regional Banks			
Interest-earning assets	1.75	Interest-bearing liabilities	0.55
Loans	1.36	Time deposits	0.91
Bonds	3.10		

Notes: 1. Estimated by the Bank of Japan.  
2. As of the end of September 2006.

longer (Chart 50).

The results of the individual scenarios can be summarized as follows. In the baseline scenario for the major banks, both the present value of bond holdings and net interest income decline in the short term as the yield curve rises and flattens. As a result, the sum of net interest income and capital gains/losses from bond holdings decreases, albeit slightly. One and a half years later, however, it reaches the initial level of the first half of fiscal 2006. As for the regional banks, since the pace of recovery in interest income from lending and bond holdings is slow, the sum of net interest income and capital gains/losses from bond holdings does not reach the initial level even three years later.

In the steepening scenario, the present value of bond holdings declines sharply in the short term both for the major banks and the regional banks. In the medium term, the increase in interest income from lending gradually exceeds that in interest payments on deposits.

Finally, in the parallel shift scenario, the capital loss from bond holdings both for the major banks and the regional banks is the largest in the short term among all three scenarios, though this loss is less than the amount of net interest income recorded in the first half of fiscal 2006 both for the major banks and the regional banks. In addition, since the rise in short-term interest rates is larger than that in the steepening scenario, interest payments on short-term debts both for the major banks and the regional banks are larger in the short term. In the medium term, however, the amount of increase in interest income from lending exceeds that in interest payments on deposits, as in the steepening scenario.

In summary, when the yield curve rises and flattens moderately, as implied in the baseline scenario, the changes in net interest income and net capital gains from bond holdings are marginal both for the major

banks and the regional banks. Under the steepening scenario and the parallel shift scenario, the capital loss from bond holdings is large, although it is less than the amount of net interest income recorded in the first half of fiscal 2006. In the medium term, net interest income recovers. The recovery, however, is slow for the regional banks due to the long maturity of their lending and bonds.

## D. Macro Stress-Testing of Credit Risk

Lastly, this section assesses the robustness of Japan's financial system against credit risk by using macro stress-testing (see Box 8 for the framework).

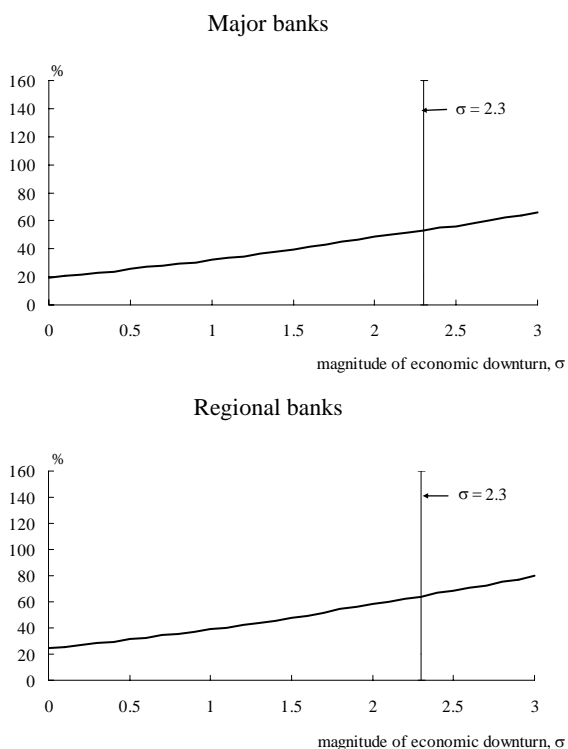
Specifically, credit risk is estimated based on the stress scenario that a rare and extreme shock exerts extreme effects on the financial system. The degree of robustness against credit risk is then evaluated by comparing the estimated credit risk with banks' capital.

Considered in the stress scenario is a decline in the GDP growth rate with a rise in the default rate. The GDP growth rate is assumed to decline by up to three standard deviations. Based on data for the GDP growth rate since 1991, one standard deviation corresponds to a change in the GDP growth rate of 1.6 percentage points; three standard deviations consequently are equivalent to 4.8 percentage points. Note that the probability that the growth rate declines by three standard deviations is about 0.1 percent, assuming that the GDP growth rate follows a normal distribution.

This section uses the ratio of the maximum loss relative to Tier I capital as the criterion for the assessment of the financial system's robustness against credit risk. In case of an unexpectedly severe economic downturn, it is highly probable that interest from loans and loan-loss provisions will be insufficient to cover the increase in credit risk. Therefore, in assessing the robustness against credit risk in case of a large economic downturn, it is necessary to compare the maximum loss with Tier I capital. Note that estimates of the maximum loss depend on the estimation method and the underlying assumptions, and it is therefore necessary to interpret the level of the maximum loss/Tier I capital ratio with care.

Using the aggregate of the major and the regional banks' loan portfolios at the end of fiscal 2005, Chart 51 shows

Chart 51: Stress-Testing on the Loan Portfolio at the End of Fiscal 2005: Ratios of Maximum Losses to Tier I Capital<sup>1,2</sup>



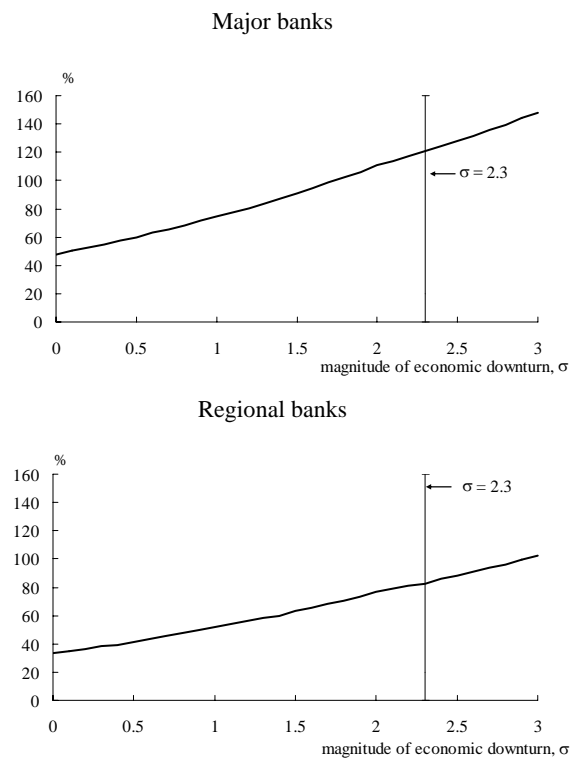
- Notes: 1. Estimated by the Bank of Japan.  
2. Maximum losses are estimated with a confidence interval of 99 percent.

how the credit-risk indicator, the maximum loss/Tier I capital ratio, changes with the depth of the economic downturn. The chart illustrates that the maximum loss/Tier I capital ratio increases with the extent of the economic downturn. Specifically, assuming a large downturn equivalent to 2.3 standard deviations, the probability of which is 1 percent assuming the GDP growth rate follows a normal distribution, the maximum loss/Tier I capital ratio reaches 53 percent for the major banks and 64 percent for the regional banks.

The above simulation results demonstrate that although the maximum loss of the major and the regional banks is within their Tier I capital, the magnitude of the credit risk in loan portfolios originating only from an economic downturn cannot be ignored. Economic downturns cause not only a deterioration of credit risk but also a decline in stock prices. As already seen, at the major banks, the risk associated with price fluctuations in their stockholdings amounts to almost 50 percent of their Tier I capital (Chart 15). Moreover, considering that there is a considerable overlap between firms that banks lend to and that they hold stocks in, it is important for banks to take a comprehensive approach in the management of credit risk and the risk associated with swings in stock prices.

To confirm the recent improvement in the quality of loan portfolios, the same simulation is conducted again using the default rate at the end of fiscal 2005, but this time considering the aggregate loan portfolio at the end of fiscal 2002. Assuming, as before, an economic downturn of 2.3 standard deviations, Chart 52 shows that the maximum loss/Tier I capital ratio for the major banks reaches 121 percent and that for the regional banks 83 percent -- ratios that are far higher than the results in Chart 51. Note that the extent of the decrease in the ratio of the major banks is larger than that of the regional banks. This result implies that the major banks

Chart 52: Stress-Testing on the Loan Portfolio at the End of Fiscal 2002: Ratios of Maximum Losses to Tier I Capital<sup>1,2</sup>



Notes: 1. Estimated by the Bank of Japan.  
 2. Maximum losses are estimated with a confidence interval of 99 percent.

rigorously disposed of NPLs to large borrowers in the period between the end of fiscal 2002 and 2005 as their capital increased.

Based on the estimation result in this section, it can be concluded that the quality of loan portfolios of both the major banks and the regional banks has improved, resulting in strengthened robustness against a significant increase in credit risk.



### Box 4: Financial Intermediation in Japan from the Perspective of Corporate Financing

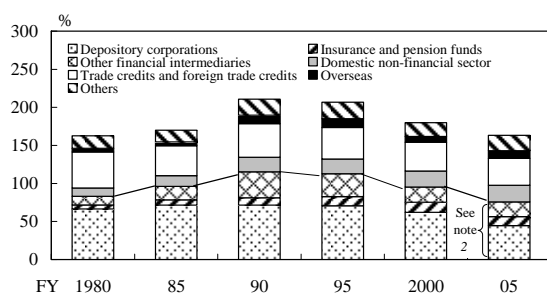
With regard to financing of Japanese private firms, an often articulated view is that the role of indirect financial intermediation such as via banks has been decreasing, while that of direct financial intermediation such as via issuance of stocks has been increasing. This box provides an overview of changes in the structure of private non-financial firms' financing based on data from the "Flow of Funds Accounts" and other statistics.

To begin with, the analysis looks at changes in the volume of financing, expressed in terms of its ratio to nominal GDP, via different channels. Financing via financial institutions (depository corporations mainly banks, insurance and pension funds, and other financial intermediaries) has been on a decreasing trend since the 1990s following an increase in the 1980s. Specifically, the ratio of financing via depository corporations decreased to about 45 percent in fiscal 2005 from about 70 percent in fiscal 1990, meaning that the ratio in recent years has been below that in the 1980s (Chart 1 [1] for Box 4).

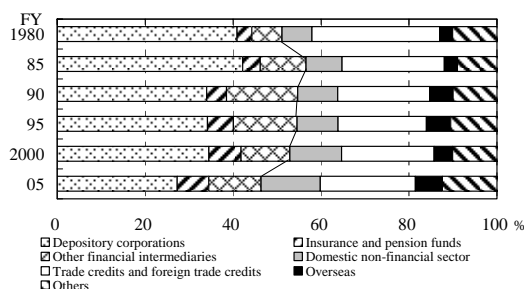
Next, an examination of the share of each channel in the total volume of funds raised shows that intermediation via financial institutions, especially banks, still plays an important role, although its share has been falling, while, in contrast, the share of direct financing via the domestic non-financial sector has been rising. In fiscal 2005, intermediation via financial institutions still accounted for a little less than 50 percent and that via banks for a little less than 30 percent (Chart 1 [2] for Box 4).

Chart 1 for Box 4: Financing Channels of Private Non-Financial Firms (Book Value or Face Value Basis)<sup>1</sup>

(1) Ratio of Volume of Funds Raised to Nominal GDP



(2) Share by Channel



Notes: 1. Estimated by the Bank of Japan.

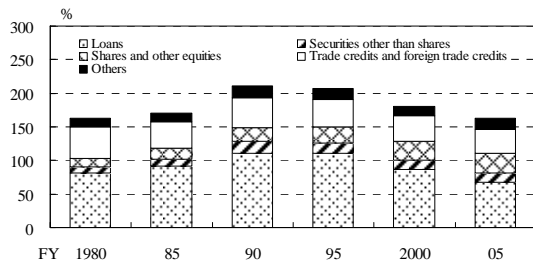
2. Financing via financial institutions (the sum of financing via depository corporations, insurance and pension funds, and other financial intermediaries).

Source: Bank of Japan, "Flow of Funds Accounts."

Turning to the trend in financing by means, loans have been decreasing since the 1990s both in relation to nominal GDP and to the total volume of funds raised. Nevertheless, in fiscal 2005, the share of loans was still about 40 percent, the largest share among all means (Chart 2 for Box 4).

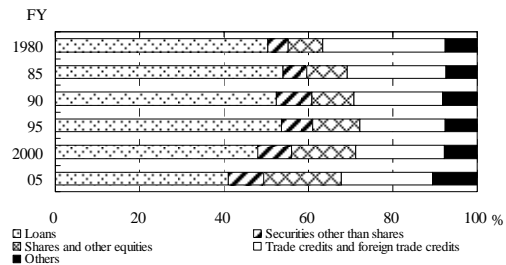
Chart 2 for Box 4: Financing Means of Private Non-Financial Firms (Book Value or Face Value Basis)

(1) Ratio of Volume of Funds Raised to Nominal GDP



Source: Bank of Japan, "Flow of Funds Accounts."

(2) Share by Means

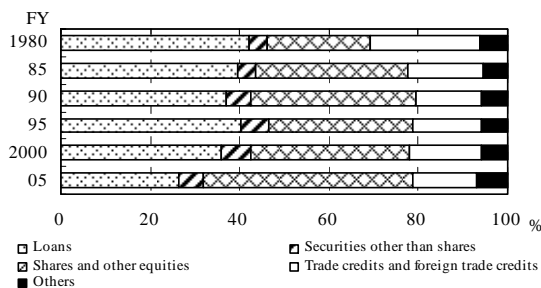


Source: Bank of Japan, "Flow of Funds Accounts."

A comparison of the features in financing of private non-financial firms in Japan and the United States shows that in Japan, the share of loans is high, while the volume of funds raised via the issuance of securities other than stocks is low (Chart 3 for Box 4). Moreover, the share of trade credits and foreign trade credits is also higher in Japan. It should be noted that since the U.S. data are available only on a market value basis, the Japanese data here are also presented on a market value basis.

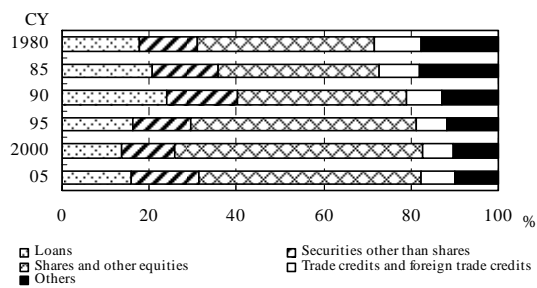
Chart 3 for Box 4: Financing Means of Private Non-Financial Firms (Market Value Basis)

(1) Japan



Source: Bank of Japan, "Flow of Funds Accounts."

(2) United States<sup>1</sup>



Note: 1. Shares exclude inter-corporate holdings of non-financial firms.

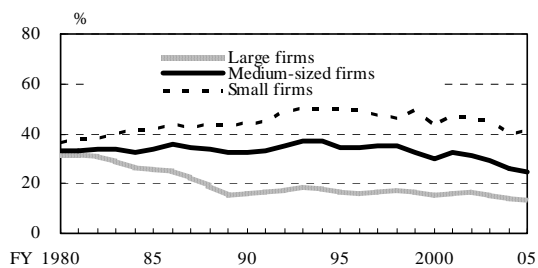
Source: Federal Reserve Board, "Flow of Funds Accounts."

Finally, changes in firms' dependence on loans are examined by looking at the ratio of borrowing outstanding to gross total asset by sector and firm size.

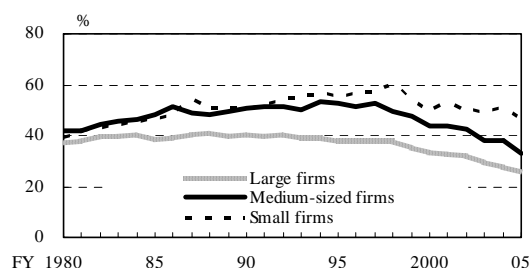
Doing so reveals that in most sectors, the ratio increased following the collapse of the bubble economy, reaching a peak in the middle of the 1990s. Although the ratio has been on a decreasing trend since then, it is not notably lower than in the past; especially in the case of small and medium-sized firms, the ratio remains relatively high. An exception, however, is large manufacturing firms, for which the ratio declined substantially in the 1980s to less than 20 percent and is now around 15 percent (Chart 4 for Box 4).

Chart 4 for Box 4: Ratio of Borrowing Outstanding to Gross Total Assets by Sector and Firm Size<sup>1,2</sup>

(1) Manufacturing Industry



(2) Non-Manufacturing Industry



Notes: 1. Borrowings = short-term borrowings + long-term borrowings.

2. Large firms: capital of 1 billion yen or over. Medium-sized firms: 100 million to 1 billion yen. Small firms: less than 100 million yen.

Source: Ministry of Finance, "Financial Statements Statistics of Corporations by Industry."

In sum, the long-term trend has been a decline in the role of indirect financing in financial intermediation. However, the large proportion of indirect financing via financial institutions remains a distinctive feature of Japan's financial system and, as in the past, financial institutions, and above all, depository corporations, continue to play a large role in financial intermediation. Consequently, a careful analysis of the banking sector continues to be extremely important in assessing the stability and functioning of Japan's financial system.

### Box 5: Economic Activity and the Financial System

Chart 42 in the main text shows the main results of a vector autoregression (VAR) model with variables of the economy and the financial system. A VAR model is a multivariate time-series model that captures the interactions between current and past values of the variables in a linear-equation system and is represented by the following equation:

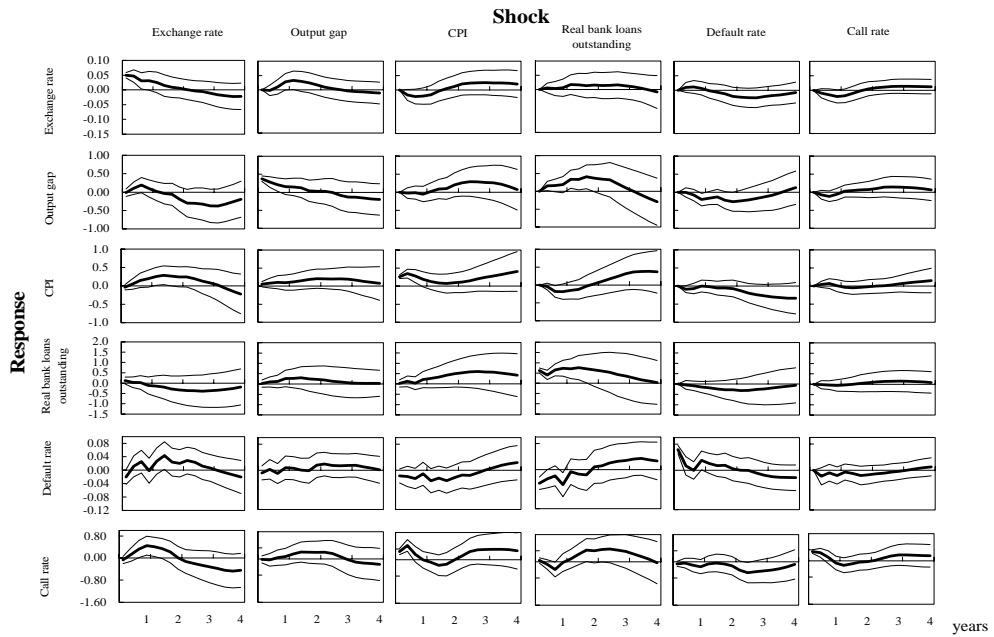
$$y_t = A_0 + \sum_{i=1}^m A_i y_{t-i} + e_t,$$

where  $y_t$  is an  $n$  column vector consisting of endogenous variables (i.e., the VAR model includes  $n$  endogenous variables);  $m$  is number of lags for each variable (i.e., the value of each endogenous variable lagged up to  $m$  periods before being used in the estimation);  $A_0$  is an  $n$  column vector consisting of constant terms;  $A_i$  is an  $n$  row and  $n$  column matrix consisting of parameters reflecting the interdependence of endogenous variables; and  $e_t$  is an  $n$  column vector consisting of error terms assumed to display standard properties.

In the analysis yielding the results reported in Chart 42 in the main text, quarterly data on the following six variables are included in the model: the foreign exchange rate (the dollar/yen exchange rate), the demand-supply gap (output gap), general prices (the CPI excluding fresh food), real bank loans outstanding (domestically licensed banks' loans excluding loans to the financial and insurance sector deflated by the CPI excluding fresh food), the default rate (the ratio of the total liabilities of defaulted firms to total bank loans outstanding), and a monetary policy variable (the uncollateralized overnight call rate). In the analysis, the sample period ranges from the first quarter of 1978 to the third quarter of 2006, divided into two subsample periods, one up to the first quarter of 1992, and the other from the second quarter of 1992 to the third quarter of 2006. The parameter value estimation and the impulse response calculation are then conducted for each subsample period (Charts 1 and 2 for Box 5). A recursive restriction with the ordering of variables mentioned above is used for identifying the innovations in the VAR model. The number of lags for each variable in the model is set to four based on the Akaike information criterion.

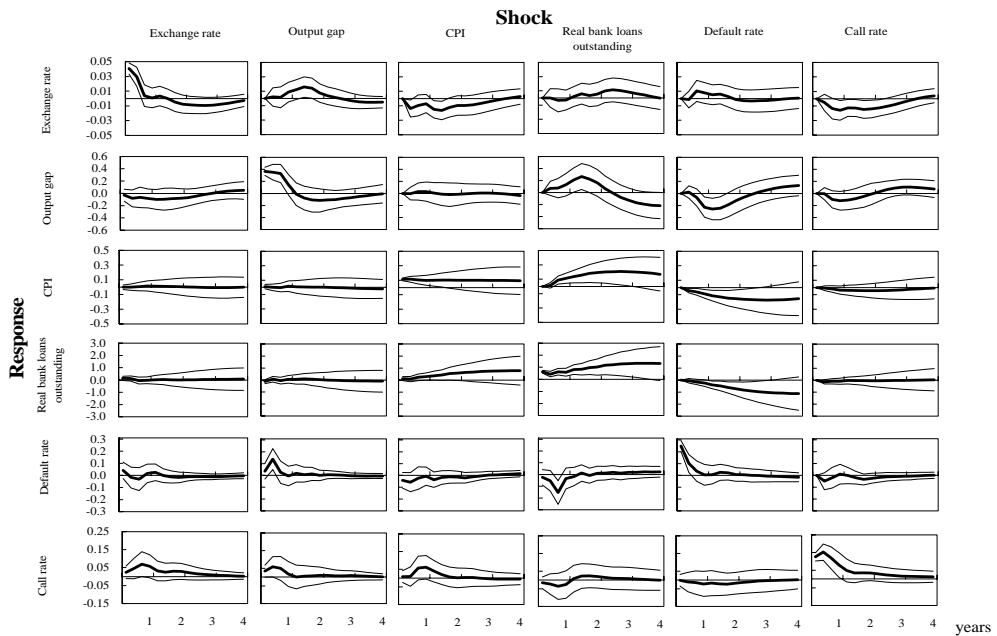
A comparison of the results for the two subsample periods reveals the following interesting observations. First, with regard to the macroeconomic variables, there is no significant difference between the shapes of the impulse response functions in the two subsample periods. Second, there is a distinct difference in the shapes of the impulse response functions relating to the financial system variables between the two subsample periods, specifically in the impulse response of the output gap, the CPI, and real bank loans outstanding to a shock to the default rate as well as the impulse response of the CPI to a shock to real bank loans outstanding. The change in the shape in some of the impulse response functions implies changes in the interactions between the macroeconomic variables and the financial system variables, especially in the direction from the latter to the former.

Chart 1 for Box 5: Impulse Response Functions, 1978/Q1-1992/Q1<sup>1</sup>



Note: 1. Impulse response to a one-standard-deviation shock. The thin lines indicate two standard error bands.

Chart 2 for Box 5: Impulse Response Functions, 1992/Q2-2006/Q3<sup>1</sup>



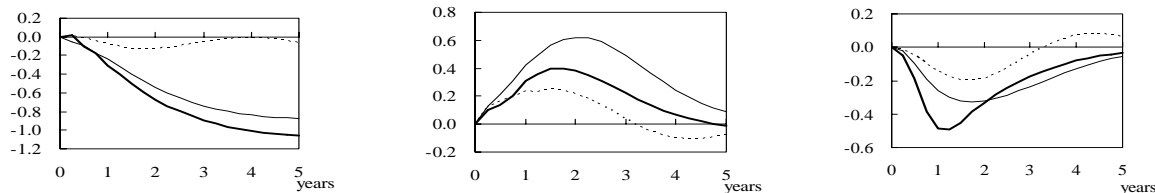
Note: 1. Impulse response to a one-standard-deviation shock. The thin lines indicate two standard error bands.

On the basis of the results in the subsample period VAR model analysis and their implications above, possible changes in the interactions between the variables are further investigated by a simple time-varying VAR model. In the time-varying VAR model used in the analysis, the parameter values showing the interaction between the variables in the model, i.e.,  $A_0$  and  $A_i$ , can vary at each point in time and are estimated by Kalman filter. At each point in time in the observation period, the estimates of the parameters in the model represent the updated relationships between the variables, and the impulse response functions reflect these updated relationships.

Chart 3 for Box 5 shows the impulse response of real bank loans outstanding to the default rate, that of the output gap to real bank loans outstanding, and that of the output gap to the default rate at three different points in time. A caveat is that the magnitudes of the effect, i.e., the degree of deviation of each impulse response from the zero horizontal line, need to be interpreted with care due to the size difference of a unit shock obtained as a result of the estimations, but the result implies that in recent years the effect of a shock to the financial system has been more long-lasting than in the past.

Chart 3 for Box 5: Impulse Response Functions in the Time-Varying VAR<sup>1</sup>

- (1) Response of Real Bank Loans to the Default Rate      (2) Response of the Output Gap to Real Bank Loans      (3) Response of the Output Gap to the Default Rate



Note: 1. The dashed lines represent the impulse responses in the first quarter of 1992, the thin lines represent those in the first quarter of 1998, and the thick lines represent those in the third quarter of 2006.

## Box 6: Macro Stress-Testing

In recent years, many central banks and financial authorities as well as international organizations have been conducting macro stress-testing exercises to assess the stability of financial systems.

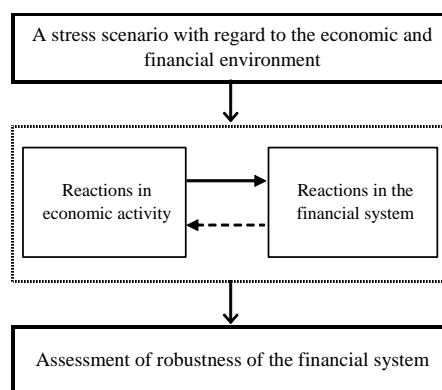
Macro stress-testing procedures generally go through three steps (Chart for Box 6):

Step 1: Establishment of stress scenarios with regard to the economic and financial environment.

Step 2: Estimation of reactions in economic activity and the financial system under each stress scenario. The effects from the reaction in the former to the latter are usually considered and, in some cases, feedback effects between economic activity and the financial system are explicitly taken into account.

Step 3: Estimation of the amount of risk held in the financial system as the result of interactions between economic activity and the financial system under each stress scenario and assessment of the robustness of the financial system by comparing the amount of risk with the amount of capital held by financial institutions.

Chart for Box 6: Procedure of Macro Stress-Testing



It should be noted that in conducting macro stress-testing, scenarios are chosen to put extreme pressure on the financial system to crystallize inherent risks. In other words, macro stress-testing does not aim to make the best forecast of the future state of the financial system. For example, Japan's experience of a boom and bust in asset prices during the period from the late 1980s to the 1990s suggests the usefulness of assuming a stress scenario of a significant change in real estate prices. This is because such a scenario is effective in assessing the stability of the financial system since large fluctuations in asset prices tend to affect the creditworthiness of firms. Assuming such a stress scenario does not mean that the probability of a reoccurrence of an asset price bubble in the near future is high.

In interpreting the results of any macro stress-testing exercises, it is important to be aware that such exercises have their limitations in terms of the scope and the framework of analysis, which is typically too simple to deal with the full complexity of economic reality. For example, most macro stress-testing exercises conducted so far only deal with a specific risk category such as interest rate risk or credit risk, and it tends to be difficult to encompass different types of risk in a unified framework. Moreover, the endogenous reactions of financial institutions to changes in the economic and financial environment, such as the adjustment of asset portfolios and loan rates, are not taken into consideration. In addition, feedback effects from the financial system to the real side of the economy, such as the effects of changes in loans outstanding to economic activity are not fully incorporated

in the framework.

Consequently, macro stress-testing exercises are still at a developmental stage, and in the future it would be useful to extend the methodology to incorporate the interactions between economic activity and the financial system, for example, via the term structure of interest rates to estimate both interest and credit risks in a consistent manner.



### Box 7: Scenarios of Future Interest Rates

The simulation of the impact of rises in market interest rates on banks' profits assumes three scenarios of future interest rates, as shown in Chart 48 in the main text.

1. The baseline scenario assumes that future short-term interest rates follow the expected path implied in the forward rate curve at the end of September 2006. The term premium is assumed to be zero for every maturity.
2. The steepening scenario assumes that the 10-year spot rate shifts upward each quarter by 25 basis points relative to the baseline scenario from the end of September 2006 to the end of September 2007. For spot rates with time-to-maturity of less than ten years, the shorter the time-to-maturity, the smaller the upward shift.
3. The parallel shift scenario assumes that the spot rate curve shifts upward evenly in each quarter by 25 basis points relative to the baseline scenario from the end of September 2006 to the end of September 2007.

The three scenarios are produced by following three steps (Chart for Box 7):

Step 1: The yield curve model is estimated by fitting the generalized Nelson-Siegel model (Nelson and Siegel [1987]) to the observed market rates at the end of September 2006 (Note 1). Observations are the uncollateralized overnight call rate, LIBOR (1-month, 3-month, 6-month, 9-month, and 12-month), and swap rates (2- to 13-year, 15-year, and 20-year).

Step 2: The future spot rate curves for the baseline scenario are computed using the expected path of short-term interest rates implied in the forward rate curve at the end of September 2006.

Step 3: The spot rate curves under the two alternative scenarios, i.e., the steepening scenario and the parallel shift scenario, are computed.

The spot rate curve in the future is projected to flatten gradually, reflecting the moderately upward-sloping shape of the spot rate curve at the end of September 2006.

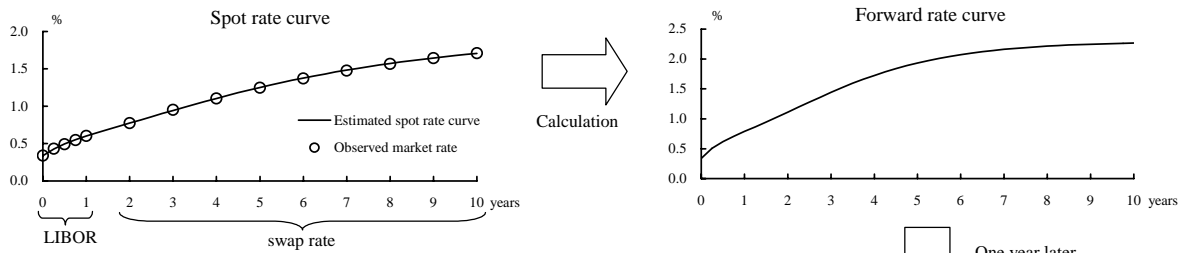
Note: 1. The functional form of the generalized Nelson-Siegel model is

$$r(m) = \beta_0 + \beta_1 \cdot \exp\left(-\frac{m}{\tau_1}\right) + \beta_2 \cdot \left(\frac{m}{\tau_2}\right) \cdot \exp\left(-\frac{m}{\tau_2}\right),$$

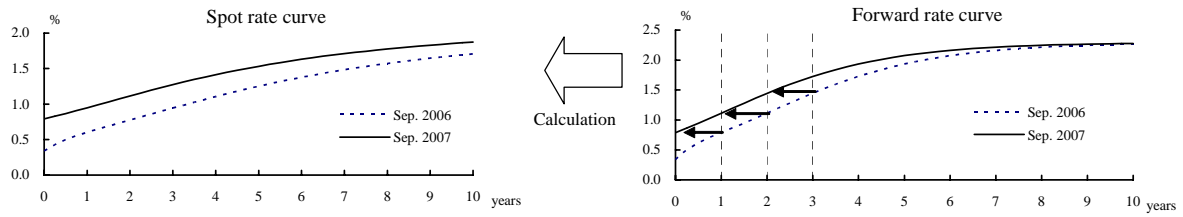
where  $r(m)$  is the instantaneous forward rate starting from  $m$  years ahead, and  $\beta_0$ ,  $\beta_1$ ,  $\beta_2$ ,  $\tau_1$ , and  $\tau_2$  are the five parameters to be estimated. We add the restriction that the uncollateralized overnight call rate is equal to  $\beta_0 + \beta_1$  to avoid having the very short end of the yield curve becoming negative. See Okina and Shiratsuka (2004) for an application of the model to Japan's experience.

### Chart for Box 7: Scenarios for Changes in the Yield Curve (Illustration)

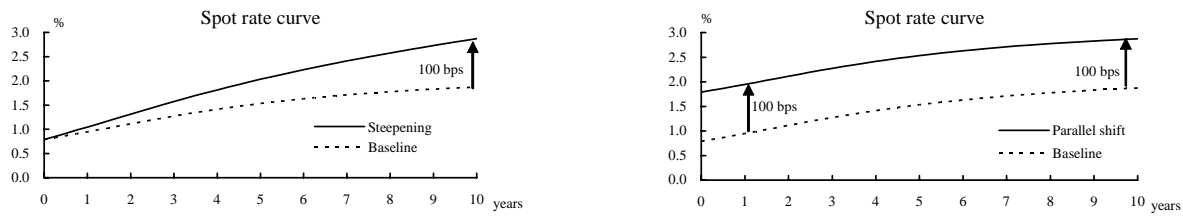
Step 1: Estimation of yield curves at the end of September 2006



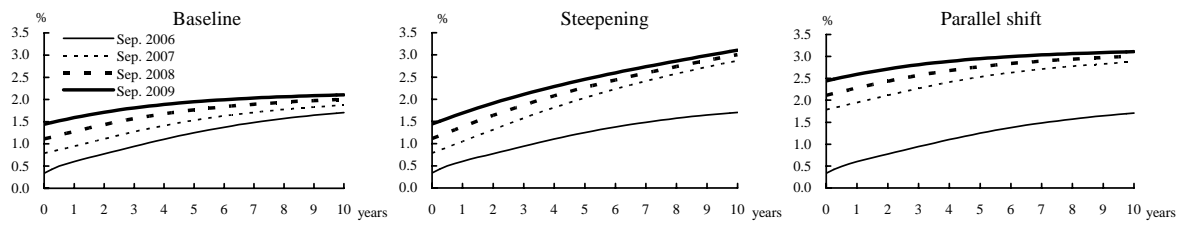
Step 2: Estimation of spot rate curves under the baseline scenario at the end of September 2007



Step 3: Estimation of spot rate curves under the alternative scenarios at the end of September 2007



#### Changes in yield curves under each scenario



**References:**

Nelson, Charles R., and Andrew F. Siegel, "Parsimonious Modeling of Yield Curves," *The Journal of Business*, 60 (4), 1987, pp. 473-489.  
 Okina, Kunio, and Shigenori Shiratsuka, "Policy Commitment and Expectation Formation: Japan's Experience under Zero Interest Rates," *North American Journal of Economics and Finance*, 15, 2004, pp. 75-100.

## Box 8: The Framework for Macro Stress-Testing of Credit Risk

As discussed in Box 6, many central banks and financial authorities as well as international organizations use macro stress-testing to examine the robustness of the financial system. Among the risks to the financial system, one of the most significant is credit risk, and macro stress-testing is an important tool to assess the robustness of the banking sector overall.

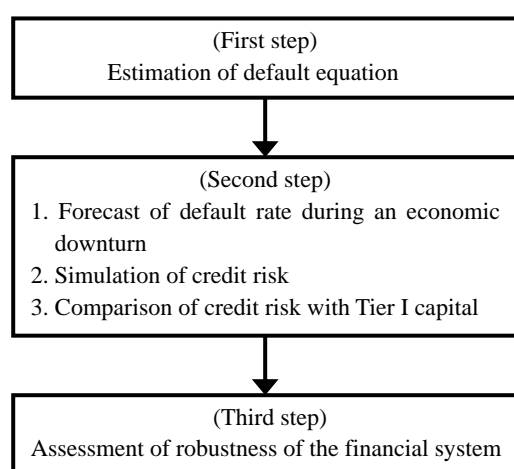
The simulation results of the macro stress-testing of credit risk are reported in Charts 51 and 52 in the main text based on the framework shown in Chart 1 for Box 8.

The macro stress-testing consists of three steps. In the first step, the relationship between the default rate and macroeconomic variables is estimated. Concretely, the following equation is used:

$$L(p_{i,t}) = c_i + \alpha_i BC_t + \beta_i DEBT_t + \gamma_i R_t + \varepsilon_{i,t},$$

where subscripts  $i$  and  $t$  denote borrowers' credit rating and time, respectively.  $L(p)$  is the logit-transformed value of the default rate,  $p$  (i.e.,  $\ln((1-p)/p)$ ).  $BC$  stands for the diffusion index of business conditions,  $DEBT$  for the debt-to-assets ratio, and  $R$  for the real money market rate (the estimation results of the default equation are shown in Chart 2 for Box 8).

Chart 1 for Box 8: Framework for Macro Stress-Testing    Chart 2 for Box 8: Estimation Results of the Default Equation<sup>1</sup>



	Constant term	$BC$	$DEBT$	$R$	Adj. $R^2$
"Normal" borrowers	5.283*** (6.26)	0.016*** (5.43)	0.019 (0.91)	-0.112** (2.16)	0.65
"Need attention" borrowers	6.539*** (7.58)	0.012*** (4.04)	-0.040* (1.83)	-0.087 (1.65)	0.64
"Special attention" borrowers	6.459*** (8.42)	0.010*** (3.79)	-0.055*** (2.86)	-0.045 (1.00)	0.68

Note: 1. The estimation period is 1985-2005. The equation is estimated by seemingly unrelated regression (SUR) taking account of possible correlation between error terms in each rating category. Figures in parentheses are t-statistics. \*\*\*, \*\*, and \* denote 1 percent, 5 percent, and 10 percent significance, respectively.

The default rates for each credit rating are estimated as follows. To begin with, defaults are defined as private and legal bankruptcies. We use the scores in the "Matrix Data for the Calculation of Probabilities of Default," published by Teikoku Databank to divide borrowers into three categories according to their creditworthiness: "normal" borrowers, "need attention" borrowers, and "special attention" borrowers. We then calculate the default rates of large, medium-sized, and small firms in each rating category and finally weight the default rates by the outstanding amount of loans from financial institutions to firms of each size.

In the second step, we forecast the change in the default rate caused by an economic downturn based on the above equation. In doing so, we use the upper limit of the 95 percent confidence interval, taking account of the standard error from the default equation. We estimate credit risk by Monte Carlo simulation using the forecasted

default rates. Using the results thus obtained, it is then shown how the credit risk/Tier I capital ratio changes with the severity of the recession. Note that it is assumed that the recession lasts only for one year and we estimate the credit risk after one year.

Finally, in the third step, the simulation results from the second step are used to evaluate the robustness of the financial system overall to credit risk. That is, the robustness of the financial sector to credit risk associated with the macroeconomic stress scenario is assessed based on the relationship between the depth of the recession and the magnitude of the credit risk.