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Nobuhiro Abe*
nobuhiro.abe@boj.or.jp

Naohisa Hirakata**
naohisa.hirakata@boj.or.jp

Yuto Ishikuro***
yuuto.ishikuro@boj.or.jp

Yosuke Koike*
yousuke.koike-1@boj.or.jp

Yuki Konaka*
yuuki.konaka@boj.or.jp

Yutaro Takano****
yuutarou.takano@boj.or.jp

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Bank of Japan
2-1-1 Nihonbashi-Hongokucho, Chuo-ku, Tokyo 103-0021, Japan

* Financial System and Bank Examination Department

** Niigata Branch

*** International Department

**** Monetary Affairs Department

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Nobuhiro Abe[†], Naohisa Hirakata[‡], Yuto Ishikuro[§],
Yosuke Koike[**], Yuki Konaka[††], Yutaro Takano[‡‡]

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Abstract

In this paper, we use a counterfactual simulation to analyze the effect on the function of financial intermediation in Japan of the decline in interest rates due to large-scale monetary easing. The results show that the decline in interest rates due to large-scale monetary easing put downward pressure on interest margins on loans and securities investments of banks. However, capital adequacy ratios were not necessarily pushed down significantly, because the decline in interest rates boosted the price of stocks and bonds and reduced credit risk. On the other hand, the improving real economy and lower lending interest rates increased demand from the corporate sector, leading to an increase in loans outstanding. In addition, the improvement in corporate finances due to an improved real economy, lower lending interest rates, and rising land and other asset prices, reduced credit risk in lending and contributed to an increase in loans outstanding. The results of the counterfactual simulation suggest that the decline in interest rates due to large-scale monetary easing contributed to the facilitation of financial intermediation.

JEL classification: E44, E59, G21, G28
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[†] Financial System and Bank Examination Department, Bank of Japan (nobuhiro.abe@boj.or.jp)
[‡] Niigata Branch, Bank of Japan (naohisa.hirakata@boj.or.jp)
[§] International Department, Bank of Japan (yuuto.ishikuro@boj.or.jp)
[**] Financial System and Bank Examination Department, Bank of Japan (yousuke.koike-1@boj.or.jp)
[††] Financial System and Bank Examination Department, Bank of Japan (yuuki.konaka@boj.or.jp)
[‡‡] Monetary Affairs Department, Bank of Japan (yuutarou.takano@boj.or.jp)

1 Introduction

In Japan, the natural rate of interest has been declining, and the effect of the large-scale monetary easing (LSME) since 2013 has been to push down long-term interest rates, resulting in a persistently low interest rate environment. This low interest rate environment could have had the effect of boosting the real economy by pushing up consumption, investment, and other expenditures by lowering real interest rates and fostering an accommodative financial environment.[1] The improvement in the real economy also had a positive effect on banks, as it led to an increase in loans outstanding, an improvement in corporate cash flows, and a decrease in bankruptcies, all of which in turn led to a decrease in credit costs. On the other hand, when considering the effect of LSME on the function of financial intermediation, it is important to note that the profits of banks were pushed down because of the reduction in loan interest margins, due to lower lending interest rates and lower market interest rates causing a decline in yields on securities.[2] Thus, the effect of LSME varies depending on the economic agent and the subject of the analysis. The effect of LSME on the function of financial intermediation of the financial system as a whole should be considered in light of the individual effects and their interrelationships.

In this paper, we analyze the effect of the decline in interest rates resulting from LSME on the profits and capital adequacy ratios of banks and on their financial intermediation from both positive and negative perspectives. It is important to note that positive and negative factors are two sides of the same coin in the discussion. For example, a decline in interest rates due to LSME has the positive effect of stimulating the real economy and asset prices, and reducing credit risk by improving corporate finances. At the same time, however, such a decline in interest rates may reduce the interest margins on loans and investments in securities, which in turn puts downward pressure on the profits of banks. Therefore, the effect of lower interest rates due to LSME on the function of financial intermediation is not necessarily clear in advance. A decline in profits due to lower interest rates may contribute to downward pressure on the capital adequacy ratios of banks, but higher stock and bond prices have an upward effect. Lower credit risk due to improved corporate sector finances may facilitate lending transactions. These

[1] For example, Kawamoto et al. (2021).
[2] Bank of Japan (2024a) points out that a decline in the loss-absorbing capacity of banks may affect financial intermediation in various ways, such as stagnation in financial intermediation and excessive behavior in the search for yields.

positive and negative factors need to be considered when assessing the effect of LSME.

In order to take these various factors into account, we conduct a counterfactual simulation analysis to understand the effect of LSME on the function of financial intermediation. We use the financial macro-econometric model (FMM) developed at the Bank of Japan.[3] Using the FMM, it is possible to grasp the effect of the decline in interest rates due to LSME by assuming the real economy and financial markets in a counterfactual environment where there is no LSME and interest rates do not decline, calculating the banks' profits, and comparing this to the actual value.

The following three points can be noted as results of FMM's counterfactual simulation of the effect of LSME. (1) The decline in market interest rates due to the LSME has contributed to an increase in loans outstanding by improving corporate finances through lower lending interest rates, improved macroeconomic conditions, and stabilized land prices. This increase in loans outstanding and the reduction of credit risk due to improved corporate finances boosted the profits of banks. (2) However, the shrinking interest margins on loans due to lower lending interest rates and declining yields on securities investment have been a negative factor in profits to a greater extent than the increase in profits from the increase in loans outstanding and the reduction in credit costs. (3) A decrease in risk-weighted assets due to the decline in credit risk caused by an improvement in the macroeconomy and an improvement in valuation gains/losses on securities holdings due to lower interest rates and higher stock prices were factors that boosted the profits of banks and their capital adequacy ratios.

The counterfactual simulation results suggest the following points about the effect of LSME on the function of financial intermediation. Although the decline in interest rates resulting from the LSME cut the interest margins on loans and securities investments of banks, it did not necessarily lead to a significant decline in their capital adequacy ratios as a whole. In addition, an improving economy, rising land and other asset prices, and lower interest rates on loans led to improved corporate finances. The resulting reduction in credit risk is thought to have facilitated smooth lending transactions between banks and corporate firms. A similar mechanism is believed to have been at work in the increase in mortgage loans to households. In this respect, the decline in interest rates resulting from the LSME suggests that the financial system as a whole contributed to the facilitation of financial intermediation.[4]

[3] For the detail of the FMM, see Abe et al. (2023).

[4] Abadi et al. (2023) and Balloch and Koby (2023) have discussed the possibility that a decline in banks'

However, it should be noted that the counterfactual simulation results depend on the assumptions made in the analysis, the formulation of the FMM, and the estimated parameters. For example, assumptions about the portfolio of securities may change the downward pressure on banks' profits, which is the negative side of a decline in interest rates. Also, there are uncertainties in the parameters of the FMM function, which may affect the counterfactual simulation results. The results in this paper are calculated mechanically under certain assumptions, and should be viewed with some latitude. It is necessary to evaluate the function of financial intermediation with this in mind.

(Literature review)

The following is a review of the literature relevant to the analysis in this paper. Monetary policy reviews at foreign central banks have also addressed the relationship between monetary policy and financial stability. In a review conducted by the Federal Reserve System for the period 2018-2020, Federal Open Market Committee (2020) pointed out the importance of a stable financial system for the sustained achievement of maximum employment and price stability. In Kashyap and Siegert (2020), a paper presented as part of the same review, the interrelationship between monetary policy and financial stability is an important point, noting that while financial instability may threaten price stability, monetary policy may also affect financial stability. The relationship between monetary policy and financial stability was one of the issues discussed by the European Central Bank in its 2020-2021 Strategic Review. It has been pointed out that financial stability is a prerequisite for price stability, that a low interest rate environment may create incentives for more risk-taking, and that a flattening yield curve may lead to shrinking interest margins, which would adversely affect the profitability of banks and their loss-absorbing capacity (European Central Bank (2021), Altavilla et al. (2021)).

Kawamoto et al. (2021) examined the effects of monetary policy in Japan using a structural model. Kawamoto et al. (2021) conducted a counterfactual simulation using the Q-JEM (Quarterly Japanese Economic Model), a macroeconomic model developed by the Research and Statistics Department of the Bank of Japan, as part of the "Assessment for Further Effective and Sustainable Monetary Easing" conducted in 2021.[5] Kawamoto et al. (2021) reports that the introduction of the BOJ's "Quantitative and Qualitative Monetary Easing" had a positive effect

profitability due to a decrease in interest rates may reduce lending. In our analysis, given that the capital ratio of banks does not decrease significantly, the decline in interest rates due to the LSME did not necessarily impede financial intermediation.

[5] For the detail of the Q-JEM, see Ichiue et al. (2009), Hirakata et al. (2019), among others.

on real GDP and consumer prices until July-September 2020. More recently, Monetary Affairs Department, Bank of Japan (2023) examined the effect of unconventional monetary policy on the economy and prices using a factor-augmented VAR and confirmed its positive effects on the real economy and prices. The report also shows that unconventional monetary policies have increased loans outstanding, but have shrunk the profits of banks by squeezing interest margins due to lower loan interest rates. In this paper, we use a structural model that describes the financial sector in more detail to analyze the effect on the function of financial intermediation of the decline in interest rates resulting from the LSME. This point differs from Kawamoto et al. (2021), who used a standard macroeconomic model.

(Structure)

The structure of this paper is as follows. First, we explain the analytical method and our assumptions on the variables that are the premises of the counterfactual simulation. Next, we explain the counterfactual simulation results and discuss how the function of financial intermediation during the period of the LSME can be evaluated from the counterfactual simulation results. Finally, we present our conclusions.

2 Methods and Assumptions

In this paper, we conduct a counterfactual simulation to analyze the effect on the function of financial intermediation of the decline in interest rates resulting from the LSME. The analysis is divided into two steps, as shown in Chart 1. First, as a preparation for the analysis, we set the level of market interest rates in the absence of LSME (counterfactual scenario) with reference to Bank of Japan (2024b) and Nakazawa and Osada (2024). The results of real GDP, output gap, stock price, and nominal exchange rate (yen/dollar) under the counterfactual market interest rate computed using the Q-JEM are used for the real economy.[6] Second, we compute variables such as loan balance, net interest income, credit cost, and capital adequacy ratio in the counterfactual scenario using the above assumed variables as exogenous variables in the FMM (financial macro-econometric model), a macro model for analyzing the financial system. Chart 2 overviews the variables that are input into the FMM as exogenous variables and the main variables simulated using the FMM. We evaluate the effect on the function of financial intermediation by looking at these variables related to the financial system.

[6] Izawa et al. (2024) examine the effects of the LSME on the real economy using the results of the analysis of long-term interest rates in Bank of Japan (2024b). For the use of long-term interest rates in analysis, see Nakazawa and Osada (2024).

2.1 Assumptions on counterfactual simulation

The left panel of Chart 3(1) shows the actual and counterfactual values of JGB interest rates by maturity. The counterfactual values, i.e., the level of interest rates in the absence of LSME, are simulated by taking into account the effects of JGB purchases as well as Yield Curve Control (YCC). The dotted line indicates that the market interest rate in the counterfactual scenario is higher than the actual rate shown by the solid line. Looking at different maturities, the counterfactual interest rate level is higher relative to the actual in the longer-term zone, indicating that the level of interest rates in the longer-term zone was pushed down more significantly by the LSME. The right panel of Chart 3(1) shows the actual and counterfactual yield curves. In the absence of LSME, the yield curve in the counterfactual scenario is much steeper than in the actual. This suggests that the LSME had the effect of significantly flattening the yield curve.

Next, we calculate counterfactual values for the real economy, exchange rates, and stock prices under the above counterfactual interest rate levels using the Q-JEM developed by the Research and Statistics Department of the Bank of Japan. Chart 3(2) shows the annual growth rate of real GDP and the output gap. The actual results exceed the counterfactual, indicating that the decline in interest rates due to the LSME has pushed up real GDP and the output gap. In addition, the stock price index (TOPIX) of the actual shown in the left panel of Chart 3(3) also exceeded the counterfactual, indicating that the decline in interest rates due to the LSME pushed up the stock price index. The nominal exchange rate shown in the right panel of Chart 3(3) is simulated to be higher than the actual exchange rate in the counterfactual scenario where interest rates are higher than in the actual because the Q-JEM is formulated to determine the exchange rate based on interest rate parity.

The counterfactual simulation period is ten years, from April-June 2013 to January-March 2023, the period after the introduction of Quantitative and Qualitative Monetary Easing (QQE), when the difference between the counterfactual and actual market interest rates became large. We simulate the effect of the LSME on the financial sector using the financial macro-econometric model (FMM) that incorporates the financial system, with market interest rates, real GDP, the output gap, stock prices, and the nominal exchange rate as given. We regard the difference between the financial sector's behavior under the counterfactual, in the absence of LSME, and the financial sector's behavior under the actual, with LSME, as the effect of the LSME.

2.2 Effect of low interest rates on the financial system in the FMM

In this section, we explain the effect of the LSME assumed in the counterfactual simulation. The effect of a decline in market interest rates on the function of financial intermediation is not necessarily clear *a priori*, as it requires comprehensive consideration of the real economy, corporate finances, banks' profits, capital adequacy ratios, and other factors.

First, let us examine the positive factors affecting the profits of banks (Chart 4(1)). The decline in interest rates due to the LSME, accompanying improvement in the economy, and the rise in asset prices, such as land prices, improve corporate finances and increase corporate creditworthiness. As a result, credit risk in lending transactions declines. This improves the profits of banks through lower credit costs and boosts their capital adequacy ratios through lower credit risk-weighted assets. The improvement in the real economy due to the LSME increases loans outstanding due to increased demand for funds, and this is a factor that boosts the profits of banks. Lending to households, especially housing loans, is affected in much the same way as lending to corporate firms. That is, an improvement in the economy and lower lending interest rates due to LSME increases demand for borrowing by households, and an improvement in the income environment, such as a decline in the unemployment rate due to LSME, reduces the delinquency rate and credit costs of housing loans, thereby increasing the profits of banks.

On the other hand, a decline in market interest rates lowers yields on securities held by banks and loan rates, and with little room for a decline in deposit rates, this puts downward pressure on the profits of banks by reducing their interest margins (Chart 4(2)). In addition, an increase in loan balances and a rise in stock prices causes capital adequacy ratios to decline through an increase in risk-weighted assets. Thus, the effect of a decline in interest rates on profits and capital adequacy ratios of banks is determined by the relative magnitude of these factors. Thus, the direction of the effect is not clear in advance.

In assessing the function of financial intermediation, it is necessary to consider not only the profits and capital adequacy ratios of banks, but also the macroeconomic environment, including corporate sector finances and the household income environment. In addition, the effect of a decline in interest rates due to LSME may differ depending on the economic agent. For example, even if lower interest rates have a negative effect on the profits and capital adequacy ratios of banks, if corporate sector finances improve and credit risk is controlled, loans outstanding may increase and financial intermediation may function more smoothly. Thus,

while trends in loans outstanding are an important indicator of the effect of lower interest rates due to LSME on the function of financial intermediation, it is also necessary to evaluate the effect based on developments in other variables, such as capital, corporate finances, and credit risk of banks.

(Points to note in evaluation)

Before explaining the analysis on the results, we explain the function for loans outstanding, which plays an important role in the FMM's counterfactual simulation, and review some points to keep in mind when considering the effect on the financial system. The evaluation of the function of financial intermediation depends to a large extent on the function for loans outstanding, which formulates how much the loans outstanding is affected by factors such as loan interest rates, land prices, GDP, and the capital adequacy ratio of banks. Chart 5 shows the loan functions for the FMM. For domestic corporate loans and domestic loans to individuals, variables that indicate demand for funds include structural factors such as population growth rate and expected growth rate, as well as the output gap that indicates business cycle fluctuations. The supply factors for lending include the profits and capital adequacy ratios of banks. In addition, the rate of change in land prices, which is related to the collateral value of loan transactions and corporate finances, is also used. These variables are expected to have a positive effect on lending, and the estimated parameters are actually positive. The other explanatory variable, the lending interest rate, has the potential to have both a positive and negative effect on loans outstanding, but based on the estimation results, the FMM assumes that an increase in the lending interest rate decreases loans outstanding. Since these parameters of the loan functions in the FMM are still subject to endogeneity issues, the results of the FMM simulation should be viewed with some latitude.

3 Counterfactual Simulation Results using the FMM

This section describes the results of the counterfactual simulation analysis.

3.1 Net interest income

First, let us discuss net interest income. As shown in Chart 6(1), the net interest income in the actual is lower than the counterfactual. This suggests the possibility that lower interest rates due to the LSME may have pushed down net interest income. In this regard, the figures for the respective contributions of loan profit and securities profit, which make up net interest income, show that the actual results for both were lower than the counterfactual, indicating that the

LSME pushed down the net interest income. This point is explained below.

(Loan-related net interest income)

First, the decline in interest rates resulting from the LSME has reduced loan interest margins and loan profits, while the room for a decline in deposit rates has been limited (the left panel of Chart 6(2)). On the other hand, factors such as the improved economy due to the LSME, lower lending interest rates, rising land prices, and improved financial condition of banks boosted the overall loans outstanding and mortgage loans outstanding, as shown in the middle two panels of Chart 6(2). However, the positive contribution from the increase in loans outstanding is not enough to offset the effect of shrinking loan interest margins, and loan-related net interest income is pushed down by the decline in market interest rates resulting from the LSME.

Loan-related net interest income is depressed by lower interest rates, but loans outstanding is boosted. Based on the counterfactual simulation results, land price appreciation due to the LSME contributed to this increase in loans outstanding. The right panel of Chart 6(2) shows simulated land prices. While the rate of increase in land prices is negative in the counterfactual, the actual rate of increase is positive, suggesting that land prices were boosted by the improvement in the real economy, which benefited from the decline in interest rates resulting from the LSME. It is possible that the increase in collateral values and improved corporate finances due to higher land prices may have increased loans outstanding by easing borrowing constraints and reducing credit risk. In addition, it is possible that the accommodative financial environment further improved corporate finances and the real economy, which in turn led to higher land prices and increased loans outstanding.[7] Similarly, for housing loans, as in the corporate sector, higher land prices and improved income conditions increased borrowing demand and reduced credit risk, which led to an increase in the amount outstanding of mortgage loans. In the case of housing loans, as in the case of the corporate sector, rising land prices and improved income conditions may have boosted borrowing demand and reduced credit risk, which may have boosted the loans outstanding. It should be noted, however, that even in an accommodative financial environment, demographic changes, a structural component, have consistently contributed to put downward pressure on loans outstanding in both the actual and

[7] This point suggests that the so-called "financial accelerator effect" may be working. The financial accelerator effect is when the effects of monetary policy are amplified by credit channels through changes in the financial conditions of corporate firms and banks. See Bernanke et al. (1999) for more details on the mechanism. See Kiyotaki and Moore (1997) for the propagation mechanism of credit channels with collateral constraints. See Aoki et al. (2004) for an analysis of financial accelerators in the household sector.

the counterfactual scenario.

(Securities-related net interest income)

Next, we discuss securities-related net interest income. The decline in market interest rates due to LSME is a factor that lowers the return on securities investments. However, the rate of return on securities portfolios varies depending on the duration composition, even if the balance is identical. Under the low-for-long interest rates and flat yield curve, banks have had an incentive to lengthen the duration of their securities portfolios due to the need to secure profits from securities-related net interest income.[8] In contrast, under the counterfactual scenario in the absence of LSME, the yield curve would have been much steeper than it has been in the past. Therefore, in the counterfactual scenario, there is no incentive to lengthen the duration of securities, as there is in the actual. Therefore, in the counterfactual simulation, we assume a securities portfolio in which the duration is not lengthened, and calculate the securities profit under such a portfolio.[9]

Chart 7(1) shows the durations of domestic bonds assumed when calculating securities-related net interest income. In the actual, regional banks and *shinkin* banks, in particular, had to take on longer durations in order to compensate for the decline in profits due to lower yields. On the other hand, in the counterfactual, duration is assumed to be almost constant because there is no need to take duration risk.

Chart 7(2) shows the interest margins on securities investments calculated under the above assumptions. The interest margins on securities investments are higher in the counterfactual scenario than in the actual. This means that the higher market interest rates in the counterfactual scenario relative to the actual exceeded the effect of lengthening bond durations in the actual. This implies that the decline in market interest rates due to the LSME had an effect that could not be fully compensated for by duration lengthening alone. As shown in Chart 6(1), the result of securities-related net interest income for the actual, reflecting the effect of the LSME, are lower than for the counterfactuals in the absence of LSME.

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[8] See Bank of Japan (2023) and Financial System and Bank Examination Department, Bank of Japan (2024) for information on the accumulation of interest-rate risks in a low-rate environment.

[9] Although it can be assumed that the longer duration of securities portfolios is due to the need to secure profits under low interest rates, the counterfactual duration assumption works in the direction of reducing the extent of the decline in securities profits due to the drop in interest rates under the Great Moderation. It should be noted that this assumption may understate the negative side of LSME, i.e., the decrease in earnings of financial institutions due to lower interest rates.

3.2 Credit costs

While the decline in market interest rates due to the LSME put downward pressure on net interest income due to shrinking interest margins, the decline in borrowing rates and the accompanying improvement in the economy also improved corporate finances, which in turn helped to contain credit risk. Chart 8(1) compares actual and counterfactual loan portfolios by borrower classification. The actual results show that, in contrast to the counterfactual, the downgrading of regional banks and *shinkin* banks to "in danger of bankruptcy" or below was suppressed, indicating that the improvement in the economy and corporate finances due to low interest rates led to an improvement in portfolio quality, thereby suppressing credit risk. As a result, the credit cost ratio of the actual in Chart 8(2) is also lower than the counterfactual, mitigating the impact of the decline in net interest income on capital caused by the narrowing of interest margins. The counterfactual value of the mortgage delinquency rate shown in Chart 8(3) is also higher than that of the actual. In other words, the improvement in the income environment due to the decline in the unemployment rate accompanying the improvement in the economy has suppressed the cost of mortgage credit. Therefore, although the decline in market interest rates due to the LSME put downward pressure on net interest income, the decrease in credit costs due to the improved economy worked to reduce the effect of the decline in final profits on capital, which is considered to have been a factor pushing up the capital adequacy ratio.

3.3 Risk-weighted assets and valuation gain/loss on securities holdings

Chart 9(1) shows actual and counterfactual risk-weighted assets. In the actual, which reflects the effect of lower interest rates due to LSME, the increase in loans outstanding and the rise in stock prices are the main factors increasing risk-weighted assets. On the other hand, for major banks and regional banks, many of which use the internal model approach, risk-weighted assets in the actual are lower than the counterfactual because the lower probability of default due to improved corporate finances suppresses credit risk-weighted assets. In other words, the lower interest rates resulting from LSME have the effect of reducing risk-weighted assets by lowering credit risk, and this has been a factor in boosting capital adequacy ratios.

Chart 9(2) shows the valuation gains/losses on securities holdings. The actual valuation gains/losses on securities holdings exceeded the counterfactual, indicating that the decline in interest rates due to the LSME had the effect of raising bond prices and stock prices, thereby improving valuation gains/losses on securities holdings. This is another reason why the capital

adequacy ratio is expected to increase.

3.4 Capital adequacy ratios

Finally, we examine the effect on capital adequacy ratios. Chart 10(1) shows the capital adequacy ratios on a regulatory capital basis. In all bank types, the pre-provision net revenue (PPNR) excluding trading income in the actual has been lower than in the counterfactual. This is due to the fact that the decline in interest rates has had a greater impact on the reduction of interest margins than the increase in loans outstanding due to the LSME. On the other hand, the improvement in corporate finances due to the improved real economy and the decrease in credit costs and risk-weighted assets due to lower credit risk have worked to improve the actual capital adequacy ratio relative to the counterfactual.

Chart 10(2) shows the capital adequacy ratio on an economic capital basis, which takes into account the valuation gains/losses on securities holdings. The results for internationally active banks are identical to those shown in Chart 10(1) above, as they take into account valuation gains/losses on securities holdings on a regulatory capital basis. On the other hand, domestic banks do not take into account valuation gains/losses on securities holdings in their capital adequacy ratios on a regulatory capital basis, so there is a difference between the regulatory capital basis and the economic capital basis. In other words, on an economic capital basis, valuation gains/losses on securities holdings contributed positively to the capital adequacy ratio of the counterfactual, reflecting the rise in bond prices and stock prices due to lower interest rates.

In both the regulatory and economic capital cases, the decline in interest rates reduced the PPNR excluding trading income through a narrowing of interest margins, which in turn lowered the capital adequacy ratio. On the other hand, the decline in interest rates and the accompanying improvement in the real economy side pushed up the capital adequacy ratio through a decrease in credit costs and credit risk-weighted assets, as well as through an improvement in valuation gains/losses on securities holdings. As a result of both positive and negative forces, the results indicate that the capital adequacy ratio was not necessarily pushed down significantly by the decline in market interest rates.

3.5 Evaluation of the effects of LSME on financial intermediation

In the following, we summarize the relationship between the counterfactual simulation results and the function of financial intermediation. According to the counterfactual simulation

results, the decline in interest rates due to the LSME has reduced the interest margins of banks, which are the main providers of funds. However, the capital adequacy ratio was not necessarily pushed down significantly, as lower interest rates boosted the price of stocks and bonds and reduced credit risk. On the other hand, the improving economy and lower lending interest rates have increased demand from the corporate sector, which is the main source of demand for funds, leading to an increase in the loans outstanding. In addition, the improvement in corporate finances due to the improved economy, lower lending interest rates, and rising price of land and other assets has contributed to the facilitation of financial intermediation by reducing the credit risk involved in lending by banks, thereby facilitating smooth lending transactions between firms and banks. Furthermore, for housing loans, as in the case of the corporate sector, the improvement in the income environment due to the improved economy, lower lending interest rates, and the rising price of land and other assets is believed to have led to an increase in the loans outstanding through increased demand for borrowing by households and the suppression of credit risk. This point can be interpreted as a spillover effect of the lower interest rates resulting from the LSME that improved the financial conditions of firms and households.

In light of these points, it seems that a decline in interest rates due to LSME does not necessarily have a negative effect on the function of financial intermediation, taking into account the impact not only on banks but also on the real economy and the corporate sector. Abadi et al. (2023) and others have discussed the possibility that a large decline in interest rates would reduce the profits of banks, which would in turn reduce their lending (reversal rate theory). However, based on the discussion so far, it seems that in Japan the decline in interest rates due to the LSME has not necessarily reduced the financial intermediation function as a whole, although it has reduced the interest margins of banks.

In this paper, the evaluation of the function of financial intermediation is focused on whether lending transactions between banks, which are the providers of funds, and corporate firms, which are the main source of demand for funds, have been conducted smoothly. In this sense, we have focused our evaluation on changes in the loans outstanding. For this reason, we have not included details of the increase in loans in our analysis. However, as the period of monetary easing was prolonged, banks increased lending to real estate-related businesses, including housing loans, and to middle-risk corporate firms with relatively low profitability, in order to secure profits. This raises the question as to whether, while it improved corporate finances, the low interest rate environment resulting from the LSME also led to the preservation of low-

productivity firms.[10] A separate analysis is needed to address this issue.

4 Concluding Remarks

In this paper, we examine the effects of the decline in interest rates resulting from LSME on the profits and capital adequacy ratio of banks, and on the function of financial intermediation. There are both positive and negative effects of the decline in interest rates resulting from LSME, and it is not clear *a priori* which is the larger of the two. For this reason, in examining the effects of the LSME in Japan, we use the FMM to simulate corporate finances, loan balances, banks' profits, and capital adequacy ratios under a counterfactual scenario in which interest rates do not fall, and we compare them to the actual values to examine the effect of the decline in interest rates due to LSME.

The counterfactual simulation results suggest the following. First, the decline in interest rates resulting from the LSME had a negative impact on capital adequacy ratios by reducing the interest margins on loans and securities and thereby lowering the profits of banks. However, an improving economy and lower lending interest rates increased demand for funds from corporate firms, leading to an increase in loans outstanding. In addition, the improvement in corporate finances due to the improved economy, rising asset prices, and lower lending interest rates are thought to have curbed credit risk and enabled banks to lend more smoothly. Similar to the corporate sector, the increase in demand for housing loans due to rising land prices and improved income conditions, as well as the suppression of credit risk, led to an increase in mortgage loans outstanding. This suggests that the effect of lower interest rates due to the LSME may have had a spillover effect through the improvement of the financial conditions of firms and households. In this respect, the decline in interest rates resulting from the LSME contributed to the facilitation of the function of financial intermediation of the financial system as a whole.

The first point to note about the counterfactual simulation results is that (1) the duration was set flat in the counterfactual bond portfolio. It should be noted that this assumption also affects the results of the simulation of the downward pressure on the profits of banks, which is a negative aspect of a decline in interest rates. (2) Next, regarding the formulation of the model, the results and implication of this analysis are particularly dependent on the formulation and

[10] For the characteristics of bank lending in a low interest rate environment, see Financial System and Bank Examination Department, Bank of Japan (2024). In recent years, some studies have pointed out that low interest rate environments can distort the allocation of capital and reduce productivity. See Kiyotaki et al. (2021), Gopinath et al. (2017), Asriyan et al. (2021) and Hirakata and Sunakawa (2019), for example.

parameters of the loan functions. For example, the estimation of the loan functions is subject to a certain degree of uncertainty in the accuracy of parameter estimation due in part to endogeneity issues. It should be noted that the analysis presented here is the result of mechanical simulations based on such assumptions and models. In light of the above, the results should be interpreted with some latitude.

Finally, while the LSME lengthened the duration of loans, bonds, and other investments, the increase in loans outstanding has been dominated by real estate-related loans and loans to low-profit middle-risk firms. This point is beyond the scope of this model analysis but is discussed in detail in the review of the function of financial intermediation over the past 25 years in Financial System and Bank Examination Department, Bank of Japan (2024). Another important issue is how future changes in the economic and financial environment will manifest the risks of these loans and how they may affect the profitability of banks and the function of financial intermediation.

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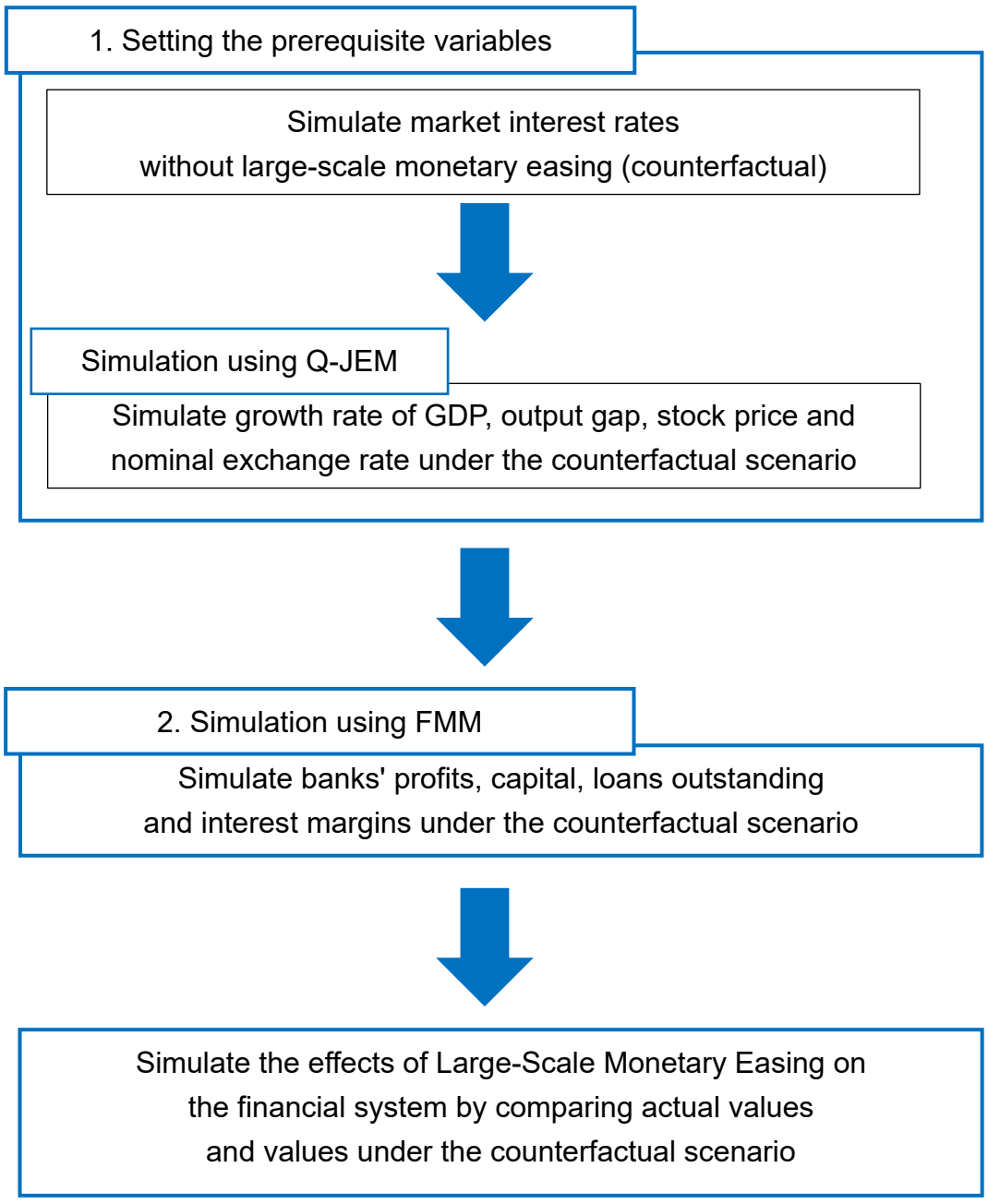
(Chart 1)

Simulation method



(Chart 2)

Assumptions in the counterfactual analysis

<Exogenous variables input into FMM>

	Note
Government bond yields	Bank of Japan (2024b), Nakazawa and Osada (2024)
Real GDP	Izawa, Takahashi and Yoneyama (2024)
FX rate, stock price	Izawa, Takahashi and Yoneyama (2024)

<Variables simulated by FMM>

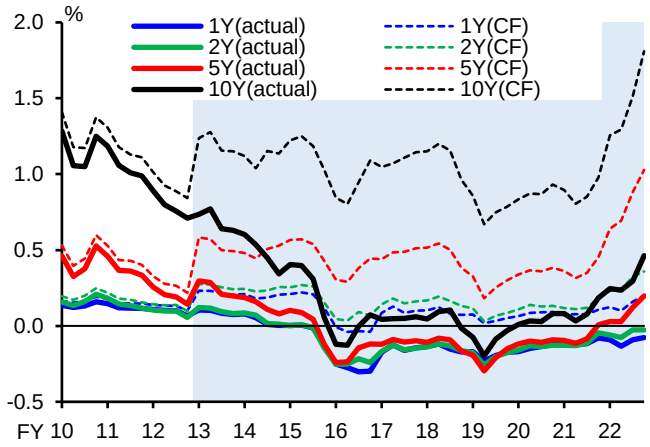
	Note (factors behind changes, etc.)
Loans outstanding	Function of lending interest rates, land price, financial conditions, GDP, population, etc.
Lending interest rates	Function of market interest rates, durations, etc.
Outstanding amount of securities	Unchanged from the end of actual period
Duration of bonds	Unchanged from the end of actual period
Yields on securities	Function of market interest rates, durations
Deposits	In line with loans outstanding and outstanding amount of securities
Land price	Function of real GDP
Net interest income	Function of interest margins of loans and securities, outstanding amount of investment
Credit costs	Function of real GDP, borrower firms' ICR (lending interest rates), etc.
Valuation gains/losses on securities holdings	Sovereign bonds : function of durations, interest rates Credits products : function of durations, interest rates, rating composition Stocks etc. : function of stock price, fund price
Risk-weighted assets	Internal rating-based approach : In line with credits of borrower firms Standardized approach : Unchanged
Capital adequacy ratios	Function of capital, risk-weighted assets, etc.

(Chart 3)

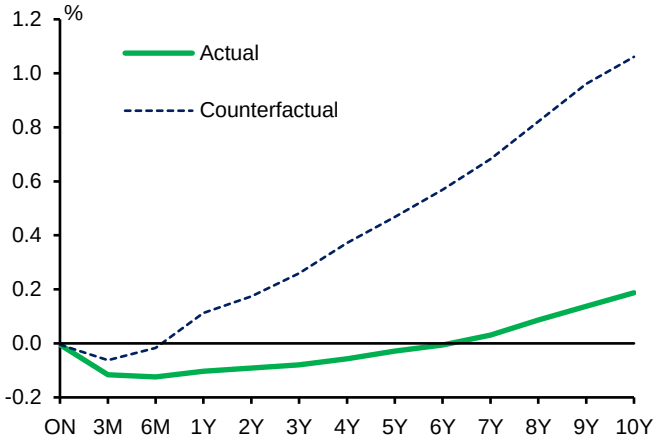
Assumptions on counterfactual scenario

(1) Interest rates

<By maturity>

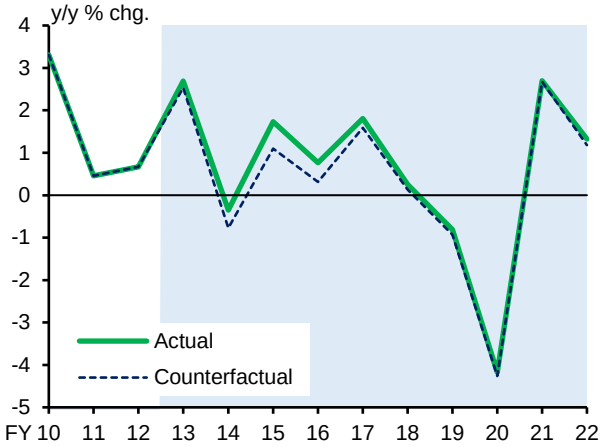


<FY2013-2022 average>

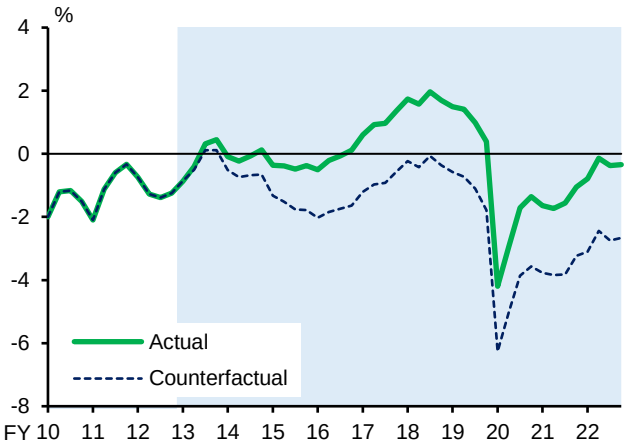


(2) Real gross domestic product

<Real GDP>

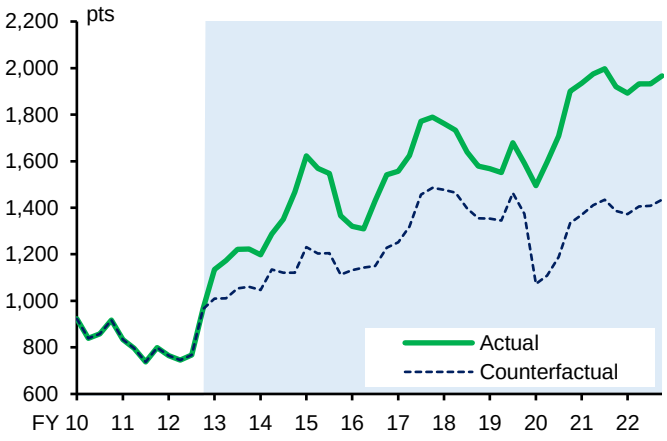


<Output gap>

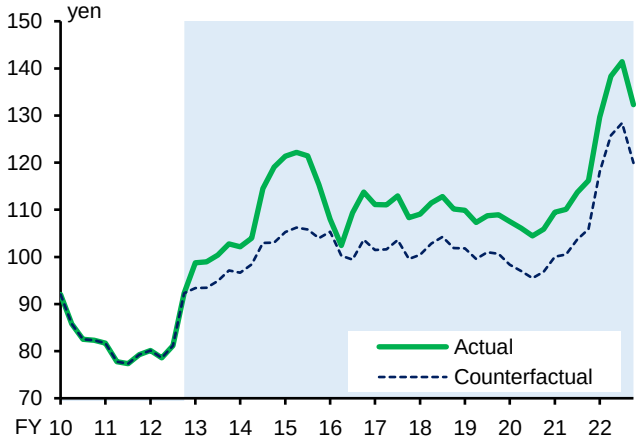


(3) Financial variables

<TOPIX>



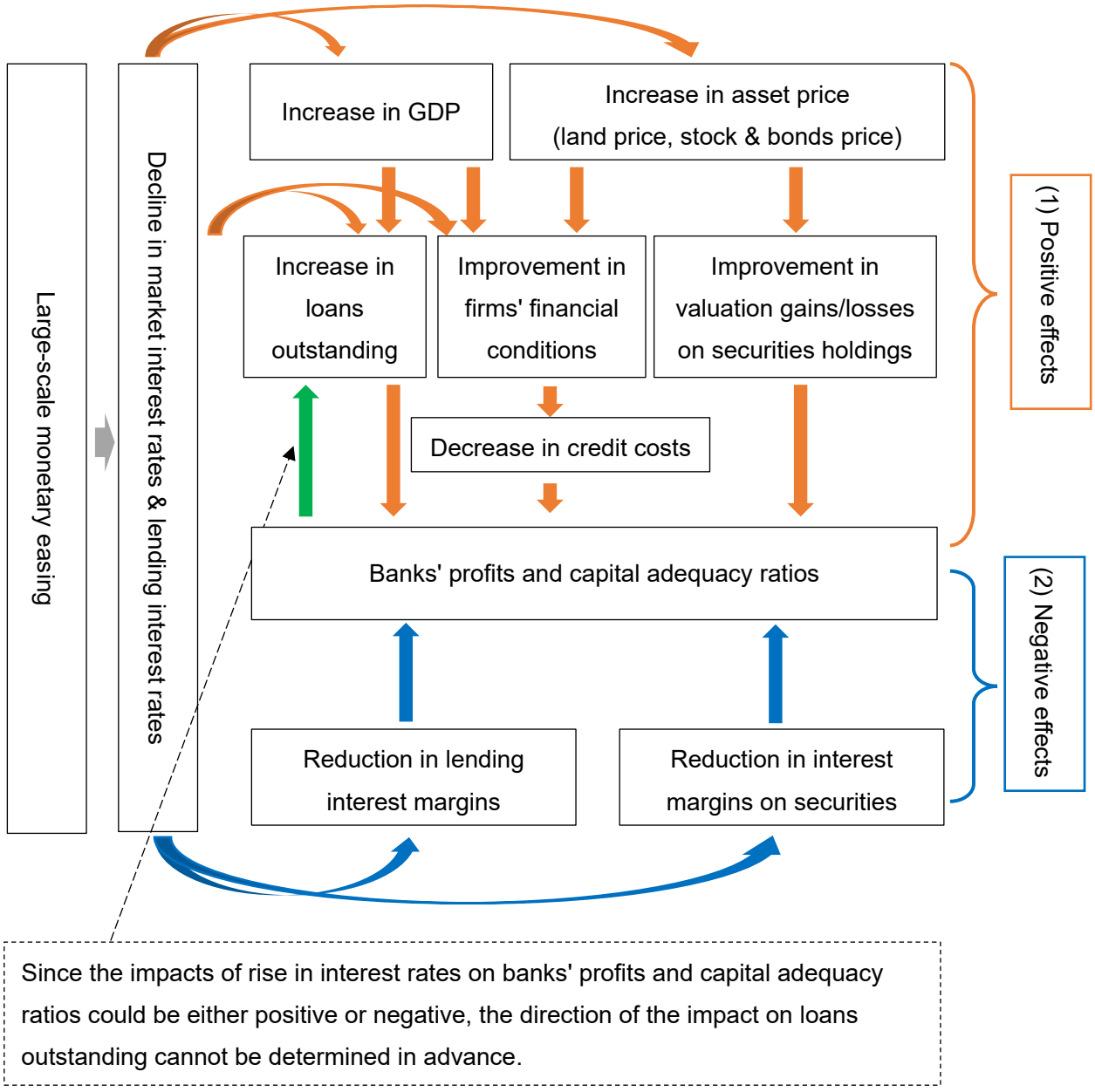
<U.S. yen/dollar rates>



Note: The shaded areas in the charts indicate simulation periods.
Source: Cabinet Office; JPX Market Innovation & Research; Ministry of Finance; BOJ.

(Chart 4)

The effects of large-scale monetary easing



(Chart 5)

Functions for loans outstanding in FMM

▽ Specification of the model for domestic corporate loans

$$\begin{aligned}&\text{Domestic corporate loan}_i\text{[y/y chg.]}\\&= \alpha_1 \times \text{Output gap} + \alpha_2 \times \text{Expected economic growth rate}\\&+\alpha_3 \times \text{Population growth rate} + \alpha_4 \times \text{Growth rate of land prices}\\&+\alpha_5 \times (\text{Capital adequacy ratio}_i - \text{Threshold}_i) \times \left(1 + \gamma_1 \times \text{Dummy}_{\text{CAR}_i<\text{threshold}_i}\right)\\&+\alpha_6 \times ROA_i \times \left(1 + \gamma_2 \times \text{Dummy}_{\text{Net income ROA}_i<0}\right)\\&+\alpha_7 \times \text{Domestic lending interest rate}_i \text{ [1 − quarter lag, chg. from previous year]}\\&+\text{Fixed effect}_i + \text{Constant}\end{aligned}$$

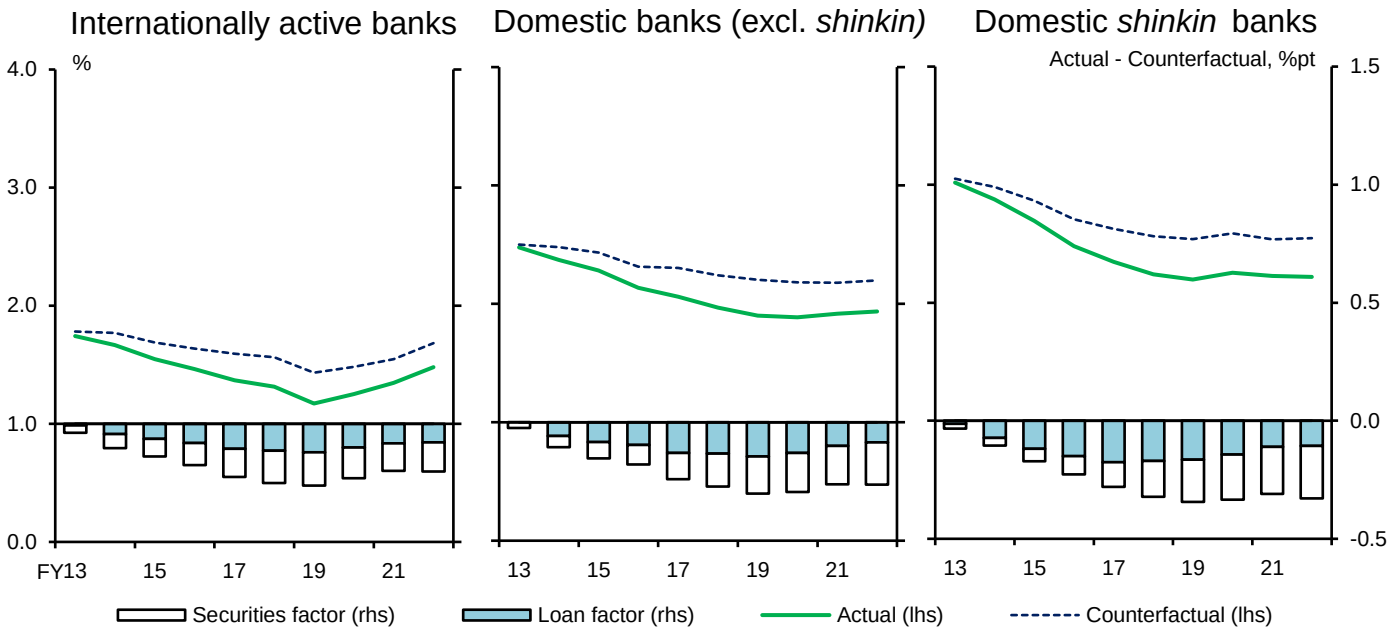
—— i denotes individual banks, hereafter.

▽ Specification of the model for domestic loans to individuals

$$\begin{aligned}&\text{Domestic household loans}_i \text{ [y/y chg.]}\\&= \alpha_1 \times \text{Output gap} + \alpha_2 \times \text{Expected economic growth rate}\\&+\alpha_3 \times \text{Population growth rate} + \alpha_4 \times \text{Growth rate of land prices}\\&+\alpha_5 \times (\text{Capital adequacy ratio}_i - \text{Threshold}_i) \times \left(1 + \gamma_1 \times \text{Dummy}_{\text{CAR}_i<\text{threshold}_i}\right)\\&+\alpha_6 \times ROA_i \times \left(1 + \gamma_2 \times \text{Dummy}_{\text{Net income ROA}_i<0}\right)\\&+\alpha_7 \times \text{Domestic lending interest rate}_i \text{ [1 − quarter lag, chg. from previous year]}\\&+\text{Fixed effect}_i + \text{Constant}\end{aligned}$$

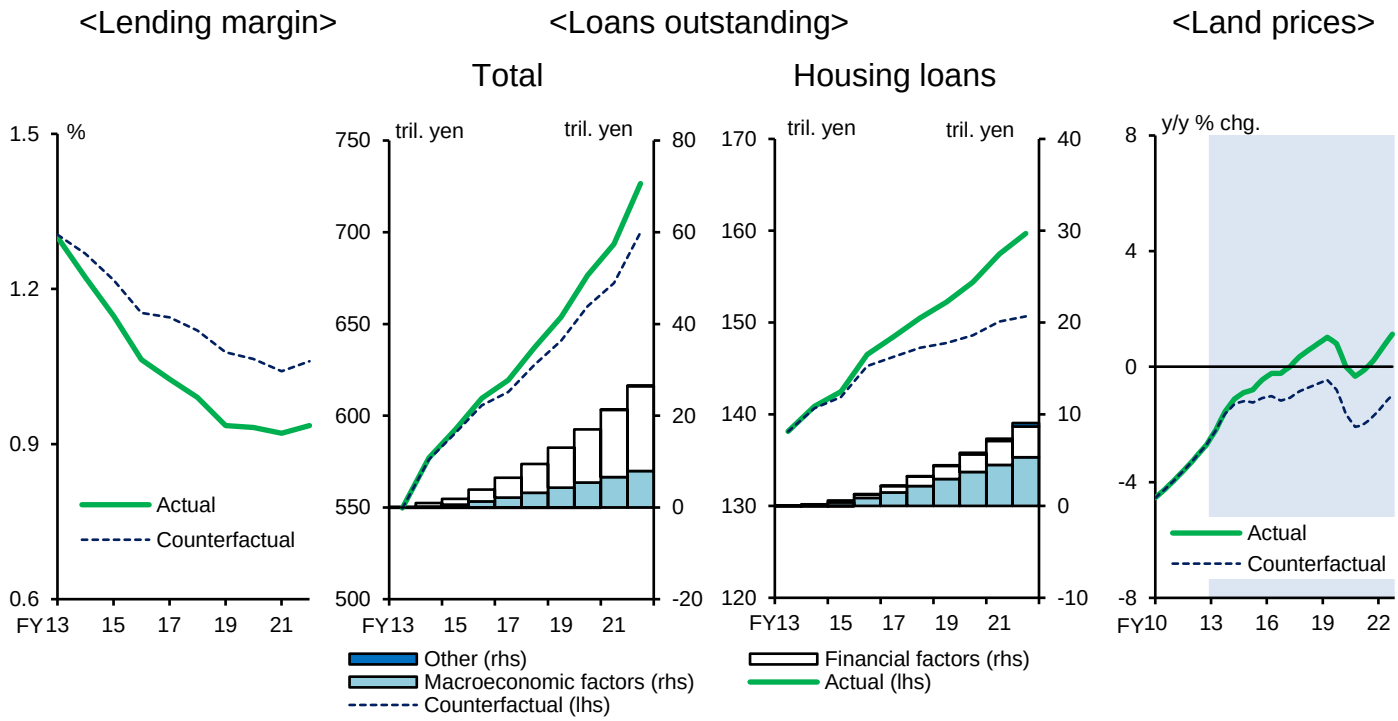
Simulation result (1)

(1) Net interest income



Note: Shows net interest income (relative to risk-weighted assets) and the contribution of each factor to the difference between the actual and counterfactual.
Source: BOJ.

(2) Net interest income on loans



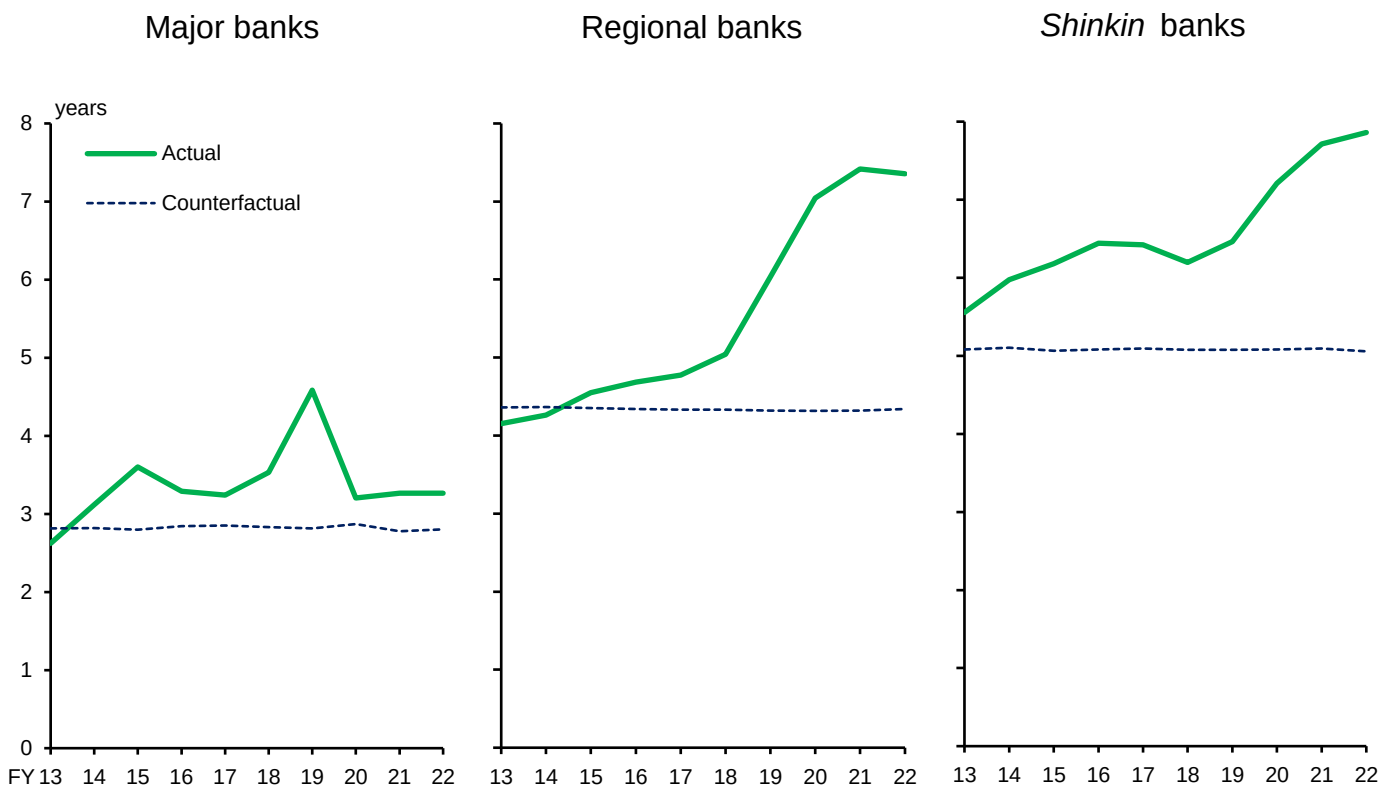
Note: 1. In the left-hand chart of (2), lending margin is defined as lending rate minus funding rate.
2. The middle chart of (2) shows actual and counterfactual loans outstanding and the contribution of each factor to the difference between the actual and counterfactual. "Financial factors" includes the effects of lending rate, land prices, bank's financial conditions, etc. "Macroeconomic factors" includes the effects of output gap, population, etc.
3. In the right-hand chart of (2), "Land prices" refers to "Urban Land Price Index". The shaded area indicates simulation period.

Source: Japan Real Estate Institute; BOJ.

(Chart 7)

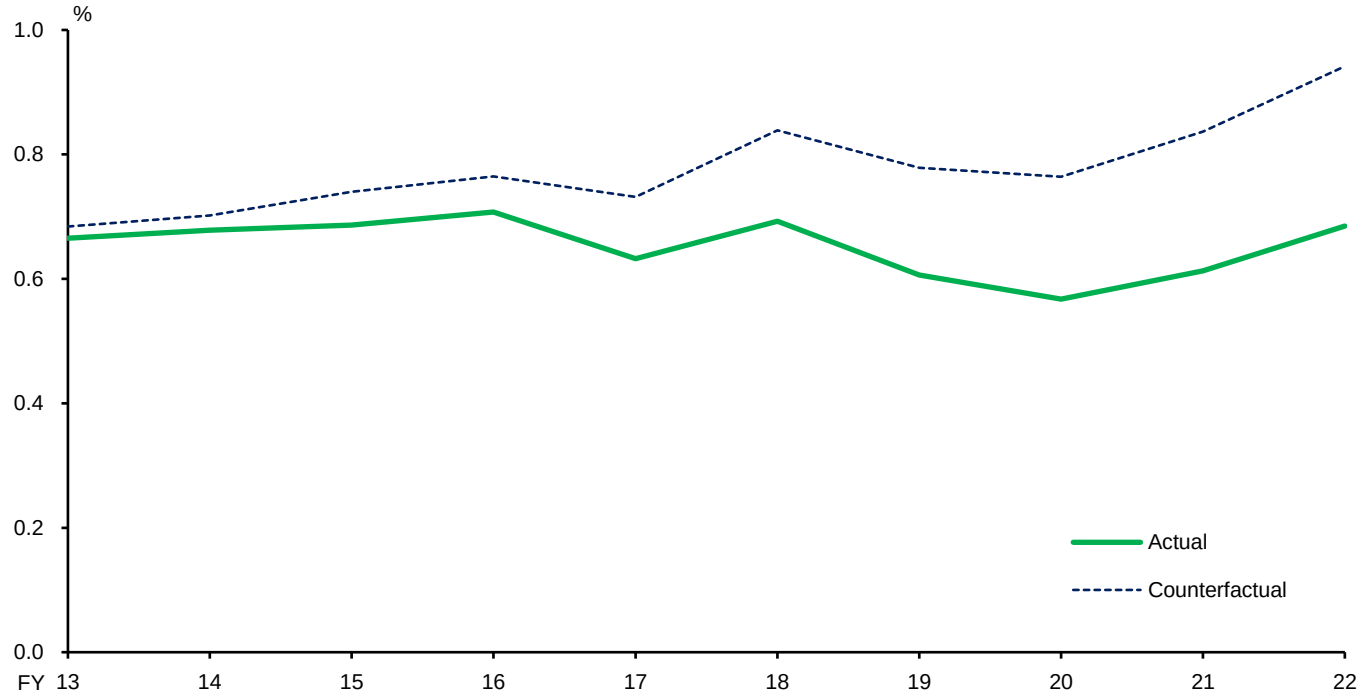
Simulation results (2)

(1) Duration of bonds



Note: Covers domestic bonds.
Source: BOJ.

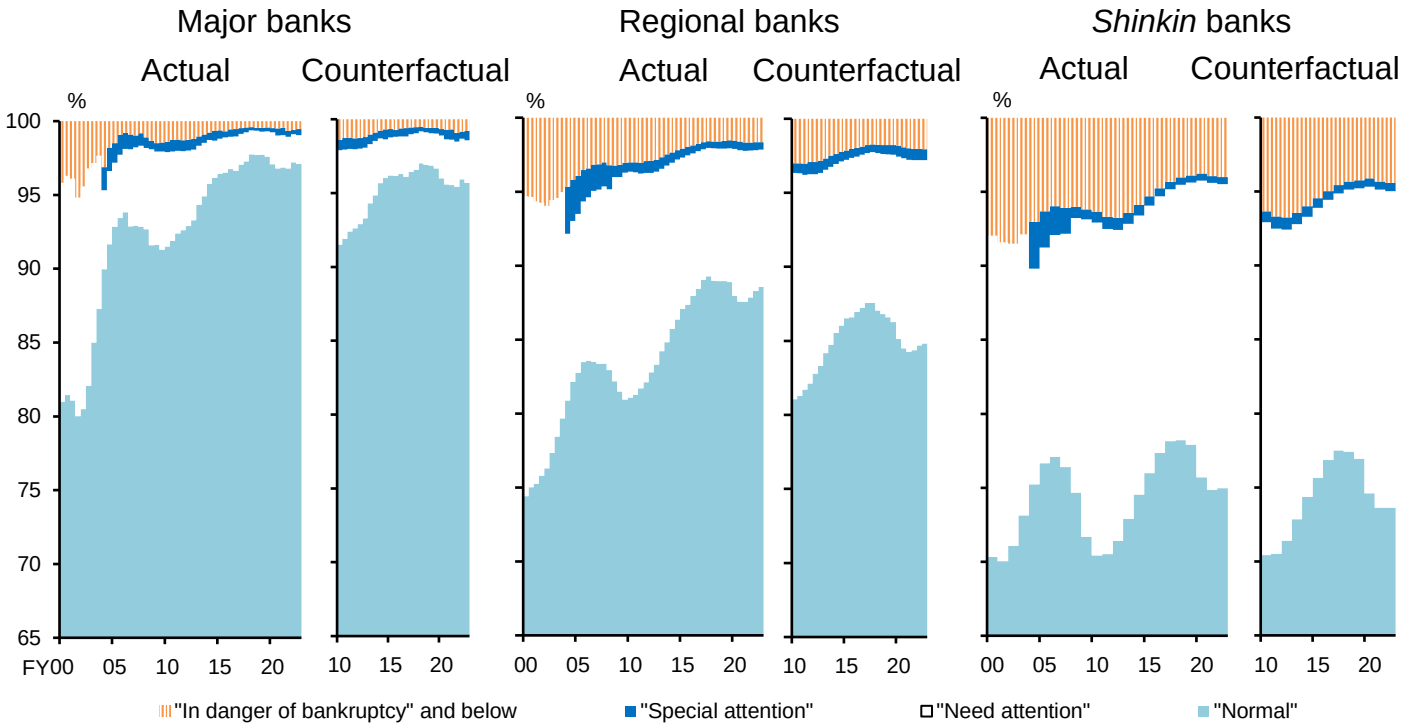
(2) Margins on securities



Note: Covers domestic securities. "Margins on securities" is calculated as yields on securities minus funding rates.
Source: BOJ.

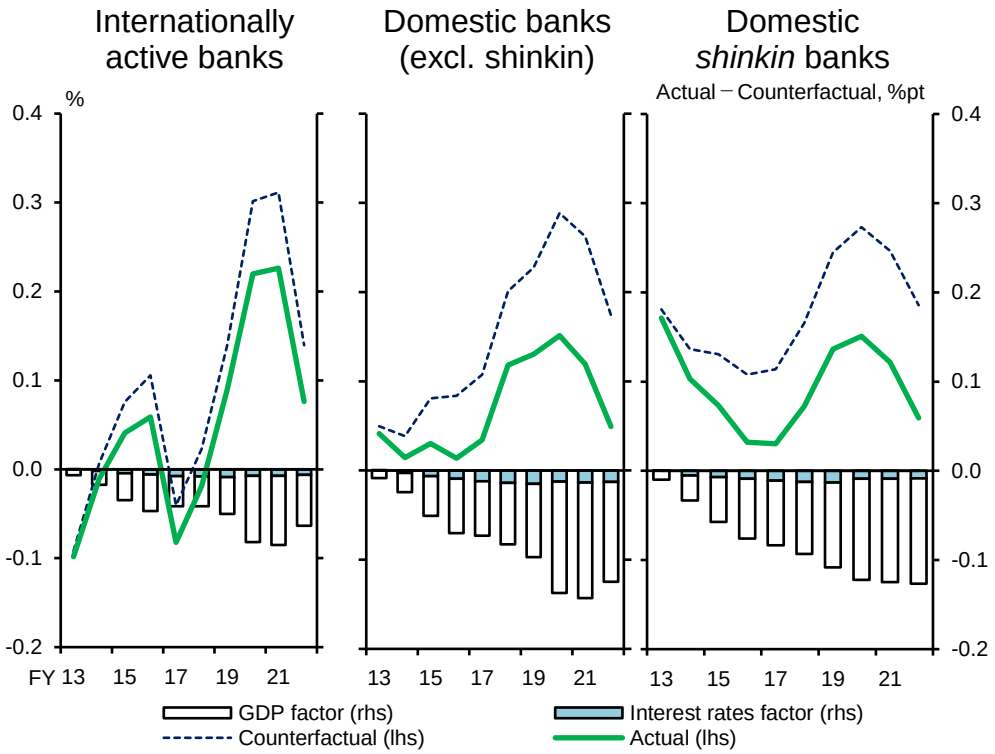
Simulation results (3)

(1) Borrower classification

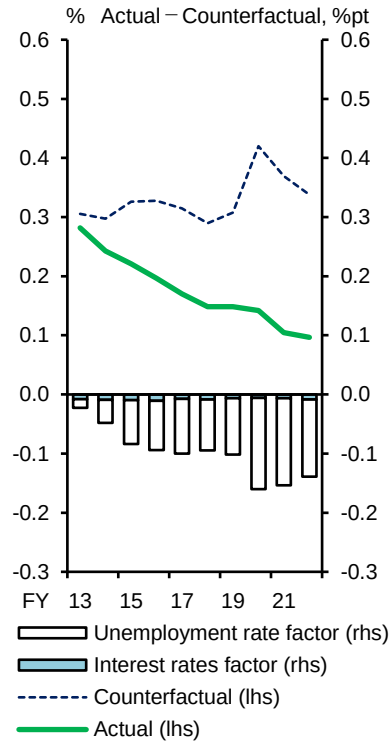


Note: "Need attention" indicates "Need attention excluding special attention" from fiscal 2004.
Source: BOJ.

(2) Credit cost ratios



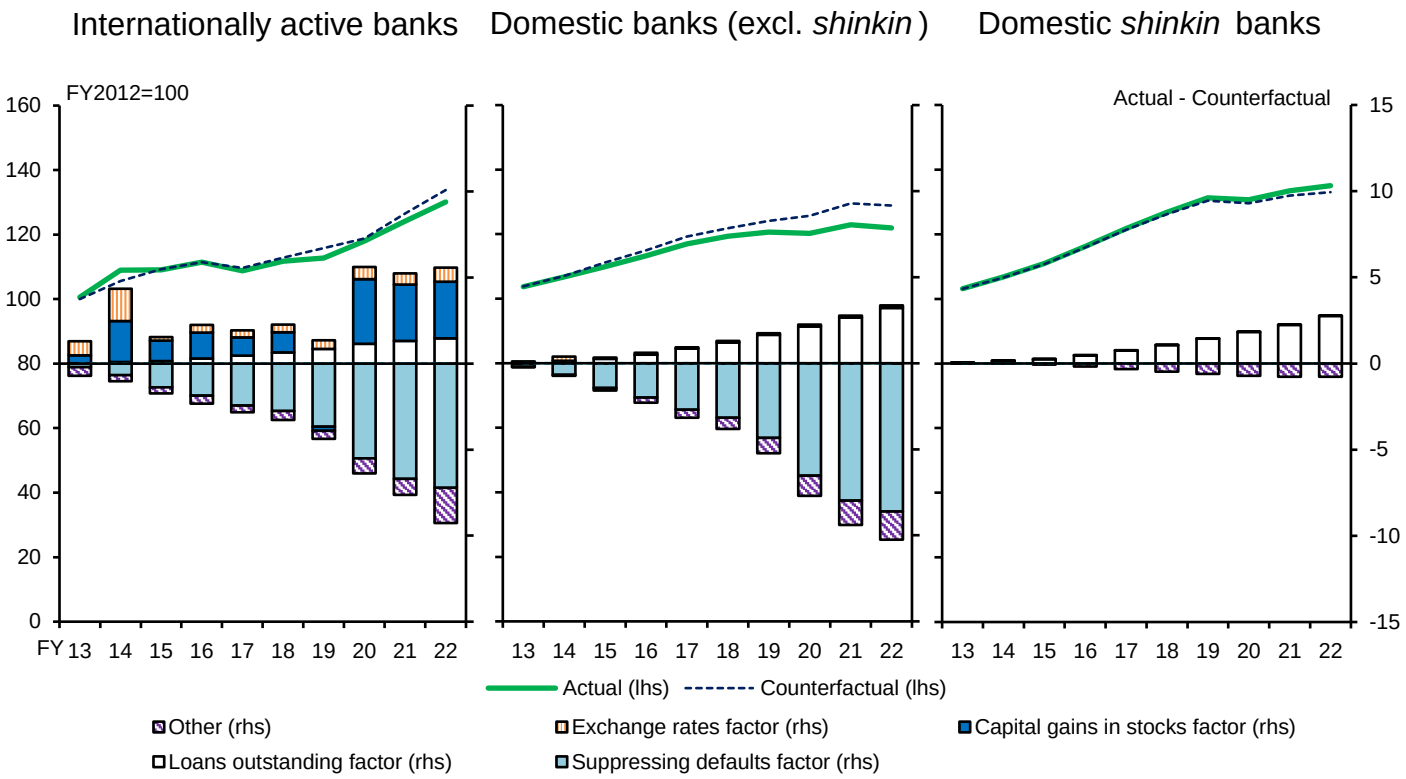
(3) Mortgage delinquency rates



Note: In mortgage delinquency rates (three months over), the sum of the deviation factors does not match the difference between actual and counterfactual because only the umemployment rate and the interest rate factor are shown as deviation factors.
Source: BOJ.

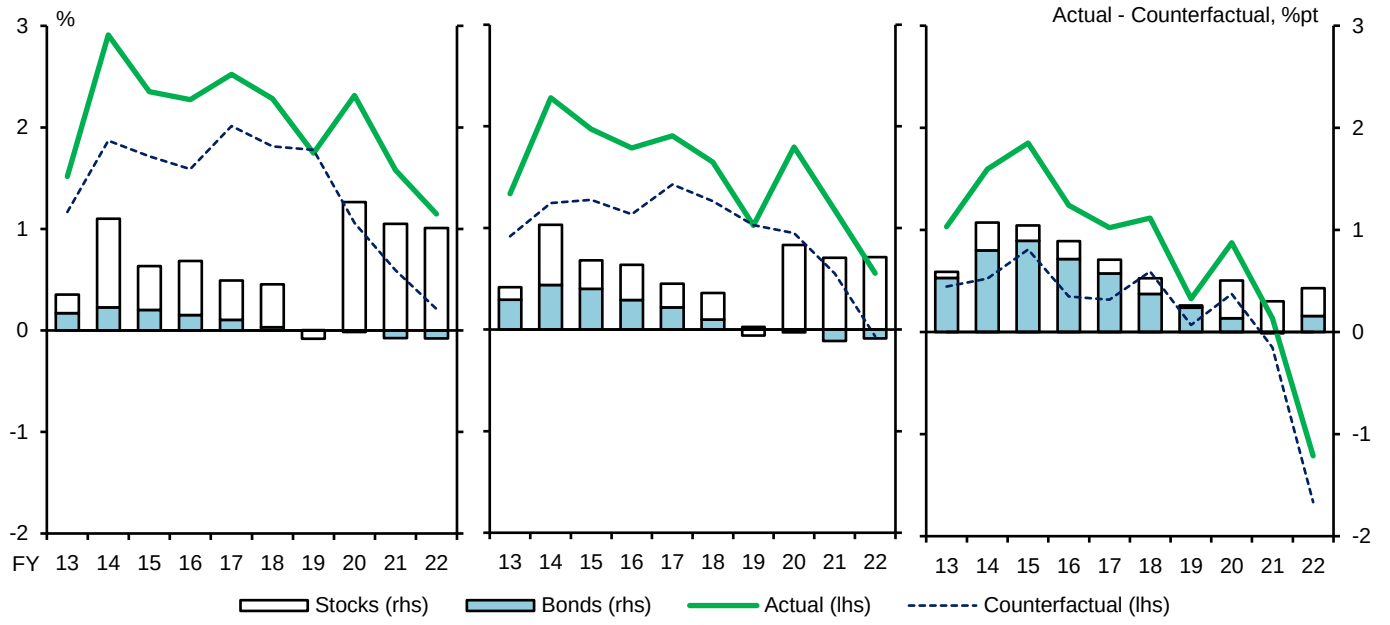
Simulation results (4)

(1) Risk-weighted assets



Note: "Loans outstanding factor" includes the valuation change of corporate bonds.
Source: BOJ.

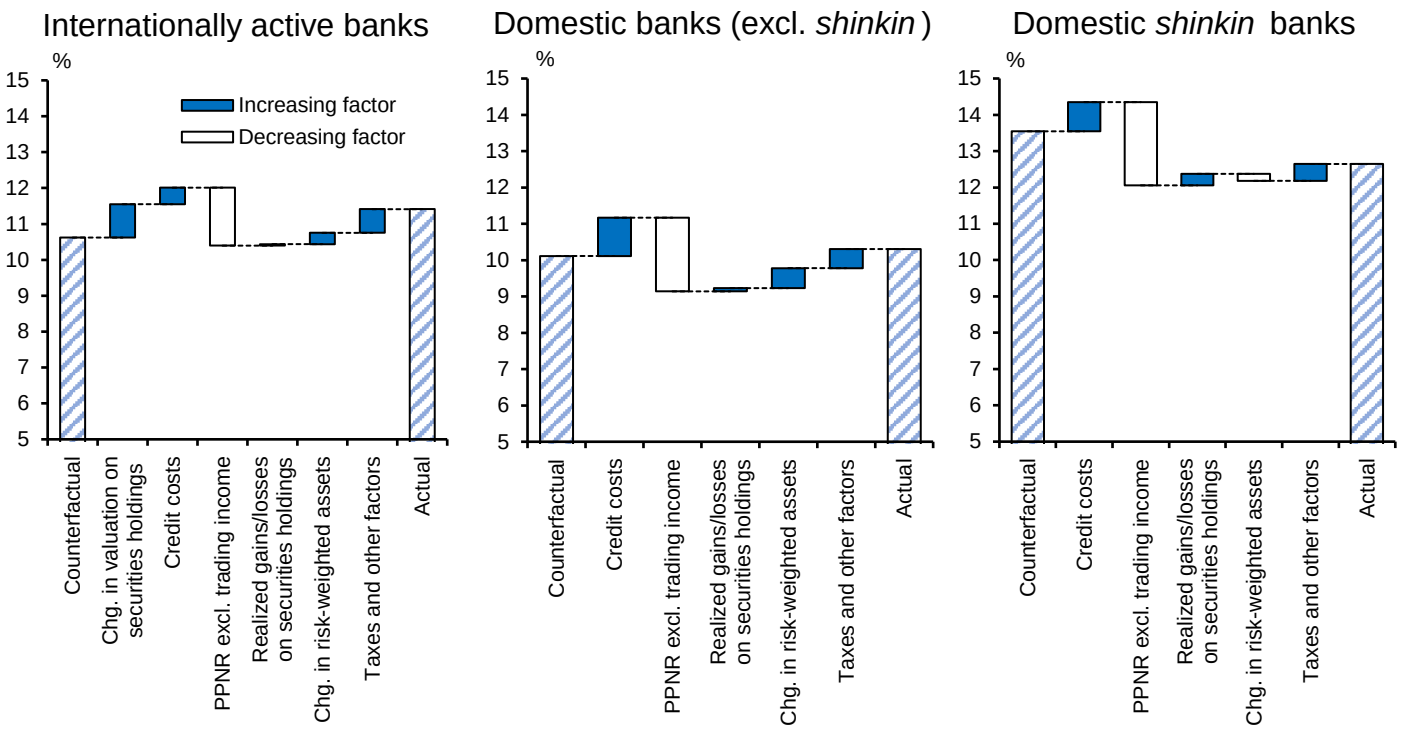
(2)The ratio of valuation gains/losses on securities



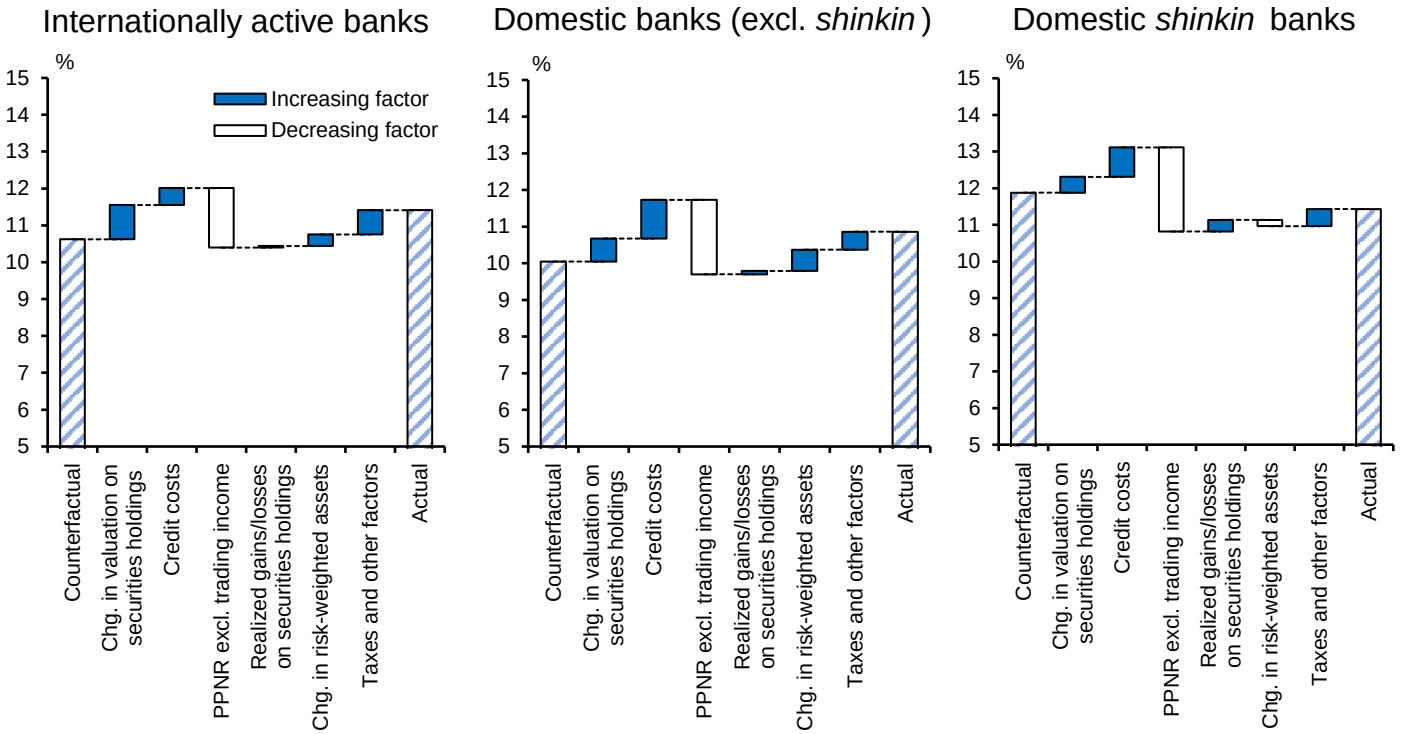
Note: Shows the ratio of valuation gains/losses on securities (excluding held-to-maturity securities and including strategic stockholdings) to risk-weighted assets and the contribution of each factor to the difference between the actual and counterfactual.
Source: BOJ.

Simulation results (5)

(1) Capital adequacy ratios



(2) Economic capital ratios



Note: 1. Indicates the contribution of each factor to the difference between the capital adequacy ratios under the counterfactual scenario and the actual capital adequacy ratios at the end of the simulation period (as of end-fiscal 2022).
2. The left-hand chart shows the CET1 capital ratio of internationally active banks. The middle and right-hand charts show the core capital ratio of domestic banks.
3. The economic capital ratios of domestic banks take into account the changes in valuation on securities holdings.

Source: BOJ.