March 19, 2021
Bank of Japan

Assessment for Further Effective and Sustainable Monetary Easing

The Background[Note]

(English translation prepared by the Bank's staff based on the Japanese original)

[Note] "The Background" provides explanations of "The Bank's View," which was decided by the Policy Board of the Bank of Japan at the Monetary Policy Meeting held on March 18 and 19, 2021, and released as Attachment 1 to the statement on monetary policy.

I. Motivation behind the Assessment

The Bank has been pursuing powerful monetary easing since the introduction of quantitative and qualitative monetary easing (QQE) in April 2013, with a view to achieving the price stability target of 2 percent. Setting the price stability target at 2 percent is appropriate when considering the characteristics of price statistics and in terms of securing room for future policy responses, and is a global standard. The Bank introduced the price stability target of 2 percent in January 2013.[1] It also clearly stated this target in the joint statement released together with the government.[2]

In September 2016, the Bank conducted the Comprehensive Assessment of developments in economic activity and prices since the introduction of QQE as well as its policy effects.[3] Based on the findings, a new policy framework, QQE with Yield Curve Control, was introduced. This framework has been working well, including in response to the impact of the novel coronavirus (COVID-19). However, due to that impact, economic activity and prices are projected to remain under downward pressure for a prolonged period, and it is expected to take time until the price stability target of 2 percent is achieved. Under these circumstances, the Bank decided to conduct an assessment for further effective and sustainable monetary easing, with a view to achieving the 2 percent target.

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[1] Bank of Japan, "The 'Price Stability Target' under the Framework for the Conduct of Monetary Policy," January 2013, https://www.boj.or.jp/en/announcements/release_2013/k130122b.pdf.

[2] Cabinet Office, Ministry of Finance, and Bank of Japan, "Joint Statement of the Government and the Bank of Japan on Overcoming Deflation and Achieving Sustainable Economic Growth," January 2013, https://www.boj.or.jp/en/announcements/release_2013/k130122c.pdf.

[3] Bank of Japan, *Comprehensive Assessment: Developments in Economic Activity and Prices as well as Policy Effects since the Introduction of Quantitative and Qualitative Monetary Easing (QQE)*, September 2016, https://www.boj.or.jp/en/announcements/release_2016/rel160930d.pdf.

II. Developments in Economic Activity and Prices under QQE with Yield Curve Control

A. The Comprehensive Assessment and Policy Responses Based on the Findings

In September 2016, the Bank conducted the Comprehensive Assessment of developments in economic activity and prices since the introduction of QQE as well as its policy effects. The findings of the assessment showed the following. First, reflecting the introduction of QQE in April 2013, financial conditions improved significantly, thereby boosting economic activity and corporate profits. Second, under such economic conditions, the economy no longer was in deflation in the sense of a sustained decline in prices. Third, however, the price stability target of 2 percent had not been achieved. In this context, the mechanism through which inflation expectations are formed played an important role. The formation of inflation expectations in Japan is largely adaptive, and raising them in the presence of adaptive expectations formation is associated with uncertainties and likely to take time. Fourth, monetary easing affects the functioning of the Japanese government bond (JGB) market and may have a negative impact on the functioning of financial intermediation through the cumulative impact mainly on financial institutions' profits and the investment environment for insurance and pension products.

Based on these findings, the Bank introduced QQE with Yield Curve Control in September 2016 (Chart 1). This framework consists of two major components. The first is yield curve control, in which the Bank controls short- and long-term interest rates. In order to achieve the price stability target of 2 percent, the Bank encourages the formation of the most appropriate shape of the yield curve while taking into account developments in economic activity and prices as well as financial conditions. Under the guideline for market operations, in which the short-term policy interest rate is set at minus 0.1 percent and the target level of 10-year JGB yields is around zero percent, the Bank has thus far managed to encourage the formation of an appropriate shape of the yield curve. The second component is an inflation-overshooting commitment, in which the Bank commits to continuing to "expand the monetary base until the year-on-year rate of increase in the observed consumer price index (CPI) exceeds 2 percent and stays above the target in a stable manner."

The introduction of this framework has three aims. The first, in order to achieve the price stability target of 2 percent, is to maintain the output gap in positive territory for as long as possible, given that the formation of inflation expectations in Japan is largely adaptive. The second is to introduce a framework in which the Bank controls interest rates to appropriate levels while taking into consideration both the positive and side effects of monetary easing, with the expectation that monetary easing will be prolonged. The third is to strengthen the forward-looking element of inflation expectations formation with the inflation-overshooting commitment.

B. Developments in Economic Activity and Prices since the Comprehensive Assessment

The situation where inflation rates do not rise easily continued even after the conduct of the Comprehensive Assessment. Given this, a further assessment of the mechanism behind inflation developments shows the following (Appendix 1). The mechanism of adaptive inflation expectations formation reflects not only the observed inflation rate at the time but also people's past experiences, and therefore it is relatively complex and sticky. In other words, changing people's mindset and behavior based on the assumption that prices will not increase easily, which have become deeply entrenched because of the experience of prolonged deflation, will take time. In addition, elastic labor supply, mainly of women and seniors, and a rise in firms' labor productivity have consequently constrained inflation.

Under these circumstances, QQE with Yield Curve Control has had positive effects in line with the intended mechanism (Chart 2). First, with nominal interest rates being kept at extremely low levels through yield curve control and inflation expectations that are higher than those prior to the introduction of QQE, real interest rates (calculated by subtracting inflation expectations from nominal interest rates) have been clearly negative. Second, the low real interest rates have improved financial conditions, mainly through low funding costs as well as favorable conditions in financial and capital markets. The year-on-year rate of change in the amount outstanding of bank lending has continued to be at around 2 percent, and that in the aggregate amount outstanding of CP and corporate bonds has increased, with its pace of acceleration also increasing since 2016. In financial and capital markets, foreign exchange rates have been stable on the whole and stock prices have been on an uptrend. Third, as a result, these developments have pushed up economic activity, and corporate profits and the employment situation have improved. The output gap turned clearly positive (representing excess demand) in 2017 and expanded within positive territory. Fourth, with these favorable economic conditions, wages have increased moderately, as seen in the fact that base pay -- which did not rise during the period of deflation -- has increased for seven consecutive years, and underlying inflation has taken hold in positive territory.

Under QQE with Yield Curve Control, the output gap has improved and labor market conditions have tightened. Under these circumstances, as mentioned earlier, labor force participation of women and seniors has increased and firms have improved their labor productivity. With economic developments continuing to be favorable, positive moves toward addressing the medium- to long-term challenges facing Japan's economy have been observed.

III. Policy Effects of QQE with Yield Curve Control

A. Effects of QQE with Yield Curve Control on Nominal Interest Rates

Looking at developments in JGB yields under yield curve control, long-term interest rates (10-year JGB yields) have been at around 0 percent and yields on JGBs with other maturities also have been stable at low levels (Chart 3). After the outbreak of COVID-19, liquidity in the JGB market declined temporarily and a subsequent increase in issuance of JGBs intensified upward pressure on yields. Even in this situation, the yield curve has been stable at a low level on the whole.

Long-term interest rates reflect factors such as the outlook for economic activity and prices as well as long-term interest rates abroad. Controlling for these factors, quantitative analysis of the effects of the Bank's JGB purchases shows that its purchases have statistically significant effects on long-term interest rates in terms of lowering them by around 1 percentage point on average (Chart 4).

B. Effects of Accommodative Financial Conditions on Economic Activity and Prices

The main transmission mechanism of QQE with Yield Curve Control is to achieve accommodative financial conditions, mainly brought about by low real interest rates, and thereby exert positive effects on economic activity and prices. Actual developments in economic activity and prices as described earlier have been in line with this mechanism.

Using its large-scale macroeconomic model -- the Quarterly Japanese Economic Model (Q-JEM) -- the Bank examined the effects of monetary easing under QQE with Yield Curve Control on economic activity and prices (Appendix 2). Specifically, it carried out counterfactual simulations to compare actual developments in economic activity and prices with simulated developments obtained assuming QQE had not been introduced. The simulation results show that actual figures are higher than the counterfactual estimates for the period through the July-September quarter of 2020; on average, the level of real GDP is between around 0.9 and 1.3 percent higher, the output gap is between around 0.9 and 1.3 percentage points higher, and the year-on-year rate of change in the CPI (all items less fresh food and energy) is between around 0.6 and 0.7 percentage points higher. This suggests that QQE (and QQE with Yield Curve Control) has had positive effects to those extents on economic activity and prices.

Since 2020, reflecting the decline in demand stemming from the large shock due to the COVID-19 pandemic, the output gap has deteriorated significantly, inflation has been restrained, and inflation expectations have weakened somewhat (Chart 2). However, the simulation results indicate that monetary easing under QQE with Yield Curve Control has been effective in supporting economic activity and prices even amid the COVID-19 shock.

C. Transmission Channels through Which a Decline in Interest Rates Affects Economic Activity and Prices

There are two transmission channels through which a decline in interest rates affects economic activity and prices. The first is via funding costs. In fact, under QQE with Yield Curve Control, lending rates have declined clearly and interest rates on CP and corporate bonds have been at extremely low levels (Chart 5). The second channel is via financial and capital markets. That is, a decline in interest rates also affects economic activity and prices through favorable conditions in financial and capital markets. Although financial transactions such as lending are not usually conducted at negative interest rates, transactions in financial and capital markets more commonly take place even at such rates. Thus, it has been pointed out that the transmission channel via financial and capital markets is less susceptible to the effective lower bound on nominal interest rates (Chart 3[1]).

To examine these points, the Bank used a vector-autoregressive (VAR) model to analyze the transmission channels through which a decline in interest rates improves the output gap (Chart 6). The analysis shows that the transmission channel via funding costs accounts for more than 30 percent of the effects on the output gap, while that via financial and capital markets accounts for more than 50 percent. Although the results should be interpreted with some latitude, they indicate that the decline in interest rates has been exerting positive effects on economic activity and prices through both funding costs and financial and capital markets.

D. Effects of a Decline in Interest Rates with Different Maturities on Economic Activity and Prices

The degree to which a decline in real interest rates affects economic activity and prices depends on the maturity of those interest rates. In the Comprehensive Assessment conducted in 2016, the Bank examined the effects of a given decline in real interest rates on the output gap, employing the concept of the "natural yield curve."[4] The results indicated that the effects were relatively large for short- and medium-term interest rates and became smaller the longer the maturity. While taking changes in economic and financial developments to date into account, the Bank examined the effects in this assessment, using the same approach. The results indicate that this pattern is unchanged (Chart 7[1]).

In addition, in the 2016 Comprehensive Assessment, the results pointed to the possibility that an excessive decline in super-long-term interest rates will lead to anxiety about the future sustainability of the functioning of financial activities in a broader sense and have a negative impact on economic activity by, for example, undermining people's sentiment. In

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[4] The "natural yield curve" applies the concept of the natural rate of interest not to the interest rate at a certain maturity but across the entire yield curve. For details on the analysis, see Appendix 8 in the *Comprehensive Assessment: Developments in Economic Activity and Prices as well as Policy Effects since the Introduction of Quantitative and Qualitative Monetary Easing (QQE)* released in September 2016 (https://www.boj.or.jp/en/announcements/release_2016/rel160930d.pdf).

the current assessment, the effects of a decline in super-long-term interest rates on the consumer confidence index were examined, using the VAR model. The results indicate that a decline in super-long-term interest rates does have a negative impact on consumer sentiment (Chart 7[2]).

E. Market Participants' Expectations with Regard to Short-Term Interest Rate Cuts

The results of a survey of market participants show that fewer of them expect short-term interest rate cuts to be an option for additional easing compared with the time immediately after the introduction of the negative interest rate policy (Chart 8). While market participants' expectations with regard to short-term interest rate cuts could change in response to economic and price developments at any given time, anecdotal information suggests that an increasing number of those who are not expecting interest rate cuts tend to point to the impact on the functioning of financial intermediation.

F. Effects of Policy Responses to the Impact of COVID-19

Since March 2020, in response to the impact of COVID-19, the Bank has conducted powerful monetary easing under QQE with Yield Curve Control. The aim is to provide support for financing, mainly of firms, so that they can sustain their businesses, and to maintain stability in financial and capital markets in order to prevent a vicious cycle between turmoil in the markets and deterioration in the real economy.

The Bank's responses to the impact of COVID-19 have been effective (Chart 9). Through the Special Program to Support Financing in Response to the Novel Coronavirus (COVID-19), coupled with the government's measures to support financing and active efforts made by financial institutions, the environment for external funding has remained accommodative. Through the Special Funds-Supplying Operations to Facilitate Financing in Response to the Novel Coronavirus (COVID-19), the Bank has been encouraging financial institutions' efforts, in that it provides funds on favorable terms for their COVID-19 support lending by applying interest rates as an incentive to their current account balances that correspond to the amounts outstanding of loans provided through this operation. The increase in purchases of CP and corporate bonds by the Bank has prevented a rise in spreads, thereby helping to maintain a favorable environment for firms to obtain funding through the issuance of CP and corporate bonds.

Looking at financial and capital markets, JGB yields have been stable at low levels under yield curve control even after the outbreak of COVID-19, when liquidity in the JGB market declined temporarily and a subsequent increase in issuance of JGBs intensified upward pressure on yields. Although U.S. dollar funding costs rose significantly in response to the surge in demand for dollar funding due to the COVID-19 shock, the impact was only temporary due to the provision of U.S. dollar liquidity through the cooperation of six central banks, including the Federal Reserve and the Bank of Japan. In addition, flexible purchases of exchange-traded funds (ETFs) and Japan real estate investment trusts (J-REITs) have contained instability in financial and capital markets (see Section V for more details).

IV. Effects on the Functioning of the JGB Market and Financial Intermediation

A. Effects on the Functioning of the JGB Market

Yield curve control has affected the functioning of the JGB market. With the range of fluctuations in interest rates having narrowed, many indicators suggest that the functioning of the JGB market has decreased since the introduction of yield curve control (Chart 10).

The effects of yield curve control on the functioning of the JGB market are, in a sense, an inevitable consequence of maintaining interest rates stably at extremely low levels. In terms of the sustainable conduct of yield curve control, it is important to strike an appropriate balance between maintaining market functioning and controlling interest rates. On this point, although significant fluctuations in interest rates could lead to adverse effects on developments in economic activity and prices, fluctuations within a certain range could have positive effects on the functioning of the JGB market without impairing the effects of monetary easing. Examination on the effects of interest rate fluctuations on business fixed investment indicates that the degree to which monetary easing affects business fixed investment is more or less unchanged, except when the range of fluctuations in 10-year JGB yields over the preceding six months exceeds 50 basis points (Appendix 3).

In July 2018, in order to enhance the sustainability of QQE with Yield Curve Control, the Bank made the conduct of JGB purchases more flexible, making clear that 10-year JGB yields might move upward and downward to some extent, mainly depending on developments in economic activity and prices. Specifically, regarding the range of fluctuations in 10-year JGB yields, it announced that those yields might move upward and downward in about double the range, which was previously between around plus and minus 0.1 percent from the target level. In fact, from July 2018 through 2019, the range widened to between plus 0.16 and minus 0.29, and many indicators suggested that the functioning of the JGB market had improved.

Looking at developments since the spread of COVID-19 in 2020, 10-year JGB yields temporarily fluctuated to a considerable degree with financial and capital markets becoming volatile, but thereafter remained within a narrow range through the beginning of this year. Meanwhile, even though the functioning of the JGB market has recovered from the significant deterioration, it has not yet returned to the level prior to the pandemic.

B. Effects on the Functioning of Financial Intermediation

Downward pressure on financial institutions' profits stemming from low interest rates could have a negative impact on the functioning of financial intermediation by, for example, making financial institutions more reluctant to lend.

Financial institutions' core profitability has continued to decline as a trend, mainly due to a shrinking of the margin between domestic deposit and lending rates (Chart 11). The shrinking of net interest margins is caused by the prolonged low interest rate environment and structural factors such as the downtrend in loan demand due to, for example, the declining population and the resultant severe competition among financial institutions. Meanwhile, financial institutions have continued to make efforts to enhance their profitability, mainly through risk taking in lending and securities investment as well as through cost cutting and saving. Owing to QQE with Yield Curve Control, economic activity has been boosted and corporate profits have improved, which in turn likely had positive effects on financial institutions' profits, mainly through increased loans and contained credit costs.

That said, profits of financial institutions, regional ones in particular, are expected to remain under downward pressure, continuing to be affected by the low interest rate environment and structural factors. Since the effects of financial institutions' profits on their financial soundness is cumulative, attention needs to be paid to the risk that prolonged downward pressure on profits may lead to a gradual pullback in financial intermediation. On the other hand, while financial institutions are expected to continue making various efforts to enhance their profitability, the vulnerability of the financial system could increase in the process, mainly as a result of financial institutions' search for yield behavior. As for these overheating and pullback risks, in the *Outlook for Economic Activity and Prices*, the Bank, based on the *Financial System Report*, has been examining financial imbalances from a longer-term perspective.

C. Operation of the Complementary Deposit Facility

In January 2016, the Bank introduced QQE with a Negative Interest Rate. This aims to lower the short end of the yield curve by slashing the deposit rate on current account balances into negative territory and to exert further downward pressure on interest rates across the entire yield curve, in combination with large-scale purchases of JGBs. In keeping short-term interest rates in negative territory, the Bank decided to apply a negative interest rate only to the marginal increase in current account balances so that the direct burden on financial institutions' profits is eased. Specifically, the Bank revised the Complementary Deposit Facility. It divided the current account balance into three tiers: the Basic Balance, the Macro Add-on Balance, and the Policy-Rate Balance. To the Basic Balance and the Macro Add-on Balance, which make up most of the current account balance, a positive interest rate of 0.1 percent and a zero interest rate are applied respectively, and a negative interest rate of minus 0.1 percent is applied only to the Policy-Rate Balance. Under this three-tier system, short-term interest rates have been stable in negative territory to date.

That said, with more than five years having passed since the revision of the Complementary Deposit Facility, there is a gap between the actual Policy-Rate Balances and the "hypothetical" Policy-Rate Balances, which are calculated based on the assumption that arbitrage transactions fully take place, and the gap has been widening recently (Appendix 4). In order to address this situation, the Bank can make technical adjustments to compress the unused amounts of Macro Add-on Balances and a portion of the Policy-Rate Balances by reviewing some parts of the method to calculate the limit of the Macro Add-on Balances.

V. Effects of ETF and J-REIT Purchases and Points to Note

A. Effects of ETF and J-REIT Purchases

The Bank has been purchasing ETFs and J-REITs to lower risk premia in the stock and J-REIT markets in order to exert positive effects on economic activity and prices.

The Bank estimated the effects of ETF purchases, using two of the indicators of risk premia -- equity risk premium implied by option prices and yield spreads (Chart 12 and Appendix 5).[5] The results show that ETF purchases have the effect of lowering risk premia. Further, the Bank estimated how effects differ depending on market conditions and the size of ETF purchases. The estimation results suggest that the effects of ETF purchases per single amount are larger (1) the lower the level of stock prices relative to their trend at the time of purchases, (2) the higher the volatility in the stock market when stock prices are below their trend, (3) the larger the rate of decline in stock prices immediately before the conduct of purchases, and (4) the larger the size of purchases.

These results are consistent with the view of market participants (Chart 13). Namely, survey results of market participants indicate that, during periods of market instability such as when stock prices decline or volatility heightens, ETF purchases by the Bank draw the market's attention and are seen as a positive factor for the stock market. On the other hand, when the market is stable, they lose its attention and fewer market participants see such purchases as positive.

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[5] Since there is no single indicator that captures developments in risk premia, the Bank incorporates various pieces of data and indicators to judge them from a comprehensive perspective -- such as developments in corporate profits, dividends, and stock prices, as well as the level of interest rates -- and also anecdotal information from market participants. The analysis in this assessment uses two of these indicators to estimate the effects of ETF purchases.

B. Points to Note with Regard to ETF and J-REIT Purchases

While the results show that purchases of ETFs and J-REITs are effective, some points to note have been raised.

One example is the effects that the Bank's holding of ETFs may have on corporate governance. Specifically, it has been argued that, when the Bank holds ETFs, this will weaken business discipline in the management of individual firms. However, voting rights in ETF component firms are to be exercised appropriately by asset management companies that have accepted the Stewardship Code. With this, management discipline is being exerted. That said, it is possible that such concern could grow as the Bank further increases its ETF holdings (Chart 14). Another point is that the Bank's indirect shareholding ratio in some ETF component firms tends to increase much more rapidly through such purchases in the case of ETFs tracking the Nikkei 225 Stock Average or the JPX-Nikkei Index 400 (JPX-Nikkei 400) than ETFs tracking the Tokyo Stock Price Index (TOPIX). The Bank has been addressing this issue by increasing the share of purchases of ETFs tracking the TOPIX. With regard to J-REIT purchases, while the Principal Terms and Conditions stipulate that the maximum amount of each J-REIT to be purchased shall not exceed 10 percent of the total amount of that J-REIT issued, there are some J-REITs for which the percentage of the Bank's holdings has been rising toward this threshold. Besides these points, some have pointed to the potential impact of ETF and J-REIT purchases on the Bank's balance sheet. In this context, the Principal Terms and Conditions stipulate that in case the total market value of ETFs or J-REITs purchased by the Bank falls below their total book value, the Bank shall record provisions for possible losses. This has ensured its financial soundness. However, as the Bank's ETF holdings increase further, the impact on the Bank's balance sheet would become large.

VI. Examination on the Effectiveness of the Inflation-Overshooting Commitment

Given that it may take time to raise inflation expectations, of which the formation in Japan is largely adaptive, the Bank decided in September 2016 to adopt a new policy framework, with yield curve control at its core. Under this framework, it aims to enhance the sustainability of monetary easing while striking a balance between the positive and side effects of monetary easing.

Together with yield curve control, the Bank introduced an inflation-overshooting commitment so as to strengthen the forward-looking element of inflation expectations formation. Through this commitment, the Bank commits to expanding the monetary base until the year-on-year rate of increase in the observed CPI exceeds the price stability target of 2 percent and stays above the target in a stable manner. Generally, it is considered desirable for central banks to conduct monetary policy based on the outlook for economic activity and prices, since it takes a certain amount of time for monetary policy to affect economic activity and prices. From this perspective, the inflation-overshooting commitment is an extremely strong commitment, in that the Bank promises to continue with monetary easing based on observed CPI inflation rather than the outlook for CPI inflation.

Through an inflation-overshooting commitment, the Bank is implementing the so-called makeup strategy, in which monetary easing is conducted taking into account instances when the observed inflation rate continued to stay below the target. The idea underlying this strategy is that a central bank would aim to attain a situation where the inflation rate is 2 percent on average over the business cycle. The Bank has clearly stated its stance of adopting this idea.[6]

The results of simulations using a simple macroeconomic model show that, when the observed inflation rate in Japan is below the inflation target, monetary policy should be conducted by also referring to the past inflation rate for some period of time (Appendix 6). In addition, the results indicate that the lower the natural rate of interest, the longer the past inflation rate should be used for reference.

[6] In the Bank's policy statement, it is described that "[a]chieving the price stability target means attaining a situation where the inflation rate is 2 percent on average over the business cycle." For details, see "New Framework for Strengthening Monetary Easing: 'Quantitative and Qualitative Monetary Easing with Yield Curve Control'," January 2016, https://www.boj.or.jp/en/announcements/release_2016/k160921a.pdf.

Appendix 1: Mechanism behind Inflation Developments in Japan

Based on the situation since the Comprehensive Assessment, the Bank conducted a further assessment of the mechanism behind inflation developments in Japan.

Complex and Sticky Mechanism of Adaptive Inflation Expectations Formation

As pointed out in the Comprehensive Assessment, the adaptive element plays a strong role in the mechanism of inflation expectations formation in Japan. Using data up until recently, the Bank examined this mechanism and found that the adaptive element still plays a much larger role in the mechanism in Japan than in the United States and other countries (Appendix Chart 1-1).

The adaptive formation of inflation expectations has the characteristic that it reflects not only the observed inflation rate at the time but also people's past experiences.[7] With regard to households' perception of inflation in Japan, microdata from the *Opinion Survey on the General Public's Views and Behavior* show that the younger the age groups, which have not experienced inflation, (1) the lower inflation expectations and (2) the less sensitive their inflation expectations to actual fluctuations in prices. The results suggest that past experiences and the norms developed in the process have deeply affected the formation of inflation expectations (Appendix Chart 1-2).

In theoretical frameworks, the formation of inflation expectations has been assumed traditionally to follow "full-information rational expectations," where economic entities use all available information to form their expectations.[8] However, in recent years it has been pointed out that, considering the stickiness and complexity of the formation process, other

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[7] For studies analyzing the effects of past experiences on inflation expectations, see the following papers: Malmendier, U. and Nagel, S., "Learning from Inflation Experiences," *The Quarterly Journal of Economics*, vol. 131, issue 1 (2016): 53-87; Diamond, J., Watanabe, K., and Watanabe, T., "The Formation of Consumer Inflation Expectations: New Evidence from Japan's Deflation Experience," *International Economic Review*, vol. 61, issue 1 (2020): 241-281.

[8] For "full-information rational expectations," see, for example, Sargent, T. J. and Wallace, N., "'Rational' Expectations, the Optimal Monetary Instrument, and the Optimal Money Supply Rule," *Journal of Political Economy*, vol. 83, no. 2 (1975): 241-254.

hypotheses such as the "sticky information hypothesis" (a hypothesis that it takes time for information to be incorporated into expectations given that acquiring information involves costs) and the "rational inattention hypothesis" (a hypothesis that information judged to be of little importance will not be incorporated into expectations when information processing capacity is limited) may be empirically valid.[9,10] In this context, a recent analysis examines the empirical validity of "full-information rational expectations," the "sticky information hypothesis," and the "rational inattention hypothesis" in the inflation expectations formation process of Japanese firms. The results show that about 60 percent of the firms are subject to sticky information constraints, whereas about 40 percent frequently acquire information and update their expectations.[11] Of the roughly 40 percent of the firms that are not subject to sticky information constraints, half are "rationally inattentive," in that they form inflation expectations without using information to which they attach little importance, and the other half, which accounts for about 20 percent of the total, follows "full-information rational expectations" and thereby form inflation expectations by using all available information at the time (Appendix Chart 1-3).

These findings suggest that the mechanism of adaptive inflation expectations formation in Japan is relatively complex and sticky. This means that, with regard to people's mindset and behavior based on the assumption that prices will not increase easily having become deeply entrenched because of the experience of prolonged deflation, it will take time for these to change.

Elastic Labor Supply and Enhancement of Firms' Labor Productivity

In addition, price developments since the Comprehensive Assessment have been affected by the fact that elastic labor supply has absorbed upward pressure on wages and that

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[9] For the "sticky information hypothesis," see, for example, Mankiw, N. G. and Reis, R., "Sticky Information versus Sticky Prices: A Proposal to Replace the New Keynesian Phillips Curve," *The Quarterly Journal of Economics*, vol. 117, no. 4 (2002): 1295-1328.

[10] For the "rational inattention hypothesis," see, for example, Sims, C. A., "Implications of Rational Inattention," *Journal of Monetary Economics*, vol. 50, no. 3 (2003): 665-690.

[11] Kitamura, T. and Tanaka, M., "Firms' Inflation Expectations under Rational Inattention and Sticky Information: An Analysis with a Small-Scale Macroeconomic Model," *Bank of Japan Working Paper Series*, no. 19-E-16, November 2019.

enhancement of firms' labor productivity has absorbed upward pressure on costs.

Since the mid-2010s, with the output gap improving and labor shortage intensifying, labor participation by women and seniors has accelerated, mainly against the background of the government's initiatives to improve their working environment and of the increase in the elderly population. In Japan, wage elasticity, which is the rate of increase in labor supply in response to a given increase in wages, tends to be higher for women and seniors than for working-age men. Thus, although an acceleration in labor participation by women and seniors has been favorable for Japan's economy, it has constrained a rise in wages in the short run (for details, see Box 1 in the July 2018 *Outlook for Economic Activity and Prices*).

Meanwhile, in order to address labor shortage, firms have absorbed upward pressure on costs by enhancing labor productivity. Labor-saving and efficiency-improving investments through the use of IT have become more active, mainly in labor-intensive industries including retail, accommodations, eating and drinking, and construction. In addition, firms have been streamlining their business processes, such as reconsidering existing services they provide. In the long run, these efforts are likely to improve firms' productivity, raise Japan's economic growth potential, and thereby intensify upward pressure on prices. However, they have constrained inflation in the short run (for details, see Box 3 in the July 2017 *Outlook for Economic Activity and Prices* and Box 4 in the July 2018 *Outlook for Economic Activity and Prices*).

Appendix 2: Examination on Policy Effects
Using the Bank's Macroeconomic Model (Q-JEM)

The Bank's large-scale macroeconomic model, Q-JEM, was used to examine the policy effects since the introduction of QQE.[12] In its examination, the Bank estimated the counterfactual path that major financial variables would have followed if QQE had not been introduced. Assuming that they followed each of their own counterfactual paths, it conducted a counterfactual simulation of developments in real GDP, the output gap, and the CPI. The difference between actual values and simulation results is regarded as the policy effects.

Outline of the Simulation

The simulation assumes that the Bank's policy measures will affect economic activity and prices through channels of four financial variables: (1) a decline in real interest rates, (2) improvement in loan availability in lending markets, (3) a depreciation of the yen, and (4) an increase in stock prices.

The Bank estimated as follows the counterfactual paths of these four financial variables in the case that QQE had not been introduced.

(1) Real interest rates

The counterfactual path of nominal long-term interest rates was assumed by using two estimation approaches. Approach (a) is based on variables such as the active job openings-to-applicants ratio. Specifically, by employing the method shown in Chart 4-1, the Bank used developments before the introduction of QQE in nominal long-term interest rates

[12] Q-JEM is a large-scale macroeconomic model with more than 200 variables that are important for analyzing Japan's economy, including real variables, financial variables, and expectations variables. Each equation is estimated using historical data for Japan. For details, see Hirakata, N. et al., "The Quarterly Japanese Economic Model (Q-JEM): 2019 Version," *Bank of Japan Working Paper Series*, no. 19-E-7, 2019; Kan, K., Kishaba, Y., and Tsuruga, T., "Policy Effects since the Introduction of Quantitative and Qualitative Monetary Easing (QQE): Assessment Based on the Bank of Japan's Large-scale Macroeconomic Model (Q-JEM)," *Bank of Japan Working Paper Series*, no. 16-E-15, 2016.

as a dependent variable and those in the active job openings-to-applicants ratio, the CPI, and U.S. Treasury bond yields as independent variables, and estimated the counterfactual path of subsequent developments in nominal long-term interest rates. Estimation approach (b) is based on the share of the Bank's JGB holdings. The Bank estimated how much the Bank's JGB purchases have lowered nominal long-term interest rates by using the method shown in Chart 4-2, and the counterfactual path was assumed by subtracting their effects. As for the counterfactual path of medium- to long-term inflation expectations, it was assumed that they were unchanged since the October-December quarter of 2012. On this basis, two counterfactual paths of real interest rates were assumed, calculated by subtracting the path of inflation expectations from that of nominal long-term interest rates.

(2) Loan availability in lending markets

The loan availability in lending markets can be indicated by the lending attitude DI. The estimation approach for the loan availability is based on the correlation between developments in the business conditions DI and the lending attitude DI before the introduction of QQE. The level of the lending attitude DI as suggested by subsequent developments in the business conditions DI was considered as the counterfactual path of the loan availability in lending markets.

(3) Foreign exchange rates

Two approaches were taken to estimate the counterfactual path of foreign exchange rates. One is (a) the estimation approach, in which the levels of foreign exchange rates were estimated under the counterfactual path of real interest rates (as shown by the aforementioned approach (1)(a)). The other is (b), the event study approach, in which the counterfactual path was estimated assuming that various changes to policy measures had not been made and the levels of foreign exchange rates prior to the announcement on policy changes have continued through the following quarter.

(4) Stock prices

As for stock prices, the Bank also took two approaches to estimate the counterfactual path. One is (a) the estimation approach, in which the levels were estimated under the counterfactual paths of real interest rates and foreign exchange rates (as shown by the aforementioned approaches (1)(a) and (3)(a)). The other is (b), the event study approach, in which the counterfactual path was estimated assuming that various changes to policy measures had not been made and the levels of stock prices prior to the announcement on policy changes have continued through the following quarter.

The Bank conducted four counterfactual simulations -- namely, Simulations A, B, C, and D -- with different combinations of the counterfactual paths of the four financial variables as described below.

Methodology for Estimating Policy Effects in Each Simulation:

Counterfactual path of each financial variable without the conduct of QQE

<table>
<tr><th rowspan="2"></th><th colspan="4">Counterfactual path used in each simulation</th></tr>
<tr><th>A</th><th>B</th><th>C</th><th>D</th></tr>
<tr><td>(1) Real interest rates</td><td colspan="2">(a) Estimation approach
(based on variables such as the active job openings-to-applicants ratio)</td><td colspan="2">(b) Estimation approach
(based on the share of the Bank's JGB holdings)</td></tr>
<tr><td>(2) Loan availability in lending markets</td><td colspan="4">Estimation approach</td></tr>
<tr><td>(3) Foreign exchange rates</td><td rowspan="2">(a) Estimation approach</td><td rowspan="2">(b) Event study approach</td><td rowspan="2">(a) Estimation approach</td><td rowspan="2">(b) Event study approach</td></tr>
<tr><td>(4) Stock prices</td></tr>
</table>

In addition to the above four simulations, the Bank, as with the simulation carried out in the Comprehensive Assessment, conducted a counterfactual simulation -- namely, Simulation E. In this simulation, it was assumed as counterfactual paths that real interest rates were unchanged since before the conduct of QQE and that the other three financial variables -- loan availability in lending markets, foreign exchange rates, and stock prices -- were obtained endogenously from the counterfactual path of real interest rates using Q-JEM.

Simulation Results

The results indicate that, in all cases, real GDP, the output gap, and the year-on-year rate of change in the CPI (excluding fresh food and energy) in the counterfactual scenario assuming no policy effects are below the actual values (Appendix Charts 2[1][2][3]). In other words, the results suggest that the policy effects since the introduction of QQE via lower real interest rates, favorable conditions in financial and capital markets, and accommodative lending attitudes have pushed up the output gap and prices.

In terms of the size of the policy effects, the results suggest that, during the period from the introduction of QQE through the July-September quarter of 2020, QQE, on average, pushed up the level of real GDP by between around 0.9 and 1.3 percent, the level of the output gap by between around 0.9 and 1.3 percentage points, and the year-on-year rate of change in the CPI (excluding fresh food and energy) by between around 0.6 and 0.7 percentage points (Appendix Chart 2[4]).

Although the results differ depending on how the counterfactual paths of financial variables with no policy effects are captured, it is clear that QQE (and QQE with Yield Curve Control) has had positive effects on Japan's economic activity and prices. Moreover, the simulation results also show that monetary easing has been effective in supporting economic activity and prices even since 2020, when the economy faced a major negative shock due to COVID-19.

Appendix 3: Estimation of the Impact of Interest Rate Fluctuations on the Real Economy

Interest rate fluctuations, if significant, can have a negative impact on economic activity and prices through an increase in uncertainties, which can impair the effects of monetary easing. In order to examine how significant fluctuations would have to be to create a negative impact, this appendix focuses on business fixed investment, which is relatively sensitive to interest rates.

Outline of the Estimation

The effects of monetary easing on business fixed investment were estimated by regressing business fixed investment (investment-capital stock ratio) on the real interest rate gap, which represents the degree of monetary easing, while controlling for economic variables and economic uncertainty. To capture the impact of interest rate fluctuations on the easing effects, two different coefficients were set for the real interest rate gap: coefficient β_1, which can be captured regardless of the range of fluctuations in long-term interest rates; and coefficient β_2, which can be captured for each range of fluctuations in long-term interest rates (Appendix Chart 3[1]).

Investment-capital stock ratio (%)

= α_1 × Lagged dependent variable (1 quarter) + α_2 × Real GDP growth forecast (%)

+ α_3 × Economic uncertainty index (level)

+ $\underline{\beta_1 \times \text{Real interest rate gap (\%)}}$

+ $\underline{\beta_2 \times \text{Real interest rate gap (\%)} \times \text{Dummy for interest rate fluctuations}_i}$

+ Constant

Estimation period: 1995/Q1 to 2020/Q3.

Dummy for interest rate fluctuations$_i$ takes a value of 1 when the range of fluctuations in long-term interest rates (10-year JGB yields) over the preceding six months falls into the i^{th} quartile. The real GDP growth forecast is the forecast for the next 6-10 years. The economic uncertainty index is an index calculated by counting the number of newspaper articles that simultaneously contain words related to the economy and policy as well as words related to uncertainty.

Estimation Results

The estimation results show that the coefficient of the real interest rate gap ($\beta_1 + \beta_2$) is close to zero for the fourth quartile (fluctuations of more than 0.51 percentage points in the long-term interest rate level), where the range of interest rate fluctuations is largest. This indicates that, even when the real interest rate gap is accommodative, business fixed investment is not pushed up (Appendix Chart 3[2]). On the other hand, for the first to third quartiles of the range of interest rate fluctuations (fluctuations of 0.51 percentage points or less in the long-term interest rate level), the coefficients ($\beta_1 + \beta_2$) show more or less the same negative figures, indicating that an accommodative (negative) real interest rate gap pushes up business fixed investment to about the same extent for all three quartiles. Thus, the results show that the degree to which monetary easing affects business fixed investment is more or less unchanged, except when the range of fluctuations in long-term interest rates over the preceding six months exceeds 50 basis points.

Appendix 4: Operation of the Complementary Deposit Facility

Background

When the Bank introduced QQE with a Negative Interest Rate in January 2016, it revised the Complementary Deposit Facility and divided the current accounts that financial institutions hold at the Bank into three tiers: (1) the "Basic Balance" (the Benchmark Balance, which is the average outstanding balance for 2015, minus required reserves) to which a positive interest rate of 0.1 percent is applied; (2) the "Macro Add-on Balance" (including required reserves, balances associated with the Bank's various fund-provisioning measures, and adjustment portion calculated as the Benchmark Balance multiplied by the Benchmark Ratio) to which an interest rate of 0 percent is applied; and (3) the "Policy-Rate Balance" (obtained by subtracting the Basic Balance and the Macro Add-on Balance from current account balances) to which a negative interest rate of minus 0.1 percent is applied.

Three-Tier System of the Complementary Deposit Facility

<table>
<tr><th></th><th></th><th>Applied interest rate</th></tr>
<tr><td>(1) Basic Balance</td><td>Benchmark Balance (average outstanding balance for 2015) – Required reserves</td><td>+0.1%</td></tr>
<tr><td rowspan="5">(2) Macro Add-on Balance</td><td>Benchmark Balance × Benchmark Ratio</td><td rowspan="5">0%</td></tr>
<tr><td>Balances associated with the Bank's various fund-provisioning measures (Loan Balance 1)</td></tr>
<tr><td>Increase in balances associated with the Bank's various fund-provisioning measures compared with at end-March 2016 (Loan Balance 2)</td></tr>
<tr><td>Amount based on the special rules for money reserve funds and those for new institutions</td></tr>
<tr><td>Required reserves</td></tr>
<tr><td>(3) Policy-Rate Balance</td><td>Amount obtained by subtracting (1) and (2) from current account balances</td><td>–0.1%</td></tr>
</table>

With more than five years having passed since the revision, the following developments have been seen in the meantime.

1. The calculation for determining the limits of the Basic Balance and the Macro Add-on Balance for each eligible counterparty is based on the Benchmark Balance with the benchmark period of 2015, which is before the introduction of QQE with a Negative Interest Rate. In this regard, since the introduction, current account balances for some counterparties have increased substantially, due mainly to inflows of funds, and net interest payments to the Bank have become a normal situation.

2. It is assumed that the Policy-Rate Balances encourage arbitrage transactions between counterparties holding Policy-Rate Balances and those holding unused amounts of Macro Add-on Balances, and thus are compressed to a minimum amount of outstanding balances that is necessary for transactions at negative interest rates to take place in money markets (these outstanding balances are referred to hereinafter as Hypothetical Policy-Rate Balances, which are calculated based on the assumption that arbitrage transactions fully take place). However, in practice, due to transaction costs and other factors, arbitrage transactions have not fully occurred. As a result, it has always been the case that actual Policy-Rate Balances have been higher than the Hypothetical Policy-Rate Balances, while there remain unused amounts of Macro Add-on Balances (Appendix Chart 4[1]).

   Moreover, with a view to providing incentives to use various fund-provisioning measures, balances of those measures (Loan Balances 1) as well as the increase in balances compared with at the end of March 2016 (Loan Balances 2) are included in the calculation of the Macro Add-on Balance limit. In this regard, with the share of loan-related balances in the limit of the Macro Add-on Balances growing as a result of the use of measures such as the Special Funds-Supplying Operations to Facilitate Financing in Response to the Novel Coronavirus (COVID-19), current account balances have not risen to the same extent as the loan-related balances and thus the unused amounts of Macro Add-on Balances have been on an increasing trend recently (Appendix Chart 4[2]).

3. Due to the rise in the share of loan-related balances in the limit of the Macro Add-on Balances reflecting the increased use of various fund-provisioning measures, as described in 2., the adjustment portion based on the Benchmark Ratio has been shrinking. As a result, the Benchmark Ratio has fallen to around 10-15 percent (Appendix Chart 4[3]).

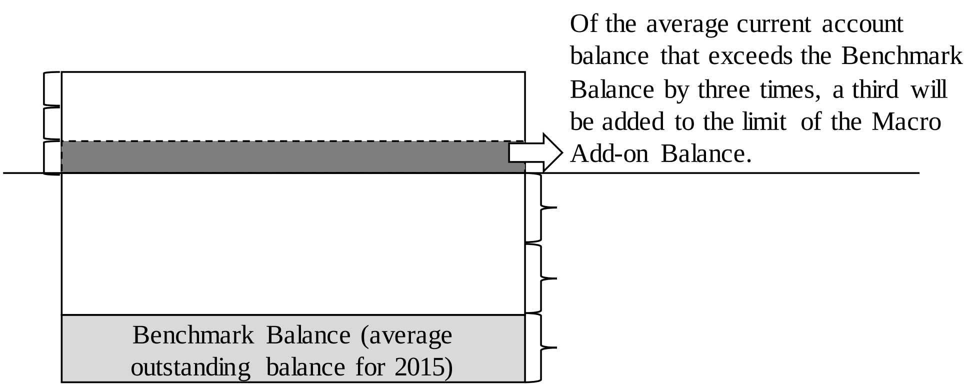
Revisions

In light of the aforementioned developments in current account balances, and from the perspective of contributing to the smoother operation of the Complementary Deposit Facility, the Bank considers it appropriate to implement the following revisions.

Revision regarding 1.

For counterparties whose current account balances have increased substantially since the introduction of QQE with a Negative Interest Rate and for which net interest payments to the Bank have become a normal situation, a certain amount will be added in the calculation of the limit of the Macro Add-on Balance in accordance with the degree of increase in current account balances through 2019.

Illustration

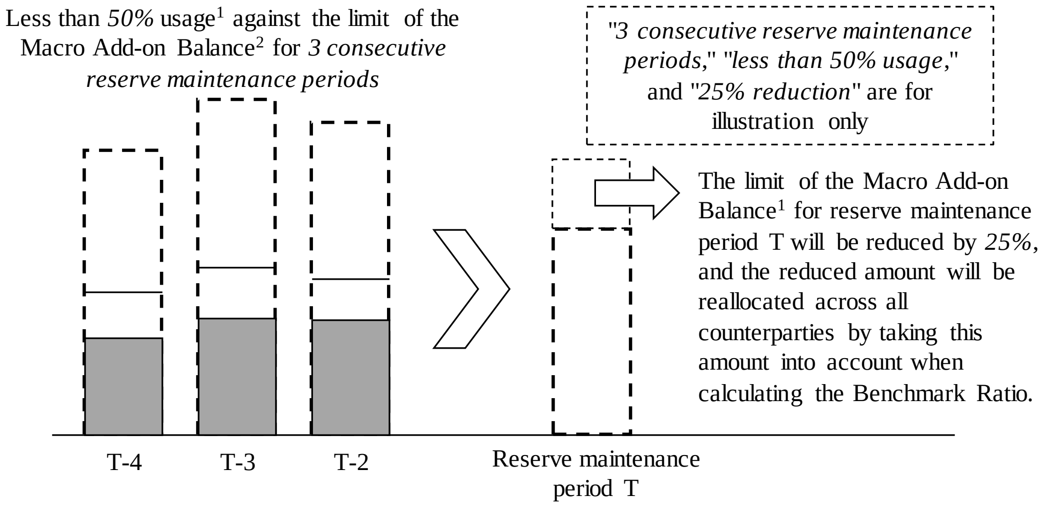


Average current account balances for reserve maintenance periods between February 2016 and December 2019 (excluding the increase in loan-related balances)

Revision regarding 2.

The limit of the Macro Add-on Balances of counterparties who regularly have large unused amounts will be reduced to a certain degree and then the reduced amount will be reallocated across all counterparties. Specifically, a counterparty who has used less than a certain degree (e.g., 50 percent)[1] of the limit of its Macro Add-on Balance excluding required reserves for a certain period of time (e.g., three consecutive reserve maintenance periods) will have the limit reduced by a fraction (e.g., 25 percent) in the second reserve maintenance period after said certain period of time. This will create an environment where arbitrage transactions can proceed more smoothly.

Illustration

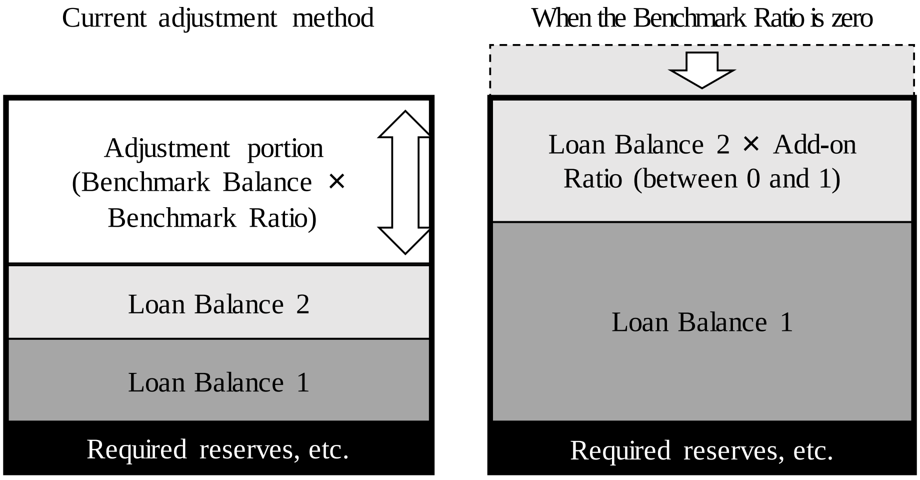


[1] To determine whether the usage against the limit of the Macro Add-on Balance has been less than a certain degree, its limit before a reduction takes place -- which is the sum of Loan Balance 1, Loan Balance 2, and the adjustment portion based on the Benchmark Ratio -- is used as a basis.
[2] Excluding required reserves.

Revision regarding 3.

The Bank will make clear the treatment of cases where the Benchmark Ratio declines further. Specifically, it will set the lower limit of the Benchmark Ratio at zero. On this basis, in the case that the Macro Add-on Balance limit cannot be adjusted even when the Benchmark Ratio is reduced to zero, Loan Balance 2 will be multiplied by a ratio between 0 and 1 (this newly introduced ratio will be called the "Add-on Ratio").

Illustration



Appendix 5: Estimation of the Effects of ETF Purchases

The Bank examined whether its ETF purchases have had an impact on risk premia in the stock market and how the effects differ depending on market conditions and the details of purchases, such as their size.

Outline of the Estimation

The effects of ETF purchases were estimated by regressing indicators related to risk premia in the stock market on the indicators representing the volume of the Bank's ETF purchases (purchase volume indicators). Two estimations were conducted. Estimation I examined whether the purchase volume indicators have a statistically significant effect on risk premia. Estimation II examined whether the effects of ETF purchases per single amount differ depending on market conditions and the purchase details. Specifically, in Estimation II, the coefficient of the purchase volume indicators (θ in Estimation I), which indicates the effects of purchases, is formulated so that it changes depending on state variables, such as stock prices at the time of purchase, the volatility, and the size of purchases (purchase effect function). The estimation period starts from December 2010, when the Bank began purchasing ETFs.

Estimation I:

Dependent variable (risk premium indicator)

= β × Control variables + <u>θ × Purchase volume indicator</u>

Estimation II:

Dependent variable (risk premium indicator)

= β × Control variables

+ <u>Purchase effect function × Purchase volume indicator</u>,

where Purchase effect function = F (state variable)

Estimation period: December 2010 to December 2020

Variables Used in the Estimation

Two different <u>dependent variables</u> were used as a risk premium indicator: (1) the change in the equity risk premium (ERP) implied by option prices and (2) changes in the yield spreads of individual stocks.[13] The change in the ERP is a single time series of daily frequency, whereas changes in the yield spreads constitute a panel data set of weekly frequency. As a purchase volume indicator, the amount of ETF purchases relative to the TOPIX market capitalization was used for dependent variable (1), and the amount of individual stocks purchased indirectly through ETF purchases relative to the market capitalization of the corresponding stocks was used for dependent variable (2).[14]

Dependent variable	Definition	Control variable
(1) Change in ERP implied by option prices	Change in the ERP estimate from the close of the morning session to the close of the day[15]	▪ Dollar/yen exchange rate at close of morning session of the stock market (compared with previous day's close) ▪ TOPIX at close of morning session (compared with previous day's close) ▪ Variables used in the definition of the state variables

[13] The ERP is the excess return required by investors for taking on the risk of stock price volatility. It is defined as the expected return on stocks minus the risk-free interest rate. The estimation in this appendix uses the estimates (annualized estimates of the expected return over the next 30 days minus the risk-free rate) of the ERP obtained using Nikkei 225 options price data and employing the approach in the following study: Martin, I., "What is the Expected Return on the Market?" *The Quarterly Journal of Economics*, vol. 132, issue 1, (2017): 367-433.

[14] Following the existing studies (e.g., Charoenwong, B., Morck, R., and Wiwattanakantang, Y., "Bank of Japan Equity Purchases: The (Non-)Effects of Extreme Quantitative Easing," *NBER Working Paper*, no. 25525, 2020, forthcoming in *Review of Finance*), the amount of indirect purchases of the corresponding stocks was estimated by using the weights of ETFs tracking the TOPIX, the Nikkei 225, and the JPX-Nikkei 400 in the Bank's purchases, as well as the weights of individual stocks in the basket of stocks of these indices.

[15] The use of the change from the closing price in the morning session to the closing price of the day follows the existing studies on the effect of ETF purchases (e.g., Shirota, T., "Evaluating the Unconventional Monetary Policy in Stock Markets: A Semi-parametric Approach," *Hokkaido University Discussion Paper Series A*, no. 2018-322, 2018; Harada, K. and Okimoto, T., "The BOJ's ETF Purchases and Its Effects on Nikkei 225 Stocks," *RIETI Discussion Paper Series*, no. 19-E-014, 2019).

(2) Changes in the yield spreads of individual stocks	Changes in the yield spreads of all individual stocks on the First and Second Sections of the Tokyo Stock Exchange based on end-of-week prices (relative to the preceding week)	▪ Fixed effects for individual stocks ▪ Time fixed effects

Four state variables were used to represent different market conditions: (a) the percentage downward deviation of stock prices from the trend; (b) stock market volatility when stock prices are below their trend; (c) the percentage decline in stock prices immediately before the purchases; and (d) the size of purchases. These state variables were used to define the purchase effect functions.

Purchase effect function (state variables are underlined)
(a) $\alpha + \sigma \times$ min{0, Percentage deviation from 100-day moving average of TOPIX}
(b) $\alpha + (\gamma + \sigma \times$ Nikkei 225 VI) × Dummy for market conditions * * Takes value 1 if the TOPIX (previous day's closing price for dependent variable (1) and previous week's closing price for dependent variable (2)) is below the 100-day moving average, and 0 otherwise.
(c) $\alpha + \sigma \times$ min{0, Percentage change in TOPIX immediately before ETF purchases}
(d) $\alpha + \sigma \times$ Total ETF purchases relative to TOPIX market capitalization

Estimation Results

Two estimations were conducted in Estimation I -- one each for the two dependent variables (the change in the ERP and the changes in yield spreads) -- and eight estimations in Estimation II for the different combinations of the two dependent variables and the four purchase effect functions.

The results are shown in Appendix Chart 5. In Estimation I, a statistically significant effect of ETF purchases (a decrease in risk premia) is found in both estimations. In Estimation II, the results suggest that the effects of ETF purchases are larger (a) the lower the level of stock prices relative to their trend at the time of purchases, (b) the higher the volatility in the stock market when stock prices are below their trend, (c) the larger the percentage decline in stock prices immediately before the purchases, and (d) the larger the size of purchases.

Appendix 6: Examination on the Inflation-Overshooting Commitment Using a Macroeconomic Model

In the inflation-overshooting commitment, the Bank commits to continuing to expand the monetary base until the year-on-year rate of increase in the observed CPI exceeds the price stability target of 2 percent and stays above the target in a stable manner. Through this commitment, the Bank is implementing the so-called "makeup strategy," in which monetary easing is conducted taking into account instances when the observed inflation rate remains below the target. The idea underlying this strategy is that a central bank would aim to attain a situation where the inflation rate is 2 percent on average over the business cycle. The Bank has clearly stated its stance of adopting this idea (Chart 1).

By conducting a simulation using a small macroeconomic model, this appendix examines whether the "makeup strategy" implemented through the inflation-overshooting commitment is desirable for Japan's economy, where the mechanism of inflation expectations formation is largely adaptive.[16,17]

Outline of the Simulation

The simulation assumes two different rules for determining the policy rate: (1) the Taylor rule, which is the basic rule, and (2) an average inflation targeting rule, which uses the

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[16] This analysis employs a small macroeconomic model, which simplifies the Bank's large-scale macroeconomic model (Q-JEM), in order to make repeated simulations practically feasible while taking into account the characteristics of Japan's economy. Specifically, in the model, (1) the demand function consists of IS curves only, and the output gap is determined by lagged values and the real long-term interest rate gap, (2) long-term interest rates are determined by the term structure of short-term interest rates (the term premium for interest rates is zero), and (3) the Phillips curve uses a hybrid type, in which the adaptive formation of inflation expectations has a large weight.

[17] The following paper focusing on the U.S. economy shows that, during the recovery phase, an average inflation targeting rule that refers to the average inflation rate over the past few years can achieve the 2 percent inflation target earlier than the Taylor rule. See Arias, J. et al., "Alternative Strategies: How Do They Work? How Might They Help?" *Finance and Economics Discussion Series*, no. 2020-068, 2020, Board of Governors of the Federal Reserve System.

inflation rates over the past few years for reference.[18] The second rule is asymmetric, in that average inflation targeting is followed only when the average inflation rate used for reference is below 2 percent (see the table below). Moreover, two cases are set for the natural rate of interest: (a) 0.5 percent, which is close to the average since 2000, and (b) a lower rate of minus 0.1 percent. The average developments in economic activity and prices in Japan were gauged by repeating 10 years of simulations for 1,000 times in which the economic model was subjected to random shocks using the distributions of demand and price shocks estimated from actual data for Japan's economy.[19] Then, the average social welfare loss function was calculated under each rule.[20]

Policy Rules Assumed in the Simulation

(1) Taylor rule	The policy rate is determined by the difference between the inflation rate and the inflation target *(Policy rule interest rate)$_t$ = (Equilibrium interest rate)$_t$ + 1.0 × {(Inflation rate)$_t$ – Inflation target} + 0.5 × (Output gap)$_t$*
(2) Average inflation targeting rule	<u>(i) Average inflation rate over N years ≤ Inflation target</u> The policy rate is determined by the difference between the average inflation rate over N years and the inflation target *(Policy rule interest rate)$_t$ = (Equilibrium interest rate)$_t$ + 1.0 × N × {(Average inflation rate over N years)$_t$ – Inflation target} + 0.5 × (Output gap)$_t$* <u>(ii) Average inflation rate over N years > Inflation target</u> The policy rate is determined by the Taylor rule

[18] In the simulation, the policy rule is formulated with lagged values. Specifically, it is specified as follows: Policy interest rate$_t$ = q × Policy interest rate$_{t-1}$ + (1 – q) × Policy rule interest rate$_t$, q = 0.9. In addition, the lower bound for interest rates is set to minus 0.1 percent. That is, even if the policy rate implied by the policy rule falls below minus 0.1 percent, interest rates do not fall below minus 0.1 percent.

[19] The initial values for the simulation are set as follows: short-term interest rate = –0.1 percent, inflation rate = 0.7 percent, output gap = 0.3 percent. The value for the inflation rate is the median of Policy Board members' forecast for CPI inflation for fiscal 2022 in the January 2021 *Outlook for Economic Activity and Prices*, while the output gap is estimated from the long-term relationship between the output gap and the inflation rate (i.e., the Phillips curve).

[20] The loss function is defined in terms of the fluctuations in the output gap and the deviation of the inflation rate from the inflation target. Specifically, Loss function = Output gap^2 + (Inflation rate – Inflation target of 2 percent)^2.

Simulation Results

The simulation results show that the inflation target of 2 percent can be achieved earlier under the average inflation targeting rule than under the Taylor rule (Appendix Charts 6[1] and [2]). Furthermore, the results for the average inflation targeting rule on the basis of the number of years used for reference indicate the following: the longer the period used for reference, the earlier the inflation target can be achieved, but the larger the fluctuations in the output gap and inflation and hence the greater social welfare costs. Comparing the social welfare loss functions calculated under each rule shows that, (a) in the case of the natural rate of interest being 0.5 percent, the loss function is minimized when the average inflation rate of the preceding two years is used for reference. On the other hand, (b) in the case of the natural interest rate being lower, at minus 0.1 percent, the loss function is minimized when the average inflation rate of the past three years is used for reference (Appendix Chart 6[3]).

The results of this analysis suggest that, in Japan, when the observed inflation rate is below the inflation target, it is desirable -- from the perspective of achieving the inflation target earlier and minimizing social welfare costs -- for the monetary policy conduct to refer to a certain period for the past inflation rates. The results further suggest that, when the natural rate of interest is low, it is desirable to refer to a longer period for the past inflation rates since the effects of monetary easing will decline. It should be noted, however, that this analysis does not reproduce the actual economic mechanisms and monetary policy conduct in great detail, as it uses a simple economic model and the monetary policy conduct in the model is expressed only in terms of the policy rule for short-term interest rates. In particular, depending on the parameters of the model and the definitions of the loss function, the number of years used for reference that minimizes the loss function could change. Therefore, the results should be interpreted with some latitude.

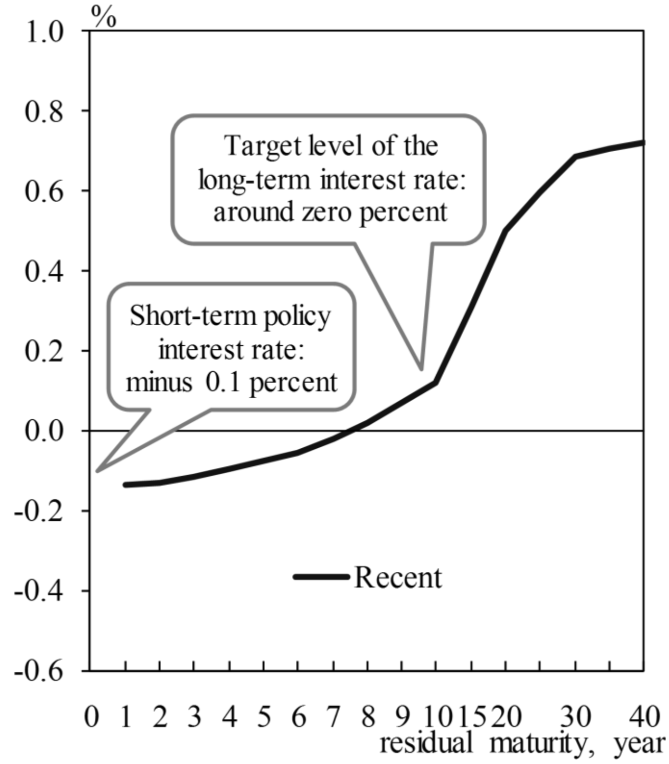
Charts

1. Charts for Main Text

2. Charts for Appendixes

Quantitative and Qualitative Monetary Easing (QQE) with Yield Curve Control

(1) Yield Curve Control



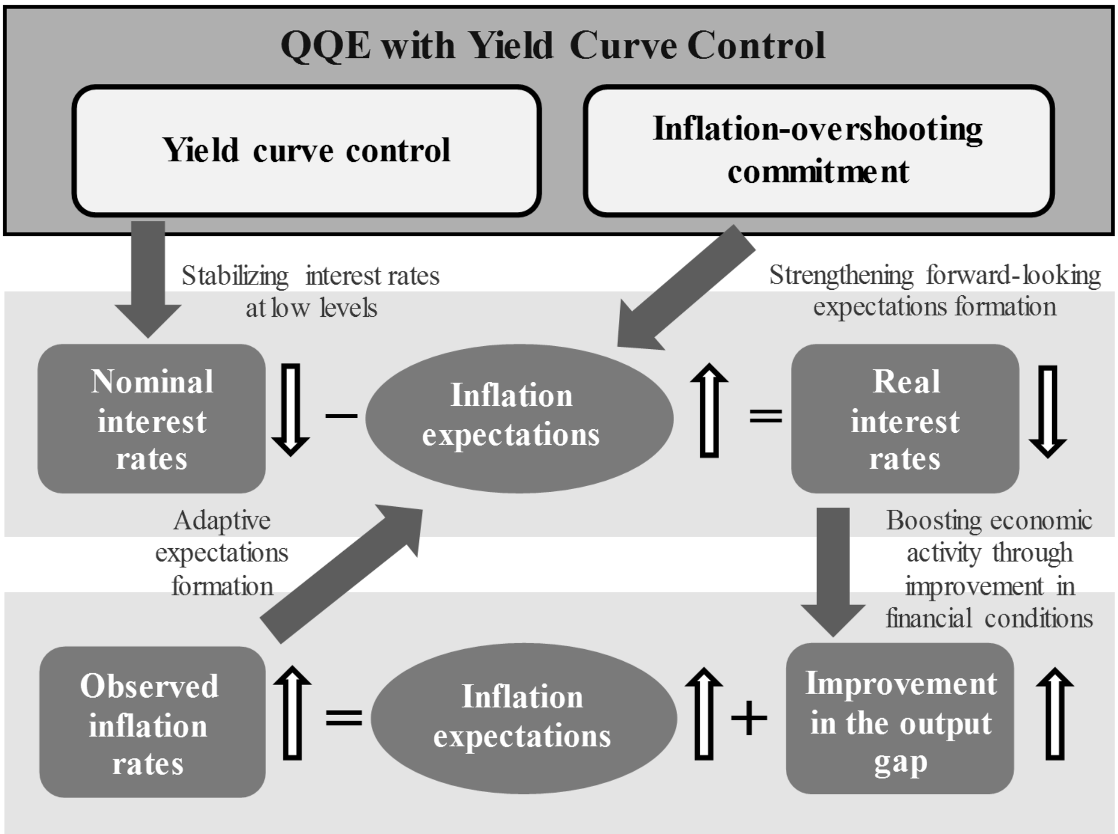
(2) Inflation-Overshooting Commitment

The Bank will continue expanding the monetary base until the year-on-year rate of increase in the observed CPI (all items less fresh food) exceeds the price stability target of 2 percent and stays above the target in a stable manner.

Achieving the price stability target means attaining a situation where the inflation rate is 2 percent on average over the business cycle.

(Statement released after the MPM in Sept. 2016)

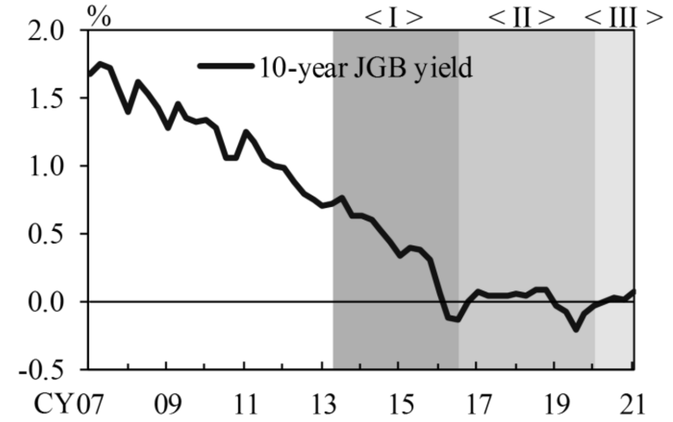
(3) Transmission Mechanism of QQE with Yield Curve Control



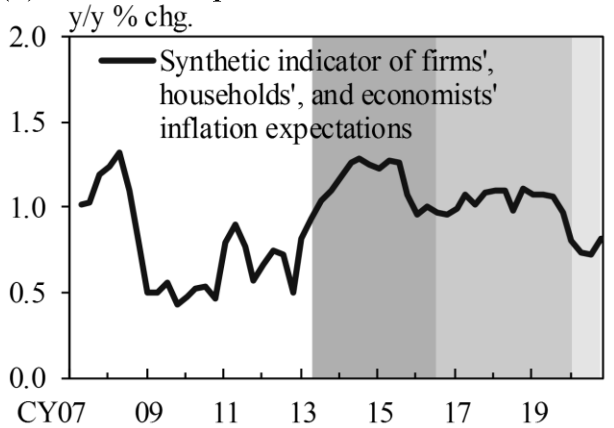
Sources: Bank of Japan; Bloomberg.

Economic and Financial Developments since the Introduction of QQE with Yield Curve Control (1)

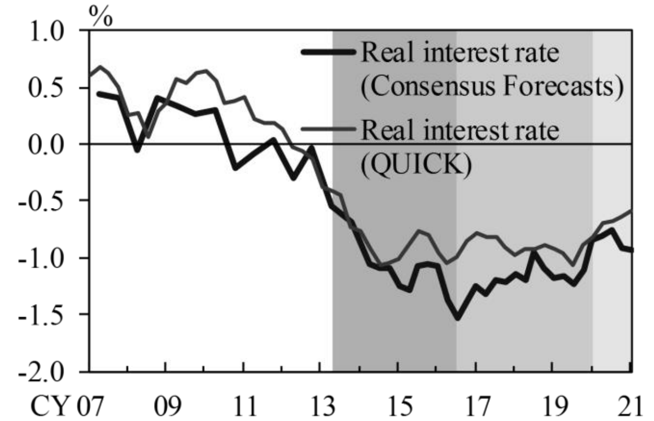
(1) Nominal Interest Rate



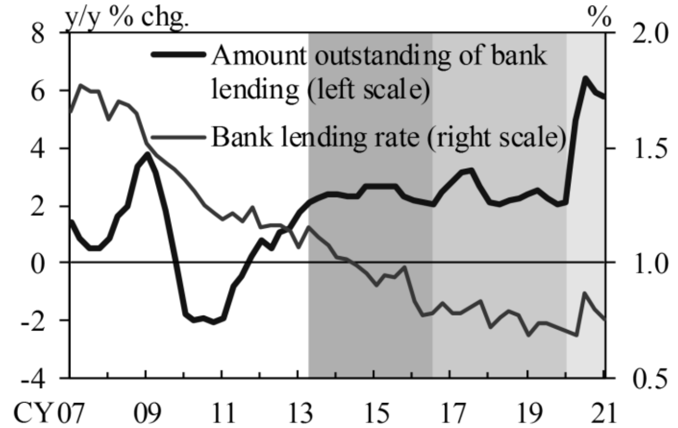
(2) Inflation Expectations



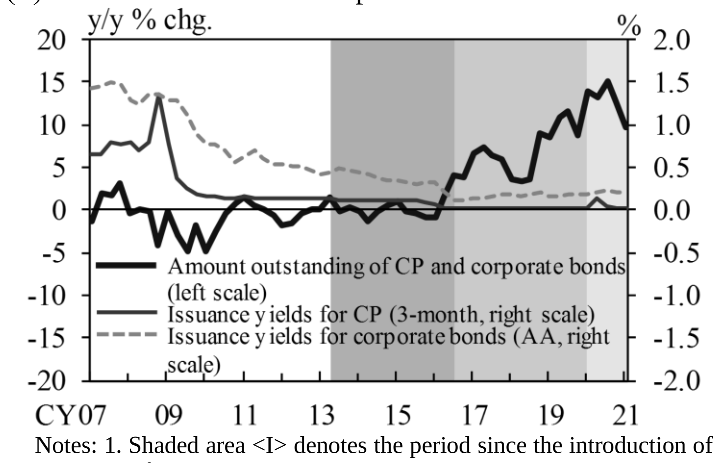
(3) Real Interest Rates



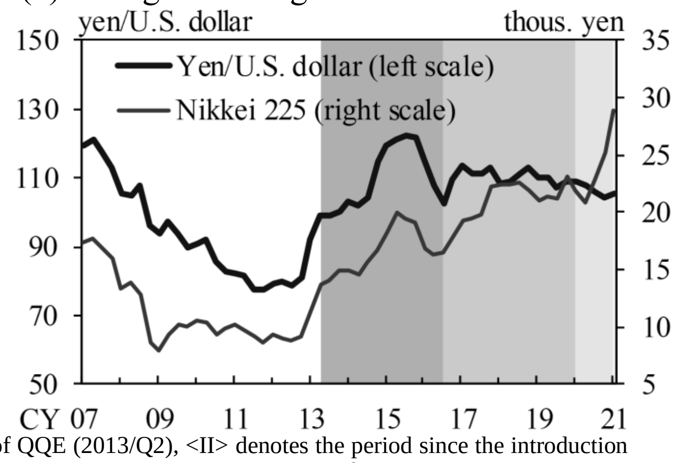
(4) Bank Lending



(5) Issuance of CP and Corporate Bonds



(6) Foreign Exchange Rate and Stock Prices



Notes: 1. Shaded area <I> denotes the period since the introduction of QQE (2013/Q2), <II> denotes the period since the introduction of QQE with Yield Curve Control (2016/Q3), and <III> denotes the period since the outbreak of COVID-19 (2020/Q1).

2. For the synthetic indicator in (2), inflation expectations data for firms are from the *Tankan*, for households from the "Opinion Survey," and for economists from "Consensus Forecasts."

3. Real interest rates in (3) are calculated as the 10-year Japanese government bond (JGB) yield minus the respective long-term inflation expectations.

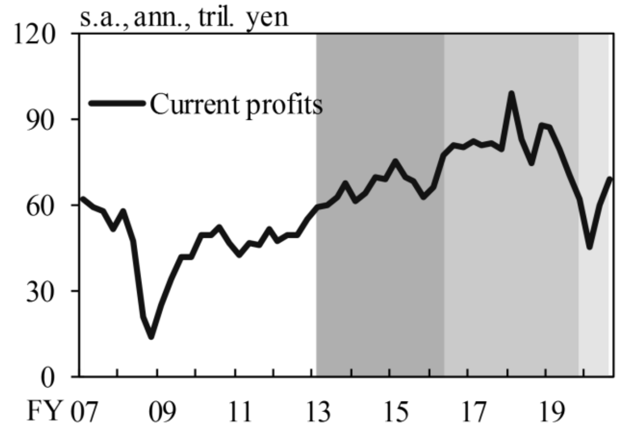
4. Figures for the amount outstanding of bank lending in (4) are monthly averages. Lending by domestic commercial banks includes loans to firms, individuals, and local governments. Figures for the bank lending rate are the average contract interest rate on new long-term loans by domestically licensed banks.

5. Figures for CP and corporate bonds in (5) are those at the end of the period. Figures for issuance yields for CP up to September 2009 are the averages for CP (3-month, rated a-1 or higher). Those from October 2009 onward are the averages for CP (3-month, rated a-1). Figures for issuance yields for corporate bonds are the averages for domestically issued bonds launched on a particular date. Bonds issued by banks and securities companies, etc., are excluded. Figures for issuance yields for corporate bonds are 6-month backward moving averages.

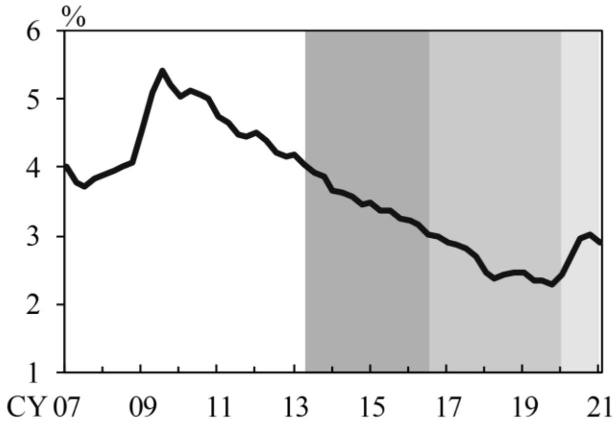
Sources: Bank of Japan; Bloomberg; Consensus Economics Inc., "Consensus Forecasts"; QUICK, "QUICK Monthly Market Survey (Bonds)"; Japan Securities Depository Center; Japan Securities Dealers Association; Capital Eye; I-N Information Systems.

Economic and Financial Developments since the Introduction of QQE with Yield Curve Control (2)

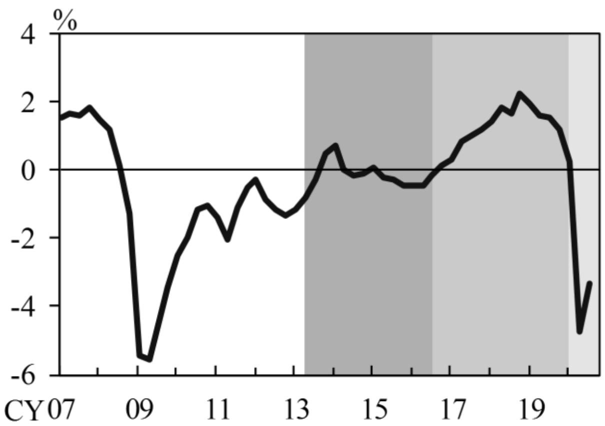
(7) Corporate Profits



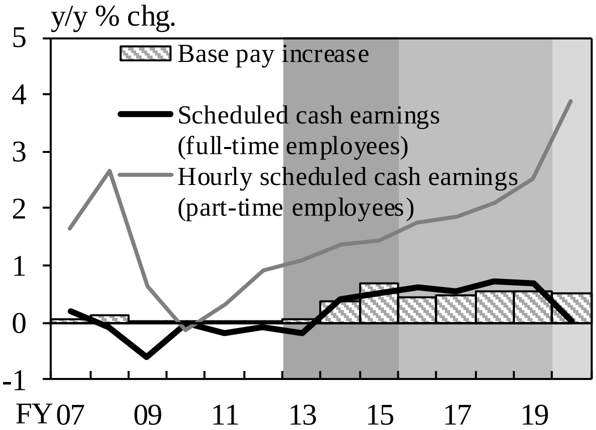
(8) Unemployment Rate



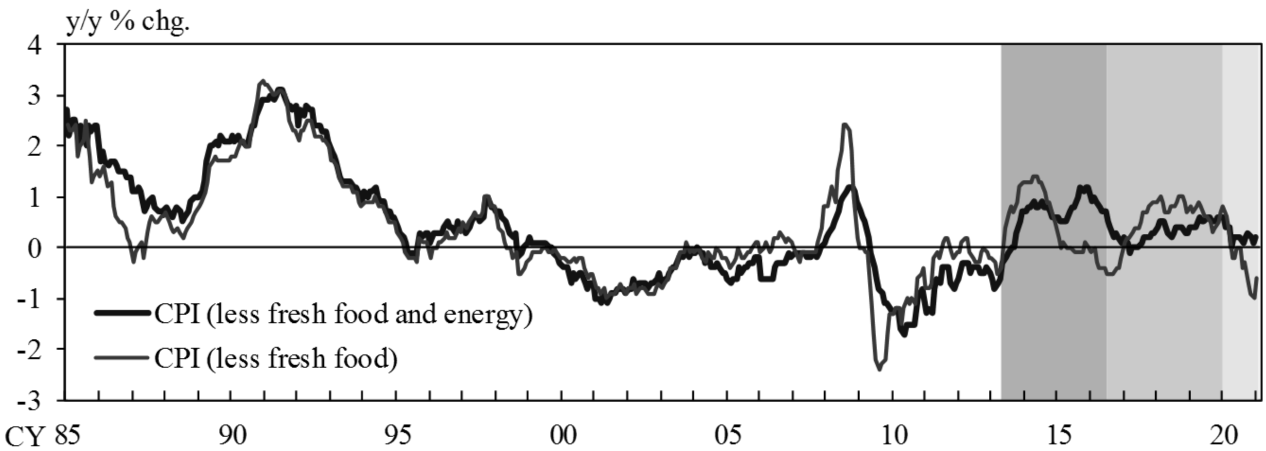
(9) Output Gap



(10) Wages



(11) Consumer Price Index (CPI)



Notes: 1. Figures for current profits in (7) are based on the "Financial Statements Statistics of Corporations by Industry, Quarterly," excluding "finance and insurance." Figures from 2009/Q2 onward exclude "pure holding companies."

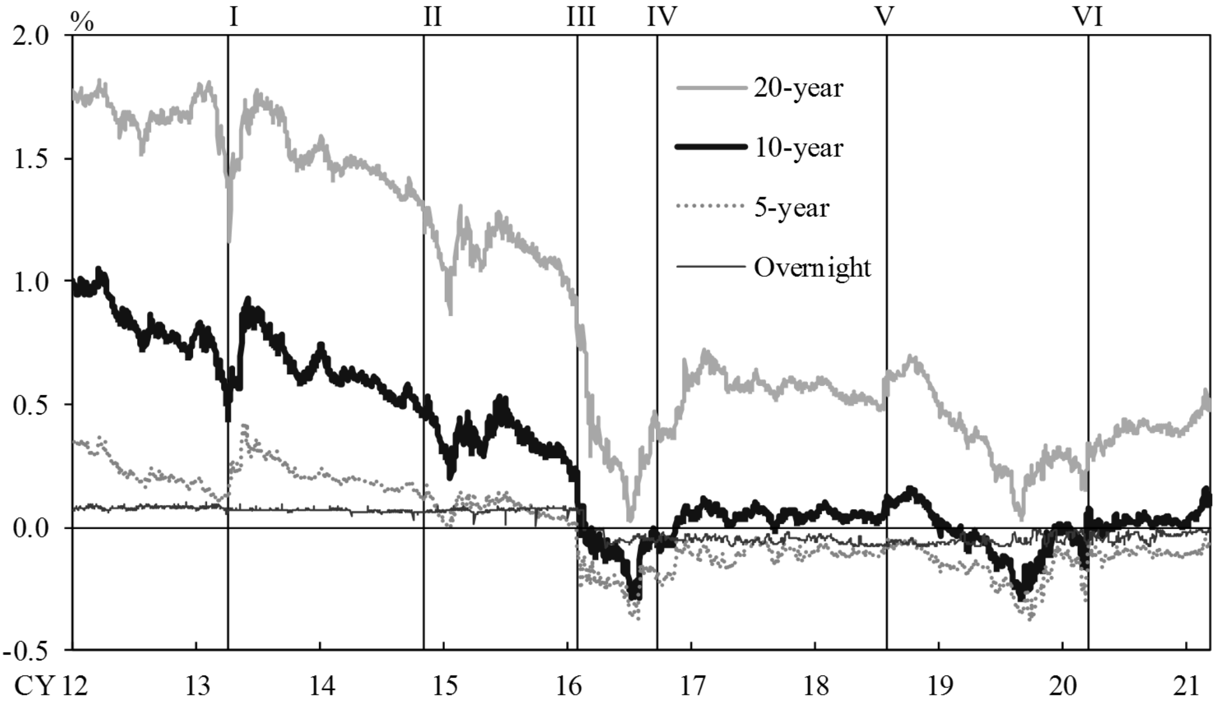
2. Figures for scheduled cash earnings in (10) from 2016/Q1 onward are based on continuing observations following sample revisions.

3. Figures for the CPI (less fresh food and energy) in (11) exclude the effects of the consumption tax hikes, policies concerning the provision of free education, and the "Go To Travel" campaign, which covers a portion of domestic travel expenses. The figures from April 2020 onward are based on staff estimations and exclude the effects of measures such as free higher education introduced in April 2020. Figures for the CPI (less fresh food) exclude the effects of the consumption tax hikes in April 1989, April 1997, and April 2014.

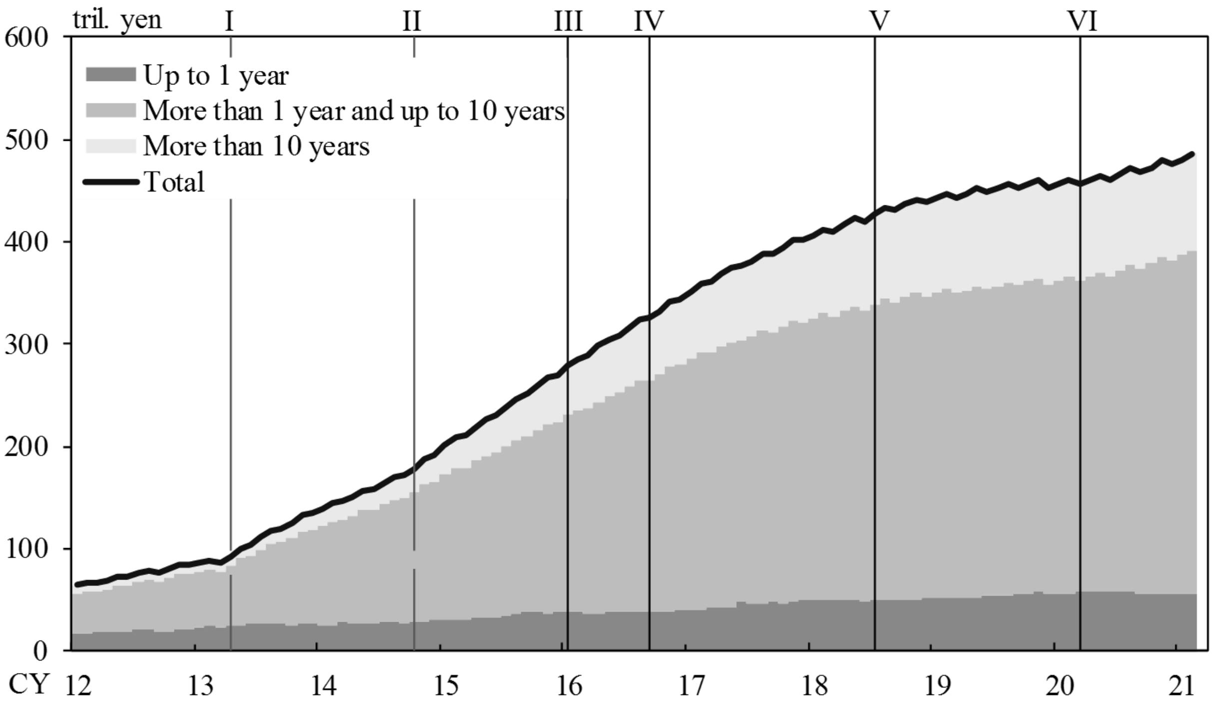
Sources: Ministry of Finance; Ministry of Internal Affairs and Communications; Bank of Japan; Ministry of Health, Labour and Welfare; Japanese Trade Union Confederation (*Rengo*).

JGB Yields under Yield Curve Control

(1) JGB Yields



(2) The Bank's JGB Holdings by Residual Maturity (Amount Outstanding)



Notes: 1. I: Introduction of QQE (Apr. 2013), II: Expansion of QQE (Oct. 2014), III: Introduction of QQE with a Negative Interest Rate (Jan. 2016), IV: Introduction of QQE with Yield Curve Control (Sept. 2016), V: Strengthening the Framework for Continuous Powerful Monetary Easing (July 2018), VI: Enhancement of Monetary Easing in Light of the Impact of the Outbreak of the Novel Coronavirus (Mar. 2020).

2. Figures for overnight yields in (1) are the uncollateralized overnight call rate.

3. Figures in (2) exclude T-Bills, floating-rate JGBs, and inflation-indexed JGBs.

Sources: Bloomberg; Bank of Japan.

Effects of JGB Purchases on Nominal Long-Term Interest Rates (1)

(1) Estimation Using Difference between Counterfactual and Actual Paths of 10-Year JGB Yields

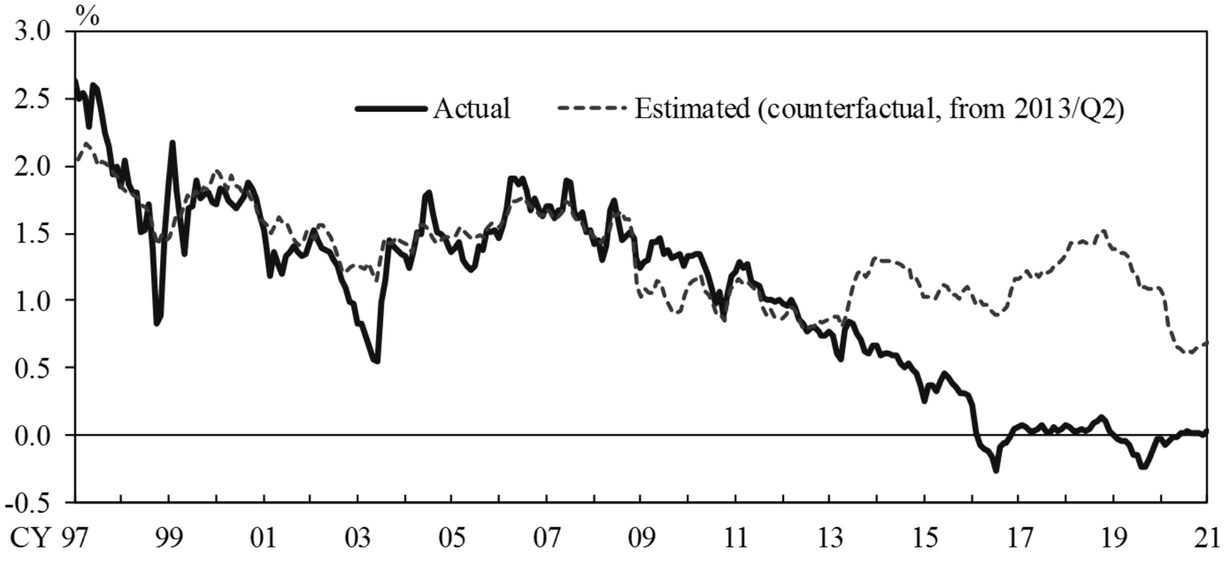
- Using data before the introduction of QQE, the Bank conducted linear regression analysis employing 10-year JGB yields as an independent variable and the following three variables as dependent variables: the active job openings-to-applicants ratio, the CPI, and U.S. Treasury bond yields (10-year). Using the estimation results, the Bank estimated the counterfactual path that 10-year JGB yields would have followed if QQE had not been introduced. The difference between the counterfactual and actual paths of 10-year JGB yields is regarded as the effects of the Bank's JGB purchases on 10-year yields since the introduction of QQE.
- As shown in (b) below, the counterfactual estimates of 10-year JGB yields have been at around 1 percent on average. Actual figures for 10-year JGB yields under yield curve control have been stable at around 0 percent. The policy effects as implied in the difference between the counterfactual estimates and the actual figures are estimated to be around minus 1 percentage point.

(a) Estimation Result

JGB yields (10-year, %)
$= 0.22^{*} + 0.26^{**}$ × Active job openings-to-applicants ratio
$+ 0.10^{**}$ × CPI (all items less fresh food, y/y change, %)
$+ 0.25^{**}$ × U.S. Treasury bond yields (10-year, %)

Estimation period: Jan. 1997 to Mar. 2013. Adjusted R-squared: 0.71.
Lagged values (lag order: 1) are used for the active job openings-to-applicants ratio and the CPI.

(b) Estimated and Actual 10-year JGB Yields



Notes: 1. ** and * denote statistical significance at the 1 percent and 5 percent levels, respectively.
2. The CPI figures used in the estimations exclude the effects of the consumption tax hikes, policies concerning the provision of free education, and the "Go To Travel" campaign, which covers a portion of domestic travel expenses. The figures from April 2020 onward are based on staff estimations and exclude the effects of measures such as free higher education introduced in April 2020.

Sources: Ministry of Health, Labour and Welfare; Ministry of Internal Affairs and Communications; Bloomberg.

Effects of JGB Purchases on Nominal Long-Term Interest Rates (2)

(2) Estimation Using the Bank's Share of JGB Holdings

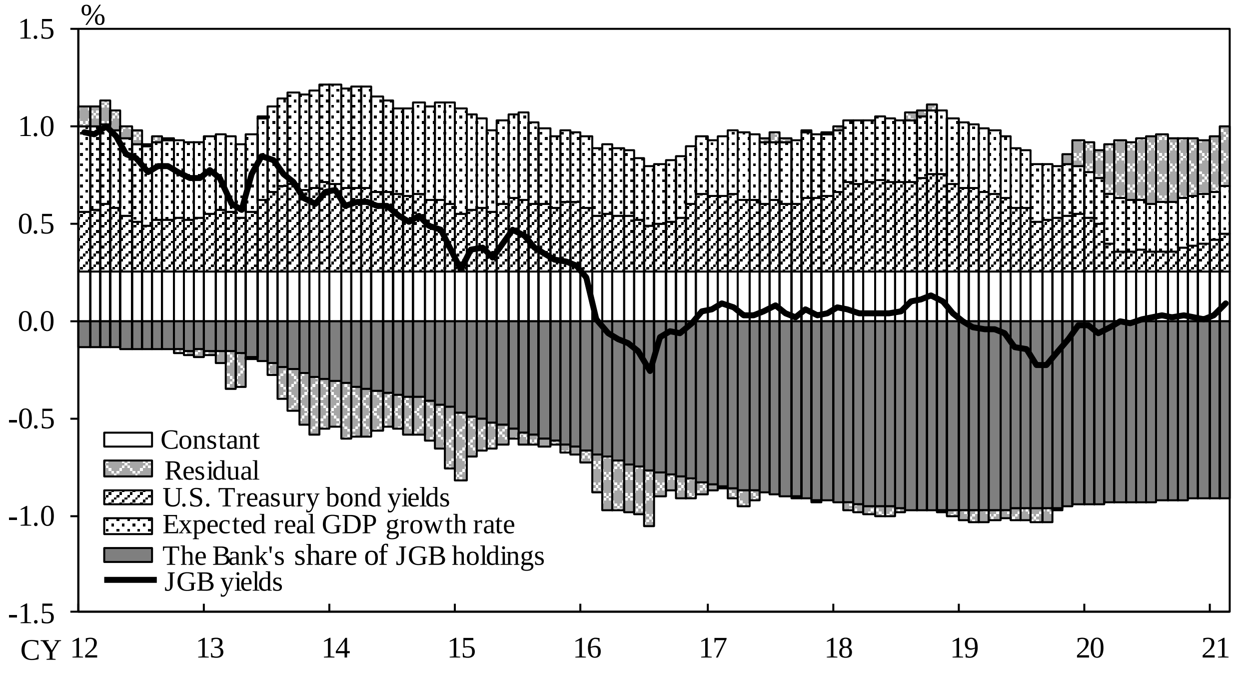
- The Bank conducted linear regression analysis employing 10-year JGB yields as an independent variable and the following three variables as dependent variables: the Bank's share of JGB holdings, U.S. Treasury bond yields (10-year), and the expected real GDP growth rate. The changes in 10-year JGB yields that are attributable to the Bank's share of JGB holdings are regarded as the effects of the Bank's JGB purchases on 10-year yields.
- Looking at developments in 10-year JGB yields shown in (b) below, the contribution of the Bank's share of JGB holdings to 10-year JGB yields expanded, pushing down the yields by about 1 percentage point as the Bank's share increased. The contribution has generally remained the same thereafter.

(a) Estimation Result

JGB yields (10-year, %)
= 0.25 *
+ 0.16 * × U.S. Treasury bond yields (10-year, %)
+ 0.45 * × Expected real GDP growth rate (%)
- 0.02 ** × The Bank's share of JGB holdings (%)

Estimation period: Jan. 2005 to Feb. 2021. Adjusted R-squared: 0.95.
Newey-West standard errors are used.

(b) Decomposition of 10-year JGB Yields

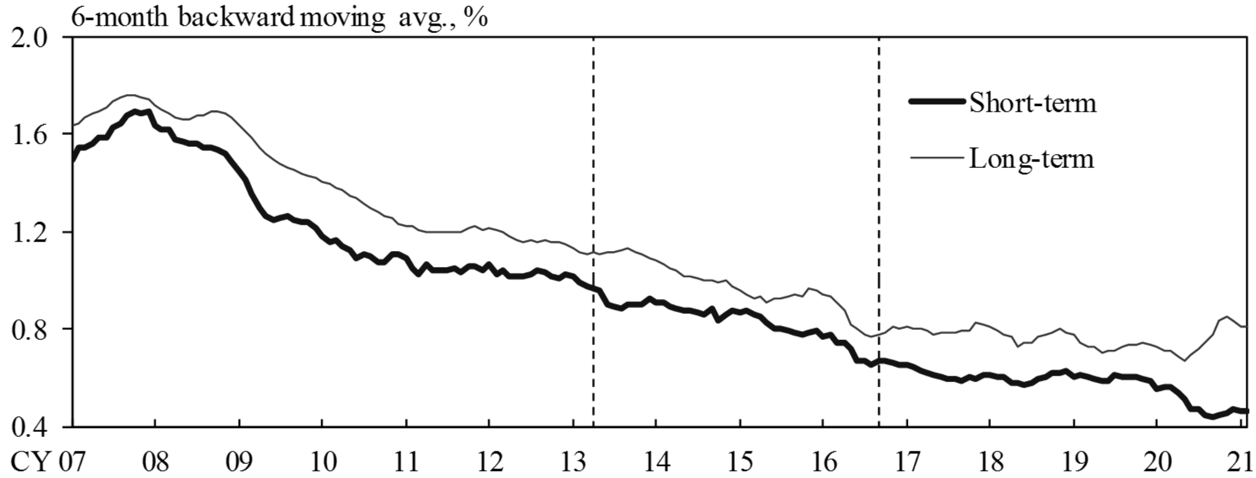


Notes 1. ** and * denote statistical significance at the 1 percent and 5 percent levels, respectively.
2. The Bank's share of JGB holdings is calculated taking into account changes in the average residual maturity. The expected real GDP growth rate and the Bank's share of JGB holdings are converted to monthly data mainly using quarterly data. The expected real GDP growth rate is the forecast for the next 6-10 years.

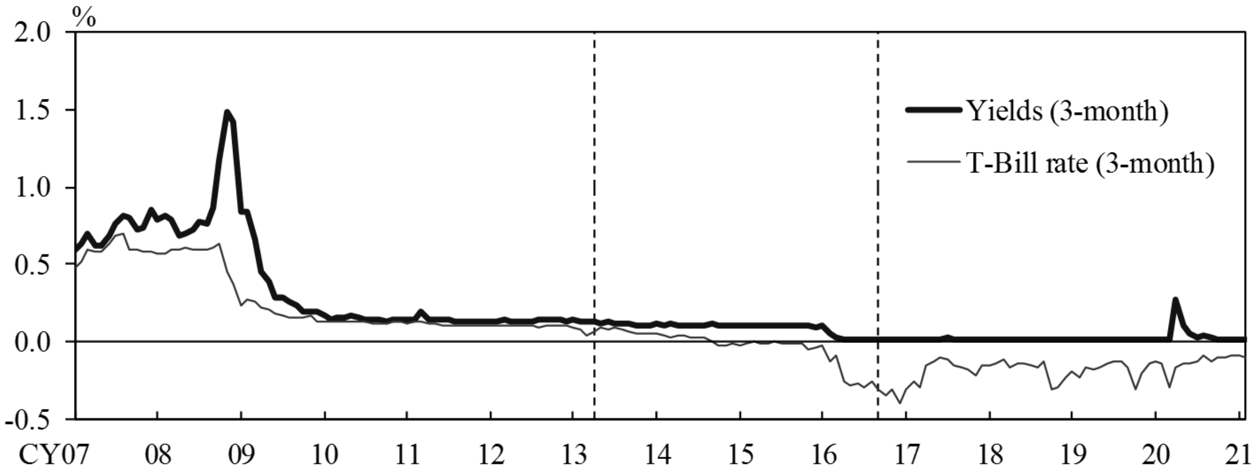
Sources: Bloomberg; Consensus Economics Inc., "Consensus Forecasts"; Bank of Japan; Ministry of Finance.

Lending, CP and Corporate Bond Rates

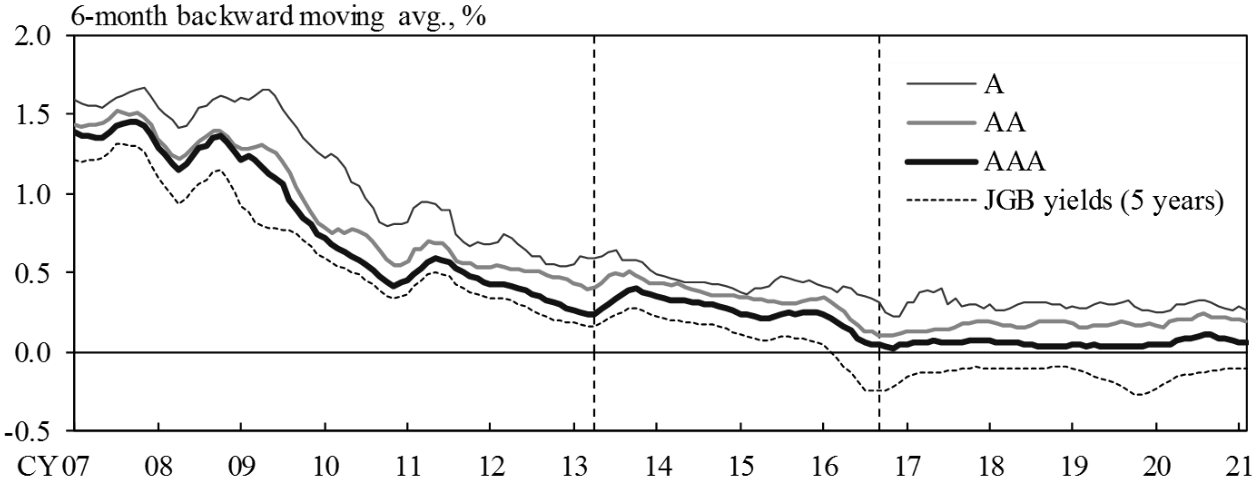
(1) Average Contract Interest Rates on New Loans and Discounts



(2) Issuance Yields for CP



(3) Issuance Yields for Corporate Bonds



Notes: 1. The vertical lines denote the introduction of QQE (Apr. 2013) and the introduction of QQE with Yield Curve Control (Sept. 2016).
2. Figures for issuance yields for corporate bonds in (3) are obtained by adding yields on 5-year JGBs to the average issuance spreads for domestically issued bonds launched on a particular date. Bonds issued by banks and securities companies, etc., are excluded. Bonds are classified based on the highest rating among the ratings from Moody's, S&P, R&I, and JCR.

Sources: Bank of Japan; Japan Securities Depository Center; Capital Eye; I-N Information Systems; Bloomberg.

Transmission Channel of the Decline in Interest Rates

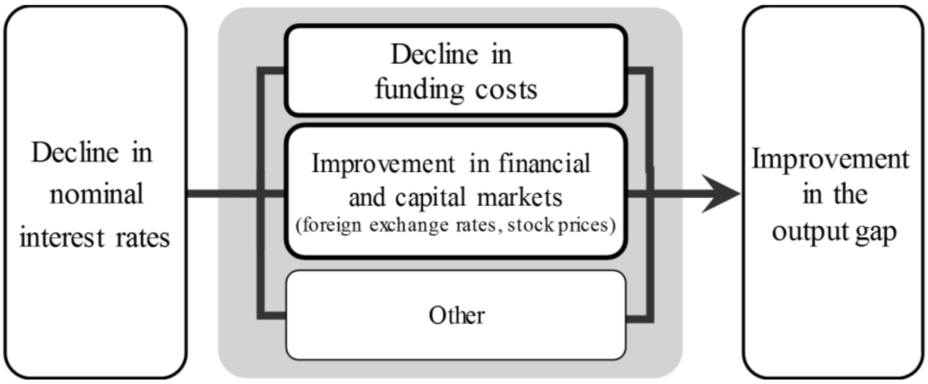
- The Bank used a vector-autoregressive (VAR) model with coefficient restrictions to estimate through which transmission channels a decline in interest rates improves the output gap. Specifically, the effects of each transmission channel (shaded area in (2) and the variables numbered 6 to 8) are calculated by imposing the restriction that the coefficients of other transmission channels are zero.
- The transmission channel through which a decline in interest rates improves the output gap via funding costs accounts for more than 30 percent of the effects on the output gap, while that via financial and capital markets (foreign exchange rate and stock prices) accounts for more than 50 percent.

(1) Model

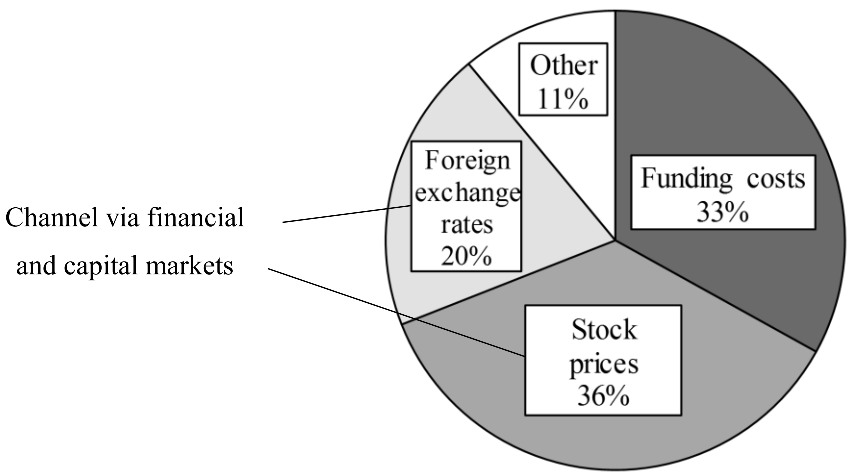
A VAR model with coefficient restrictions using the following eight variables is estimated.
1. Output gap, 2. Interest rates (3-month),
3. Interest rate spread (2-year minus 3-month),
4. Interest rate spread (5-year minus 2-year),
5. Interest rate spread (10-year minus 5-year), **6. Aggregate funding costs**,
7. Nominal effective exchange rate of the yen, **8. Stock prices**

Estimation period: 1998/Q1-2019/Q4. Lag order: 1.
Calculated as the 5-year cumulative impact on the output gap.

(2) Overview of Transmission Channel of a Decline in Interest Rates



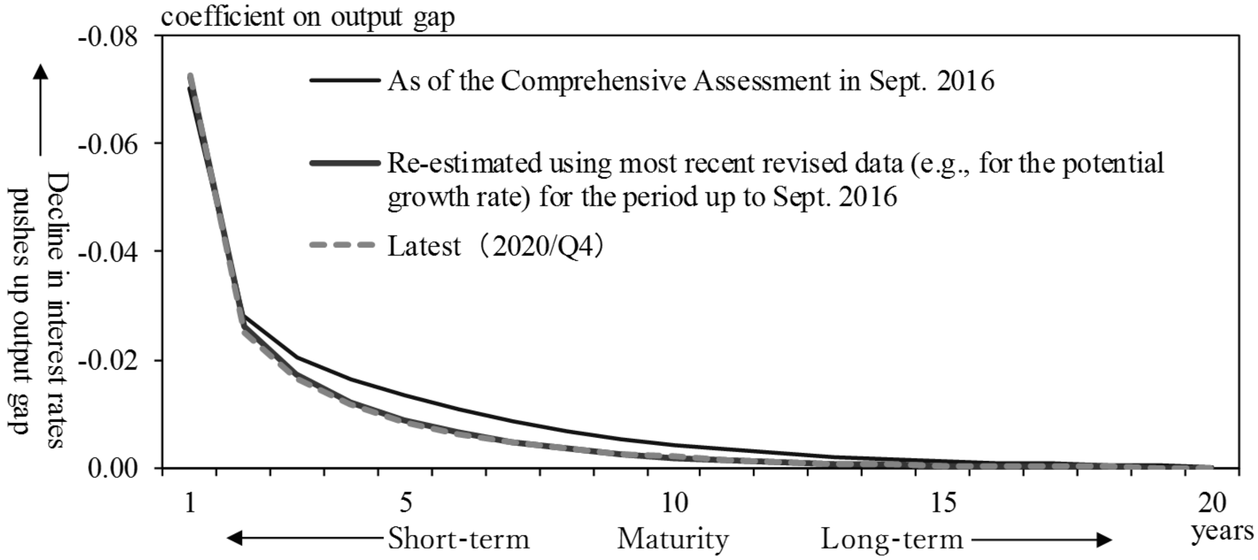
(3) Improvement in the Output Gap through the Decline in Interest Rates by Channel



Notes: 1. Aggregate funding costs are the weighted average of bank lending rates and issuance yields for CP and corporate bonds.
2. Figures in (3) show the 5-year cumulative effects.
Sources: Bank of Japan; Bloomberg, etc.

Effects of Decline in Interest Rates on Economic Activity and Prices

(1) Effects of a Change in Interest Rates by Maturity on Output Gap



(2) Response of Consumer Sentiment to Decline in Interest Rates

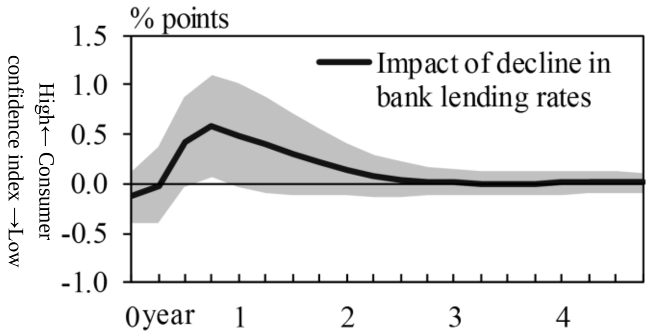
- The response of consumer confidence index (consumer sentiment) to decline in interest rates indicates that (a) a decline in borrowing rates has a positive impact on consumer sentiment, while (b) a decline in super-long-term interest rates has a negative impact.

A VAR model using the following six variables is estimated.

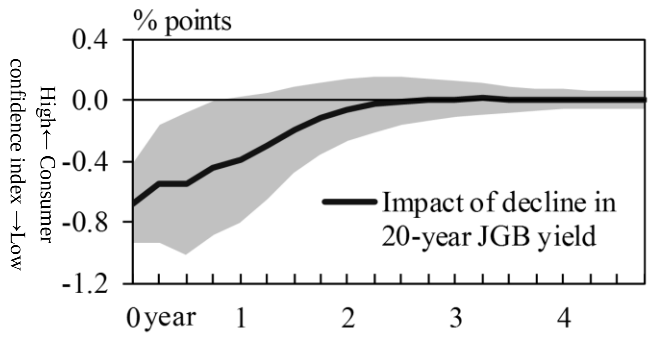
1. Active job openings-to-applicants ratio
2. CPI (all items, s.a., q/q % chg.)
3. **Bank lending rates (new loans, long-term, q/q chg.)**
4. **20-year JGB yield (q/q chg.)**
5. **Stock prices (TOPIX, q/q chg.)**
6. **Consumer confidence index (s.a.)**

Estimation period: 1993/Q2 to 2020/Q3.
Lag order: 2.

(a) Response to Decline in Borrowing Rates



(b) Response to Decline in Super-Long-Term Rates



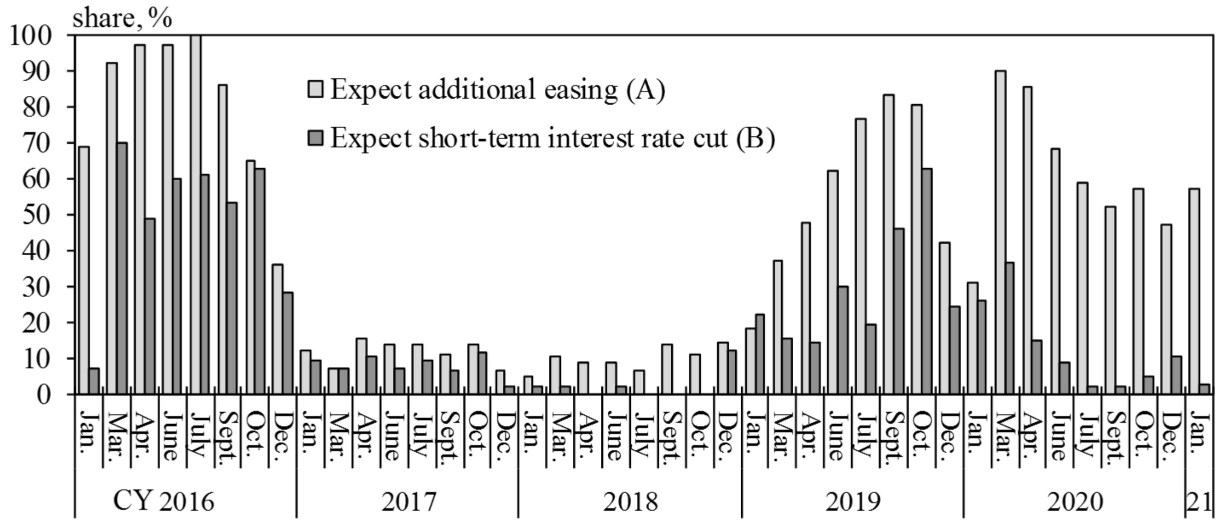
Notes: 1. For details of the methodology used for (1), see Appendix 8 in the Comprehensive Assessment released in September 2016.
2. (2) shows the impulse response to a 1σ shock. The shaded areas denote ±1.5 standard errors.

Sources: Ministry of Health, Labour and Welfare; Ministry of Internal Affairs and Communications; Bank of Japan; Bloomberg; Cabinet Office, etc.

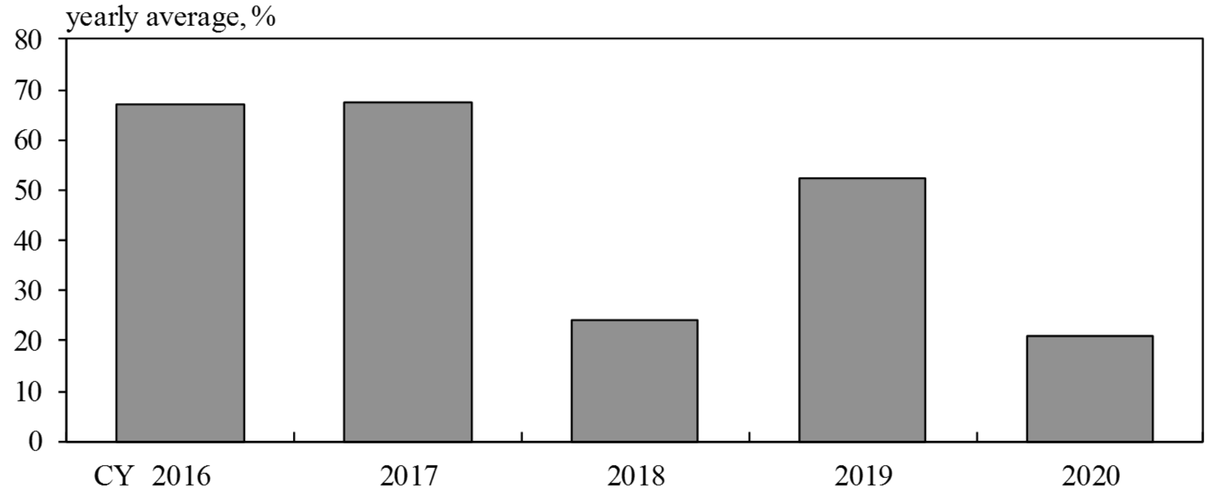
Market Participants' Expectations with Regard to Short-Term Interest Rate Cuts

- The share of respondents in a survey of market participants expecting short-term interest rate cuts to be an option for additional easing (B in chart (1)) among those expecting additional easing (A in chart (1)) shows that, as indicated in (2), the share has decreased recently to about 20 percent from about 70 percent, which was the share immediately after the introduction of the negative interest rate policy.
- Anecdotal information suggests that an increasing number of those who are not expecting interest rate cuts tend to point to the impact on the functioning of financial intermediation.

(1) Share of Respondents Expecting Additional Easing and Short-Term Interest Rate Cut in a Survey of Economists



(2) Share of Respondents Expecting Short-Term Interest Rate Cut among Those Expecting Additional Easing (B/A)



Notes: 1. Based on a survey conducted by Bloomberg before each Monetary Policy Meeting. "Expect additional easing" in (1) is the sum of all respondents expecting the next policy change of the Bank to be additional easing, regardless of when they expect it to be implemented. "Expect short-term interest rate cut" is the sum of all respondents expecting the Bank to cut the short-term policy interest rate in the future.

2. (2) shows the share of respondents expecting the Bank to cut short-term interest rates in the future (B) among those expecting additional easing as the Bank's next policy change (A). Although not all those who responded with (B) also responded with (A), the calculation here assumes that they did. For 2016, results from the January survey before the introduction of the negative interest rate policy are excluded.

Source: Bloomberg.

Financial Conditions under COVID-19 Response Measures

(1) The Bank's Measures in Response to COVID-19

Supporting Corporate Financing

Special Program to Support Financing in Response to COVID-19

- Special Funds-Supplying Operations to Facilitate Financing in Response to COVID-19
- Purchases of CP and corporate bonds

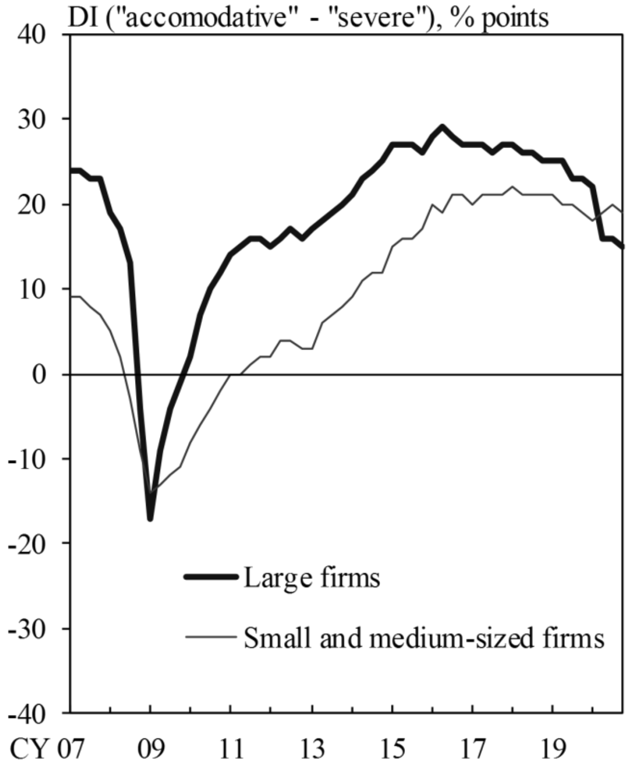
Stabilizing Financial Markets

- Further active purchases of JGBs and T-Bills
- Enhancement of the U.S. Dollar Funds-Supplying Operations

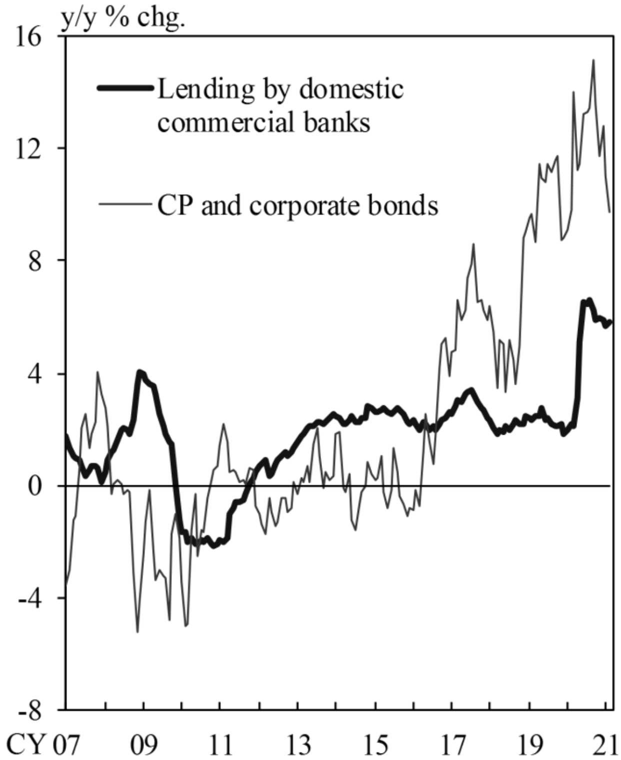
Purchases of ETFs and J-REITs

- ETFs : annual pace with the upper limit of about 12 tril. yen
- J-REITs: annual pace with the upper limit of about 180 bil. yen

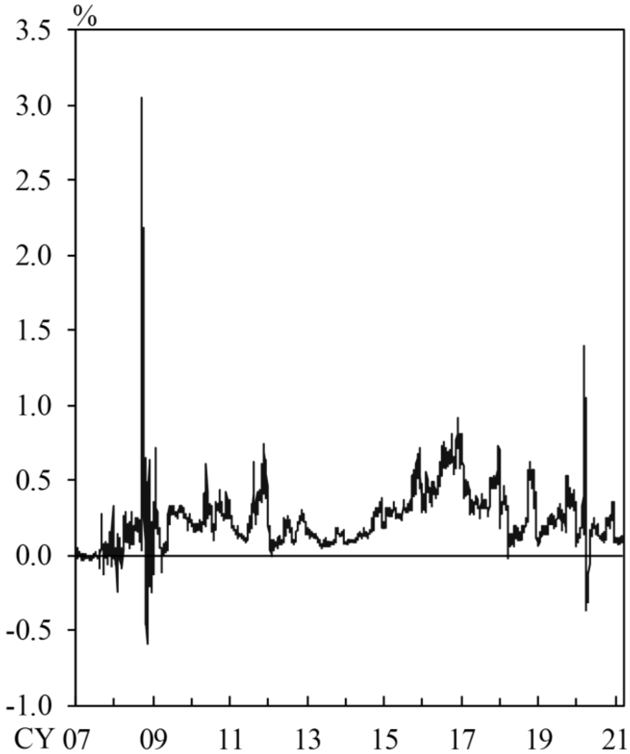
(2) Lending Attitudes of Financial Institutions as Perceived by Firms



(3) Amounts Outstanding of Bank Lending, CP, and Corporate Bonds



(4) Dollar Funding Premiums through Foreign Exchange Swaps



Notes: 1. Figures in (2) are for all industries.

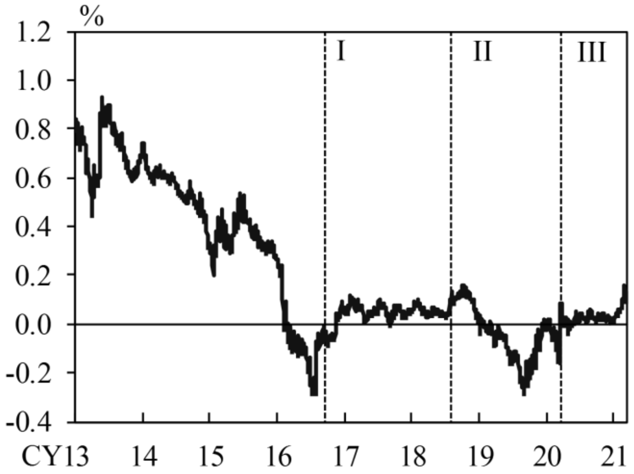
2. Figures for lending by domestic commercial banks in (3) are monthly averages. Figures for CP and corporate bonds are those at the end of the period. Lending by domestic commercial banks includes loans to firms, individuals, and local governments.

3. Figures in (4) are U.S. dollar funding rate from yen minus 3-month dollar LIBOR.

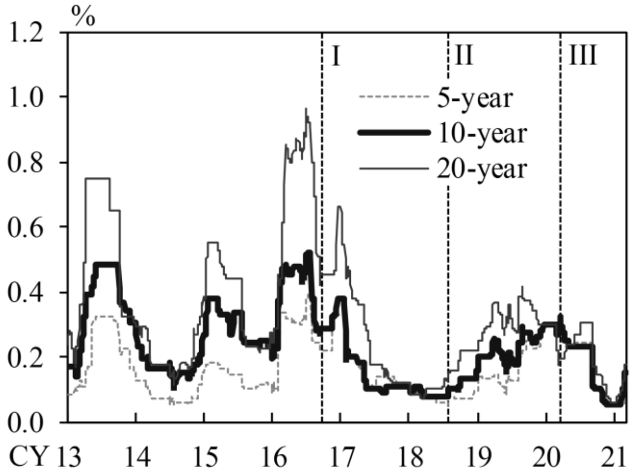
Sources: Bank of Japan; Japan Securities Depository Center; Japan Securities Dealers Association; I-N Information Systems; Bloomberg.

Functioning of the JGB Market

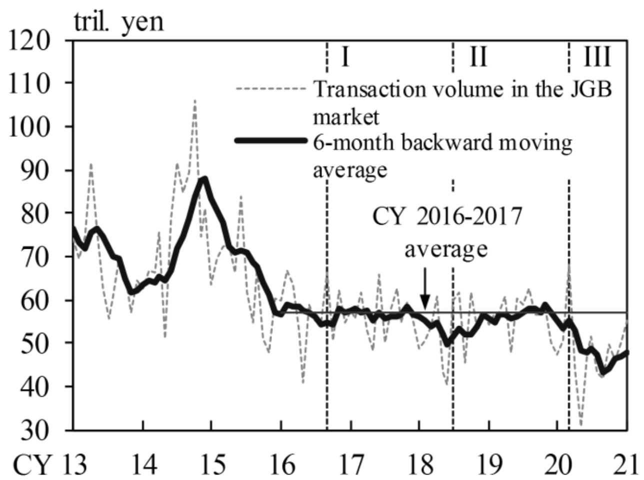
(1) 10-Year JGB Yields



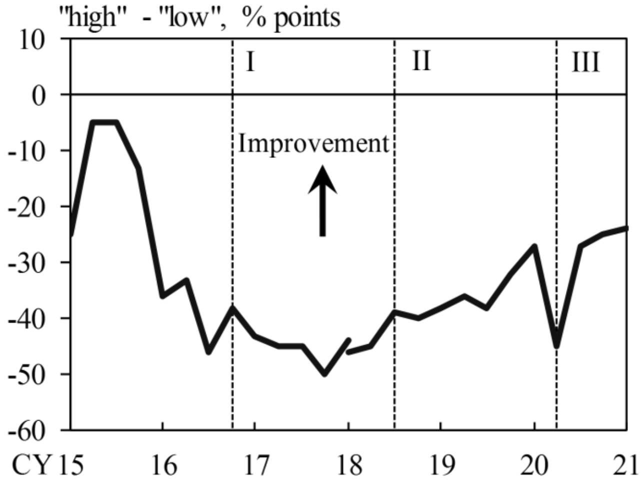
(2) Range of Fluctuations in JGB Yields



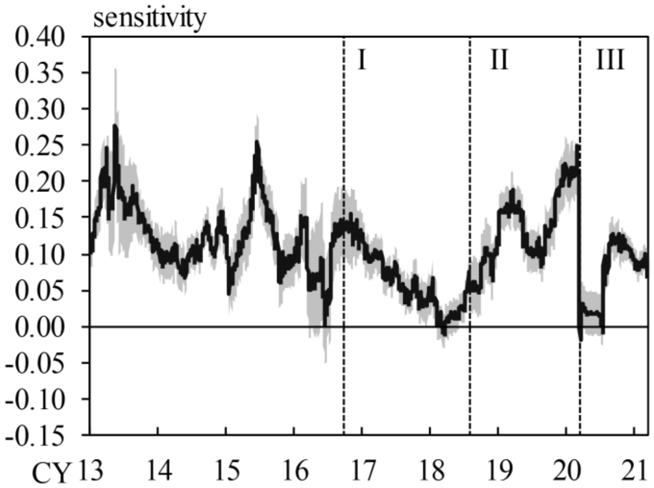
(3) Transaction Volume in the JGB Market



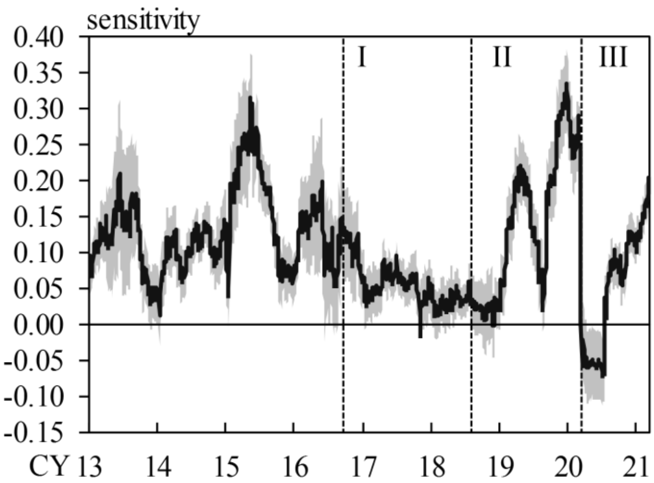
(4) Bond Market Survey (Market Functioning)



(5) Sensitivity of JGB Yields (to U.S., 10Y)



(6) Sensitivity of JGB Yields (to Germany, 10Y)



Notes: 1. I: Introduction of QQE with Yield Curve Control (Sept. 2016), II: Strengthening the Framework for Continuous Powerful Monetary Easing (July 2018), III: Enhancement of Monetary Easing in Light of the Impact of the Outbreak of the Novel Coronavirus (COVID-19) (Mar. 2020).

2. (2) shows the difference between the maximum and minimum values in JGB yields in the preceding 6-months.

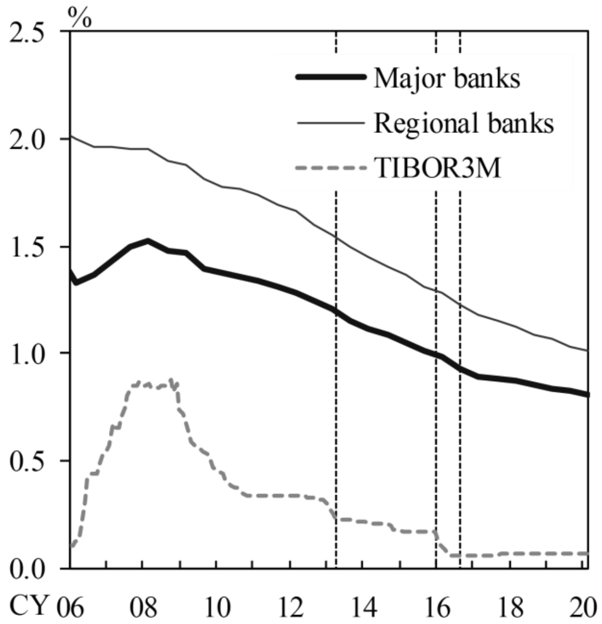
3. (3) shows the gross amount of outright purchases by banks, investors, and bond dealers.

4. (5) and (6) show rolling regression estimates for 90-day windows. The shaded areas represent ±1 standard errors.

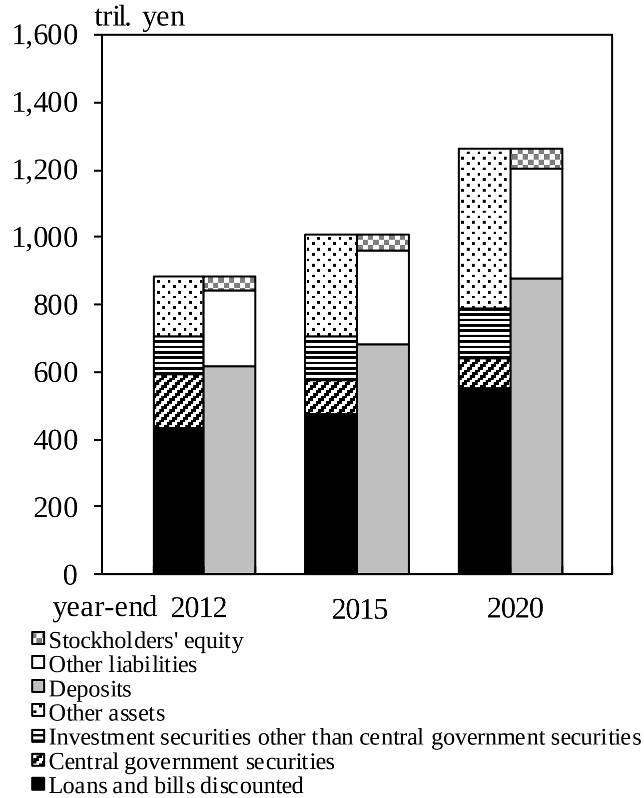
Sources: Bloomberg; Japan Securities Dealers Association; Bank of Japan.

Functioning of Financial Intermediation

(1) Domestic Deposit-Lending Margins



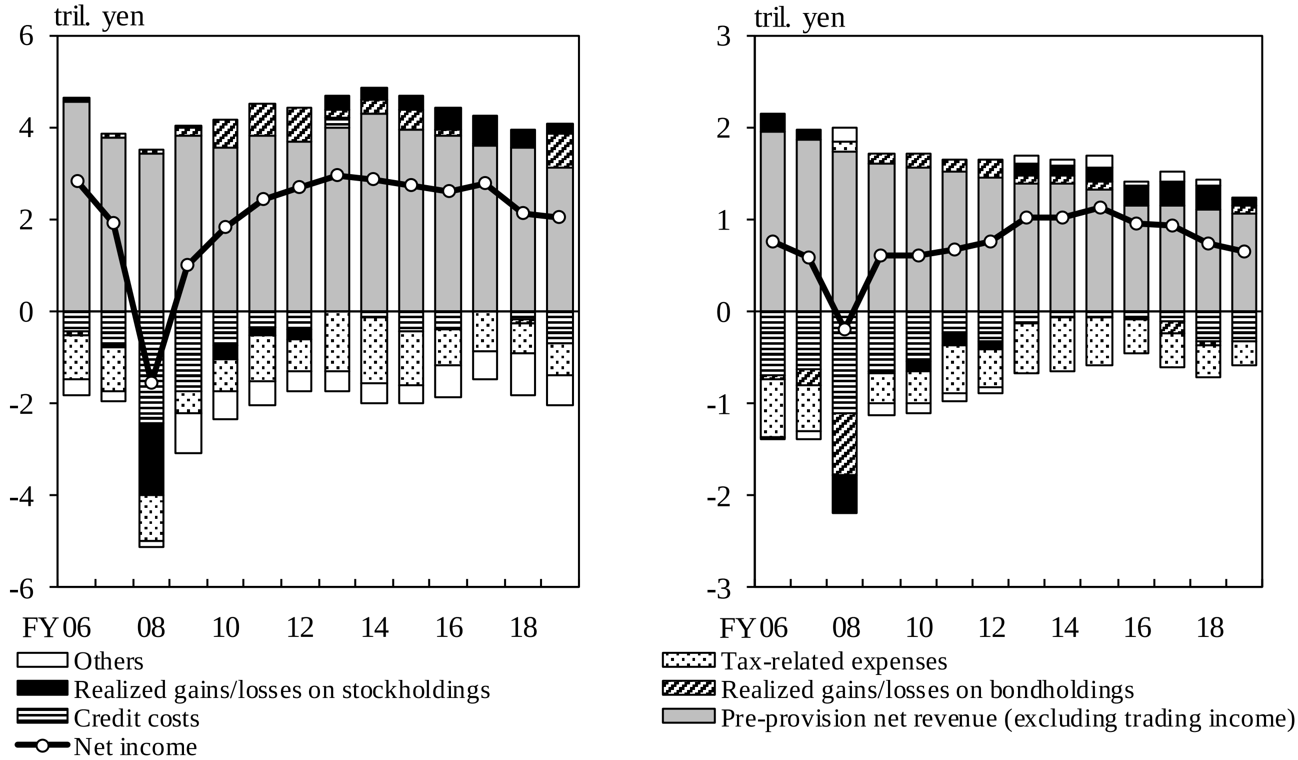
(2) Balance Sheet of Domestic Banks



(3) Net Income of Banks

(a) Major Financial Groups

(b) Regional Banks



Notes: 1. The vertical lines in (1) indicate the introduction of QQE (Apr. 2013), the introduction of QQE with a Negative Interest Rate (Jan. 2016), and the introduction of QQE with Yield Curve Control (Sept. 2016), respectively.

2. Figures for (2) are based on accounts held in Japan.

3. Figures for major financial groups in (3) are on a consolidated basis. From fiscal 2012, profits from investment trusts due to cancellations are excluded from "pre-provision net revenue (excluding trading income)."

Sources: Bloomberg; published accounts of each bank; Bank of Japan.

Estimation of the Effects of ETF Purchases

Estimation I:

Test whether ETF purchases have a significant effect on risk premia in the stock market.

- Statistically significant effect found.

Estimation II:

Test whether the effects of ETF purchases on risk premia in the stock market differ depending on market conditions at the time of purchases and on the size of purchases (four cases).

- The results indicate that the more volatile the market and the larger the size of purchases, the larger the effects of ETF purchases per single amount.

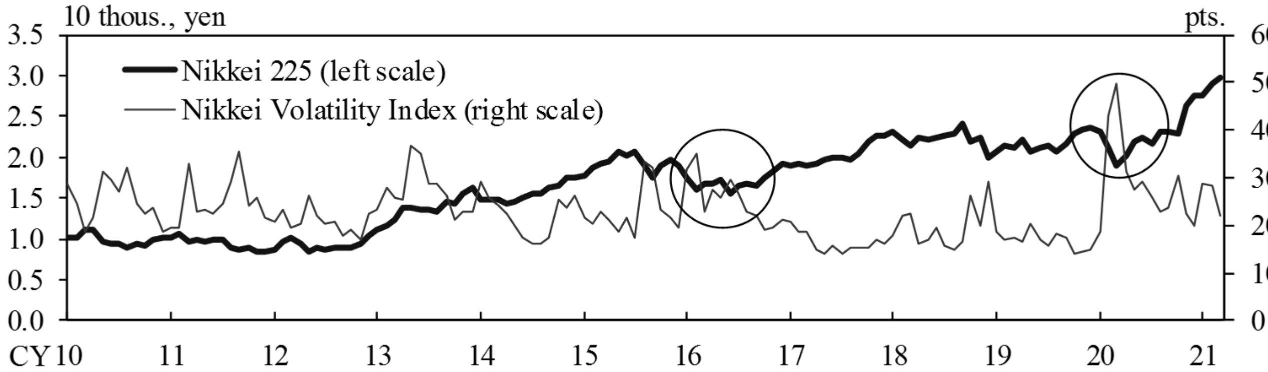
		Effects of ETF purchases on risk premia implied by option prices	Effects of ETF purchases on individual stock yield spreads
Estimation I		Yes	Yes
Estimation II Conditions at the time of purchases and the size of purchases	The lower the level of stock prices relative to their trend…	…the **larger** the effects.	…the **larger** the effects.
	The higher the volatility in the stock market (when stock prices are below their trend)…	…the **larger** the effects.	…the **larger** the effects.
	The larger the rate of decline in stock prices immediately before the purchases…	No statistically significant effect.	…the **larger** the effects.
	The larger the size of purchases …	No statistically significant effect.	…the **larger** the effects.

Note: See Appendix 5 for details.

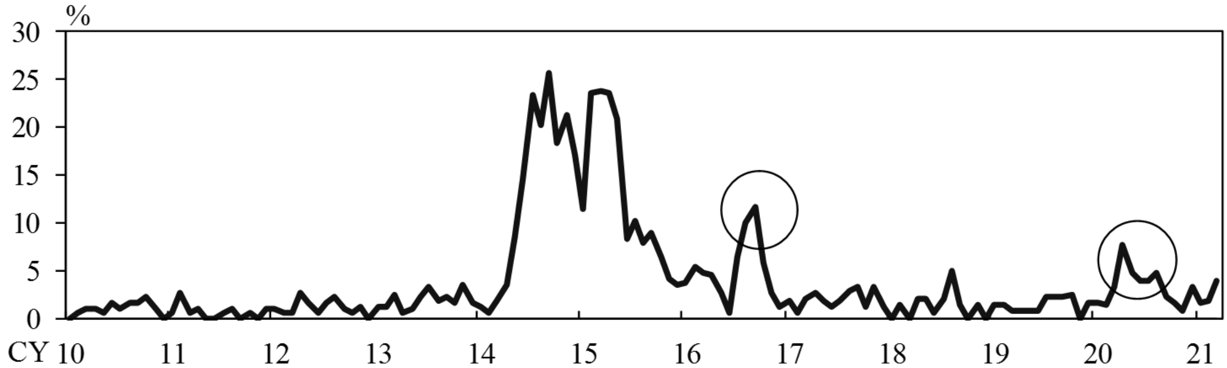
Market Participants' Views on ETF Purchases

- During periods when stock prices decline or volatility heightens such as Brexit in 2016 and the spread of COVID-19 in 2020 (A), public sector purchases including by the Bank draw the market's attention (B) and are increasingly seen as a positive factor for the stock market (C).
  - The increase in level of attention paid to the public sector in 2014 seems to be largely attributable to adoption of the new policy asset mix by the Government Pension Investment Fund (GPIF).

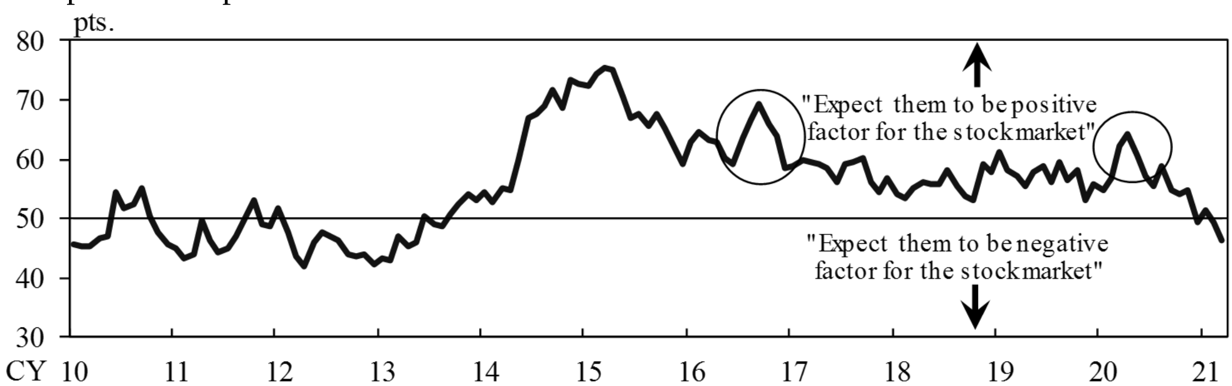
A. Stock Prices and Stock Price Volatility



B. Level of Attention Paid to Corporate Pension Funds and Public Funds by Stock Market Participants



C. Impact of Corporate Pension Funds and Public Funds on the Stock Market

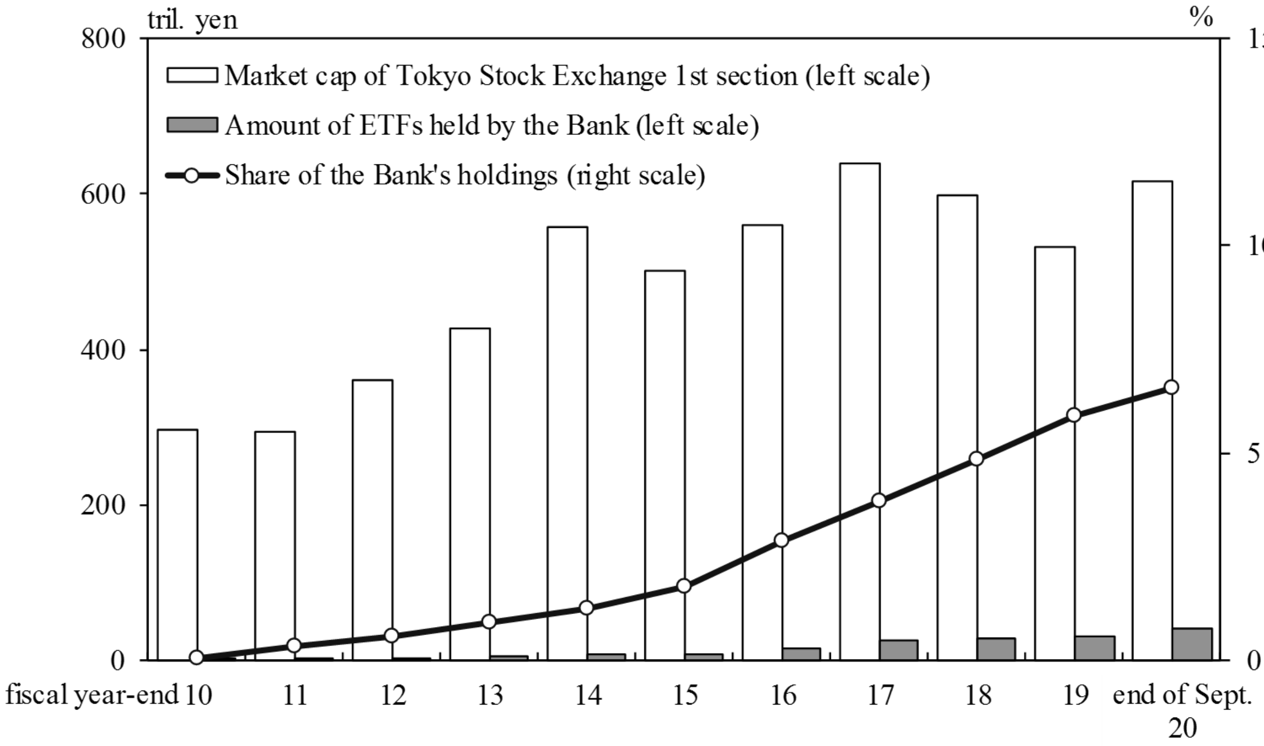


Note: Figures in B. and C. are based on a survey of market participants conducted by QUICK Corp. The level of attention in B. is the share of respondents who responded that the investment entities to which they would pay the most attention over the following six months or so were corporate pension funds and public funds out of the various investment entities (individuals, foreigners, investment trusts, financial corporations (excluding corporate pension funds and public funds), corporate pension funds and public funds, business corporations, and proprietary trading (including arbitrage trading)). The index in C. shows market participants' views of how corporate pension funds and public funds will affect stock prices over the following 6 months or so. The index is calculated as follows. Respondents are asked to indicate their expectation of the impact of corporate pension funds and public funds on the stock prices on a five-grade scale (strong positive, positive, neutral/don't know, negative, and strong negative). The index is obtained by multiplying the share of each response by 100, 75, 50, 25, and 0, respectively.

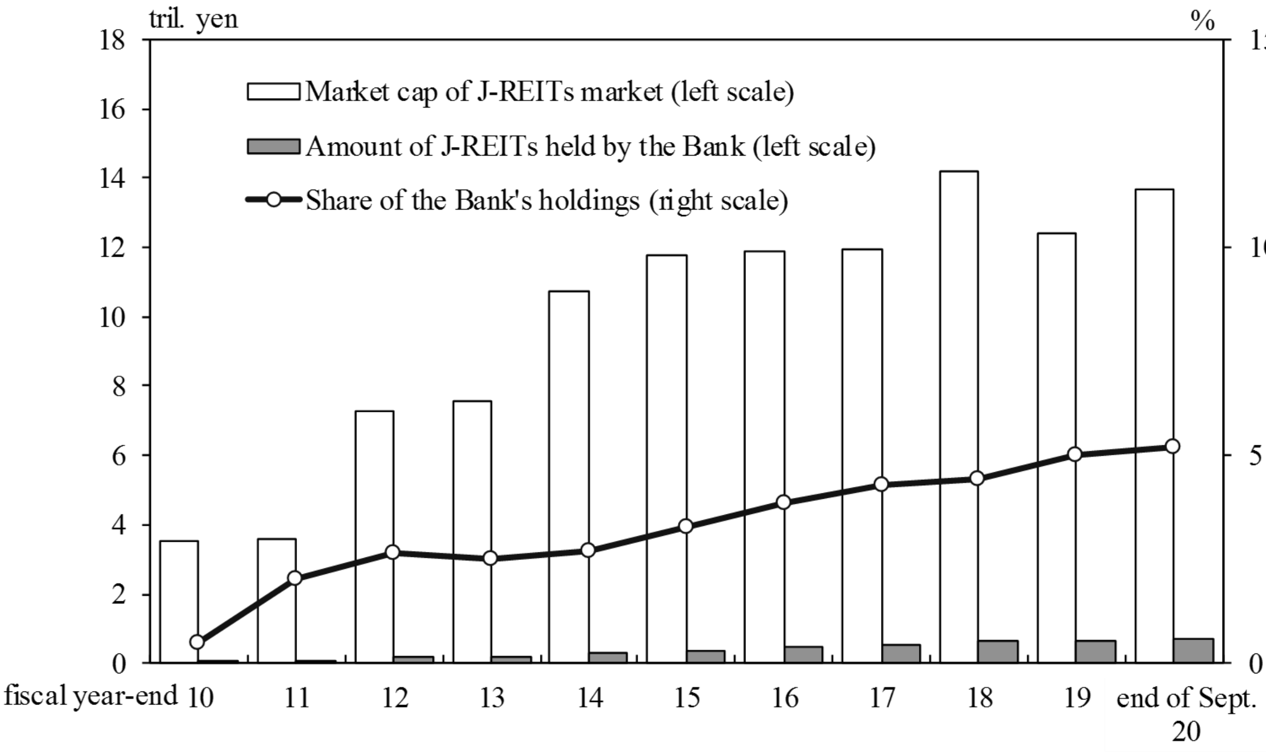
Sources: Bloomberg; QUICK, "QUICK Monthly Market Survey (Stocks)."

Amounts of ETFs and J-REITs Held by the Bank

(1) ETFs



(2) J-REITs



Sources: JPX; The Association for Real Estate Securitization; Bank of Japan.

Mechanism behind Inflation Developments in Japan: International Comparison of Adaptive Expectations Formation

- Inflation expectations formation has two elements: a forward-looking element shaped by the inflation target set by a central bank, and a backward-looking, or adaptive, element reflecting the observed inflation rate.
- As shown below, employing the same method as the Comprehensive Assessment and using data up until recently, the Bank reexamined the contribution of observed inflation to inflation expectations 1 year ahead (θ_1) and 6-10 years ahead (θ_2) for each country.
- The results show that θ_1 and θ_2 have not changed significantly from at the time when the Comprehensive Assessment was conducted, and the Bank found that the adaptive element still plays a much larger role in the mechanism in Japan.

(1) Equations

Equation (a): Contribution of observed inflation to inflation expectations 1 year ahead θ_1

Inflation expectations 1 year ahead = θ_1×Observed inflation (lagged 1 quarter)
+ (1 – θ_1) × Inflation expectations 6-10 years ahead

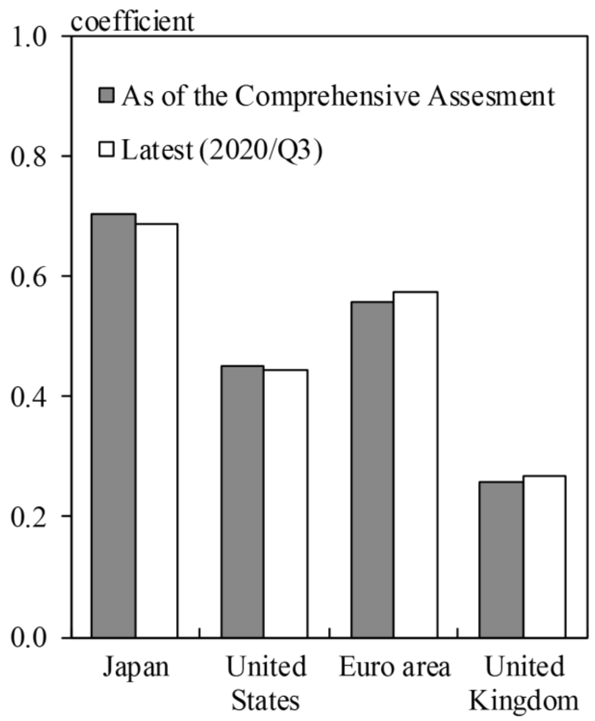
Equation (b): Contribution of observed inflation to inflation expectations 6-10 years ahead θ_2

Inflation expectations 6-10 years ahead = θ_2 × Observed inflation (lagged 1 quarter)
+ (1 – θ_2) × Central bank price stability target (2%)

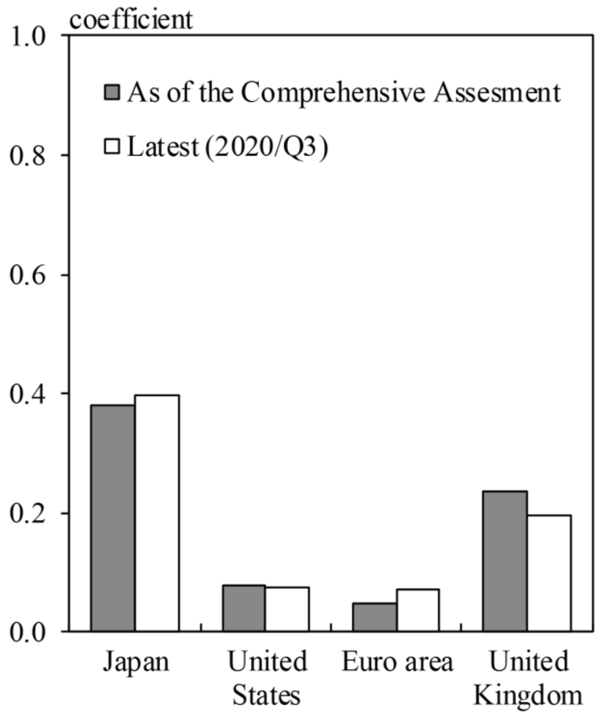
Estimation period: From 2000/Q1 for Japan and the United States, 2003/Q2 for the euro area, and 2005/Q1 for the United Kingdom to periods shown in the legends. The estimations use core inflation rates as observed inflation rates.

(2) Estimation Results (Contribution of Observed Inflation to Inflation Expectations)

(a) Inflation Expectations 1 Year Ahead (θ_1)



(b) Inflation Expectations 6-10 Years Ahead (θ_2)



Sources: Consensus Economics Inc., "Consensus Forecasts"; Ministry of Internal Affairs and Communications; BLS; Eurostat; ONS.

Mechanism behind Inflation Developments in Japan: Inflation Expectations by Cohort

- The Bank examined the difference in households' inflation expectations by cohort using microdata from the *Opinion Survey on the General Public's Views and Behavior*. As shown below, controlling for variables such as respondents' impression of economic conditions, the Bank analyzed the difference of the following across cohorts: (1) the expected inflation level (β) and (2) the impact of inflation perceptions (actual prices) on the formation of inflation expectations (sensitivity) (γ).
- The results show that the younger the age groups, which have not experienced inflation, (1) the lower inflation expectations (β), and (2) the less sensitive their inflation expectations to actual fluctuations in prices (γ).

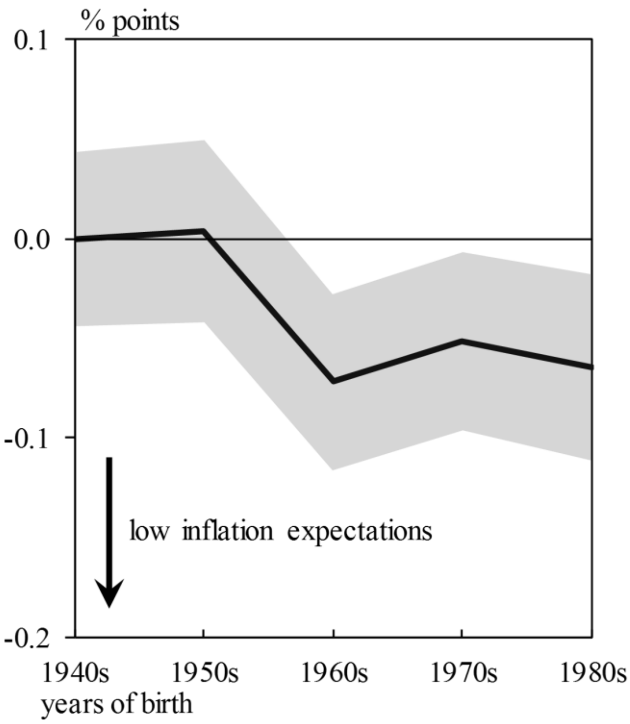
(1) Equation

$$(\text{Inflation expectations})_{i,t} = \alpha + \Sigma\, \beta_m\, (\text{Cohort dummy})_{m,i,t} + \Sigma\, \gamma_m\, (\text{Cohort dummy})_{m,i,t} \times (\text{Inflation perceptions})_{i,t} + \theta\, (\text{Control variables})_{i,t}$$

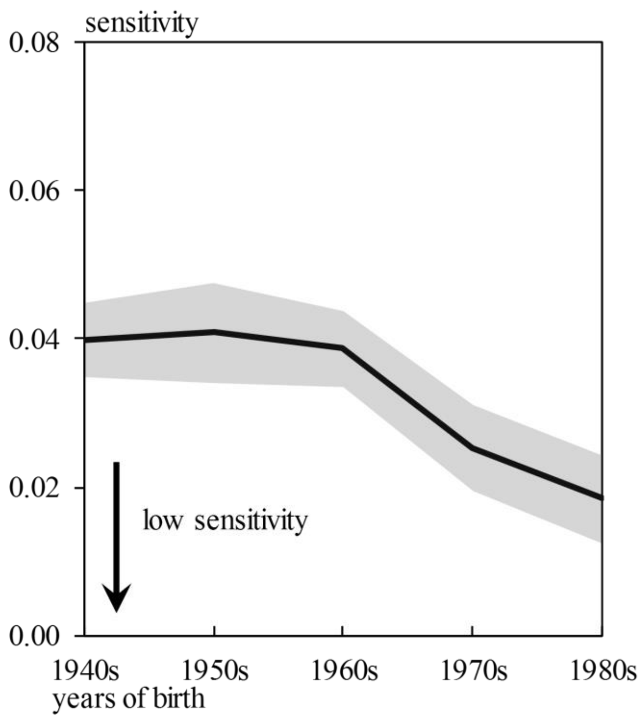
Estimation period: 2006/Q3–2020/Q4. The number of observations is approximately 60,000. The cohort dummies are calculated using the age groups of respondents at the time of each survey. Questions ask respondents to give their inflation expectations and perceptions in numbers. For the analysis, responses within the range of –5 to +5 percent of inflation expectations are used. Control variables include respondents' impression of economic conditions, income, and gender, etc.

(2) Estimation Results

(a) Difference in Expected Inflation Level across Cohorts (β)



(b) Difference in Sensitivity across Cohorts (γ)



Notes: 1. β in (2)(a) is the difference from individuals born in the 1940s.
2. The shaded areas in (2) indicate ±1.5 standard errors.
Source: Bank of Japan.

Mechanism behind Inflation Developments in Japan: Firms' Inflation Expectations Formation

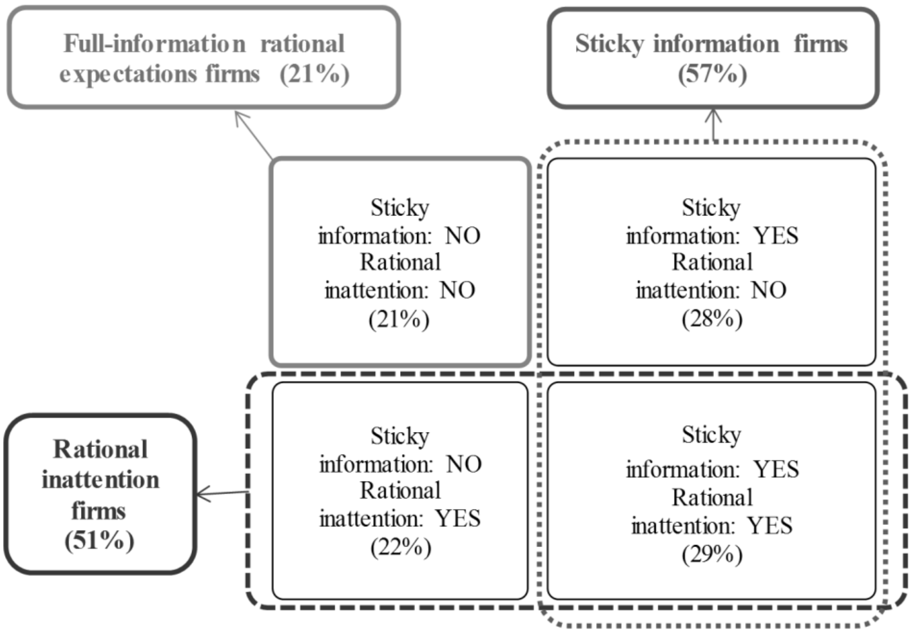
- According to a recent analysis on the inflation expectations formation process of Japanese firms:
  - About 60 percent of the firms take time to incorporate information into inflation expectations (sticky information constraints)
  - About 50 percent of the firms form inflation expectations without using information to which they attach little importance (rational inattention)

  ⇒ Only about 20 percent of the firms follow "full-information rational expectations" and thereby form inflation expectations by using all available information at the time.

(1) Three Hypotheses Regarding Inflation Expectations Formation

Full-Information Rational Expectations	・ Economic entities form expectations <u>using all information available at the time.</u> ・ Although many macroeconomic models are based on this hypothesis, recent empirical research using micro data shows that the explanatory power of such models is limited.
Sticky Information	・ <u>Economic entities do not always update their expectations</u> due to costs of acquiring information.
Rational Inattention	・ Given limited information processing capacity, economic entities rationally choose <u>to pay less attention to information to which they attach little importance</u>.

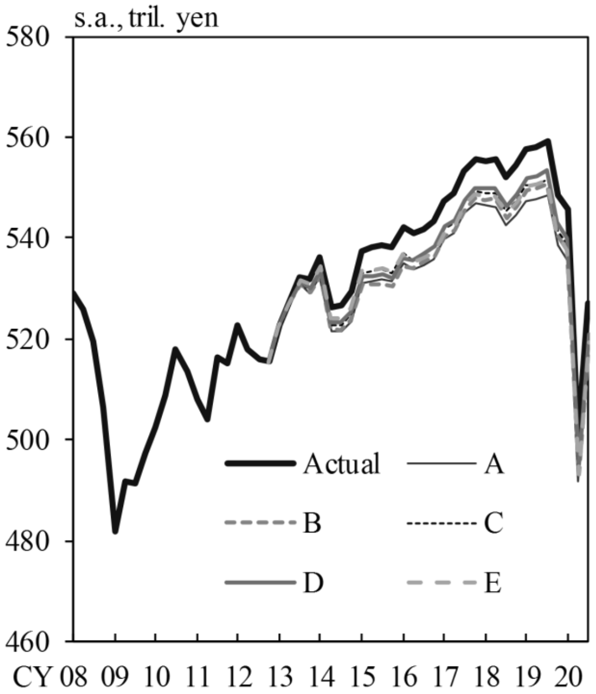
(2) Share of Japanese Firms Following Each Expectations Formation Mechanism (Kitamura and Tanaka, 2019)



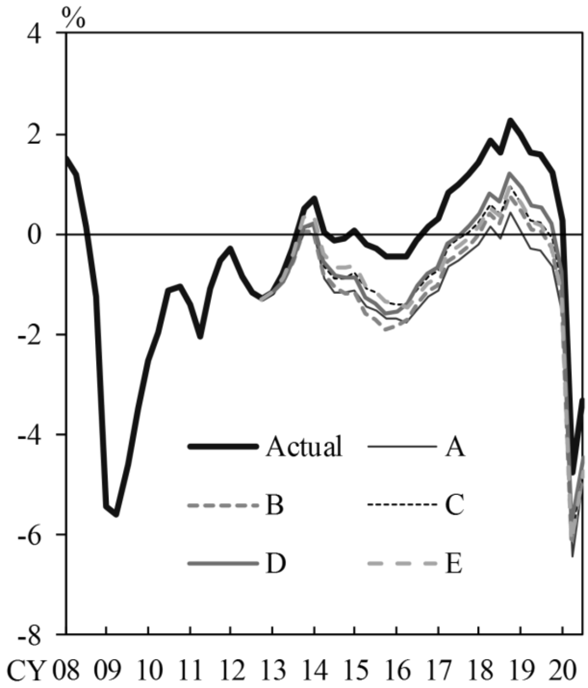
Source: Kitamura, T. and Tanaka, M., "Firms' Inflation Expectations under Rational Inattention and Sticky Information: An Analysis with a Small-scale Macroeconomic Model," *Bank of Japan Working Paper Series*, No.19-E-16, November 2019.

Examination on Policy Effects Using the Bank's Macroeconomic Model (Q-JEM): Counterfactual Simulation

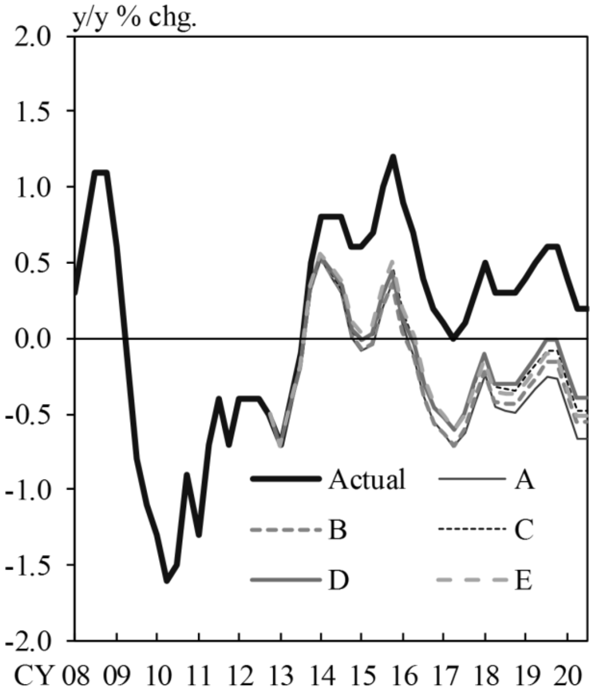
(1) Real GDP



(2) Output Gap



(3) CPI (less fresh food and energy)



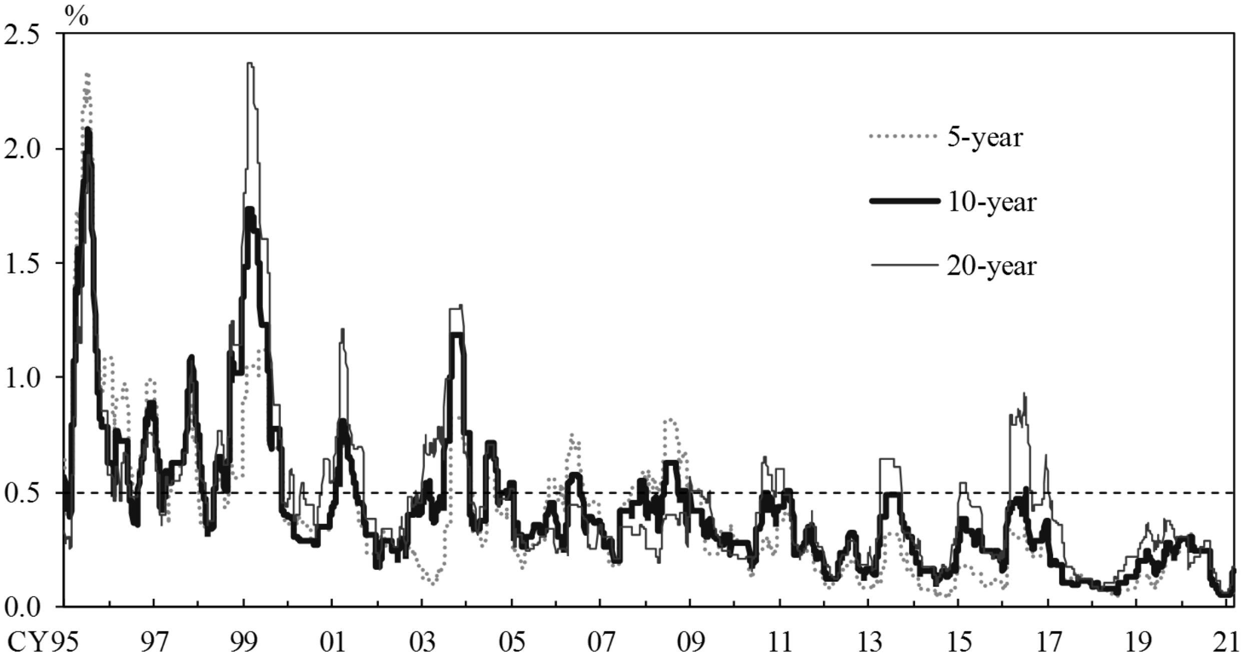
(4) Policy Effects
(average since the introduction of QQE)

	Simulation				
	A	B	C	D	E
Real GDP (level, %)	+1.3	+1.2	+1.0	+0.9	+1.0
Output Gap (% points)	+1.3	+1.2	+1.0	+0.9	+1.0
CPI (less fresh food and energy, y/y chg., % points)	+0.7	+0.6	+0.6	+0.6	+0.6

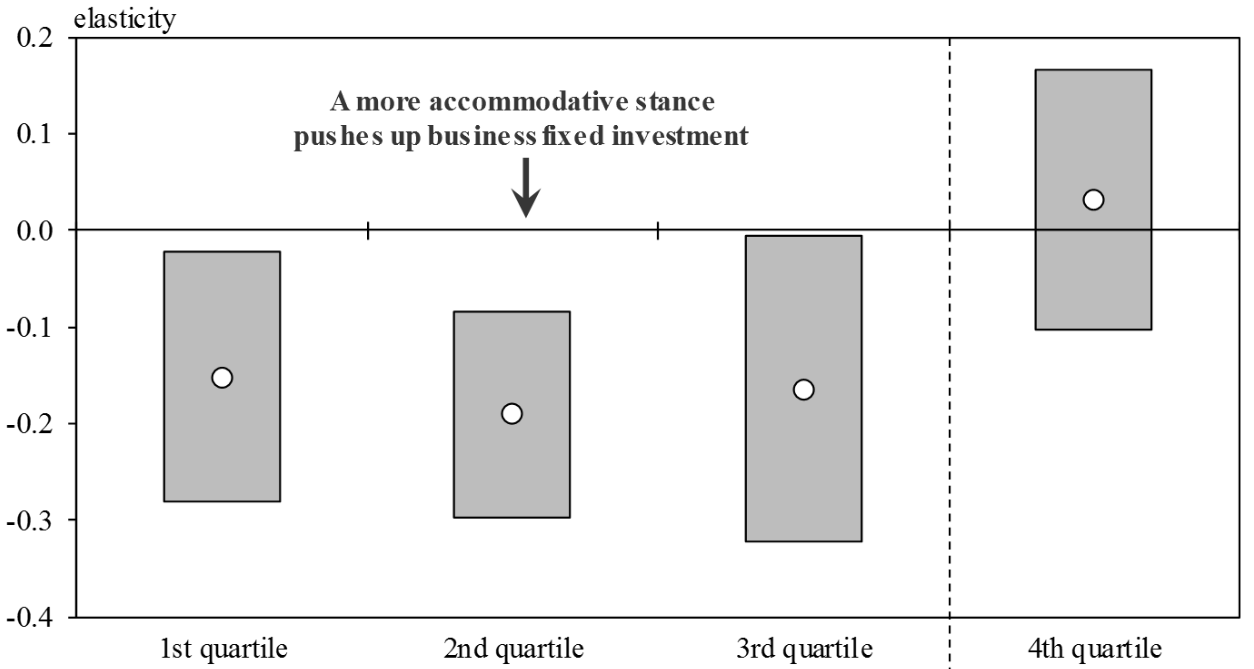
Note: For details of simulations A to E, see the main text of Appendix 2.
Sources: Cabinet Office; Bank of Japan; Ministry of Internal Affairs and Communications, etc.

Impact of Interest Rate Fluctuations on the Real Economy

(1) Range of Fluctuations in JGB Yields (max. – min. within past 6-months)



(2) Impact of Interest Rate Fluctuations on Business Fixed Investment
(Sensitivity to Real Interest Rate Gap <$\beta_1+\beta_2$>)



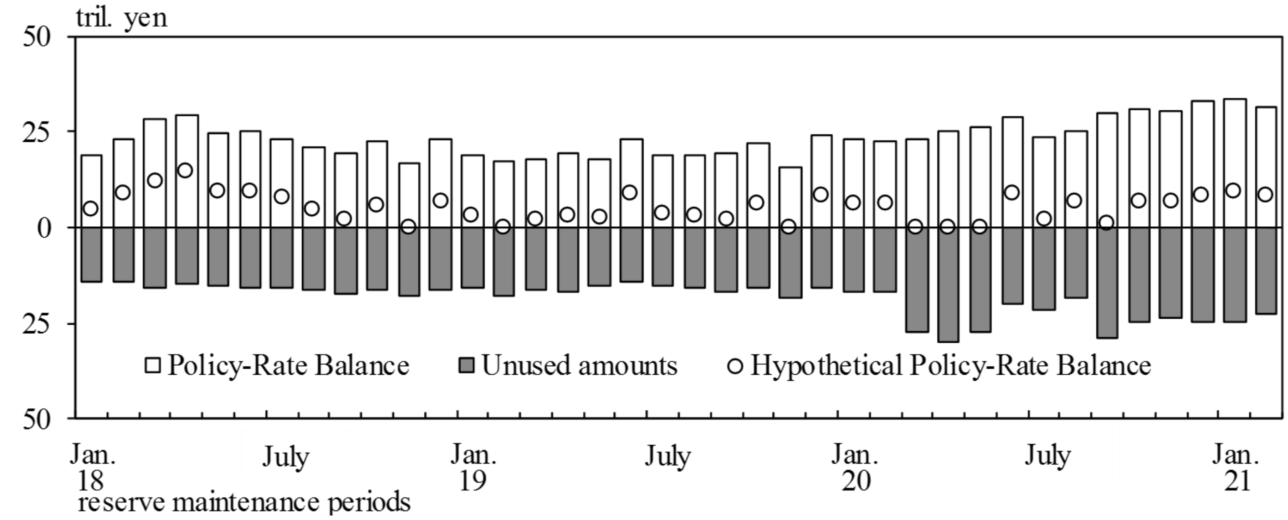
Range of fluctuations in interest rates	0.25%points or less	0.25 to 0.36%points	0.36 to 0.51%points	more than 0.51%points

← Small Range of fluctuations in interest rates Large →

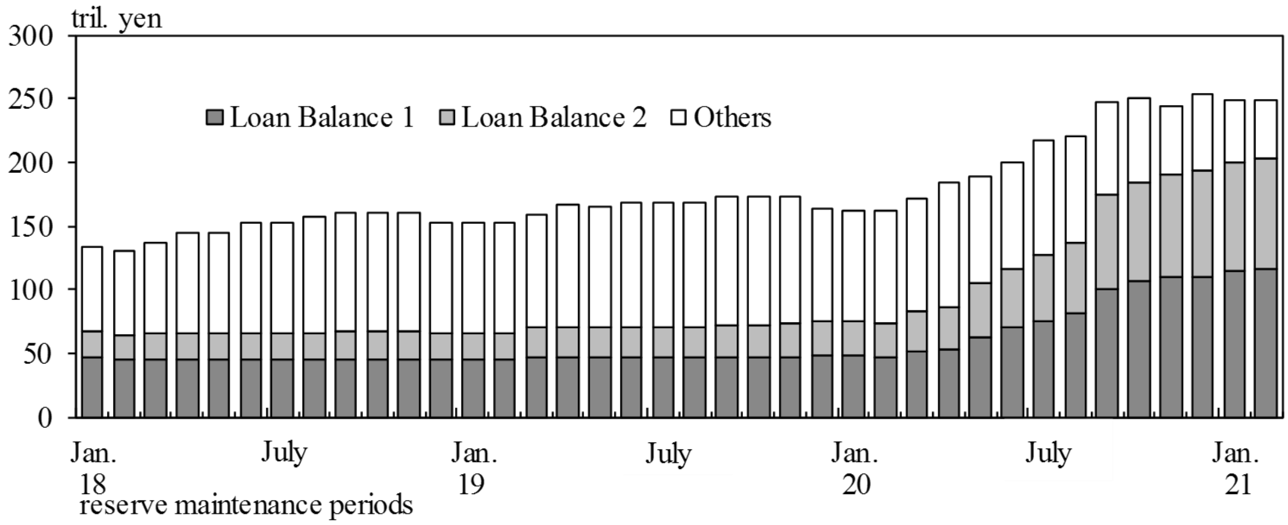
Note: Figures for the real interest rate gap in (2) are calculated using the natural yield curve model (10-year).
The vertical bands indicate ±1.5 standard errors.
Sources: Bloomberg; Consensus Economics Inc., "Consensus Forecasts"; Economic Policy Uncertainty; Cabinet Office.

Operation of the Complementary Deposit Facility

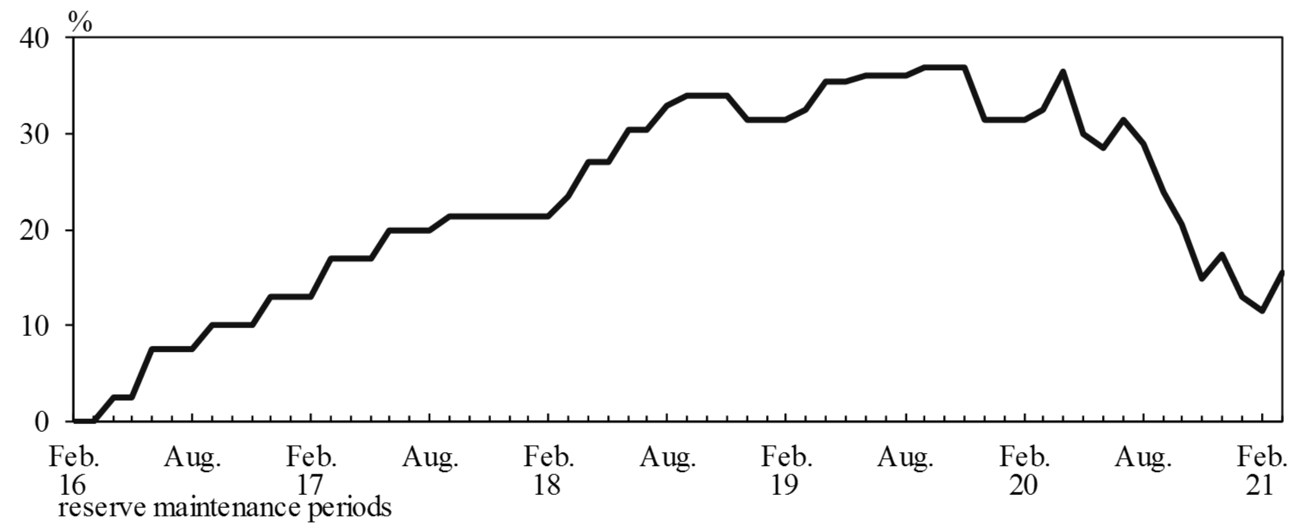
(1) Unused Amounts of Macro Add-on Balances, etc. and the Policy-Rate Balances



(2) Amounts of Macro Add-on Balances and their Breakdown



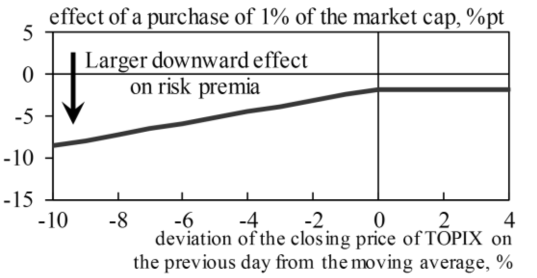
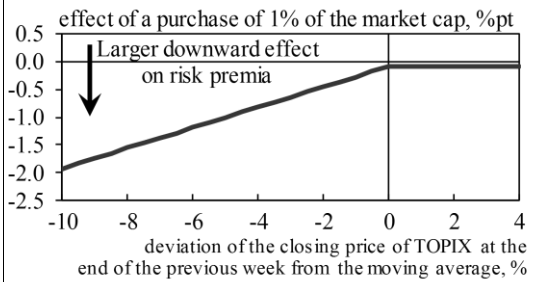
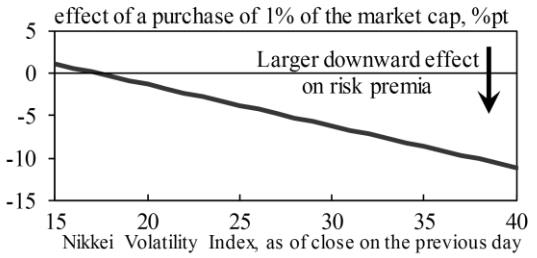
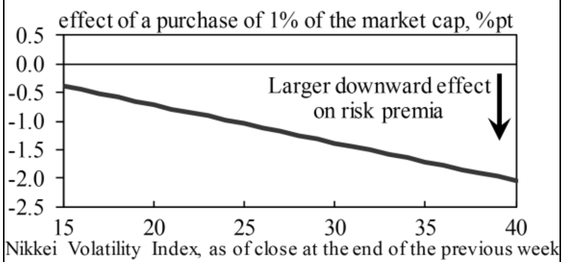
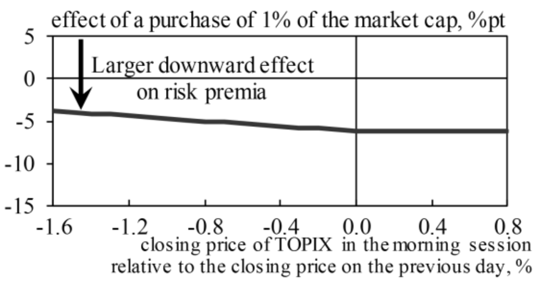
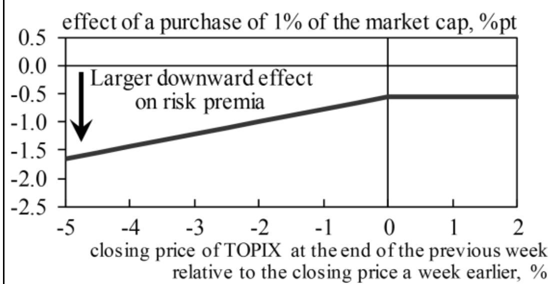
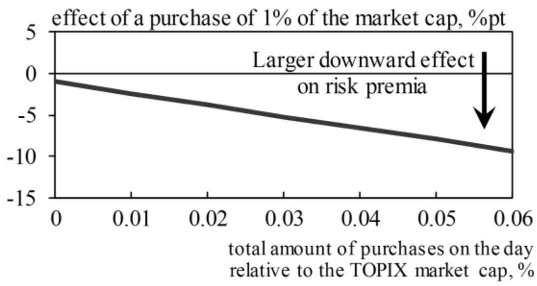
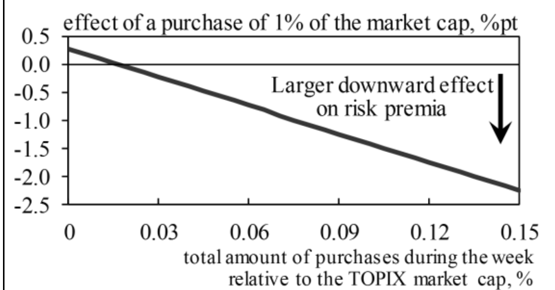
(3) Benchmark Ratio



Note: Figures for unused amounts in (1) include unused amounts of Basic Balances.

Source: Bank of Japan.

Estimation of the Effects of ETF Purchases

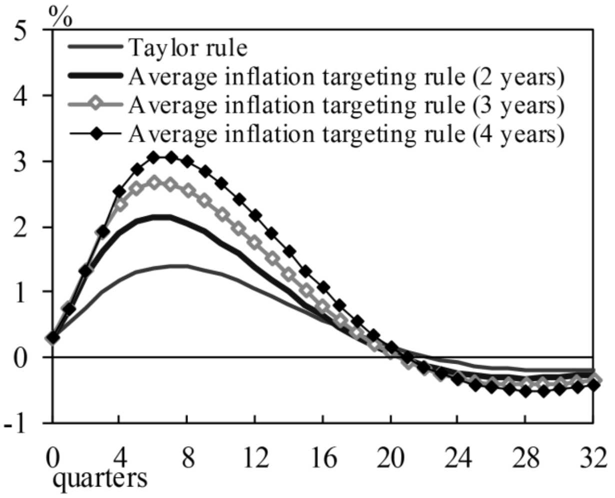
		Dependent variable (risk premia in the stock market)	
		(a) Change in the equity risk premia implied by option prices	(b) Changes in the yield spreads of individual stocks
Estimation I		Coefficient of the purchase volume indicator θ: -5.06*	Coefficient of the purchase volume indicator θ: -0.85*
Estimation II: Purchases effect function (state variable)	(a) % downward deviation of stock prices from the trend	Coefficient of state variable σ: 0.69* 	Coefficient of state variable σ: 0.18* 
	(b) Stock market volatility	Coefficient of state variable × dummy for market condition σ: -0.49* 	Coefficient of state variable × dummy for market condition σ: -0.07* 
	(c) % decline in stock prices immediately before the purchases	Coefficient of state variable σ: -1.51 	Coefficient of state variable σ: 0.22* 
	(d) Size of purchases	Coefficient of state variable σ: -137.71 	Coefficient of state variable σ: -16.66* 

Note: * indicates that the variable is statistically significant at the 5 percent level.
Sources: Bloomberg; QUICK; JPX.

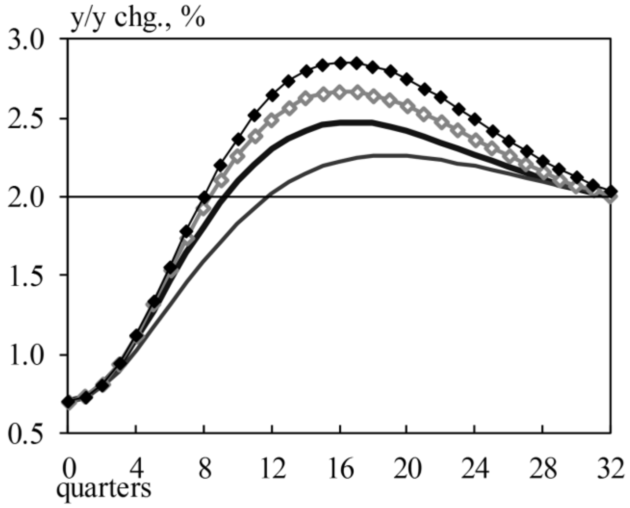
Examination on the Inflation-Overshooting Commitment Using a Macroeconomic Model

(1) Natural Rate of Interest: +0.5%

(a) Output Gap

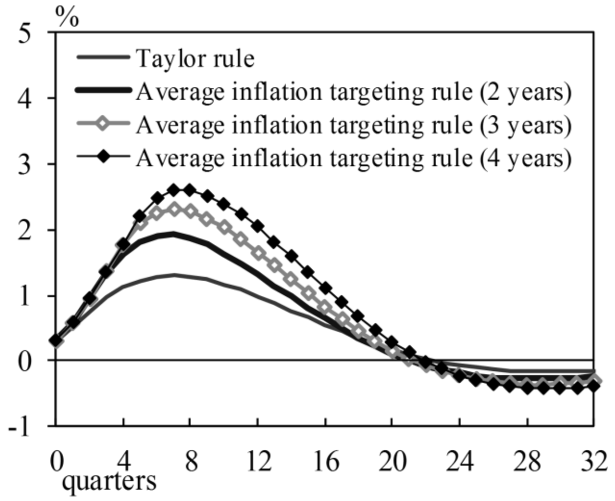


(b) Inflation Rate

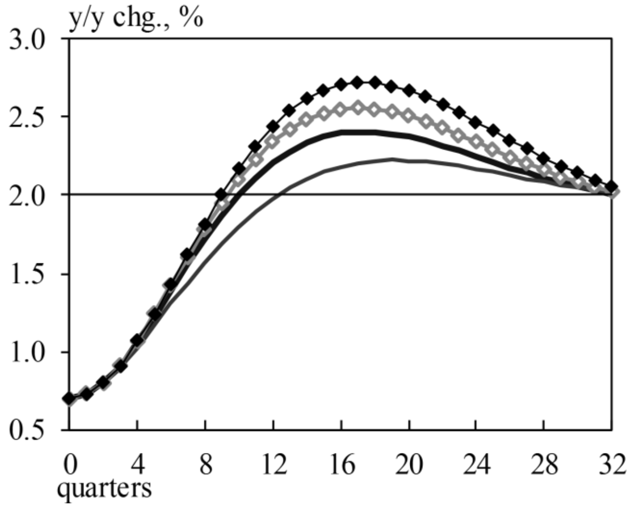


(2) Natural Rate of Interest: -0.1%

(a) Output Gap



(b) Inflation Rate



(3) Average Losses Calculated in Simulations under Each Rule

		Loss function	
		(a) Natural rate of interest: +0.5%	(b) Natural rate of interest: -0.1%
(a) Taylor rule		5.40	7.21
(b) Average inflation targeting rule	1 year average	5.31	7.02
	2 year average	4.84	6.01
	3 year average	5.01	5.83
	4 year average	5.34	5.86

Sources: Bank of Japan; Ministry of Internal Affairs and Communications, etc.