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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)**

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

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Secretariat of the Policy Board, Bank of Japan
P.O. Box 30, Nihonbashi, Tokyo 103-8660, Japan

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The Bank's View¹

I. Comprehensive Assessment

A. Transmission Mechanism of QQE

QQE has lowered real interest rates by raising inflation expectations and pushing down nominal interest rates. Although the natural rate of interest has followed a downward trend, real interest rates have been well below the natural rate of interest, leading to an improvement in financial conditions. As a result, economic activity and price developments improved, and Japan's economy is no longer in deflation, which is commonly defined as a sustained decline in prices.

B. Factors That Have Hampered Achieving the 2 Percent Price Stability Target

However, the price stability target of 2 percent has not been achieved. In terms of the mechanism described above, this is largely due to developments in inflation expectations. The following two factors have played a role in the development of inflation expectations. First, exogenous developments, including (1) the decline in crude oil prices, (2) the weakness in demand following the consumption tax hike in April 2014, and (3) the slowdown in emerging economies and volatile global financial markets, have lowered the observed inflation rate. And second, amid this decline in the observed inflation rate, inflation expectations -- after having been largely flat -- weakened, reflecting the fact that expectations formation in Japan is largely adaptive, that is, backward-looking.

C. The Mechanism of Inflation Expectations Formation

Inflation expectations need to be raised further in order to achieve the price stability target of 2 percent. However, it should be noted that, since the observed inflation rate is likely to remain subdued for the time being, a further rise in inflation expectations through the adaptive mechanism is uncertain and may take time. This highlights the important role played by the forward-looking expectations formation mechanism.

The expansion of the monetary base, together with the commitment to achieving the price stability target and the Bank's purchases of Japanese government bonds (JGBs), by bringing

¹ The text of "The Bank's View" was decided by the Policy Board at the Monetary Policy Meeting held on September 20 and 21, 2016.

about a regime change in monetary policy, has transformed peoples' perceptions of inflation and has led to a rise in inflation expectations. The relationship between the monetary base and inflation expectations seems to be of a long-run rather than a short-run nature. Therefore, what is important is the Bank's commitment to expanding the monetary base in the long run.

D. Pushing Down the Yield Curve through the Negative Interest Rate and JGB Purchases

The negative interest rate policy introduced by the Bank in January 2016, in combination with JGB purchases, has pushed down not only short-term but also long-term interest rates substantially. This shows that the combination of these policy measures is an effective means for the central bank to exert influence on the entire yield curve.

E. The Effects and Impact of the Decline in the Yield Curve

The decline in JGB yields has translated into a decline in lending rates as well as interest rates on corporate bonds and CP. Financial institutions' lending attitudes continue to be proactive. Thus, so far, financial conditions have become more accommodative under the negative interest rate policy. However, because the decline in lending rates has been brought about by reducing financial institutions' lending margins, the extent to which a further decline in the yield curve will lead to a decline in lending rates depends on financial institutions' lending stance going forward.

The impact of interest rates on economic activity and prices as well as financial conditions depends on the shape of the yield curve. In this regard, the following three points warrant attention. First, short- and medium-term interest rates have a larger impact on economic activity than longer-term rates. Second, the link between the impact of interest rates and the shape of the yield curve may change as firms explore new ways of raising funds such as issuing super-long-term corporate bonds under the current monetary easing, including the negative interest rate policy. Third, an excessive decline and flattening of the yield curve may have a negative impact on economic activity by leading to a deterioration in people's sentiment, as it can cause uncertainty about the sustainability of financial functioning in a broader sense.

II. Directions for Monetary Policy Suggested by the Comprehensive Assessment

These findings of the comprehensive assessment suggest the following directions for monetary policy.

- (1) Inflation expectations need to be raised further in order to achieve the price stability target of 2 percent. Given that a further rise in inflation expectations through the adaptive mechanism is uncertain and may take time, measures to strengthen the forward-looking expectations formation mechanism are warranted. At the same time, the Bank needs to adopt measures that enable the Bank to make flexible adjustments according to developments in economic activity and prices as well as financial conditions and that enhances the sustainability of monetary easing.
- (2) The Bank should commit itself to expanding the monetary base in the long run.
- (3) The Bank can exert influence on interest rates along the entire yield curve through the appropriate combination of a negative interest rate and JGB purchases.
- (4) To work toward the formation of an appropriate yield curve, the Bank should take account of economic, price, and financial conditions, including (i) the extent to which a decline in JGB yields translates into a decline in lending and corporate bond rates, (ii) the effects of a decline in JGB yields on economic activity, and (iii) the impact of a decline in JGB yields on financial functioning.

The Background²

I. Introduction

More than three years have passed since the Bank introduced QQE in April 2013. In this period, Japan's economic activity and prices have improved significantly, and Japan's economy is no longer in deflation, which is generally defined as a sustained decline in prices. However, despite the Bank's large-scale monetary easing, the price stability target of 2 percent has not been achieved. Against this background, this report examines how the intended mechanism of QQE has actually worked and what factors have hampered the achievement of the 2 percent target.

Half a year has passed since the Bank introduced "QQE with a Negative Interest Rate." Since the introduction of this measure, Japanese government bond (JGB) yields, lending rates, and interest rates on corporate bonds and CP have declined considerably, meaning that the measure has had substantial effects. At the same time, it has also had a substantial impact on financial markets and financial institutions. The effects and impact of the negative interest rate are also going to be assessed.

II. Developments in Economic Activity and Prices as well as Policy Effects over the Three Years since the Introduction of QQE

A. Transmission Mechanism of QQE Envisioned When It Was Introduced

QQE has lowered real interest rates by raising inflation expectations and pushing down nominal interest rates. Although the natural rate of interest has followed a downward trend, real interest rates have been well below the natural rate of interest, leading to an improvement in financial conditions. As a result, economic activity and price developments improved, and Japan's economy is no longer in deflation, which is commonly defined as a sustained decline in prices.

When the Bank introduced QQE, the transmission mechanism of monetary easing it envisaged was as follows.

² "The Background" provides explanations of "The Bank's View" decided by the Policy Board of the Bank of Japan at the Monetary Policy Meeting held on September 20 and 21, 2016.

The main transmission channel of QQE would be the reduction in real interest rates. Namely, (1) people's deflationary mindset would be dispelled and inflation expectations would be raised through the Bank's large-scale monetary easing under its strong and clear commitment to achieving the price stability target of 2 percent. At the same time, (2) downward pressure would be put on nominal interest rates across the entire yield curve through the Bank's purchases of JGBs. (3) Together, these developments would reduce real interest rates. (4) The decline in real interest rates would lead to an improvement in the output gap. (5) The improvement in the output gap, together with rising inflation expectations, would push up the observed inflation rate. (6) Once people experienced an actual rise in the inflation rate, they would adapt their inflation expectations, resulting in higher inflation expectations and further reinforcing this process (Chart 1 "Transmission Mechanism of QQE Envisioned When It Was Introduced").

In addition, it was envisaged that as a result of the Bank's monetary easing, (7) asset prices such as stock prices as well as the foreign exchange rate would reflect actual or anticipated improvements in economic activity and prices, thereby improving financial conditions and having a positive impact on economic activity and prices. Finally, it was envisaged that (8) it would work through the portfolio rebalancing effect by increasing investors' appetite for risky assets, thereby exerting a positive effect on prices of risky assets and leading to an increase in lending.

The following sections examine developments in economic activity and prices as well as the impact of QQE in detail in light of the transmission mechanism just described.

Overall, QQE to a large extent has had the intended effects. Looking at financial and economic developments since the introduction of QQE, real interest rates have declined, reflecting increased inflation expectations and a decline in nominal interest rates across the entire yield curve. Against this backdrop, Japan's economy is no longer in deflation, which is generally defined as a sustained decline in prices. Specifically, in terms of the real economy, the output gap has improved to around 0 percent, which is the long-term average, and the unemployment rate has declined to around 3 percent. On the price front, the rate of change in the consumer price index (CPI) for all items less fresh food and energy -- which

shows the underlying trend in prices -- turned positive from a level of about minus 0.5 percent before the introduction of QQE and has remained in positive territory for more than two and a half years.

B. Developments in Inflation Expectations

However, the price stability target of 2 percent has not been achieved. In terms of the mechanism described above, this is largely due to developments in inflation expectations. The following two factors have played a role in the development of inflation expectations. First, exogenous developments, including (1) the decline in crude oil prices, (2) the weakness in demand following the consumption tax hike in April 2014, and (3) the slowdown in emerging economies and volatile global financial markets, have lowered the observed inflation rate. And second, amid this decline in the observed inflation rate, inflation expectations -- after having been largely flat -- weakened, reflecting the fact that expectations formation in Japan is largely adaptive, that is, backward-looking.

There are several ways to gauge inflation expectations, including market indicators estimated, for example, using the yields of inflation-indexed JGBs, as well as indicators based on the results of surveys of households, firms, or experts (such as economists or market participants). While short-term fluctuations vary across these indicators reflecting their different characteristics, overall developments in inflation expectations since the introduction of QQE can be broadly divided into the following three phases.

The first phase is the period after the introduction of QQE through summer 2014. In this period, indicators of inflation expectations rose clearly. The introduction of QQE appears to have had a significant impact on inflation expectations. The second phase is from summer 2014 through summer 2015. During this period, many indicators of inflation expectations were largely unchanged. The fall in crude oil prices since summer 2014 and weak demand after the consumption tax hike in April 2014 seem to have pushed down inflation expectations. The Bank expanded QQE in October 2014. Thanks to this response, inflation expectations remained flat despite the strong headwinds. The third phase is the period since summer 2015 up until now. Many indicators of inflation expectations have weakened during this phase. This is attributable to the deceleration of global economic growth against the

backdrop of the slowdown of emerging economies, continued volatile developments in global financial markets amid this situation, and a further decline in crude oil prices toward the beginning of 2016. The Bank introduced the negative interest rate policy in January 2016, but this has been insufficient to offset the negative effects of these developments amid the continued volatility in global financial markets.

This interpretation of developments in inflation expectations is backed by analyses conducted by the Bank focusing on (1) the mechanism of inflation expectations formation and (2) the Phillips curve (Appendix 1 "Division of Inflation Expectations into Phases Using Statistical Methods" and Appendix 2 "Examination of Inflation Expectation Dynamics").

C. The Mechanism of Inflation Expectations Formation

Inflation expectations need to be raised further in order to achieve the price stability target of 2 percent. However, it should be noted that, since the observed inflation rate is likely to remain subdued for the time being, a further rise in inflation expectations through the adaptive mechanism is uncertain and may take time. This highlights the important role played by the forward-looking expectations formation mechanism.

Inflation expectations can be regarded as consisting of two components: a forward-looking component shaped by the price stability target set by the central bank; and a backward-looking, or adaptive, component reflecting the observed inflation rate. If the forward-looking component is sufficiently strong, even if the observed inflation rate deviates from the price stability target -- which is 2 percent in most advanced economies -- people expect the inflation rate to revert to close to the target in due course. Therefore, the observed inflation rate will gravitate toward the target -- the expression used in this situation is that inflation expectations are "anchored." In Japan, as the price stability target has not yet been achieved due to the prolonged deflation, it is the adaptive component that dominates in the formation of inflation expectations (Chart 2 "Phillips Curve: Japan and United States").

A comparison of the way inflation expectations in Japan and the United States are formed shows that in Japan the adaptive component plays a much larger role than in the United States (Appendix 3 "The Mechanism of Inflation Expectations Formation in Advanced Economies").

One of the factors underlying the adaptive nature of inflation expectations formation in Japan is that during the annual *shunto* (wage negotiations between workers and management in spring), wages are determined by referring to the observed inflation rate in the preceding fiscal year (Appendix 4 "The Importance of Past Price Developments in Wage Determination").

The Bank has attempted to make expectations formation more forward-looking by pursuing QQE with the aim of anchoring inflation expectations at the price stability target of 2 percent. However, in the course of this attempt, the observed inflation rate declined due to a variety of factors such as the substantial fall in crude oil prices, and inflation expectations -- reflecting their adaptive manner -- followed suit.

D. The Role of the Monetary Base in the Formation of Inflation Expectations

The expansion of the monetary base, together with the commitment to achieving the price stability target and the Bank's purchases of JGBs, by bringing about a regime change in monetary policy, has transformed peoples' perceptions of inflation and has led to a rise in inflation expectations. The relationship between the monetary base and inflation expectations seems to be of a long-run rather than a short-run nature. Therefore, what is important is the Bank's commitment to expanding the monetary base in the long run.

As explained above, QQE has helped to generally push up inflation expectations. This suggests that the expansion of the monetary base as part of the policy package played a role in this, in combination with the Bank's commitment to achieving the price stability target and JGB purchases. At the same time, since summer 2015, inflation expectations have weakened even though the monetary base has continued to expand. As theory suggests, this relationship between the monetary base and inflation expectations is of a long-run rather than a short-run nature.

E. The Downward Effects on Nominal Long-Term Interest Rates

Looking at developments in nominal long-term interest rates (10-year JGB yields) after the introduction of QQE, with the Bank carrying out large-scale purchases of JGBs, interest rates declined markedly through the end of 2014 (from about 0.7 percent to about 0.4 percent) and subsequently hovered in the range of about 0.3-0.4 percent until the end of 2015. Following the introduction of the negative interest rate policy in January 2016, nominal long-term interest rates again declined substantially and have recently been in negative territory (Chart 3 "10-Year JGB Yields").

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, the Bank conducted quantitative analyses of the impact of its JGB purchases on long-term interest rates using two different approaches. The results suggest the following: (1) the Bank's JGB purchases have been effective in lowering long-term interest rates; (2) the impact of a given increase in the Bank's JGB holdings on long-term JGB yields diminished between the start of 2014 and the introduction of the negative interest rate; and (3) the negative interest rate policy has been effective in lowering long-term interest rates (Appendix 5 "The Impact of JGB Purchases and the Negative Interest Rate Policy on Long-Term Interest Rates").

Taking also the considerations on inflation expectations in the previous sections into account, these developments in nominal interest rates can be explained as follows. First, from the start of QQE through summer 2014, the Bank's JGB purchases resulted in a clear decline in nominal interest rates. In fact, the impact of the purchases was larger than the observed decline suggests, since the decline coincided with upward pressure on nominal interest rates through the rise in inflation expectations during this period. Therefore, the impact of a given amount of JGB purchases on long-term interest rates during this period was substantial. Second, following this period, the impact of JGB purchases declined, perhaps because the Bank's remuneration rate on excess reserves (0.1 percent) worked as a floor for nominal short-term interest rates, discouraging long-term interest rates from falling below a certain level. Third, since the introduction of a negative interest rate in January 2016, the impact of the Bank's JGB purchases on long-term interest rates has strengthened

again as the floor for short-term interest rates declined, since they now could go into negative territory.

F. Effects of the Decline in Real Interest Rates on Economic Activity and Prices

As explained at the outset, the main transmission channel of QQE and "QQE with a Negative Interest Rate" is to push down real interest rates and thereby produce a positive impact on economic activity and prices (Chart 4 "Real Long-Term Interest Rates").

Changes in financial and economic indicators since the introduction of QQE can be summarized as follows. First, financial conditions have improved as evidenced by the moderate increase in bank lending and the decline in lending rates, the rise in stock prices, and the depreciation of the yen. Second, the real economy has also improved as evidenced by the decline in the unemployment rate and the narrowing output gap, which currently stands at about 0 percent, or the long-term average. Third, on the price front, the real economy, the output gap has improved to around 0 percent, which is the long-term average, and the unemployment rate has declined to around 3 percent. On the price front, the rate of change in the CPI for all items less fresh food and energy -- which shows the underlying trend in prices -- turned positive from a level of about minus 0.5 percent before the introduction of QQE and has remained in positive territory for more than two and a half years (Chart 5 "Financial and Economic Developments after the Introduction of QQE").

To examine to what extent these changes can be attributed to the effects of the decline in real interest rates, the Bank ran counterfactual simulations using its Quarterly Japanese Economic Model (Q-JEM), a large-scale macroeconomic model of the Japanese economy. Specifically, in the counterfactual simulations, actual developments in the economy and prices were compared with simulated developments obtained assuming QQE had not been introduced and real interest rates hence had not declined. The simulation results suggest that the negative output gap in fiscal 2015 would have been between 0.6 and 4.2 percentage points larger, and the annual change in the CPI (all items less fresh food and energy) in fiscal 2015 would have been between about 0.3 and 1.5 percentage points lower than was actually the case. These figures indicate that there are considerable differences in the simulation results, which reflect differences in the assumptions regarding (1) exactly when

QQE started having an impact on real interest rates and (2) whether, in addition to the decline in real interest rates, the depreciation of the yen and the rise in stock prices are regarded as part of the effects of QQE. Nevertheless, most of the simulations suggest that Japan still would have been in deflation if QQE had not been introduced.

Separately, the Bank examined why the 2 percent price stability target has not been achieved, using a vector-autoregressive (VAR) model. Specifically, the deviation of the actual path of the rate of change in the CPI (all items less fresh food) from the median of the Policy Board members' forecasts presented in the April 2013 *Outlook for Economic Activity and Prices* (Outlook Report) was decomposed into various factors. The deviation in the year-on-year rate of change in the CPI (all items less fresh food) for fiscal 2015 from the forecast is minus 1.9 percentage points (the difference between the forecast of 1.9 percent and the actual result of 0.0 percent). About half of the deviation (minus 1.0 percentage point) can be attributed to the decline in crude oil prices, while the remainder can be explained by the output gap (minus 0.3 percentage point) as well as factors specific to inflation (minus 0.7 percentage point). These results are consistent with the findings in Sections II-B and II-C that inflation expectations turned out to be lower than forecasted by the Bank due to the adaptive nature of expectations formation was a major reason why the 2 percent target has been missed (Appendix 6 "Assessment of the Policy Effects Based on Macroeconomic Models").

III. The Effects and Impact of the Negative Interest Rate

A. The Effects of the Negative Interest Rate

The negative interest rate policy introduced by the Bank in January 2016, in combination with JGB purchases, has pushed down not only short-term but also long-term interest rates substantially. This shows that the combination of these policy measures is an effective means for the central bank to exert influence on the entire yield curve.

"QQE with a Negative Interest Rate" lowers the short end of the yield curve by applying a negative interest rate to a portion of current account balances (namely, marginal increases in such balances) held by financial institutions at the Bank, and in combination with JGB purchases, exerts further downward pressure on interest rates across the entire yield curve.

Developments since the introduction of this policy measure shows that interest rates have fallen substantially across the entire yield curve; moreover, the yield curve has flattened in such a way that the extent of the decline in interest rates was larger for longer maturities (Chart 6 "Changes in the JGB Yield Curve").

The mechanism underlying these developments is as follows. First, the application of a negative interest rate to current account balances that financial institutions hold at the Bank has led to a decline in short-term interest rates. Second, in addition, it has reduced the incentive for financial institutions to sell their holdings of JGBs and thereby increase their current account balances, and with the Bank's JGB purchases compressing risk premiums, long-term interest rates have been pushed down. And third, as a result of financial institutions' "search for positive yield," it has increased the demand for assets with a positive interest rate, considerably driving down super-long-term JGB yields. This mechanism likely is responsible for the flattening of the yield curve.

The quantitative analysis in Appendix 5 suggests that the negative interest rate policy pushed down long-term interest rates by about 0.2-0.3 percent. In addition, the panel data analysis in Appendix 5 suggests that the downward effect of monetary easing measures on long-term interest rates has strengthened since the adoption of a negative interest rate and that this strengthening has been more pronounced for longer maturities. This means that the introduction of a negative interest rate has contributed to the flattening of the yield curve.

B. Developments in the Natural Rate of Interest

The basic mechanism of monetary easing -- regardless of whether it is conducted through conventional or unconventional policy means -- consists of driving the real interest rate below the natural rate of interest, which is the real interest rate at which economic activity and prices neither accelerate nor decelerate.

Japan's natural rate of interest has followed a downward trend reflecting the deceleration in the potential growth rate and other factors. While the natural rate of interest is not easy to estimate, a number of calculations suggest that it is around 0 percent (Chart 7 "Indicators Regarding Natural Rate of Interest"). Under "QQE with a Negative Interest Rate," real

interest rates are currently at levels well below the natural rate of interest, so that Japan's financial conditions can be judged to be highly accommodative. At the same time, it is also essential to raise the natural rate of interest by undertaking structural reform initiatives and measures to strengthen Japan's growth potential (Appendix 7 "The Concept and Estimation of the Natural Rate of Interest").

C. The Pass-Through of "QQE with a Negative Interest Rate" to Lending Rates and Other Interest Rates

The decline in JGB yields has translated into a decline in lending rates as well as interest rates on corporate bonds and CP. Financial institutions' lending attitudes continue to be proactive. Thus, so far, financial conditions have become more accommodative under the negative interest rate policy. However, because the decline in lending rates has been brought about by reducing financial institutions' lending margins, the extent to which a further decline in the yield curve will lead to a decline in lending rates depends on financial institutions' lending stance going forward.

Before the introduction of the negative interest rate policy, it had been argued that a further decline in risk-free yields (i.e., JGB yields) might not lead to a corresponding decline in banks' lending rates or interest rates on corporate bonds and CP, since there was little room for interest rates on deposits -- financial institutions' main source of funding -- to fall.

However, since the introduction of a negative interest rate, lending rates as well as interest rates on corporate bonds and CP have fallen significantly, each marking new historic lows (Chart 8 "Lending, Corporate Bond, CP, and Deposit Rates"). In fact, the pass-through from the decline in the policy interest rate to these funding rates has been roughly similar to that in previous episodes of policy interest rate cuts (Chart 9 "The Pass-Through Rate of Lending and Other Interest Rates in Phases of Policy Interest Rate Cuts"). These developments show that the negative interest rate policy has led to a steady decline in lending rates as well as interest rates on corporate bonds and CP.

Given that the decline in deposit rates has been smaller than the decline in lending rates, the decline in lending rates, however, has come at the expense of financial institutions' lending

margins. Therefore, the extent to which a further decline in interest rates translates into a reduction in lending rates will also depend on financial institutions' lending stance going forward.

Moreover, reflecting financial institutions' search for positive yield, new developments have been observed in the field of corporate finance such as an increase in the issuance of super-long-term corporate bonds and in funding through long-term subordinated loans (Chart 10 "Issuance of Super-Long-Term Corporate Bonds").

D. The Term Structure of Interest Rates and the Impact on Economic Activity and Prices

The impact of interest rates on economic activity and prices as well as financial conditions depends on the shape of the yield curve. In this regard, the following three points warrant attention. First, short- and medium-term interest rates have a larger impact on economic activity than longer-term rates. Second, the link between the impact of interest rates and the shape of the yield curve may change as firms explore new ways of raising funds such as issuing super-long-term corporate bonds under the current monetary easing, including the negative interest rate policy. Third, an excessive decline and flattening of the yield curve may have a negative impact on economic activity by leading to a deterioration in people's sentiment, as it can cause uncertainty about the sustainability of financial functioning in a broader sense.

A decline in real interest rates has a positive impact on economic activity and prices. However, the degree of this impact differs depending on the maturity of interest rates. In general, a decline in short- to medium-term interest rates produces a larger impact in terms of stimulating economic activity and prices. The reason is that short- to medium-term funds account for a large part of borrowing by firms and households.

The Bank examined the extent to which a decline in real interest rates of different maturities leads to an improvement in the output gap by employing the concept of the "natural yield curve," which applies the concept of the natural rate of interest not to the interest rate at a certain maturity but across the entire yield curve. The results of this analysis indicate that

the improvement in the output gap brought about by a unit decline in the real interest rate at each maturity tranche was largest at maturities of 1-2 years but gradually became smaller the longer the maturity (Appendix 8 "The Effect of the Yield Curve Gap on the Output Gap").

It should be noted, however, that the results of this analysis are based on the assumption that existing financial structures remain unchanged. Should financial structures change as a result of the environment of unprecedentedly low interest rates -- and the increase in the issuance of super-long-term corporate bonds could be a sign of such change -- this may lead to changes in the relationship between the shape of the yield curve and the economic impact of changes in real interest rates.

E. The Impact on the Functioning of Financial Intermediation

Regarding liquidity in and the functioning of the JGB market, many liquidity indicators suggest that there has been a decline in liquidity in the JGB market since the introduction of "QQE with a Negative Interest Rate." Given that the Bank's large-scale JGB purchases aim to lower interest rates by compressing term premiums, the impact on liquidity is a necessary consequence of the intended effect of JGB purchases. Moreover, so far, the Bank has faced no specific difficulties in carrying out JGB purchases. However, as the Bank will continue with unprecedentedly large-scale JGB purchases, it will continue to carefully monitor developments in liquidity in and the functioning of the JGB market (Chart 11 "Liquidity Indicators in the JGB Markets").

In addition, if the negative interest rate were to excessively reduce financial institutions' profits (deposit-taking institutions such as banks), this would make them more reluctant to lend or lead them to impose higher lending rates so as to cover the costs associated with negative interest rates, which would potentially weaken their functioning as financial intermediaries. Generally speaking, since (1) financial institutions' basic business model consists of raising short-term funds and investing in long-term assets and (2) interest rates on deposits, which are the main funding tools, rarely become negative, the flattening of the yield curve at a low level reduces the spread between deposit and lending rates, with negative consequences for financial institutions' profits. The impact of a negative interest

rate on financial institutions' profits is particularly large in Japan's case, since the amount outstanding of deposits far exceeds that of lending and credit spreads on loans are already extremely small, reflecting long-standing competition among financial institutions. Moreover, given that the impact on financial institutions' profits has a cumulative effect on their financial soundness, what also matters is how long the policy continues (Appendix 9 "The Impact of the Negative Interest Rate on Financial Institutions' Profits").

In addition, it should be noted that financial institutions can boost their profits by selling assets they hold to realize valuation gains, which tend to increase when interest rates fall and the yield curve flattens. On the other hand, when interest rates rise and the yield curve steepens, financial institutions would suffer valuation losses.

So far, however, surveys such as the Short-Term Economic Survey of Enterprises in Japan (*Tankan*) and the *Senior Loan Officer Opinion Survey on Bank Lending Practices at Large Japanese Banks* (Loan Survey) suggest that financial institutions' lending attitudes continue to be proactive and financial conditions, as shown by the decline in lending rates, have been more accommodative. Therefore, there is no evidence that financial institutions' functioning as intermediaries has been impaired (Chart 12 "Lending Attitudes as Perceived by Firms and Financial Institutions").

Another issue is that an excessive decline in interest rates -- especially at the long and super-long end -- lowers the rates of return on insurance and pension products, and increases firms' pension benefit obligations. The direct impact of this on economic activity as a whole is unlikely to be substantial. However, attention needs to be paid to the possibility that it can cause uncertainty regarding the sustainability of financial functioning in a broader sense, with a negative impact on economic activity through a deterioration in people's sentiment (Chart 13 "Life and Pension Insurances under Negative Interest Rates").

Appendixes

Appendix 1: Division of Inflation Expectations into Phases Using Statistical Methods

Appendix 2: Examination of Inflation Expectation Dynamics

Appendix 3: The Mechanism of Inflation Expectations Formation in Advanced Economies

Appendix 4: The Importance of Past Price Developments in Wage Determination

Appendix 5: The Impact of JGB Purchases and the Negative Interest Rate Policy on Long-Term Interest Rates

Appendix 6: Assessment of the Policy Effects Based on Macroeconomic Models

Appendix 7: The Concept and Estimation of the Natural Rate of Interest

Appendix 8: The Effect of the Yield Curve Gap on the Output Gap

Appendix 9: The Impact of the Negative Interest Rate on Financial Institutions' Profits

Appendix 1: Division of Inflation Expectations into Phases Using Statistical Methods

Developments in various indicators of inflation expectations in the more than three years since the introduction of QQE can be broadly divided into three phases: (1) a clear rise in all indicators through summer 2014; (2) a period in which, from summer 2014 through summer 2015, they remained largely flat; (3) and a subsequent weakening since then (Appendix Chart 1 [1]). However, different indicators of inflation expectations all move in slightly different ways, so that the exact timing of the three phases differs somewhat depending on which of the indicators one focuses on.

Therefore, the exact timing of the three phases is examined using principal component analysis. Principal component analysis is a technique that makes use of common factors that are extracted from multiple indicators. In this particular case, "synthesized inflation expectations indicators" were built based on the first principal component extracted from separate indicators of households', firms', and experts' (economists' and market participants') inflation expectations. With regard to experts' inflation expectations, several indicators were used.

Developments in the synthesized inflation expectations indicators can be regarded as capturing the common trend in the inflation expectations of the three different groups of economic agents (i.e., households, firms, and experts). These new indicators make it possible to more objectively determine the timing of the different phases.

Looking at developments in the synthesized inflation expectations indicators, these increased in Phase 1 (from April 2013 through summer 2014), remained largely flat in Phase 2 (from summer 2014 through summer 2015), and have weakened in Phase 3 (since summer 2015). The principal component analysis therefore provides support for the timing of the division into the three phases in the main text of this comprehensive assessment (Appendix Chart 1 [2]).

Appendix 2: Examination of Inflation Expectation Dynamics

The underlying trend in Japan's inflation has improved steadily since the introduction of QQE. However, the price stability target of 2 percent has not been achieved. To examine why, this appendix presents a decomposition of the deviation of the observed inflation rate from the price stability target into several factors based on the following model.

Model Specification and Three Types of Shocks

The model consists of a system of three equations, in which (1) the observed inflation rate (measured in terms of the CPI for all items less fresh food and energy) depends on the output gap and short-term inflation expectations (Phillips curve), (2) short-term inflation expectations depend on the observed inflation rate in the previous period and medium- to long-term inflation expectations (the mechanism of inflation expectations formation), and (3) medium- to long-term inflation expectations depend on the price stability target set by the central bank and medium- to long-term inflation expectations in the previous period.

Note that the residuals in equations (1) to (3) above represent shocks to (a) the observed inflation rate, (b) inflation expectations, and (c) the credibility of the price stability target, respectively. The deviation of the observed inflation rate from the price stability target of 2 percent can be decomposed into the following three shocks (Appendix Chart 2 [1]).¹

(a) Observed inflation rate shocks: These are calculated as the deviations of the observed inflation rates from the Phillips curve. These deviations include short-term fluctuations in the observed inflation rate as well as the impact of developments in the real economy on the observed inflation rate not fully captured by the output gap.

(b) Inflation expectations shocks: These are calculated as deviations of short-term inflation expectations from the relationship determining short-term inflation expectations. Such deviations include discontinuous changes in inflation expectations caused by a switch in

¹ Both short-term (1 year ahead) and medium- to long-term inflation expectations (6-10 years ahead) are taken from the *Consensus Forecasts* and represent economists' inflation expectations. Short-term inflation expectations are adjusted to exclude the estimated effects of the change in the consumption tax rate.

the monetary policy regime, the effects of exchange rate movements that potentially have a persistent effect on prices, and second-round effects caused by energy price fluctuations.

- (c) Price stability target credibility shocks: These are shocks that cause medium- to long-term inflation expectations to deviate from the price stability target. In contrast to the United States, where medium- to long-term inflation expectations are anchored, in Japan anchoring of inflation expectations to the price stability target of 2 percent is still in progress. Consequently, credibility shocks are negative throughout the observation period.

Decomposition Results

The decomposition results for each of the three phases identified in Appendix 1 can be summarized as follows (Appendix Chart 2 [2]).²

Phase 1: From April 2013 onward, Japan experienced a clear positive shock to inflation expectations, which suggests that the introduction of QQE provided a positive shock pushing up inflation expectations. Furthermore, the negative output gap, which had previously been putting downward pressure on prices, shrank to around 0 percent. A possible interpretation is that the decline in real interest rates brought about by the introduction of QQE led to an improvement in the output gap. Reflecting these developments, the deviation of the observed inflation rate from the price stability target narrowed steadily.

Phase 2: The positive effect of the shock to inflation expectations witnessed in Phase 1 diminished over time. The additional positive effect of improvements in the output gap on the observed inflation rate disappeared. These developments can be regarded as reflecting the effects of the slowdown of Japan's economy, which was partly due to the consumption tax hike in April 2014. Moreover, the size of the negative observed inflation rate shocks

² It should be noted that, as a result of the revision of the base year for the CPI from 2005 to 2010 (which resulted in a downward revision of the year-on-year rate of change in the CPI for all items less fresh food and energy for 2011 of 0.7 percentage point), the decomposition results for 2011 overestimate the negative observed inflation rate shock and the positive inflation expectations shock.

increased, which suggests that, as a result of weaker private consumption, downward pressure on prices was greater than can be explained by changes in the output gap. However, due to the expansion of QQE in October 2014, inflation expectations shocks became clearly positive again, which helped to offset the negative shocks. Consequently, the deviation from the price stability target of 2 percent remained almost flat in Phase 2.

Phase 3: Since summer 2015, with global stock prices declining partly as a result of the slowdown in emerging economies, the yen has appreciated against major currencies, while crude oil prices declined further toward the beginning of 2016. Against this backdrop, inflation expectations shocks have become negative. This suggests that inflation expectations have been pushed down by the second-round effects of the fall in crude oil prices and the world-wide decrease in inflation expectations and that these negative effects have not yet been offset by the introduction of "QQE with a Negative Interest Rate" in January 2016. In this situation, the deviation of the observed inflation rate from the price stability target of 2 percent has been gradually widening.

Appendix 3: The Mechanism of Inflation Expectations Formation in Advanced Economies

Inflation expectations are formed through a combination of two components: a forward-looking component shaped by the price stability target set by the central bank; and a backward-looking, or adaptive, component reflecting the observed inflation rate. This appendix provides a comparison of inflation expectations formation across major advanced economies.

For the comparison, short-term inflation expectations (1-year ahead expectations in the *Consensus Forecasts*) were regressed on the observed inflation rate and medium- to long-term inflation expectations (6-10 years ahead expectations in the *Consensus Forecasts*). In addition, medium- to long-term inflation expectations were regressed on the observed inflation rate and the central bank price stability target (2 percent).

The estimation results show that in Japan, the observed inflation rate accounts for around 70 percent of short-term inflation expectations and close to 40 percent of medium- to long-term expectations. The adaptive component plays a considerably larger role in Japan than in the United States, the euro area, and the United Kingdom in the formation of both short-term and medium- to long-term inflation expectations (Appendix Chart 3).

Appendix 4: The Importance of Past Price Developments in Wage Determination

A possible explanation for the fact that Japan's inflation expectations are greatly influenced by adaptive expectations formation is that, in comparison with the United States and Europe, wage negotiations in Japan such as those between workers and management in spring -- the annual *shunto* -- are more affected by developments in the observed inflation rate, including developments in energy prices.

This appendix presents the estimation results of a simple hybrid wage Phillips curve for Japan, the United States, and Germany, in which changes in nominal negotiated wages are regressed on the following three variables: medium- to long-term inflation expectations; the past inflation rate; and the unemployment rate gap. The results indicate the following: (1) for the United States and Germany, the coefficients on medium- to long-term inflation expectations (α_1 in Appendix Chart 4 [1]) are quite large, while the coefficients on the past inflation rate ($1-\alpha_1$) are only weakly significant or insignificant; on the other hand, (2) for Japan, the coefficients on both medium- to long-term inflation expectations and the past inflation rate are significant, and the latter is larger than the former, indicating that the past inflation rate has a somewhat larger impact on changes in wages than inflation expectations.

Since the end of 2014, headline inflation in all three countries has fallen substantially as a result of the decline in crude oil prices (Appendix Chart 4 [2]). Yet, while the decline in the observed inflation rate due to the decline in crude oil prices has exerted clear downward pressure on base pay increases in Japan, the impact on wages in the United States and Germany has been limited (Appendix Chart 4 [3]). This difference is partly due to the fact that negotiated wages in the United States and Germany apply for longer than in Japan, so that medium-term inflation tends to be taken into account in the wage negotiations in these countries, with the inflation target set by the central bank serving as an important reference (Appendix Chart 4 [4]).

(see Box 2 in the July 2016 Outlook Report)

Appendix 5: The Impact of JGB Purchases and the Negative Interest Rate Policy on Long-Term Interest Rates

In order to examine the extent to which the Bank's JGB purchases and the negative interest rate policy reduced long-term interest rates, two types of analyses based on different approaches have been conducted. Specifically, the first approach is to regress 10-year JGB yields on the share of JGBs outstanding held by the Bank and other variables, while the second consists of a panel regression in which the effect of the Bank's JGB purchases on JGB yields at each maturity is measured as the residual.

Approach 1: Regression Using the Bank's JGB Holdings as Explanatory Variable

Long-term (10-year) JGB yields were regressed on three different variables: the share of the Bank's JGB holdings in the total amount of JGBs outstanding; long-term U.S. Treasury bond yields (10 years); and forecasts of Japan's economic growth rate (Appendix Chart 5-1). The results show that (1) increases in the Bank's share of JGB holdings had a statistically significant downward impact on long-term JGB yields, and (2) declines in long-term JGB yields not explained by the explanatory variables (i.e., where the estimated residuals take a negative value) became larger for some time after the introduction of QQE, then gradually became smaller, and eventually turned positive in the spring of 2015. The latter finding suggests that the impact of a given increase in the Bank's JGB holdings on long-term JGB yields may have diminished during the observation period.

To examine this issue, another regression was conducted in which the coefficient on the Bank's share of JGB holdings, by including a dummy variable, was allowed to change. The results suggest that the effectiveness of the Bank's JGB purchases most likely declined in early 2014.³ Taking the estimation results of the model in which the dummy variable takes a value of one from April 2014 onward, the downward effect of a 10 trillion yen increase in the Bank's JGB holdings on long-term JGB yields was minus 6.9 bps until March 2014 and minus 0.6 bps from April 2014 onward (Appendix Chart 5-2).

³ For example, in terms of the adjusted R-squared, the best fit is obtained when the dummy takes a value of one from sometime between January and April 2014 onward.

Following the introduction of the negative interest rate policy in January 2016, long-term JGB yields have again fallen by a larger margin. Regression analysis using a dummy variable representing the negative interest rate policy and assuming that the impact of a given increase in the Bank's JGB holdings on long-term JGB yields remained unchanged from the preceding period indicates that the negative interest rate policy pushed down long-term JGB yields by 23 bps.

Approach 2: Panel Regression for JGB Yields of Different Maturities

The second approach consists of a panel analysis regressing various long-term JGB yields (2, 5, 10, and 20 years) on the following three variables: long-term U.S. Treasury bond yields (10 years); the year-on-year rate of change in the CPI (all items less fresh food); and the active job openings-to-applicants ratio, which is used as a proxy for the output gap. In this regression, the effect of the Bank's JGB purchases is regarded to be represented by the residual, since it is not incorporated as an explanatory variable in the regression equation. Developments in the estimated residuals show that (1) the effect of the Bank's JGB purchases was substantial just after the introduction of QQE but subsequently temporarily waned; (2) the downward effect on long-term JGB yields increased considerably again after the introduction of the negative interest rate policy; and (3) this downward effect was larger for longer maturities and such tendency was remarkable especially during the period after the introduction of the negative interest rate policy (Appendix Chart 5-3). Finally, the residual following the introduction of the negative interest policy is estimated to have widened by 24 bps in the case of 10-year JGB yields, which is in line with the estimation results of Approach 1 above in terms of the size of the estimated effect of the negative interest rate policy.

Appendix 6: Assessment of the Policy Effects Based on Macroeconomic Models

To assess the impact of policies since the introduction of QQE on Japan's economic activity and prices, this appendix presents (1) a simulation exercise based on the Bank's large-scale macroeconomic model (Q-JEM) and (2) an analysis of the background of the unexpected slowdown in CPI inflation based on a VAR model.⁴

Simulation Exercise Based on the Bank of Japan's Macroeconomic Model (Q-JEM)

QQE and "QQE with a Negative Interest Rate" likely affected Japan's economic activity and prices mainly through the decline in real interest rates as a result of the decline in nominal interest rates and the rise in inflation expectations. In this appendix, counterfactual simulations are carried out to compute how the output gap and the rate of change in the CPI (all items less fresh food and energy) would have evolved under the hypothetical scenario that real interest rates (nominal interest rates minus inflation expectations) remained unchanged following the introduction of QQE. The difference between the simulation results and the actual data for the output gap and CPI inflation is regarded as the policy effect.⁵

⁴ 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 indicators of expectations. Equations are estimated based on historical data for Japan. For details, see Fukunaga *et al.*, "The Quarterly Japanese Economic Model (Q-JEM): 2011 version," *Bank of Japan Working Paper Series*, No. 11-E-11, 2011.

⁵ In Bank of Japan Monetary Affairs Department, "Quantitative and Qualitative Monetary Easing: Assessment of Its Effects in the Two Years since Its Introduction," *Bank of Japan Review Series*, No. 15-E-3, 2015 (referred to "Assessment after Two Years" hereafter), the policy effects over the two years after the introduction of QQE were estimated by calculating the change in real interest rates and multiplying this by the interest-rate multipliers in Q-JEM. While conceptually the approach employed in this appendix is similar to the one used in the "Assessment after Two Years," the simulations here are conducted from the opposite perspective. The "Assessment after Two Years" estimated the impact of the decline in real interest rates on economic activity and prices. In contrast, the analysis in this appendix estimates how the economy and prices would have evolved if real interest rates had not declined. The reason why the latter approach is used is that it can better estimate the policy effects, since developments in inflation expectations have been more complex than those observed at the time of the "Assessment after Two Years." In the "Assessment after Two Years," it was assumed that the impact of the decline in real interest rates was instantaneous with the introduction of QQE. On the other hand, in the analysis here, the impact of changes in real interest rates is assumed to affect the economy gradually. For this reason, the policy effects estimated here tend to be smaller than that based on the approach in the "Assessment after Two Years," even when the same period is examined.

In the simulation exercise, two different alternatives are considered regarding (1) when the Bank's policies introduced in early 2013 started to affect the macroeconomy, and (2) whether only the decline in real interest rates or also the substantial depreciation of the yen and rise in stock prices are regarded as part of the policy effects. This means that four different simulations are conducted. With respect to point (1), in the first scenario, the policy effects are measured in terms of changes in variables from the April-June quarter of 2013, which is when the Bank actually introduced QQE. In the second scenario, the impact is measured in terms of changes in variables from the January-March quarter of 2013. The rationale for the second scenario is to include the impact of the introduction of the price stability target in January 2013, which had led to a rise in inflation expectations already before the introduction of QQE in April 2013. With respect to point (2), the first scenario regards only the decline in real interest rates as part of the policy effects, while the second scenario also includes the substantial depreciation of the yen and rise in stock prices as part of the policy effects. The reason for the latter scenario is that even though a decline in real interest rates in Q-JEM leads to some yen depreciation and rise in stock prices through the mechanisms in the model, the actually observed changes in these variables have been much larger than those generated in the model.

The simulation results (Appendix Chart 6-1) indicate that in all scenarios, the negative output gap would have been larger than actually was the case. This suggests that without the decline in real interest rates, depreciation of the yen, and rise in stock prices brought about by QQE and "QQE with a Negative Interest Rate," the output gap until recently would have been clearly negative. The size of the policy effect on the output gap differs across the four simulations, ranging from 0.6 to 4.2 percentage points for fiscal 2015. The simulation results also indicate that in all scenarios, the year-on-year rate of change in the CPI (all items less fresh food and energy) would have been lower than actually was the case, with the policy effect ranging from 0.3 to 1.5 percentage points for fiscal 2015.

Although the simulation results differ considerably depending on the extent to which developments are regarded as policy effects, it is clear that QQE and "QQE with a Negative Interest Rate" have had a positive impact on Japan's economic activity and prices. Specifically, in three of the four scenarios, the year-on-year rate of change in the CPI (all

items less fresh food and energy) would until recently have been negative or close to zero percent, meaning that Japan's economy would have still been, or even still be, in deflation without QQE.

VAR Analysis of the Unexpected Slowdown of CPI Inflation

The above simulations suggest that QQE and "QQE with a Negative Interest Rate" have had a substantial positive impact on economic activity and prices. Nevertheless, even though three years have passed since the introduction of QQE, the 2 percent price stability target has not been achieved. To examine why the 2 percent price stability target has not been achieved, a VAR model is used. Specifically, the deviation of the actual path of the rate of change in the CPI (all items less fresh food) from the Policy Board members' median forecast in the April 2013 Outlook Report is decomposed into various factors.

In this analysis, a VAR model consisting of (1) the year-on-year rate of change in the CPI (all items less fresh food), (2) the output gap, (3) the nominal effective exchange rate, and (4) crude oil prices is estimated using two sets of data: the Policy Board members' forecasts for these four variables when QQE was introduced; and actual data for these variables. Forecasted and actual rate of changes in the CPI are then decomposed respectively into the contribution of the forecasted and actual output gap, the nominal effective exchange rate, and crude oil prices and the two decompositions compared (Appendix Chart 6-2). Note that in estimating the VAR model based on the Policy Board members' forecasts, their projections of crude oil prices and the nominal effective exchange rate are assumed to be constant from the April-June quarter of 2013. Furthermore, the Policy Board members' forecasts for the output gap and the year-on-year rate of change in the CPI in the April 2013 Outlook Report, which are on a fiscal year basis, have been converted into quarterly data using statistical techniques such as linear interpolation.

The results show that of the deviation in the year-on-year rate of change in the CPI (all items less fresh food) for fiscal 2015 from the original forecast of minus 1.9 percentage points (the difference between the forecast of 1.9 percent and the actual result of 0.0 percent), about half (minus 1.0 percentage point) can be attributed to the decline in crude oil prices (measured in terms of the real West Texas Intermediate crude oil price). Of the

remainder, 0.3 percentage point can be explained by the output gap and 0.7 percentage point by factors specific to inflation. The latter represent changes in inflation that are not explained by crude oil prices, the nominal effective exchange rate, and the output gap, and likely mainly reflect changes in inflation expectations.

Appendix 7: The Concept and Estimation of the Natural Rate of Interest

The natural (or neutral) rate of interest is the real interest rate level at which economic activity and prices neither accelerate nor decelerate. From a theoretical perspective, the natural rate of interest can also be defined as the real interest rate which balances savings and investment under full employment. Under certain conditions, the natural rate of interest in the long run coincides with the potential growth rate, which is why the potential growth rate is often considered to be a good long-run approximation of the natural rate of interest. Estimates by the Bank suggest that Japan's potential growth rate currently is in the range of 0.0-0.5 percent. Recent forecasts by firms and economists put Japan's long-term growth rate at around 1 percent (Chart 7 [1]).

However, since in the short run the natural rate of interest is influenced by factors such as the business cycle, it is desirable to estimate it taking such factors into account. Existing estimation approaches can be broadly divided into two types. The first consists of smoothing out time series data of the real interest rate. The second consists of estimating the natural rate of interest using time series data of a broad range of macroeconomic variables such as the real interest rate, the inflation rate, and the output gap, taking the structural relationships between these variables into account. A representative example of the first type is the approach using the Hodrick-Prescott (HP) filter. A representative example of the second type is the approach developed by Laubach and Williams (2003), two Federal Reserve economists.⁶ The latter approach estimates the output gap and the natural rate of interest simultaneously using the Kalman filter, taking the IS curve and the Phillips curve as given. The estimation of the natural yield curve by Imakubo, Kojima, and Nakajima (2015, see Appendix 8) employs a similar approach.⁷ The first type of approach is easier to implement, but estimates are greatly affected by actual movements in the real interest rate.

⁶ Thomas Laubach and John C. Williams, "Measuring the Natural Rate of Interest," *Review of Economics and Statistics*, 85 (4), 2003, pp. 1063-1070.

⁷ Kei Imakubo, Haruki Kojima and Jouchi Nakajima, "The natural yield curve: its concept and measurement," *Bank of Japan Working Paper Series*, No. 15-E-5, 2015. See also Kei Imakubo, Haruki Kojima and Jouchi Nakajima, "The natural yield curve: its concept and developments in Japan," *Bank of Japan Research Laboratory Series*, No. 15-E-3, 2015.

The second type of approach has the advantage that it is based on theoretical foundations regarding the natural rate of interest.

Employing these various estimation approaches, the results indicate that Japan's natural rate of interest estimated employing the approaches by Laubach and Williams and by Imakubo, Kojima, and Nakajima has been around 0 percent since 2010 (Chart 7 [2]). On the other hand, in the estimation using the HP filter, the natural rate of interest stood at more than 1 percent around 2010 but subsequently declined sharply and recently reached around minus 1 percent. The results based on the HP filter estimation appear to be greatly affected by the fact that real interest rates have substantially declined since the introduction of QQE.

Given that estimates of the natural rate of interest differ depending on the estimation approach, they need to be treated with a degree of caution; however, the estimation results suggest that it is likely that Japan's natural rate of interest currently is at a low level of around 0 percent.

Appendix 8: The Effect of the Yield Curve Gap on the Output Gap

QQE and "QQE with a Negative Interest Rate" have been exerting downward pressure on the entire yield curve.

In order to evaluate the effects of monetary policy on the entire yield curve, it is necessary to examine not only the natural rate of interest (the real interest rate at which the economy and prices neither accelerate nor decelerate) at a specific short maturity, but also the natural yield curve -- that is, the yield curve composed of the natural rates of interest over all maturities (Appendix Chart 8-1 [1]). In this appendix, the effects of lowering the yield curve on the economy (the output gap) are analyzed employing an approach previously published by Imakubo, Kojima, and Nakajima (2015), staff of the Bank of Japan.⁸

Decomposing the Yield Curve into Three Components

While interest rates at different maturities evolve in a complex manner, it is possible to gain a general impression of changes along the entire yield curve employing a comparatively simple approach. For instance, using the Nelson-Siegel model, one can roughly describe changes in the yield curve in terms of three components: (1) the level (a parallel downward shift); (2) the slope (a steepening of the slope as a result of a decline in short-term interest rates); and (3) the curvature (a decline in medium-term yields, resulting in a crescent-shaped curve) (Appendix Chart 8-1 [2] and [3]).

Estimating the impact on the output gap of a 1 percentage point increase in each of the three components using data up to the January-March quarter of 2016, when "QQE with a Negative Interest Rate" was introduced, shows that changes in the level have the largest effect on the output gap (minus 0.20 percentage point), followed by the slope effect (minus 0.12 percentage point), and the curvature effect (minus 0.04 percentage point) (Appendix Chart 8-2 [1]).

⁸ See footnote 7 in Appendix 7.

Coefficient on the Yield Curve Gap for Each Maturity

Assuming a specific probability distribution, it is possible to determine the effects of a change in the yield curve gap -- that is, the gap between the actual and natural yield curves -- at different maturities on the output gap.⁹ Appendix Chart 8-2 (2) shows the coefficient estimates on the yield curve gap at different maturities. The results indicate that the absolute values of the coefficient estimates are largest for short maturities of 1-2 years but then gradually diminish as maturities increase, implying that decreases in short- and medium-term yields have larger monetary easing effects than decreases in long- and super-long-term yields. This finding is consistent with the fact that the amounts of liabilities such as bank loans, corporate bonds, and CP by the renewal period of interest rate concentrates at the short and medium maturities (Appendix Chart 8-2 [3]).

It should be noted, however, that the results of this analysis are based on the assumption that existing financial structures remain unchanged. Should financial structures change as a result of the environment of unprecedentedly low interest rates -- and the increase in the issuance of super-long-term corporate bonds could be a sign of such change -- this may lead to changes in the relationship between the shape of the yield curve and the economic impact of changes in real interest rates.

⁹ While the results presented here are based on the specific assumption that the probability distribution follows a Beta mixture distribution, the results remain largely unchanged if an alternative distribution such as a step distribution is assumed instead.

Appendix 9: The Impact of the Negative Interest Rate on Financial Institutions' Profits

The major transmission channels through which the decline in interest rates due to the adoption of the negative interest rate affects the profits of financial institutions are the compression of the spread between deposit and lending rates and the deterioration in the profitability of bond investments.

The reason for the compression of the spread between deposit and lending rates is that Japanese banks have a structural surplus of deposits over loans, and while there is little room for deposit rates to decline, lending rates are falling (Appendix Chart 9-1). Lending rates decline through the following three mechanisms.

- (1) For loans whose interest rate is linked to market interest rates, lending rates decline immediately as the base rate for those loans declines. For instance, in the case of loans linked to TIBOR, which make up the majority of loans linked to market interest rates in Japan, the base rate (i.e., TIBOR) has declined by around 10bps since the introduction of the negative interest rate.
- (2) In the case of long-term loans with a fixed interest rate, lower interest rates are applied when loans are rolled over at maturity. Given the current average duration of loans, which is about 3-4 years, about 30 percent of loans are replaced by new loans at a lower interest rate each year. If loans are refinanced before they mature, the pace of decline in lending rates will be faster.
- (3) Lending rates also decline as credit spreads on new loans narrow as a result of competition among financial institutions. Two factors play a role. The first is the trend decline in lending rates on the back of long-standing competition among financial institutions. The second factor, discussed in more detail below, is the deterioration in the profitability of bond investments due to the negative interest rate, which further increases competition in lending.

Comparing types of financial institutions, it is likely that major banks are more affected by (1) above, since they have relatively large exposures in the form of loans linked to market interest rates. On the other hand, in the case of regional banks and *shinkin* banks, it is likely that (2) and (3) have a relatively large impact on lending rates (Appendix Chart 9-2).

The reason for the deterioration in the profitability of financial institutions' bond investments is that once a bond they hold matures and is redeemed, the reinvestment return on those funds will fall under the current interest rate environment. The average duration of major banks' bond holdings is about 3-4 years, while that of regional banks and *shinkin* banks is about 4-6 years. Of course, the unrealized gains on bond portfolios will increase as interest rates decline.

Reflecting the three mechanisms through which lending rates decline, the impact of monetary easing measures on financial institutions' profits will depend on the following: (1) the extent to which the decline in risk-free interest rates (i.e., JGB yields) pushes down base rates for loans and long-term lending rates; (2) the extent of the compression of credit spreads through competition (in this context, it is necessary to take into account not only the impact of the negative interest rate, but also the trend before its introduction); and (3) the outstanding amount and maturity structure of each type of loan extended by individual financial institutions as well as the amount and maturity structure of their bond holdings and unrealized gains. These factors will need to be taken into account when assessing the impact on financial institutions' profits.

Looking at the latest financial results (for the April-June quarter of 2016) of banks in aggregate (major banks and regional banks, on a non-consolidated basis), their net income was 780.2 billion yen, which is a decline of about 28 percent from the same period last year (1,076.3 billion yen) (Appendix Chart 9-2). Apart from the impact of the negative interest rate, this decline also reflects the fall in stock prices and the appreciation of the yen during the period. A breakdown of the decline in net income shows that net interest income decreased by 301.5 billion yen, realized gains on stockholdings decreased by 136.5 billion yen, and net fees and commissions (e.g., fees and commissions for the sale of investment trusts) fell by 30.7 billion yen. Looking at the decline in net interest income in more detail,

in addition to the compression of the spread between deposit and lending rates and the deterioration in the profitability of bond investments following the introduction of the negative interest rate, factors include a decline in profits due to the cancellation of investment trusts on the back of the decline in the stock prices, a decline in profits from revenues denominated in foreign currencies due to the appreciation of the yen, and an increase in foreign currency funding costs. It should be noted, however, that the impact of the negative interest rate on financial institutions' profits was only starting to be reflected in the financial results for the April-June quarter of 2016.

The Bank will continue to carefully examine and explain the possible effects of monetary easing measures on the profits of financial institutions and the potential impact on the functioning of financial intermediation through publications such as the *Financial System Report*.

Charts

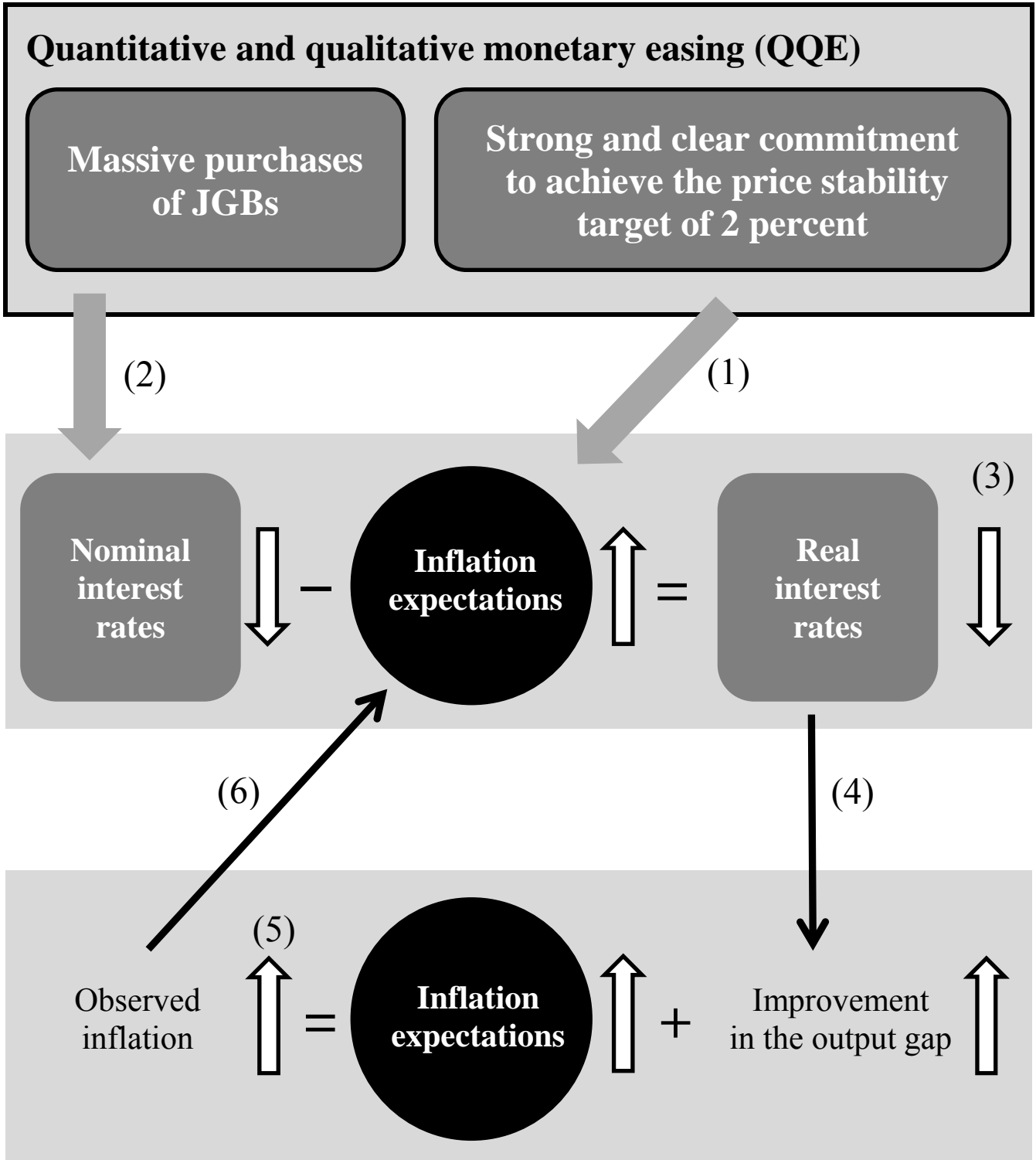
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- Chart 2 Phillips Curve: Japan and United States
- Chart 3 10-Year JGB Yields
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- Chart 13 Life and Pension Insurances under Negative Interest Rates

2. Charts for Appendix 1 to 6, 8, and 9

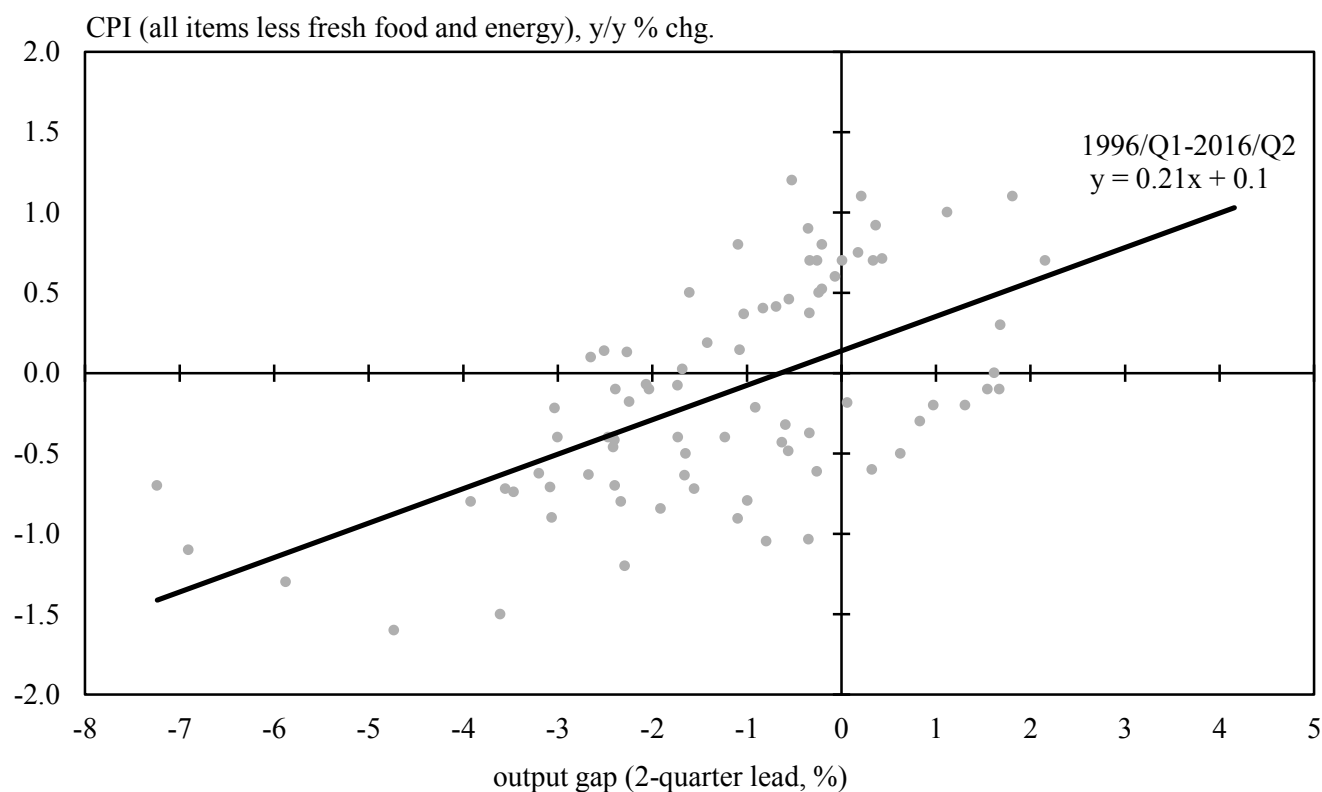
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Transmission Mechanism of QQE Envisioned When It Was Introduced

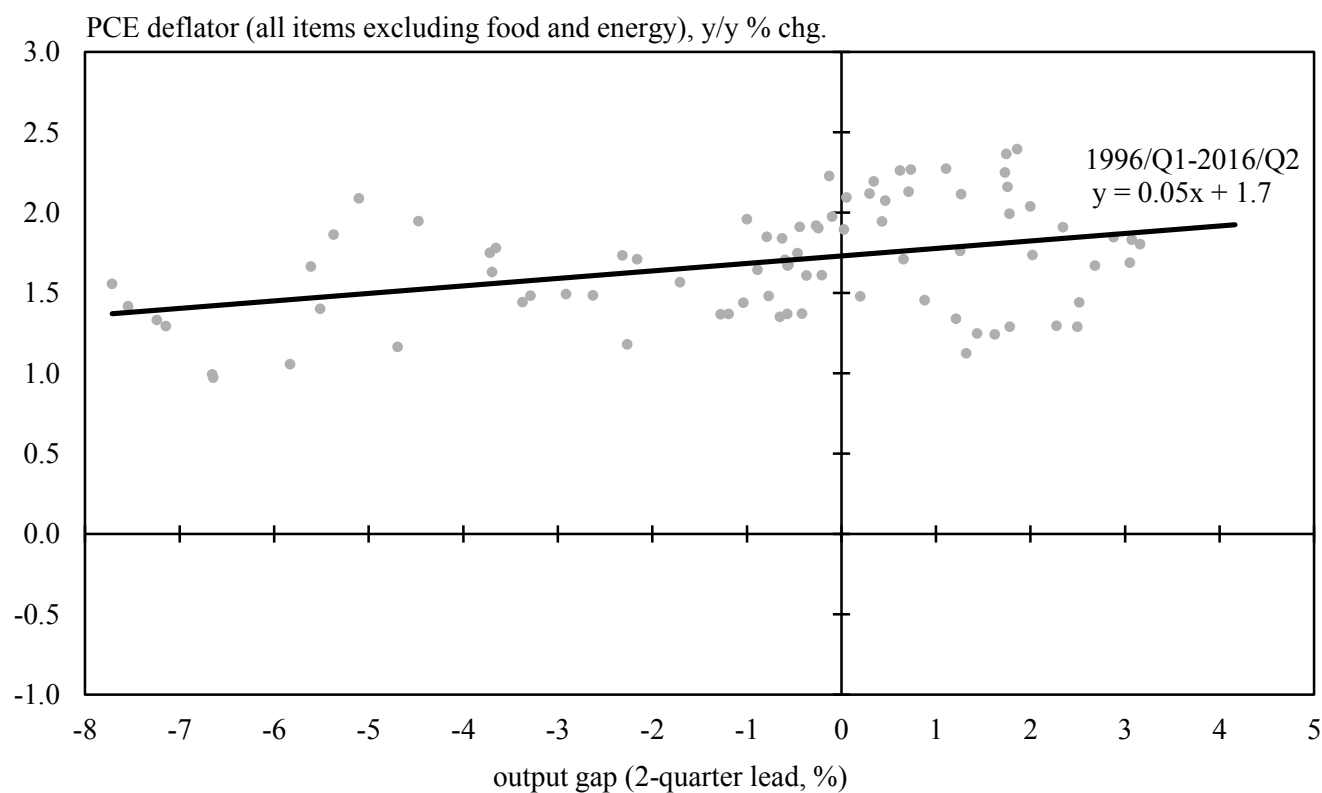


Phillips Curve: Japan and United States

(1) Japan



(2) United States

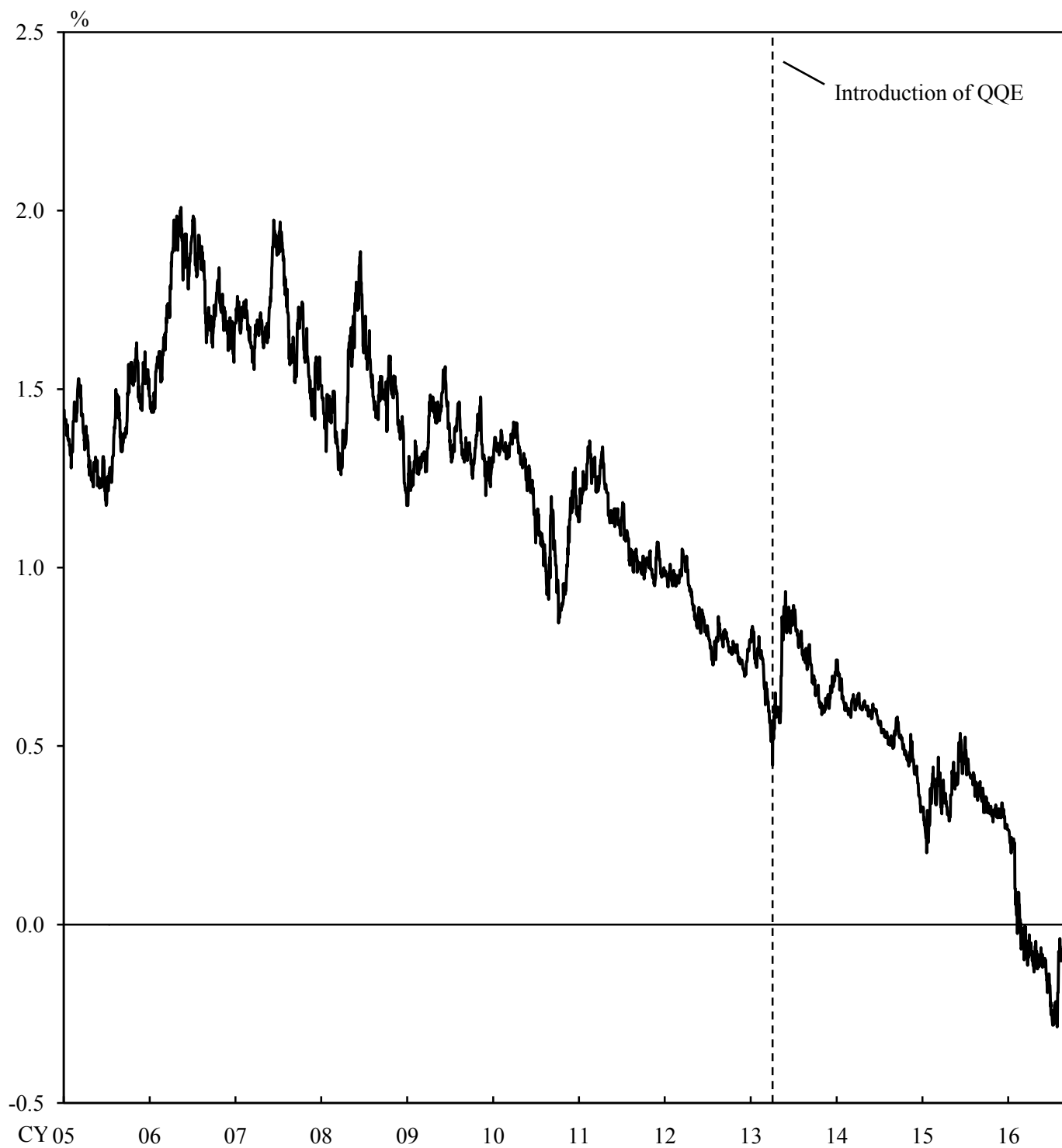


Notes: 1. Figures for the CPI (all items less fresh food and energy) are calculated by the Research and Statistics Department, Bank of Japan. The figures are adjusted to exclude the estimated effects of changes in the consumption tax rate.

2. The output gap for Japan is estimated by the Research and Statistics Department, Bank of Japan. That for the United States is estimated by the FRB.

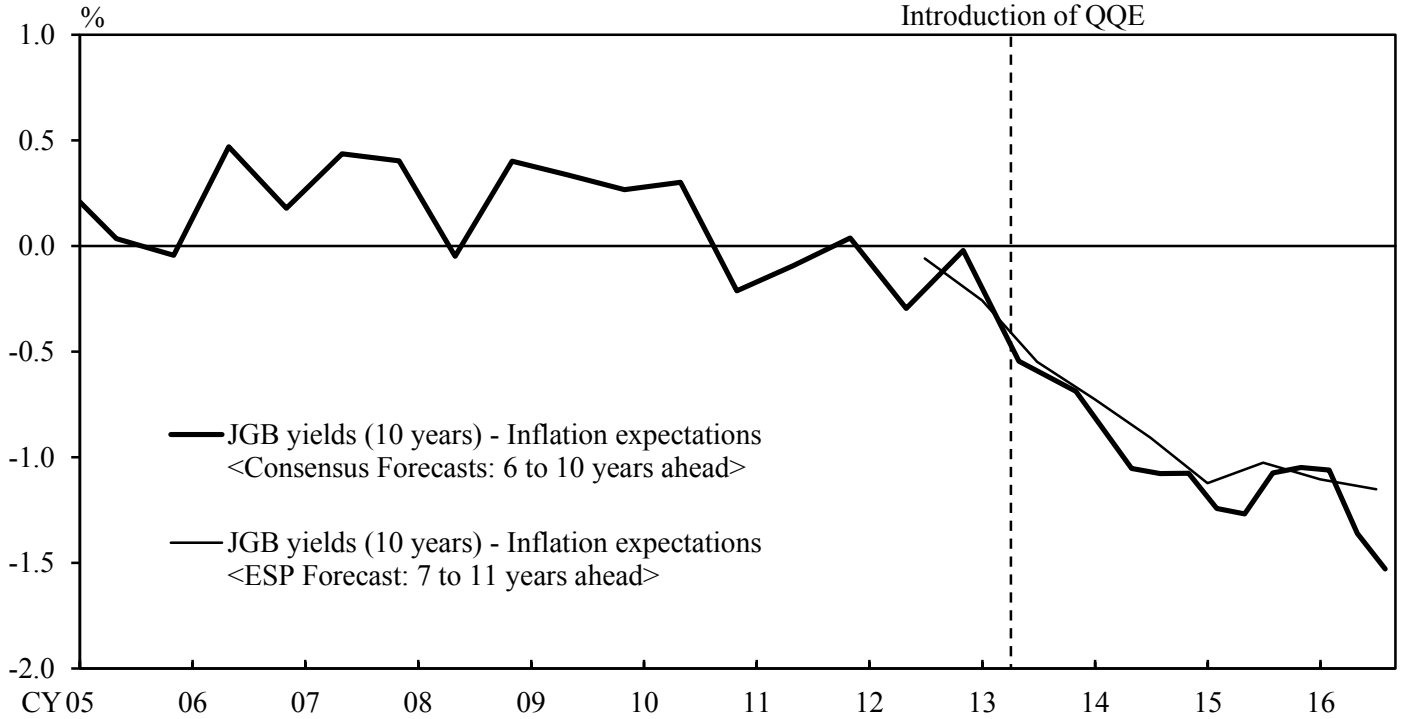
Sources: Ministry of Internal Affairs and Communications; Cabinet Office; BEA; FRB, etc.

10-Year JGB Yields

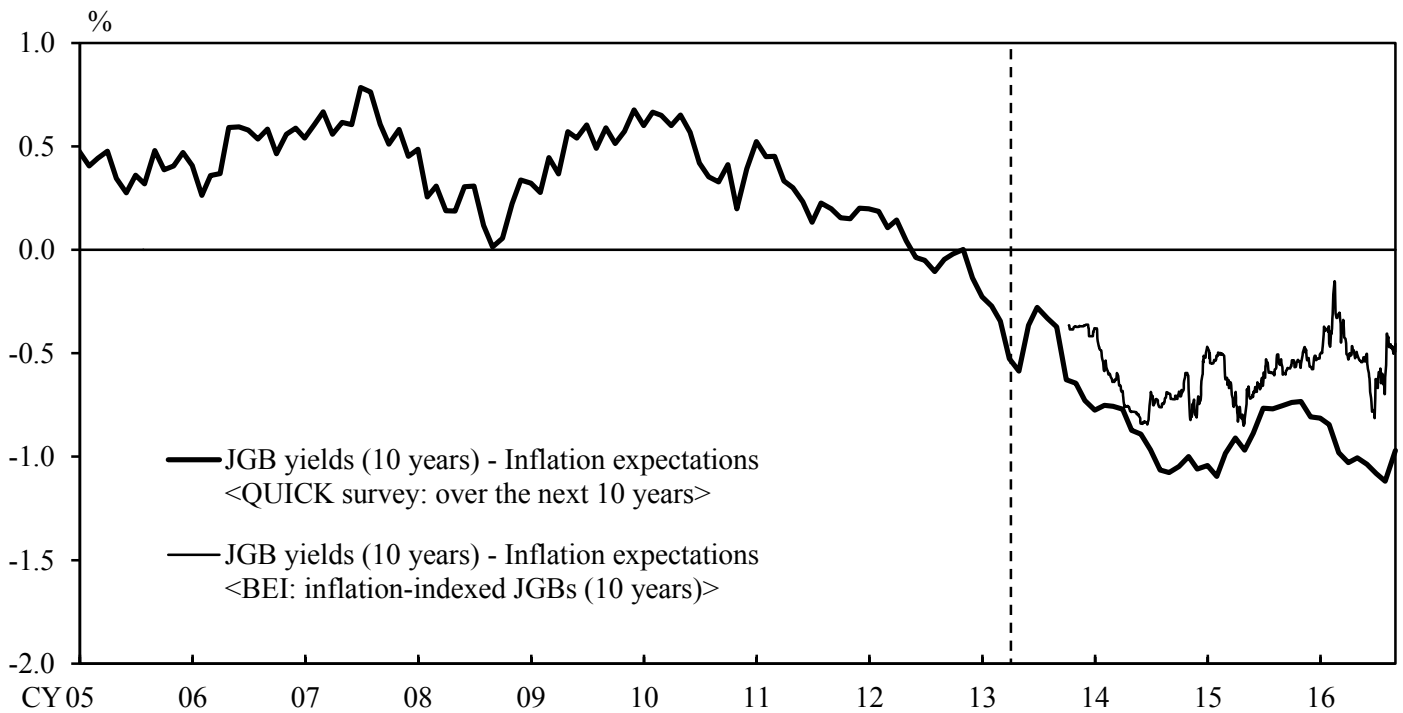


Real Long-Term Interest Rates

(1) Calculated Base on Inflation Expectations of Economists



(2) Calculated Base on Inflation Expectations of Markets



Notes: 1. Figures for the "Consensus Forecasts" are compiled every January, April, July, and October. Those up through April 2014 were compiled every April and October. Figures for the "ESP Forecast" are compiled every June and December, and exclude the effects of the consumption tax hikes.

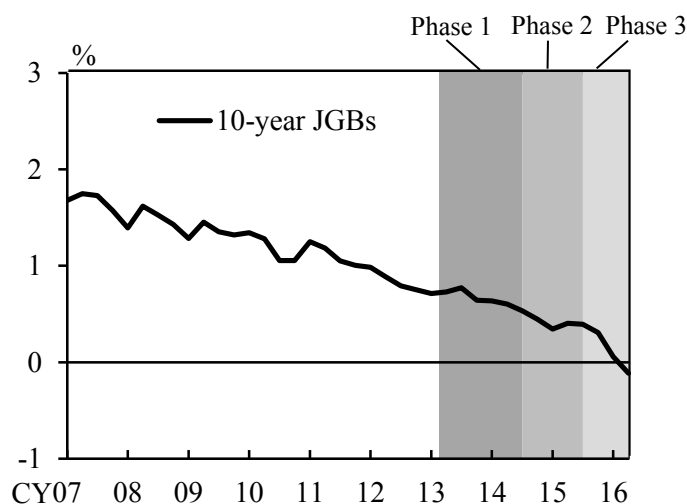
2. From the September 2013 survey, the "QUICK Monthly Market Survey (Bonds)" asks respondents to include the effects of changes in the consumption tax.

3. BEI (break-even inflation) rates are calculated as the yield spreads between fixed-rate coupon-bearing JGBs and inflation-indexed JGBs issued since October 2013.

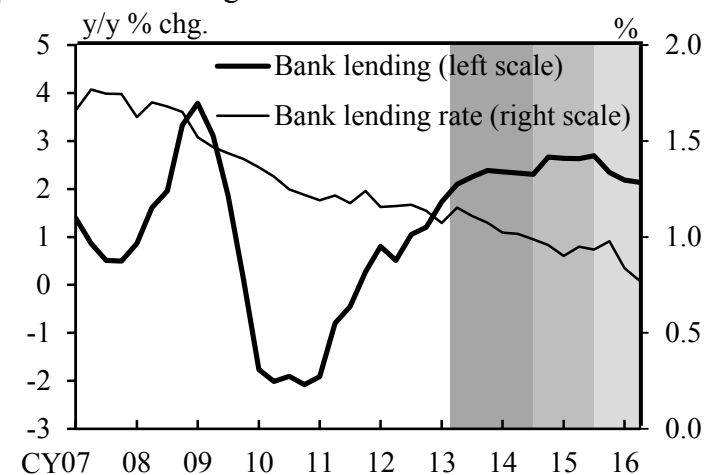
Sources: Consensus Economics Inc., "Consensus Forecasts"; JCER, "ESP Forecast"; QUICK, "QUICK Monthly Market Survey (Bonds)"; Bloomberg.

Financial and Economic Developments after the Introduction of QQE

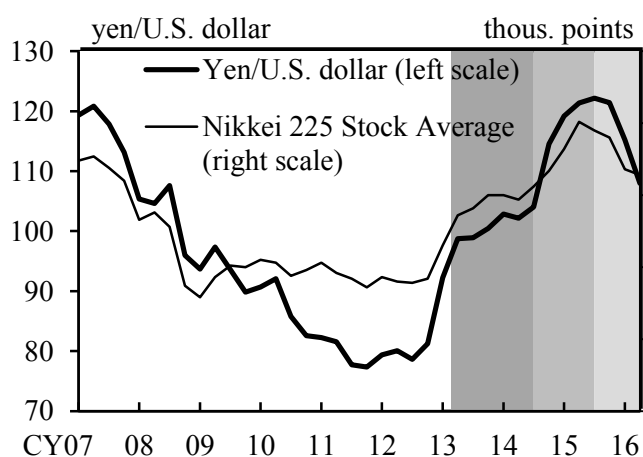
(1) Long-Term Interest Rate



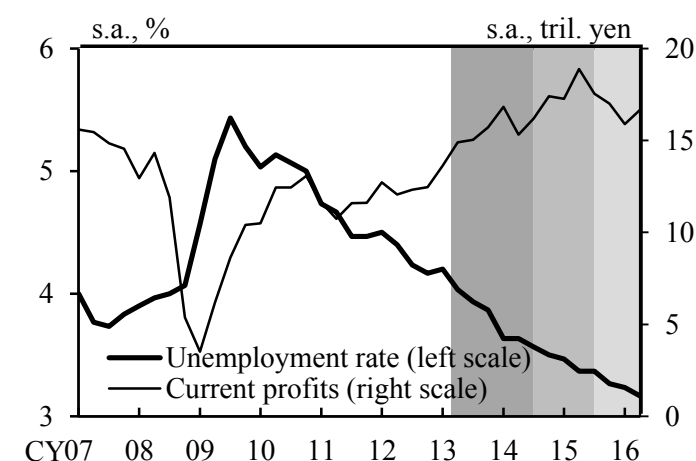
(2) Amount Outstanding of Bank Lending and Bank Lending Rate



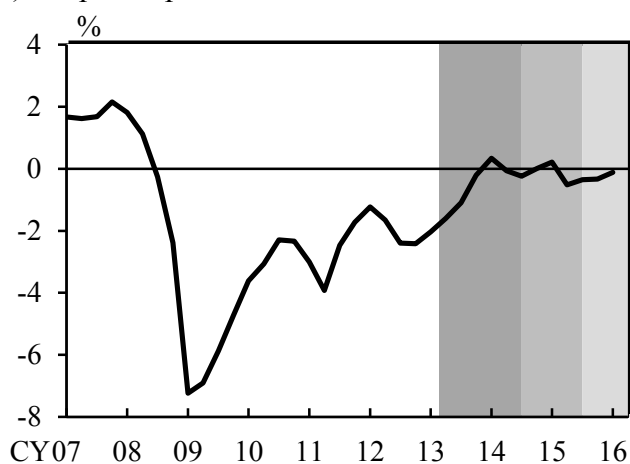
(3) Exchange Rate and Stock Prices



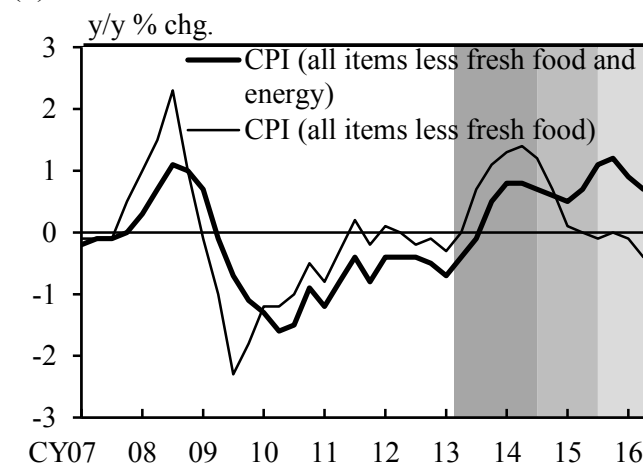
(4) Unemployment Rate and Corporate Profits



(5) Output Gap



(6) Consumer Price Index



Notes: 1. Figures for daily and monthly indicators are quarterly averages.

2. Figures for the bank lending rate are the long-term average contract interest rate on new loans and discounts.

3. Figures for current profits exclude "Finance and Insurance."

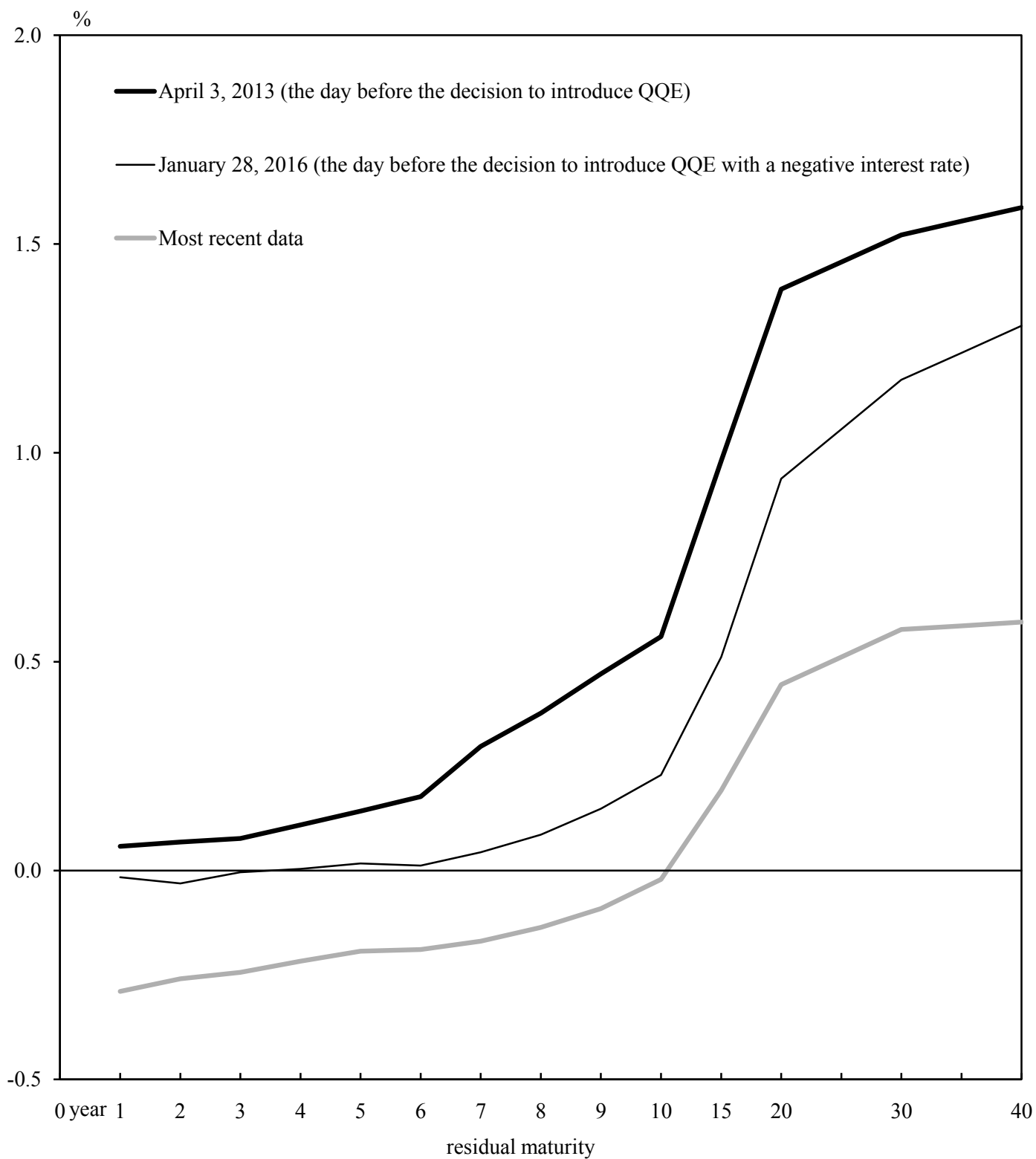
4. The output gap is estimated by the Research and Statistics Department, Bank of Japan.

5. Figures for the CPI are adjusted to exclude the estimated effects of changes in the consumption tax rate.

Figures for the CPI (all items less fresh food and energy) are calculated by the Research and Statistics Department, Bank of Japan.

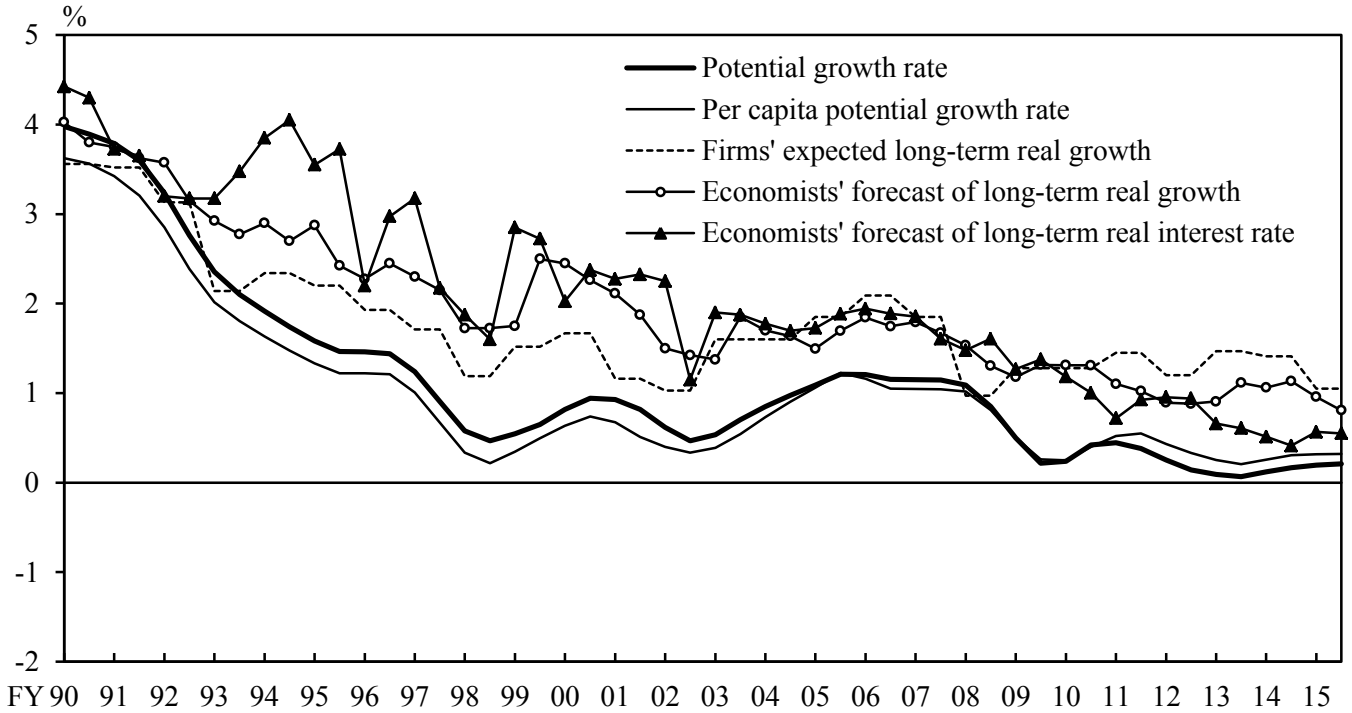
Sources: Bank of Japan; Bloomberg; Ministry of Internal Affairs and Communications; Ministry of Finance, etc.

Changes in the JGB Yield Curve



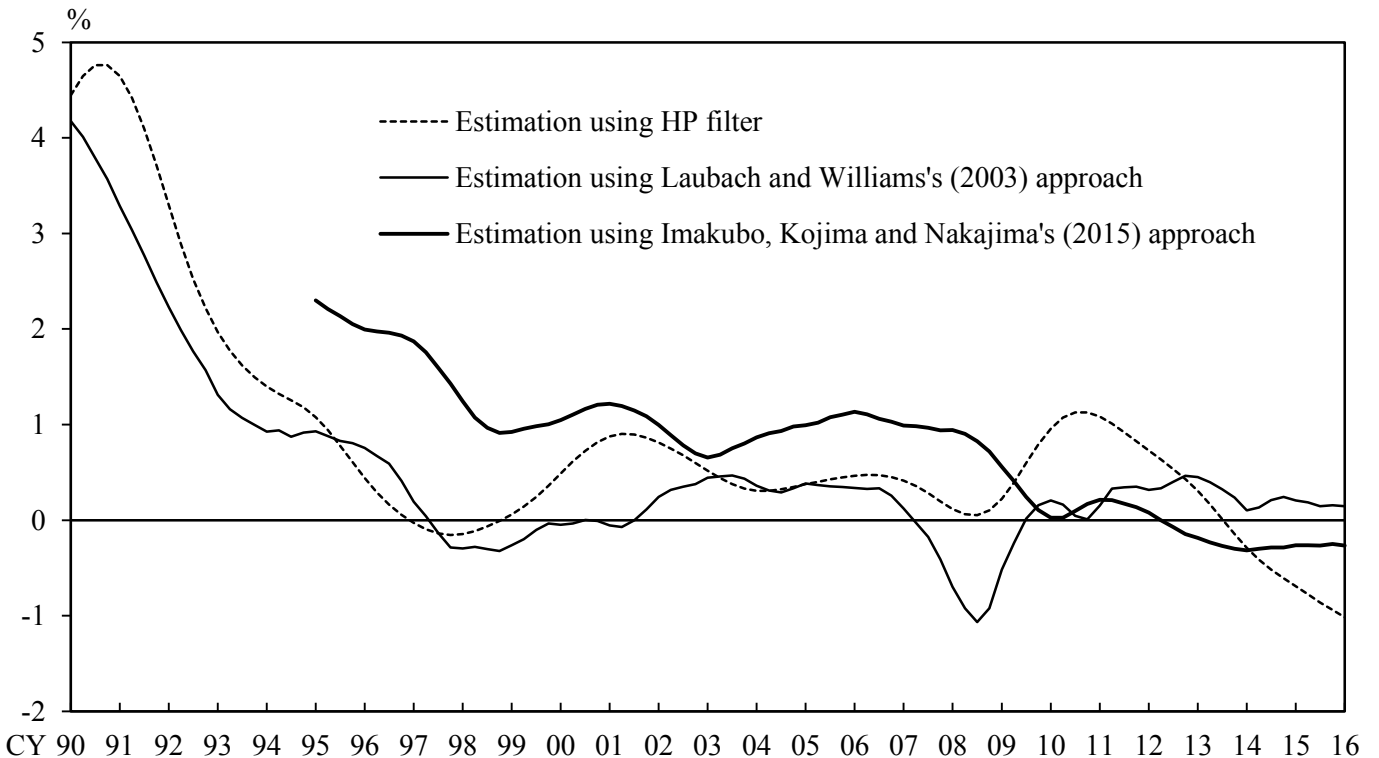
Indicators Regarding Natural Rate of Interest

(1) Natural Interest Rate Proxies from a Long-Term Perspective



Note: Firms' expected long-term real growth is firms' forecast of real economic growth rates for the next 5 years taken from the "Annual Survey of Corporate Behavior." Economists' forecasts are forecasts of real GDP growth rate and the long-term real interest rate (calculated as 10-year JGB yields minus consumer price inflation) for 6 to 10 years ahead taken from the "Consensus Forecasts." The potential growth rate is estimated by the Research and Statistics Department, Bank of Japan.

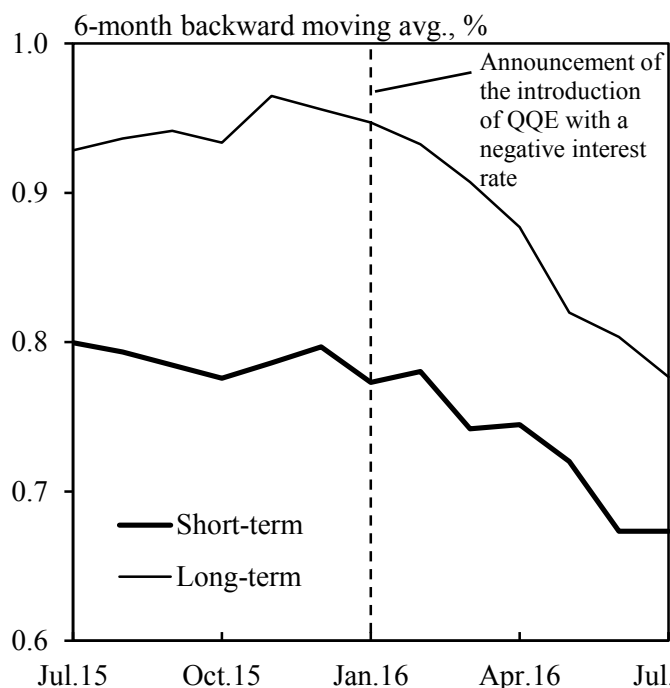
(2) Estimates of the Natural Rate of Interest



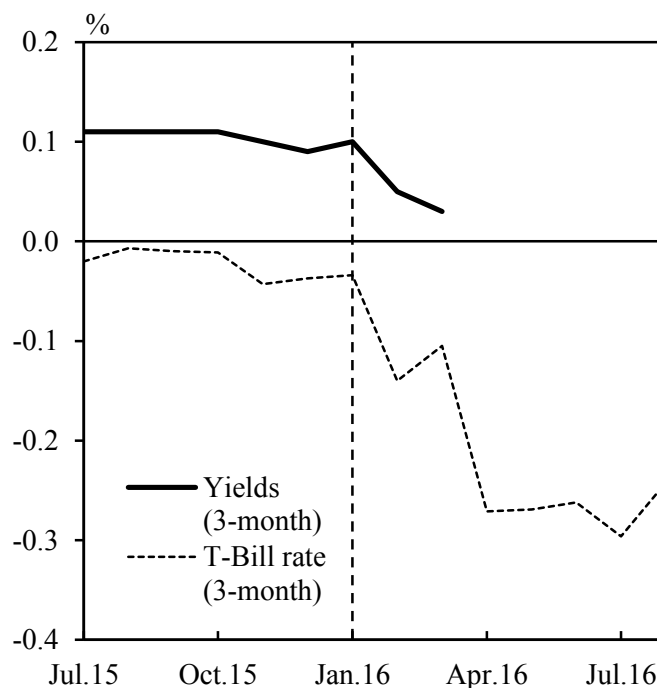
Sources: Consensus Economics Inc., "Consensus Forecasts"; Ministry of Internal Affairs and Communications; Cabinet Office; Bloomberg, etc.

Lending, Corporate Bond, CP, and Deposit Rates

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

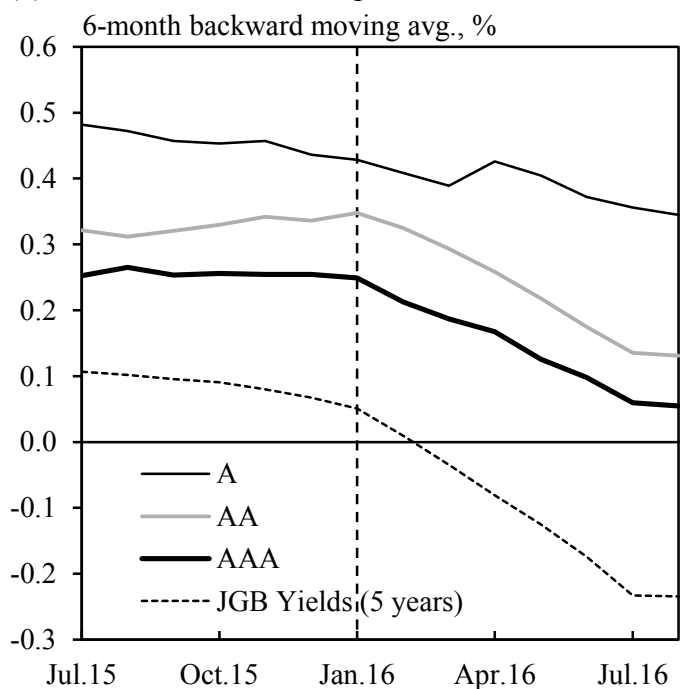


(2) Issuance Yields for CP

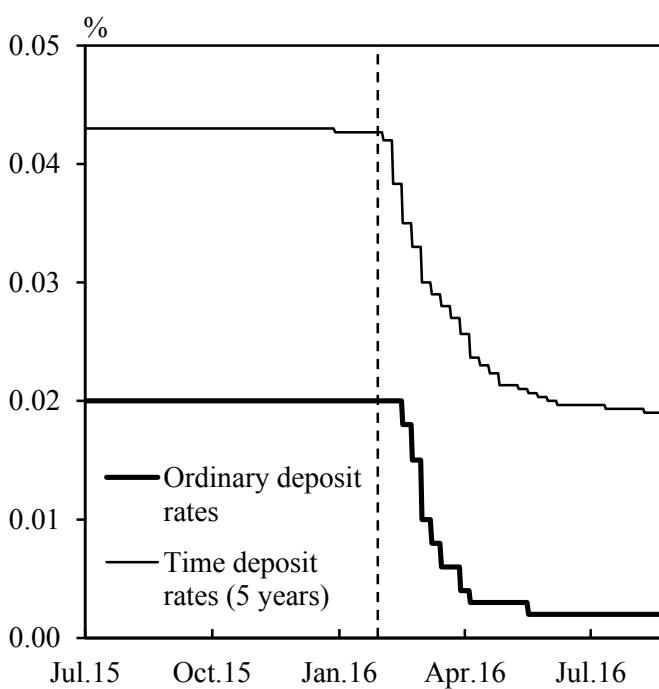


Note: Figures for issuance yields for CP are the average issuance rates of CP (3-month, rated a-1). The release of the statistics by the Japan Securities Depository Center has been suspended since late March 2016; the last available figure (for March 2016) is the average of weekly data up to March 18. According to anecdotal information, issuance yields for CP seem to be at an extremely low level on the whole. The same applies to Chart 9.

(3) Issuance Yields for Corporate Bonds



(4) Deposit Rates



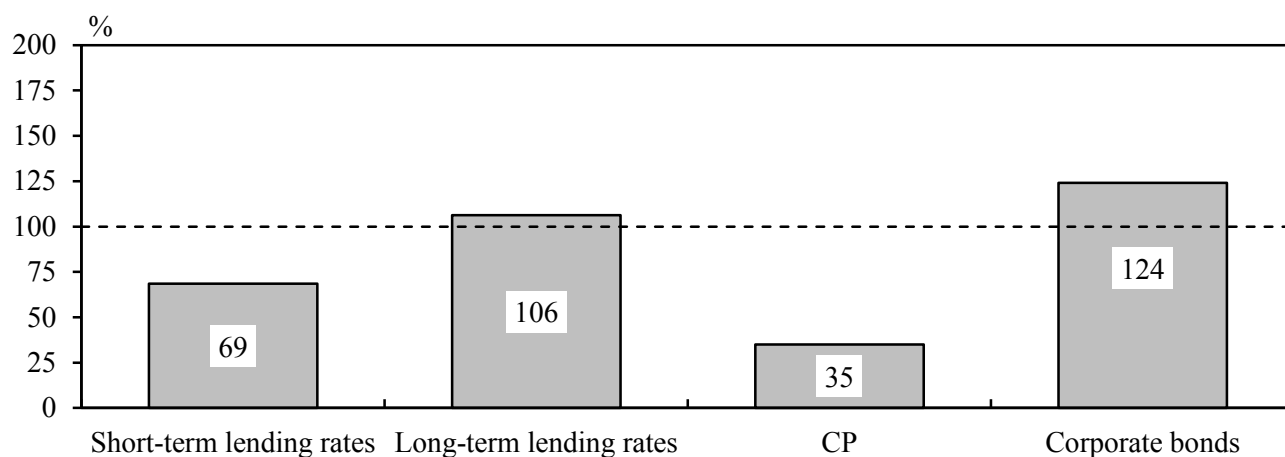
Notes: 1. Figures for issuance yields for corporate bonds are obtained by adding yields on 5-year JGBs to the average issuance spreads for domestically issued bonds launched on a particular date. Bonds issued by banks and securities companies, etc., are excluded. Bonds are classified based on the highest rating among the ratings from Moody's, S&P, R&I, and JCR. The same applies to Chart 9.

2. Figures for deposit rates cover domestically licensed banks (excluding several banks), all correspondent Shinkin banks and the Shoko Chukin bank.

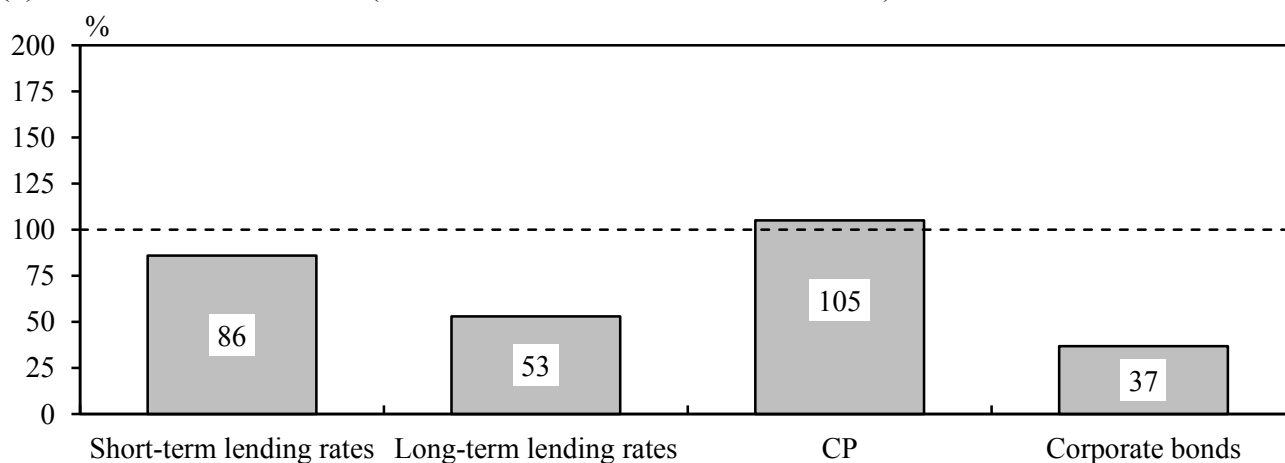
Sources: Bank of Japan; Japan Securities Depository Center; Capital Eye; I-N Information Systems; Bloomberg.

The Pass-Through Rate of Lending and Other Interest Rates in Phases of Policy Interest Rate Cuts

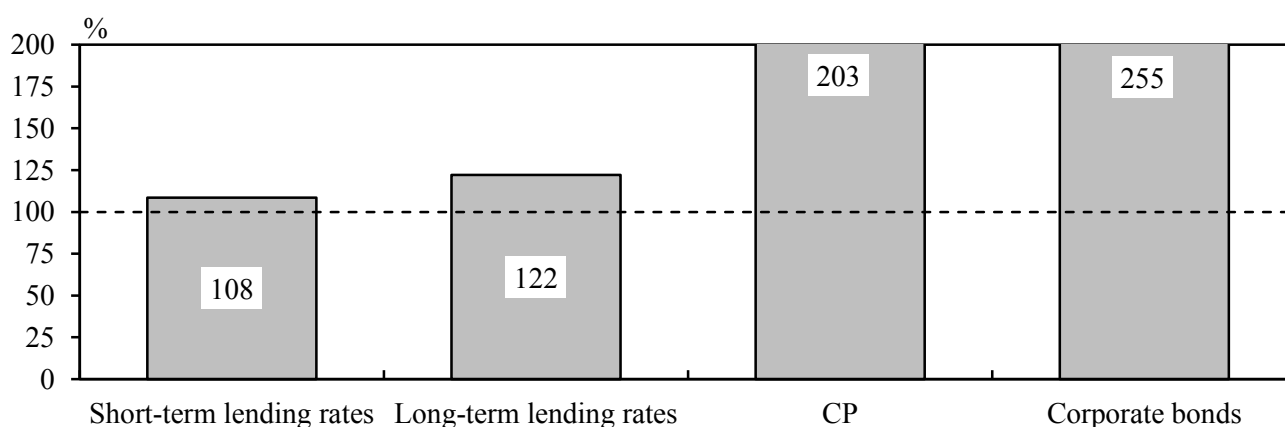
(1) January 2016 (Interest Rate Cut from +0.1% to -0.1%)



(2) October-December 2008 (Interest Rate Cut from +0.5% to +0.1%)



(3) February-March 2001 (Interest Rate Cut from +0.25% to 0%; Quantitative Monetary Easing)



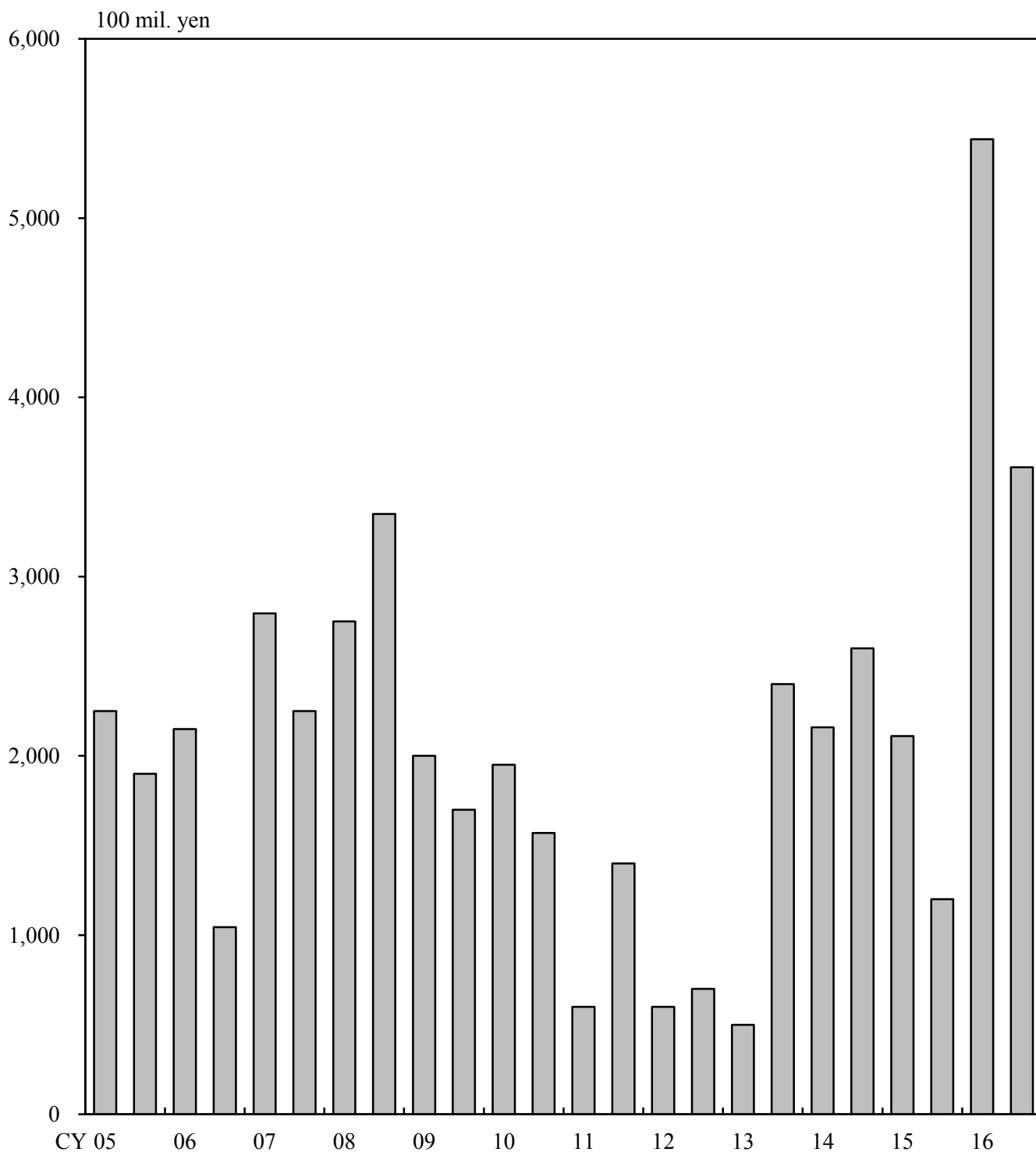
Notes: 1. The pass-through rate is the ratio of the rate of change in each interest rate to that in the policy interest rate (or the IOER). The rate of change in each interest rate is calculated as the difference between the average of each interest rate 4-6 months after the policy change and that 3 months before the policy change.

2. Figures for lending rates are the average contract interest rates on new loans and discounts. Figures for CP are issuance yields for 3-month CP rated a-1 in (1) and a-1 or higher in (2) and (3). Figures for corporate bonds are the average issuance yields of bonds rated AA.

3. The figure for CP after the policy change in (1) is that of March 2016.

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

Issuance of Super-Long-Term Corporate Bonds (Over 10 Years)

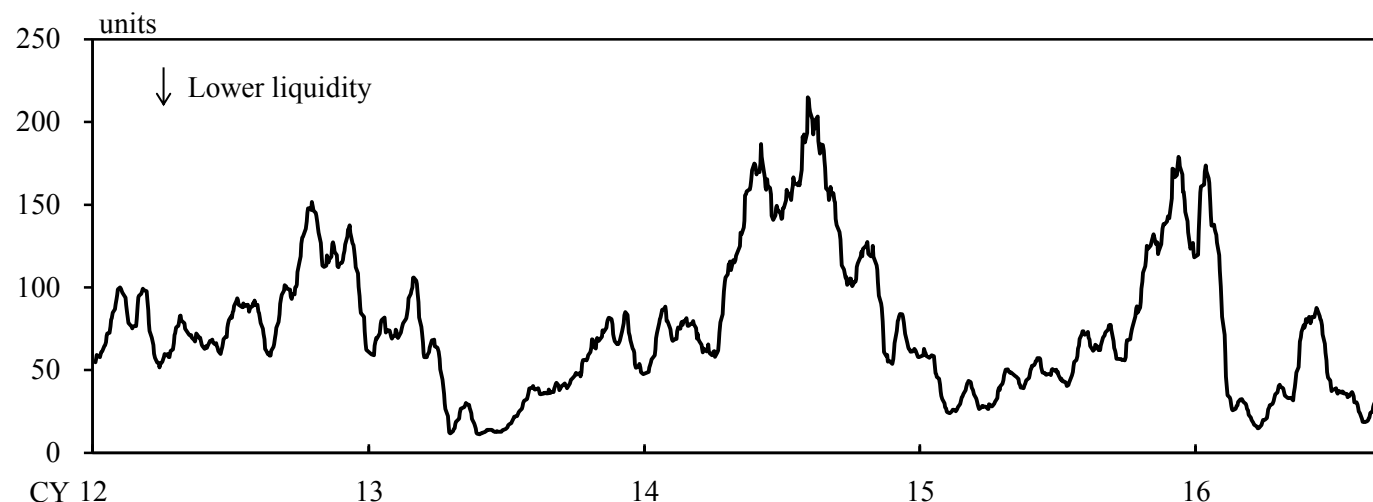


Note: Based on figures for the dates on which issuance conditions are decided. The figure for the second half of 2016 is the sum of figures for July and August. Figures exclude bonds issued by banks and securities companies as well as bonds with a first call date of less than 10 years after the issuance date.

Source: I-N Information Systems.

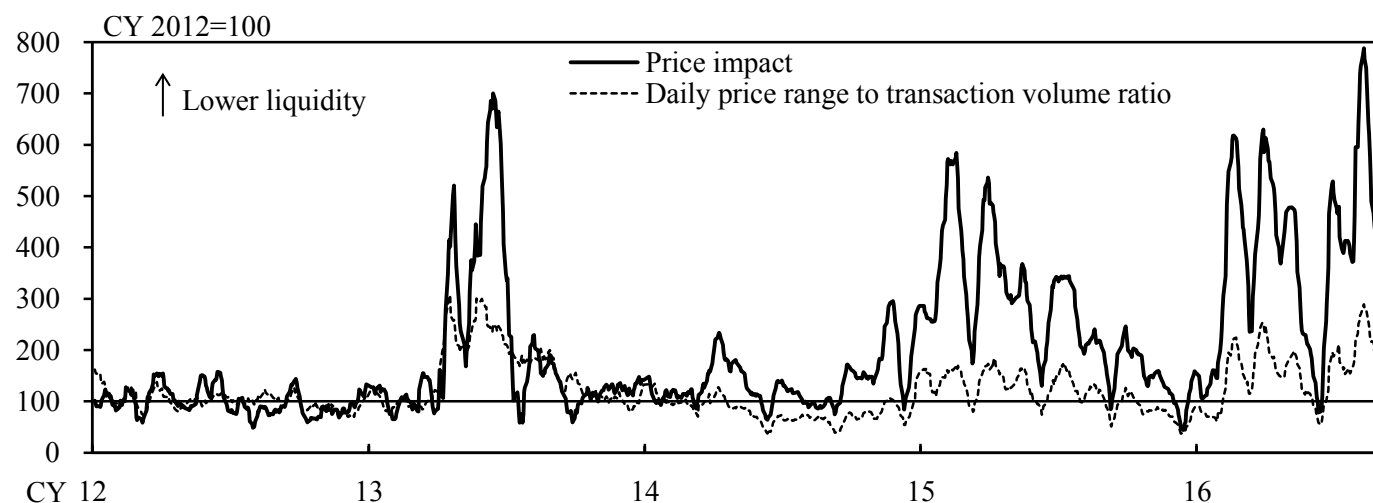
Liquidity Indicators in the JGB Markets

(1) Volume of Limit Orders at the Best-Ask Price (JGB Futures)



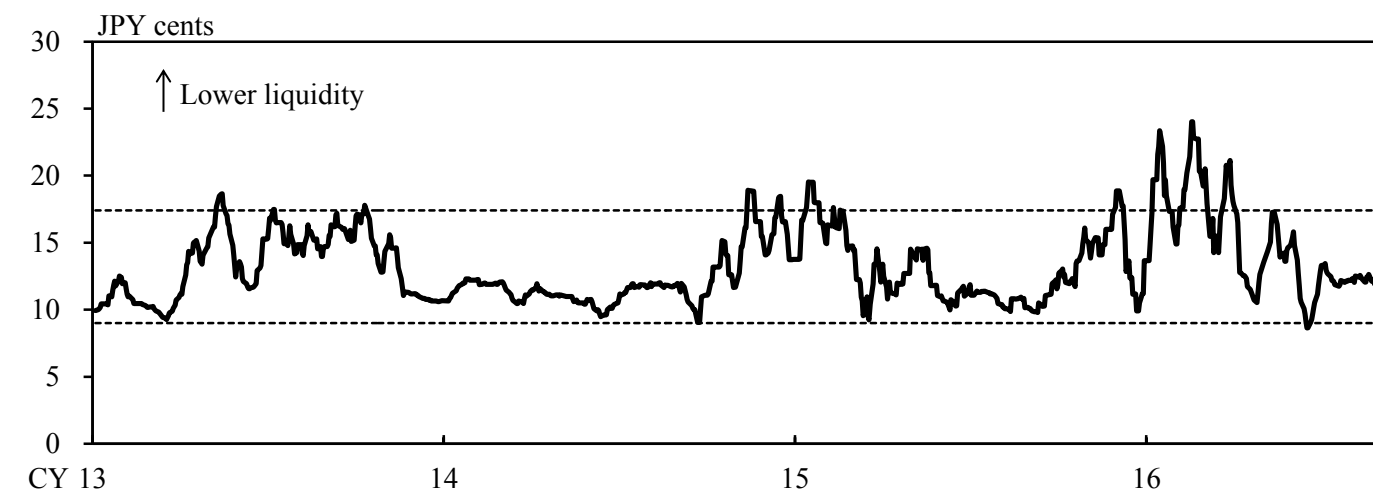
Note: Figures are calculated by taking the median of the volume of limit orders at the best-ask price with a 1-minute frequency within each business day, and then applying a 10-day backward moving average.

(2) Price Impact (JGB Futures)



Note: The figure shows 10-day backward moving averages. The price impact is calculated by first taking the average for each business day.

(3) Bid-Ask Spreads in the Dealer-to-Client Market (10-Year JGBs)



Notes: 1. 10-day backward moving average.

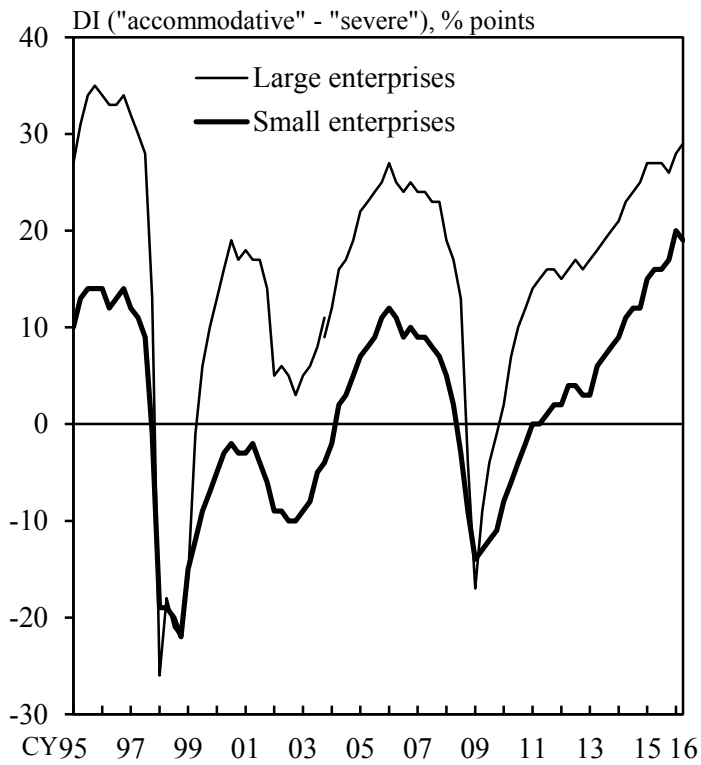
2. The dotted lines indicate the first/third quartile spreads between Jan. 2010 and Mar. 2013.

Sources: Nikkei Inc.; QUICK; Osaka Exchange, Inc.; Thomson Reuters.

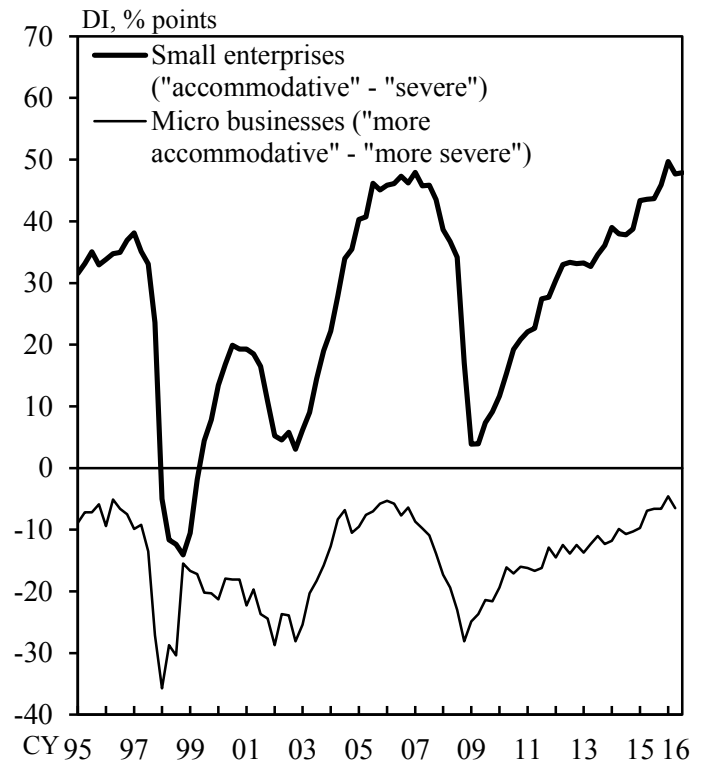
Lending Attitudes as Perceived by Firms and Financial Institutions

(1) Survey on Firms

(a) *Tankan*



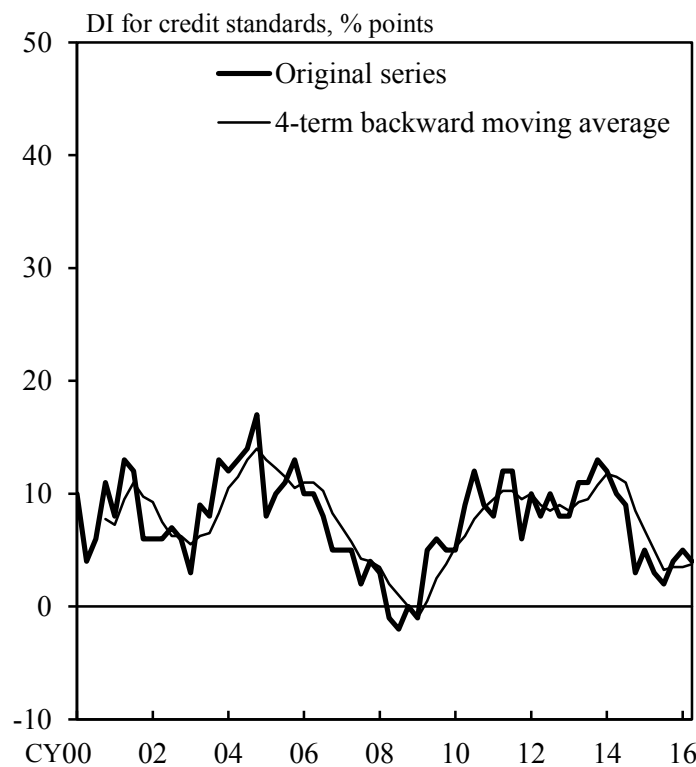
(b) Japan Finance Corporation Survey



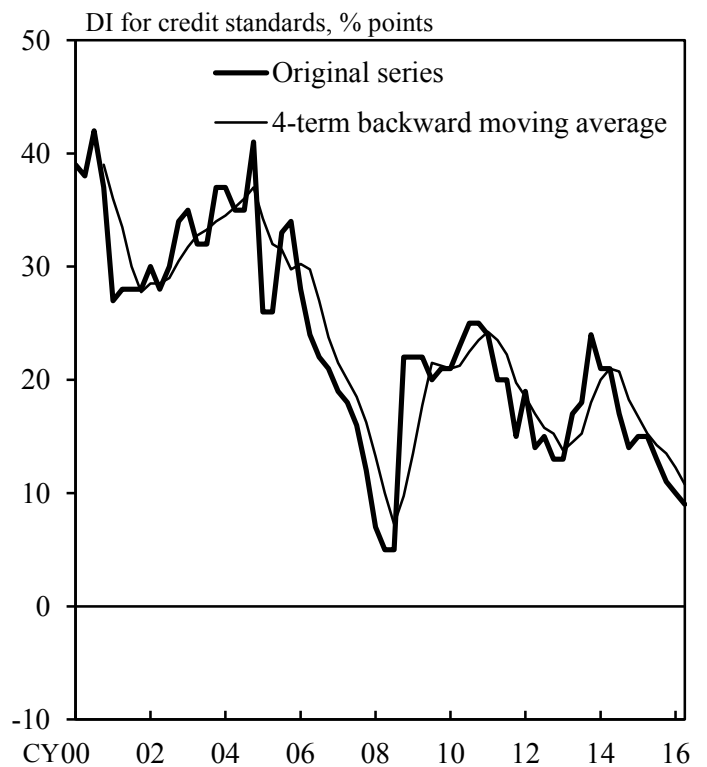
(2) Survey on Banks

<Senior Loan Officer Opinion Survey on Bank Lending Practices at Large Japanese Banks>

(a) Large Firms



(b) Small Firms



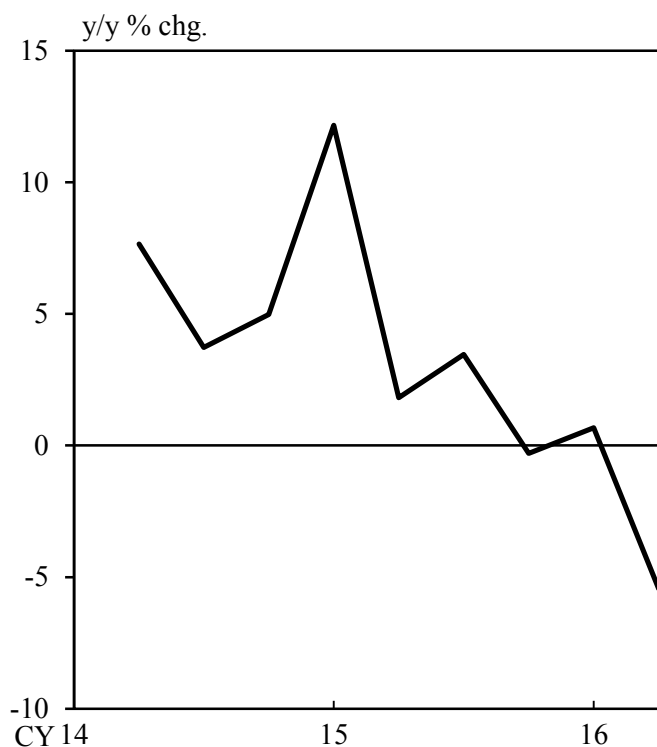
Notes: 1. Data from the *Tankan* are based on all industries. There is a discontinuity in the data in December 2003 due to a change in the survey framework.

2. The figure for 2016/Q3 is that of the July-August average.

Sources: Bank of Japan; Japan Finance Corporation.

Life and Pension Insurances under Negative Interest Rates

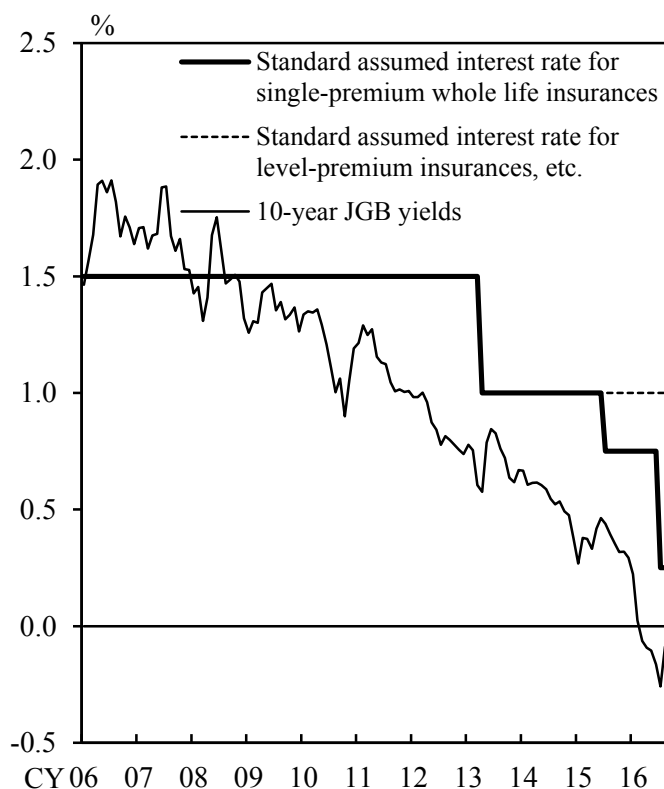
(1) Premium Income of Life Insurance Companies



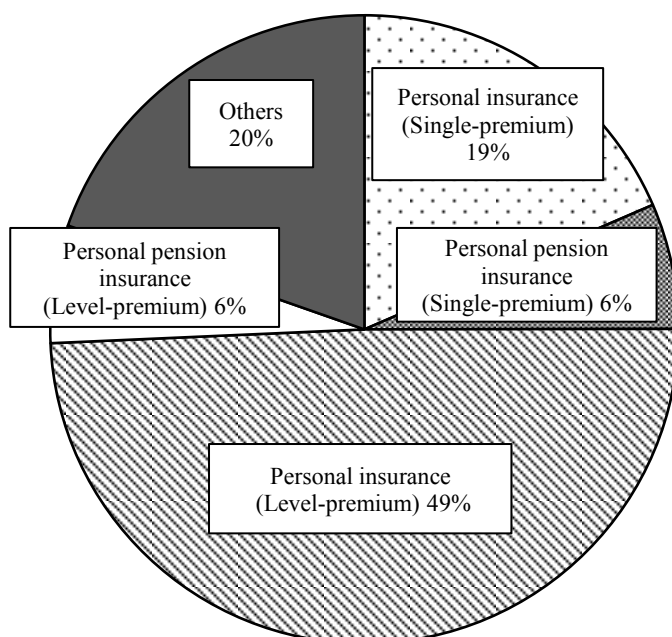
(2) Examples of Single-Premium Whole Life Insurances

	Assumed interest rates, %		
	Start of CY 2015	Start of CY 2016	Most recent date
Company A	1.00	0.75	Sale discontinued
Company B	0.90	0.85	0.30
Company C	1.00	1.00	0.60
Company D	1.01	1.01	Sale discontinued
Company E	1.02	0.76	Sale discontinued

(3) Standard Assumed Interest Rates



(4) Breakdown of Premium Income of Life Insurance Companies by Product Type (FY 2015)

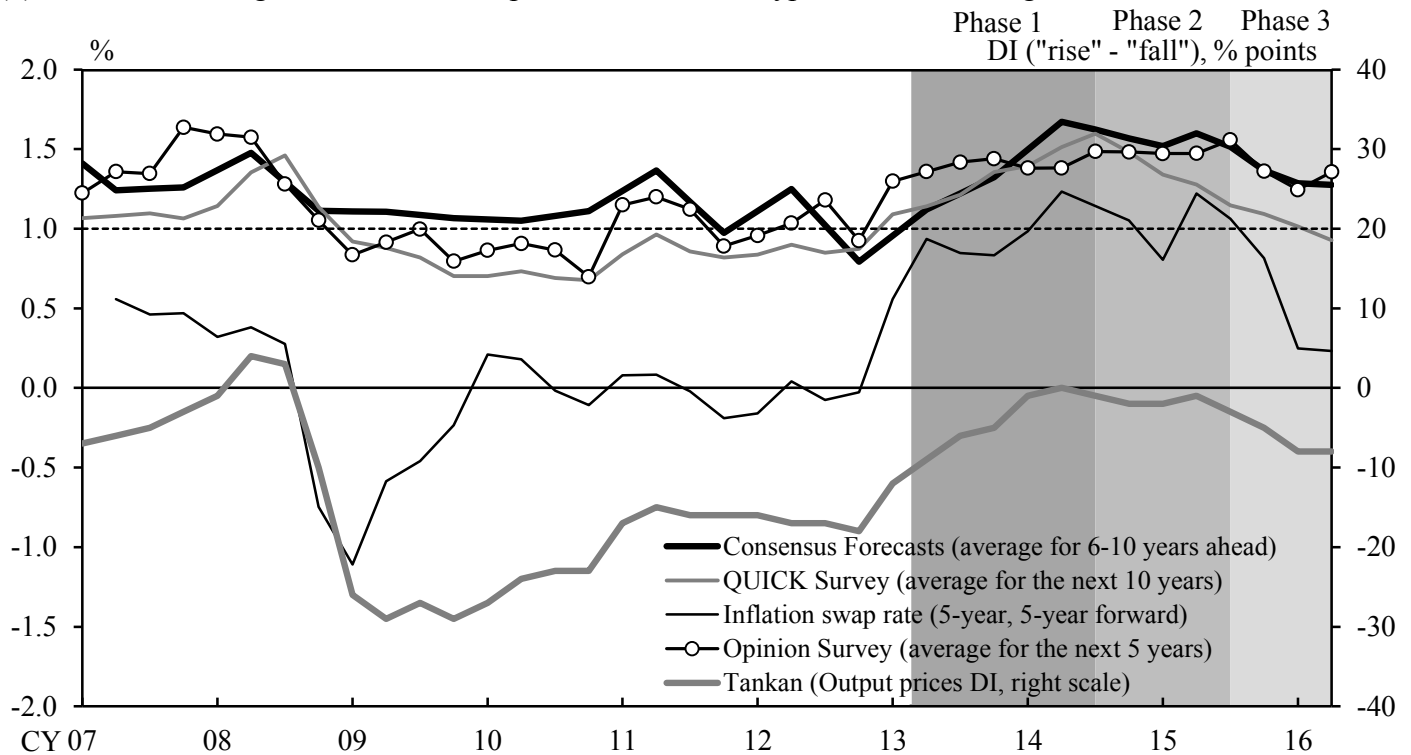


Note: Standard assumed interest rates are used as discount rates to calculate liability reserves.

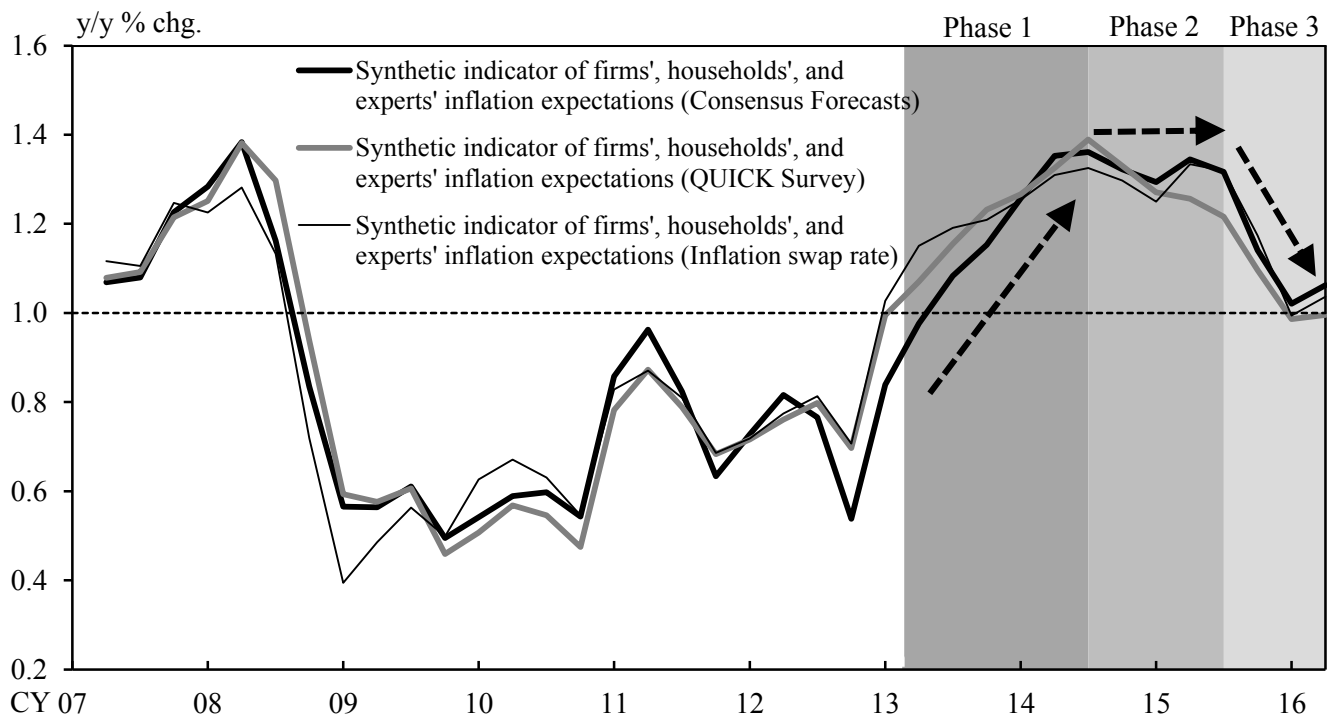
Sources: The Life Insurance Association of Japan; Ministry of Finance; company publications, etc.

Division of Inflation Expectations into Phases Using Statistical Methods

(1) Medium- to Long-Term Inflation Expectations of Each Type of Economic Agent



(2) Synthesized Inflation Expectations Indicators Obtained Through Principal Component Analysis



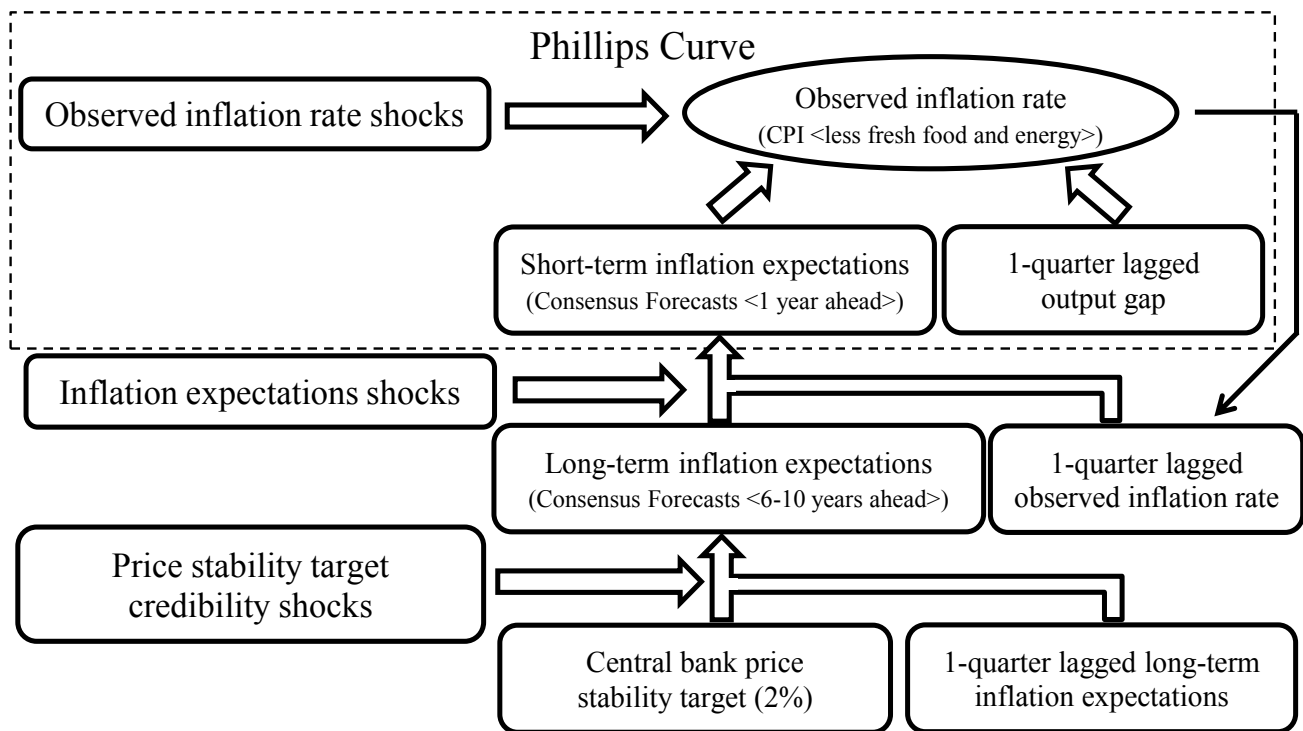
Notes: 1. Semiannual data from the "Consensus Forecasts" up through 2014/Q2 are linearly interpolated. Opinion Survey figures exclude inflation expectations by respondents whose annual inflation expectations were $\pm 5\%$ or greater. The output prices DI in the *Tankan* represents the difference between the share of firms that raised prices in the preceding three months and the share of firms that lowered prices.

2. Inflation expectations of firms are represented by the *Tankan* and those of households are represented by the "Opinion Survey." The different lines in (2) show synthesized inflation expectations when using data from the "Consensus Forecasts," the "QUICK Survey," and the inflation swap rate for experts' inflation expectations, respectively.

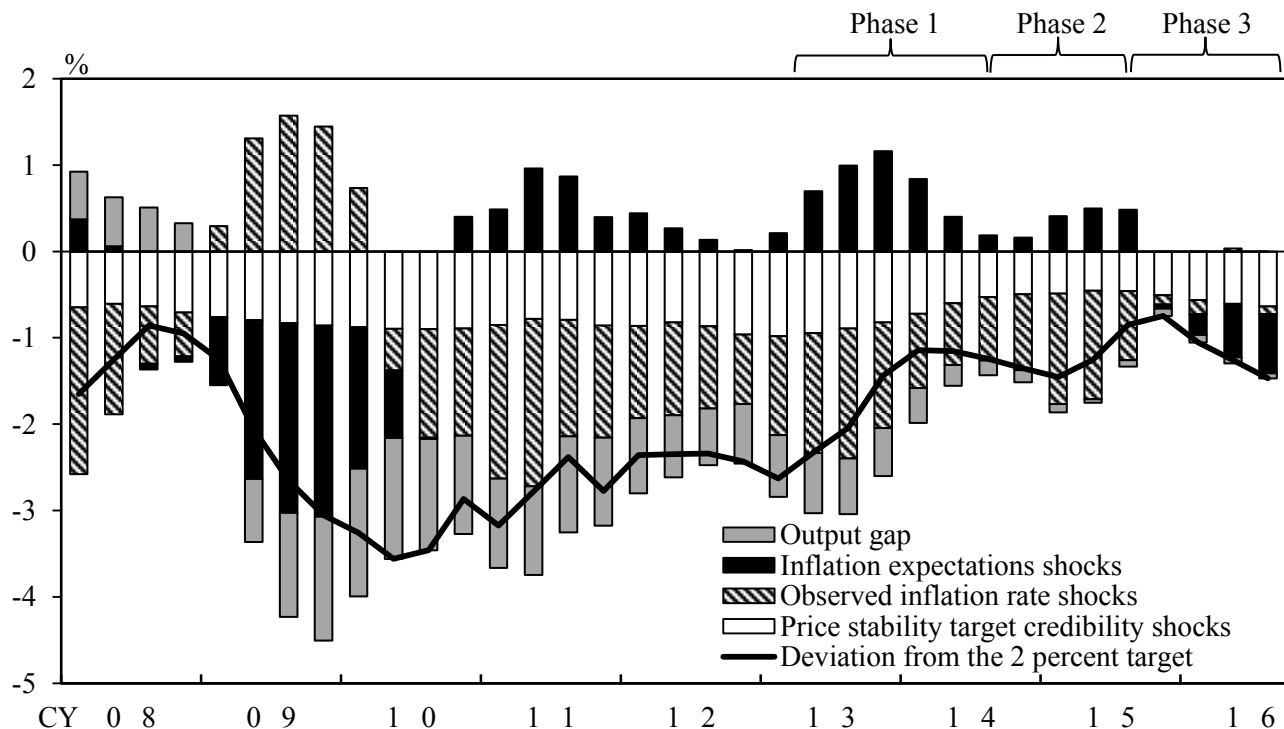
Sources: Consensus Economics Inc., "Consensus Forecasts"; QUICK, "QUICK Monthly Market Survey (Bonds)"; Bloomberg; Bank of Japan.

Examination of Inflation Expectation Dynamics

(1) Outline of the Model



(2) Decomposition of Deviation of the Observed Inflation Rate from the 2 Percent Target



Notes: 1. Figures for the CPI (all items less fresh food and energy) are calculated by the Research and Statistics Department, Bank of Japan. They are adjusted to exclude the estimated effects of changes in the consumption tax rate. The figure for 2016/Q3 is that of July.

2. The figure for the output gap for 2016/Q2 is that for 2016/Q1.

3. Semiannual data from the "Consensus Forecasts" up through 2014/Q2 are linearly interpolated, and those from 2014/Q3 onward are quarterly data. They are adjusted to exclude the estimated effects of changes in the consumption tax rate.

Sources: Consensus Economics Inc., "Consensus Forecasts"; Ministry of Internal Affairs and Communications; Bank of Japan.

The Mechanism of Inflation Expectations Formation in Advanced Economies

(1) Estimation Equations

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

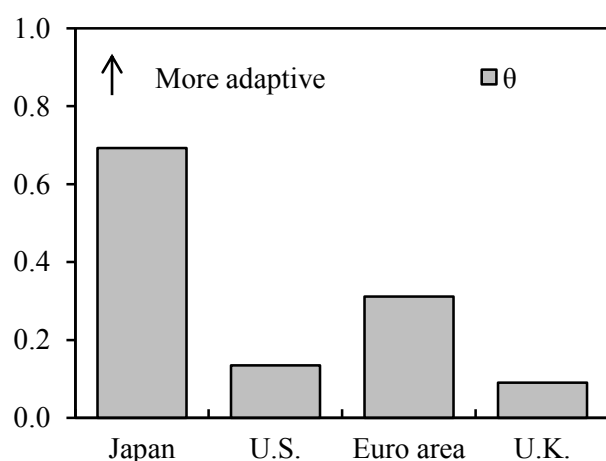
$$\text{Inflation expectations 1 year ahead (\%)} = \theta \times \text{Observed inflation rate (lagged 1 quarter, \%)} + (1 - \theta) \times \text{Inflation expectations 6-10 years ahead (\%)}$$

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

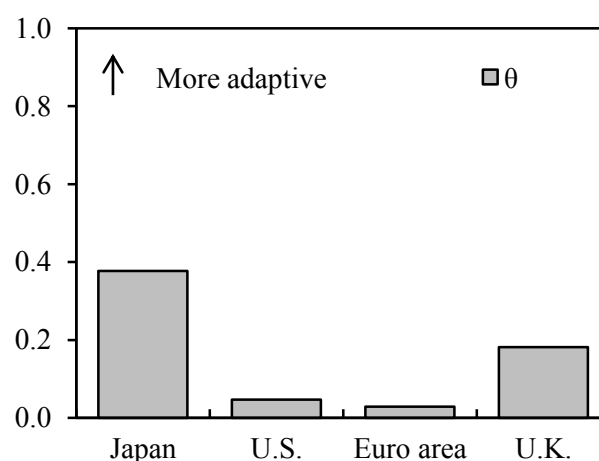
$$\text{Inflation expectation 6-10 years ahead (\%)} = \theta \times \text{Observed inflation rate (lagged 1 quarter, \%)} + (1 - \theta) \times \text{Central bank price stability target (2\%)}$$

(2) Estimation Using Headline Inflation Rates as Observed Inflation Rates

Equation (a)

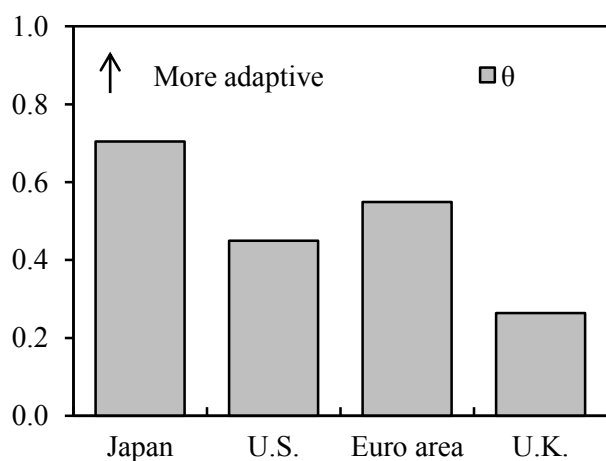


Equation (b)

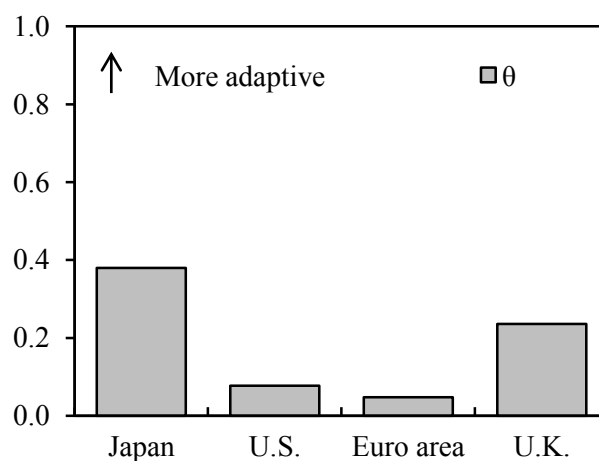


(3) Estimation Using Core Inflation Rates as Observed Inflation Rates

Equation (a)



Equation (b)



Notes: 1. The estimation periods are as follows: 2000/Q1-2016/Q3 for Japan and the United States; 2003/Q2-2016/Q3 for the euro area; and 2005/Q1-2016/Q3 for the United Kingdom.

2. Figures for the observed inflation rate and inflation expectations in Japan are adjusted to exclude the estimated effects of changes in the consumption tax rate.

3. Core inflation rates are the rate of change in the consumer price index (CPI) or the Harmonized Index of Consumer Prices (HICP) for all items excluding the following: fresh food in the case of Japan; food and energy in the case of the United States; unprocessed food and energy in the case of the euro area; and food, energy, alcohol, and tobacco in the case of the United Kingdom.

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

The Importance of Past Price Developments in Wage Determination

(1) Base Pay Increase and Inflation Expectations

<Estimation Equation>

Base pay increase (y/y % chg.)
 $= \alpha_0$ (constant)
 $+ \alpha_1 \times$ Medium- to long-term
inflation expectations
(6 to 10 years ahead, %)
 $+ (1 - \alpha_1) \times$ Past inflation rate
(4-quarter average, %)
 $+ \alpha_2 \times$ Unemployment rate gap (%)

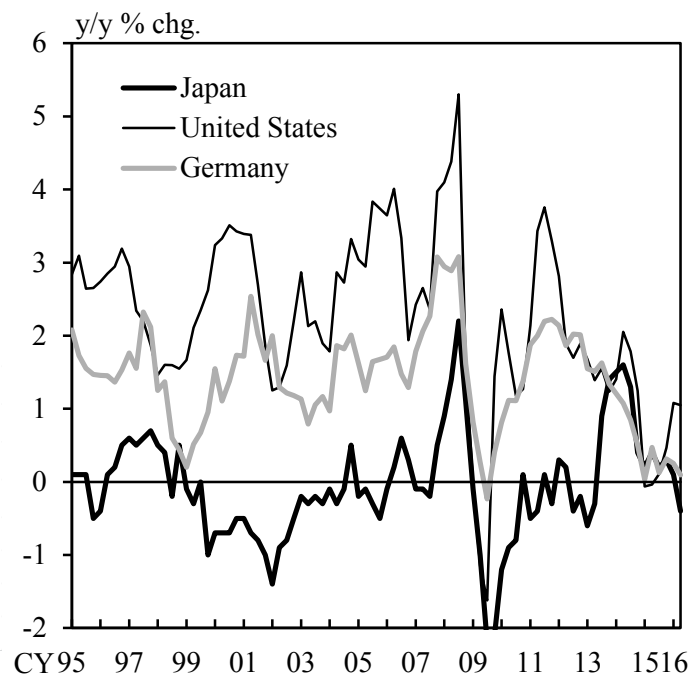
<Estimation Results>

	α_0	α_1	$1 - \alpha_1$	α_2	S.E.
Japan	-0.10	0.38**	0.62***	0.05	0.47
United States	0.23***	0.86***	0.14*	-0.05	0.56
Germany	0.52***	0.86***	0.14	-0.51***	0.69

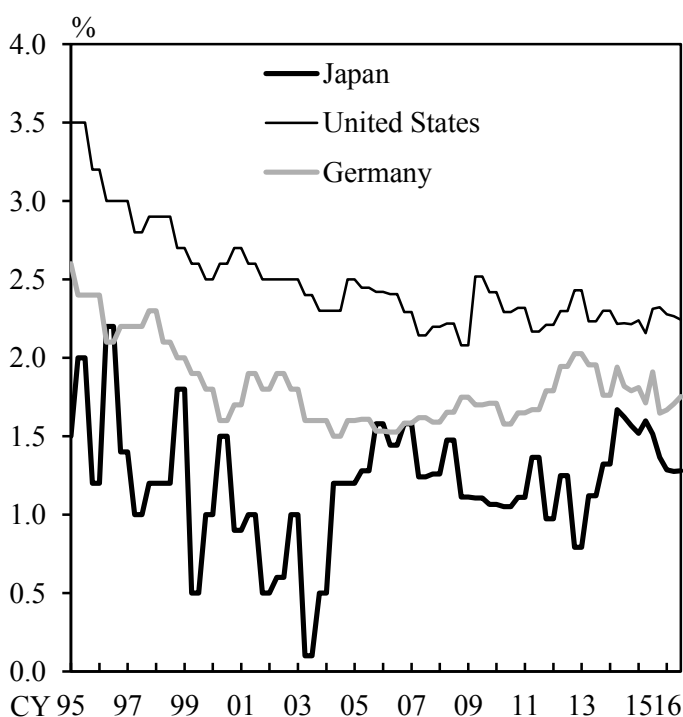
Estimation Period: FY 1991-2016 for Japan,
1995/Q1-2015/Q4 for the United States and Germany.

***, **, and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

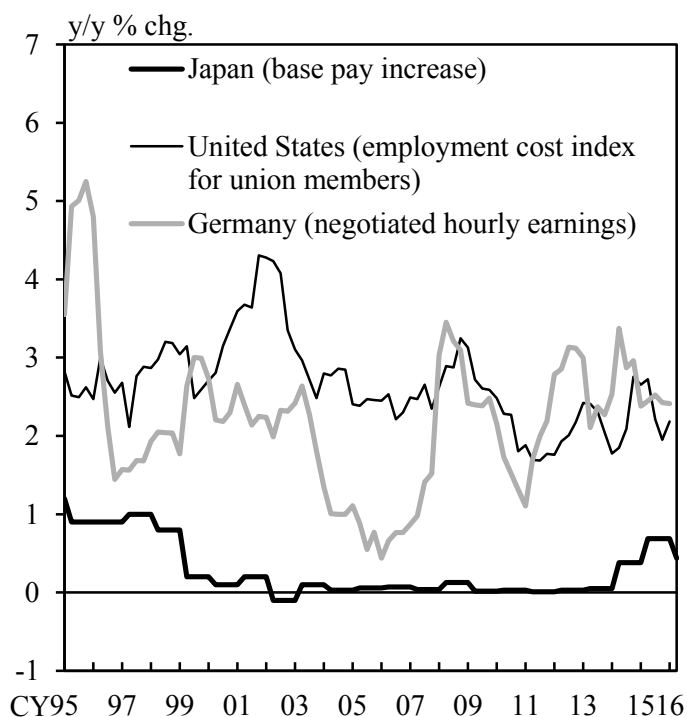
(2) Past Inflation Rate (CPI) in Each Country



(4) Medium- to Long-Term Inflation Expectations in Each Country



(3) Base Pay Increase in Each Country



Notes: 1. Figures for medium- to long-term inflation expectations are the expectations for the CPI 6 to 10 years ahead and are based on the "Consensus Forecasts."

2. Figures for the past inflation rate are based on the CPI (all items). Figures for the CPI in Japan are adjusted to exclude the estimated effects of changes in the consumption tax rate.

3. The unemployment rate gap used in the estimation is estimated by the Research and Statistics Department, Bank of Japan.

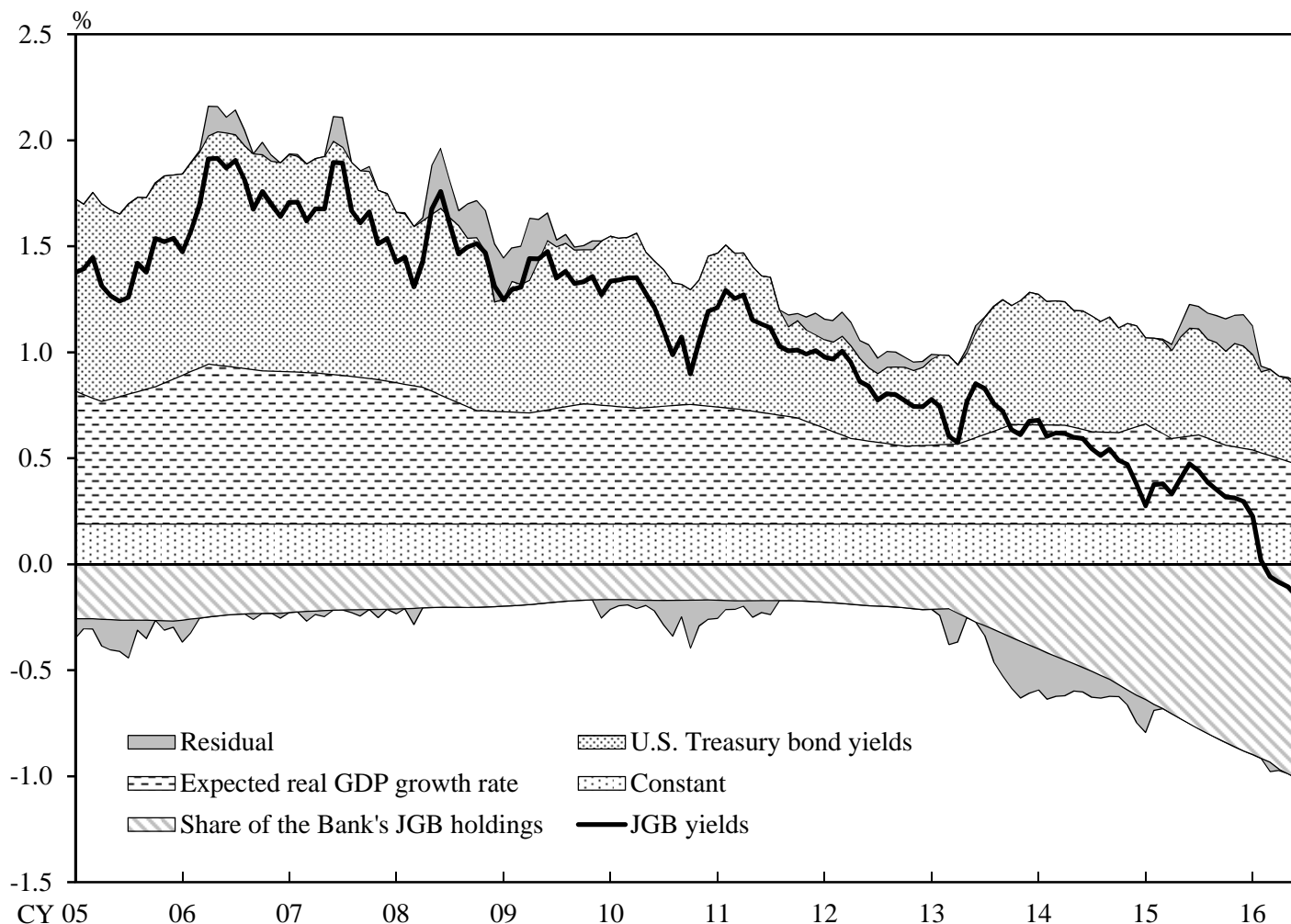
4. Figures for the employment cost index for the United States are based on wages and salaries, which include bonuses.

Sources: Central Labour Relations Commission; Japanese Trade Union Confederation (*Rengo*); Ministry of Internal Affairs and Communications; BLS; CBO; Federal Statistical Office of Germany; Deutsche Bundesbank; Consensus Economics Inc., "Consensus Forecasts."

The Impact of JGB Purchases and the Negative Interest Rate Policy on Long-Term Interest Rates (1)

1. First Approach: Linear Regression without Dummy Variables

(1) Decomposition of 10-year JGB yields



(2) Estimation Results

$$\begin{aligned}
 &\text{JGB yields (10-year, \%)} \\
 &= 0.189 \\
 &\quad (*) \\
 &+ 0.216 \times \text{U.S. Treasury bond yields (10-year, \%)} \\
 &\quad (***) \\
 &+ 0.387 \times \text{expected real GDP growth rate (\%)} \\
 &\quad (**) \\
 &- 0.022 \times \text{share of the Bank's JGB holdings (\%)} \\
 &\quad (***)
 \end{aligned}$$

The estimation period is from January 2005 to June 2016. The R-squared is 0.948. Newey-West standard errors are used. (***), (**), and (*) denote statistical significance at the 1%, 5% and 10% levels, respectively.

- Notes: 1. The share of the Bank's JGB holdings is calculated taking into account changes in the average remaining maturity.
 2. The expected real GDP growth rate and the share of the Bank's JGB holdings are converted to monthly data mainly from quarterly data.
 3. The expected real GDP growth rate is the average for the next 10 years.

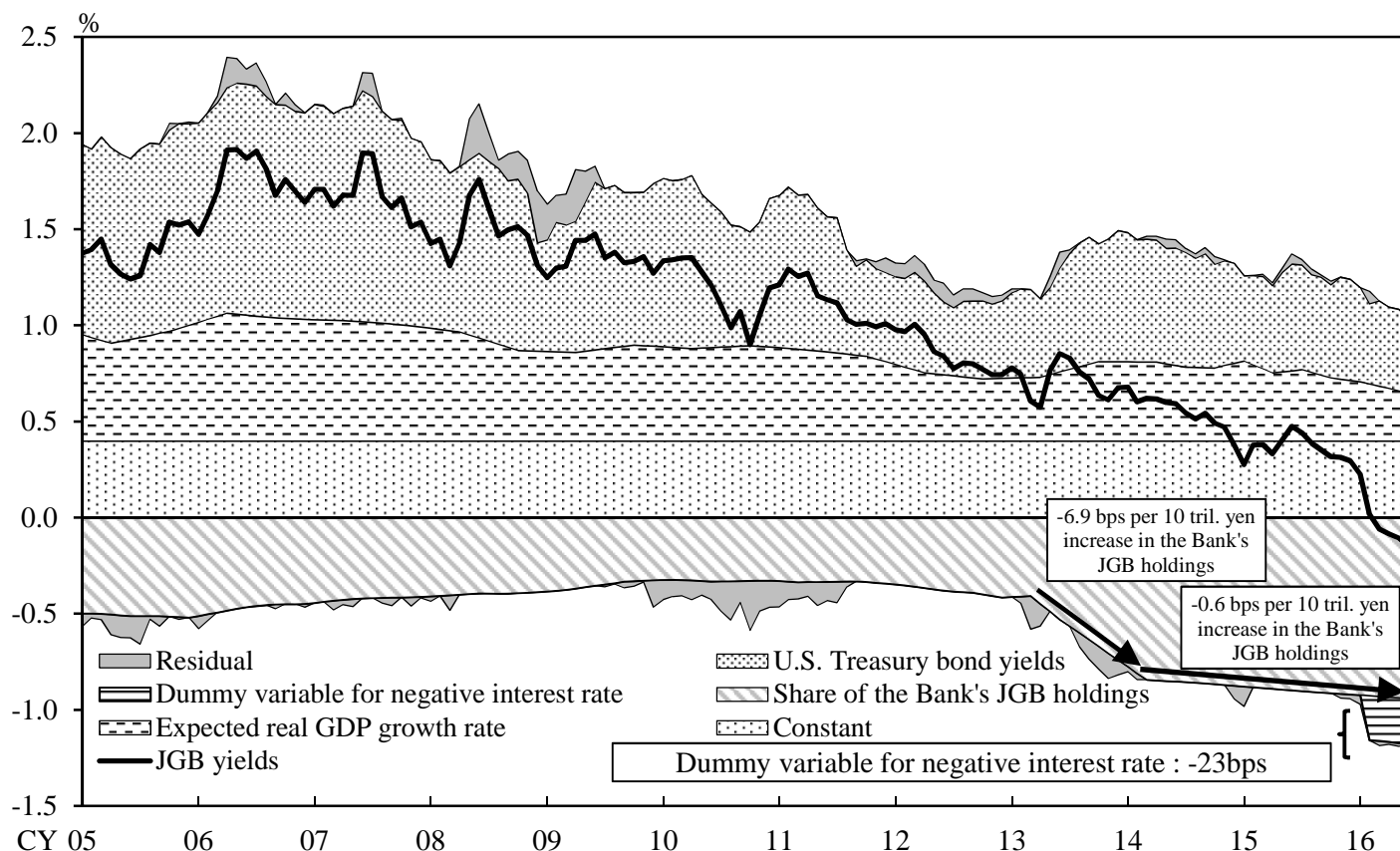
Sources: Consensus Economics Inc., "Consensus Forecasts"; Bank of Japan; Bloomberg.

The Impact of JGB Purchases and the Negative Interest Rate Policy on Long-Term Interest Rates (2)

2. First Approach:

Linear Regression with Dummy Variables for the Coefficient and the Negative Interest Rate

(1) Decomposition of 10-year JGB yields



(2) Estimation Results

<p>JGB yields (10-year, %)</p> <p>= 0.398 (***)</p> <p>+ 0.235 × U.S. Treasury bond yields (10-year, %) (***)</p> <p>+ 0.341 × expected real GDP growth rate (%) (**)</p> <p>- 0.043 × share of the Bank's JGB holdings (%) (***)</p> <p>+ 0.039 × (share of the Bank's JGB holdings (%) (***) - share of the Bank's JGB holdings as of March 2014 (%)) × dummy for coefficient</p> <p>- 0.232 × dummy for negative interest rate (***)</p>	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 5px;">Dummy for coefficient</td> <td style="padding: 5px;">{ 0 : up to March 2014 1 : from April 2014</td> </tr> <tr> <td style="padding: 5px;">Dummy for negative interest rate</td> <td style="padding: 5px;">{ 0 : up to January 2016 1 : from February 2016</td> </tr> </table>	Dummy for coefficient	{ 0 : up to March 2014 1 : from April 2014	Dummy for negative interest rate	{ 0 : up to January 2016 1 : from February 2016
Dummy for coefficient	{ 0 : up to March 2014 1 : from April 2014				
Dummy for negative interest rate	{ 0 : up to January 2016 1 : from February 2016				

The estimation period is from January 2005 to June 2016. The R-squared is 0.965. Newey-West standard errors are used. (***), (**), and (*) denote statistical significance at the 1%, 5% and 10% levels, respectively.

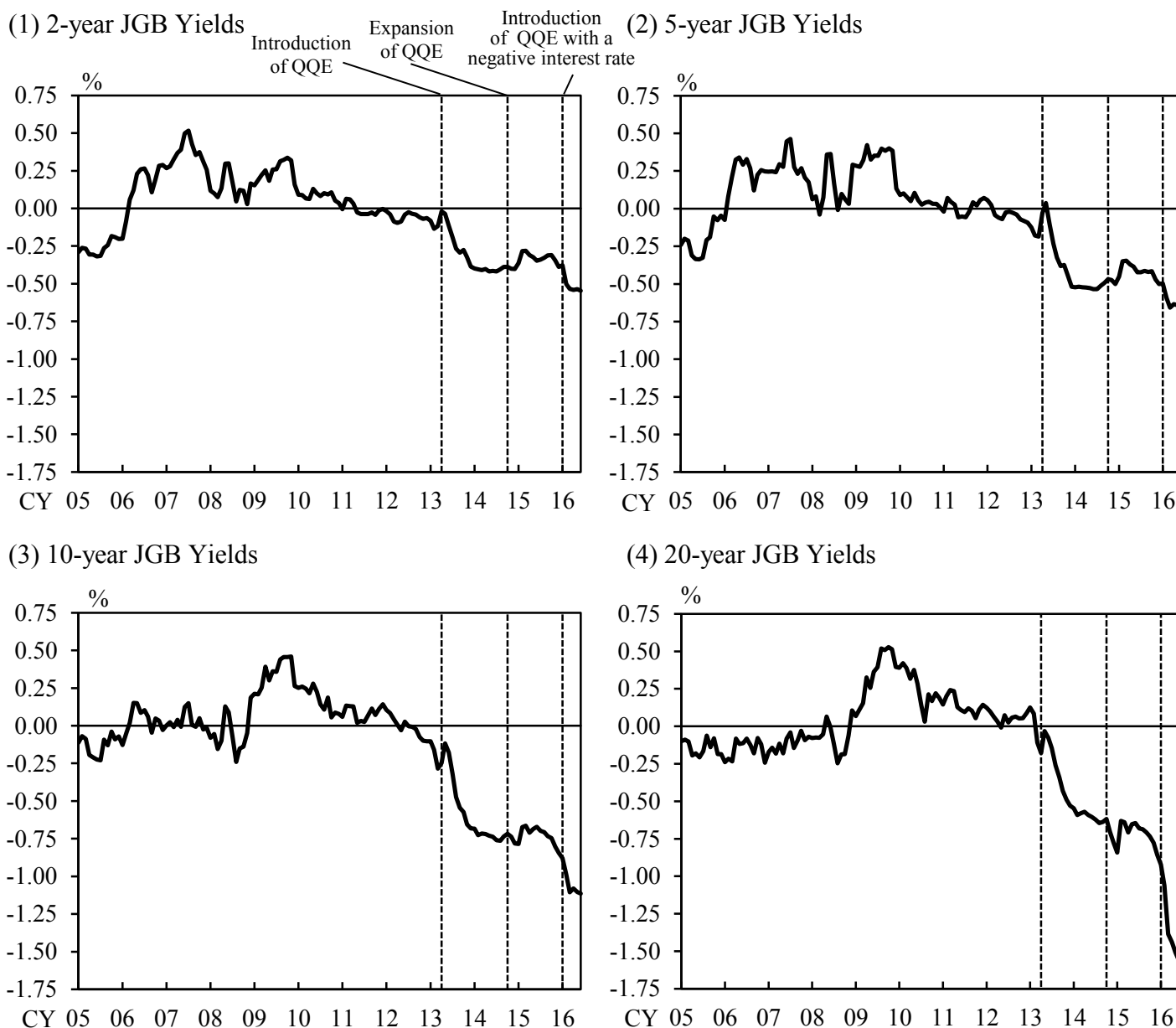
- Notes: 1. The share of the Bank's JGB holdings is calculated taking into account changes in the average remaining maturity.
2. The expected real GDP growth rate and the share of the Bank's JGB holdings are converted to monthly data mainly from quarterly data.
3. The expected real GDP growth rate is the average for the next 10 years.

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

The Impact of JGB Purchases and the Negative Interest Rate Policy on Long-Term Interest Rates (3)

3. Second Approach: Panel Regression for JGB Yields of Different Maturities

The graphs show the residuals obtained when regressing JGB yields (for 2 years, 5 years, 10 years and 20 years) on 10-year U.S. Treasury bond yields, the year-on-year rate of change in the CPI (all items less fresh food), and the active job openings-to-applicants ratio as a proxy for the output gap.



Notes: 1. Figures for the CPI (all items less fresh food) are adjusted to exclude the estimated effects of changes in the consumption tax rate.

2. The coefficients for the year-on-year rate of change in the CPI (all items less fresh food) in the four equations are restricted to be identical. The same restriction is applied to the coefficients for the active job openings-to-applicants ratio.

3. Lagged values of the year-on-year rate of change in the CPI (all items less fresh food) and the active job openings-to-applicants ratio are used.

4. The estimation period is from January 1997 to March 2013. The data end in June 2016.

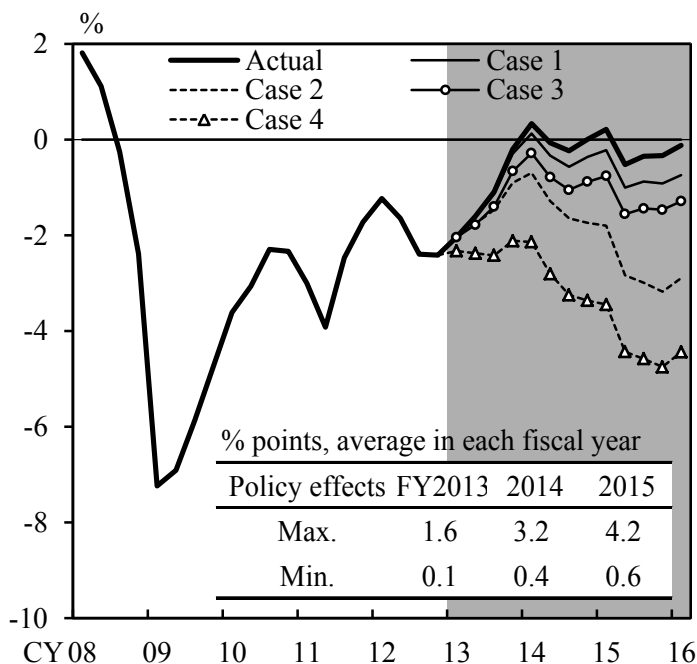
Sources: Ministry of Internal Affairs and Communications; Ministry of Health, Labour and Welfare; Bloomberg.

Assessment of the Policy Effects Based on Macroeconomic Models (1)

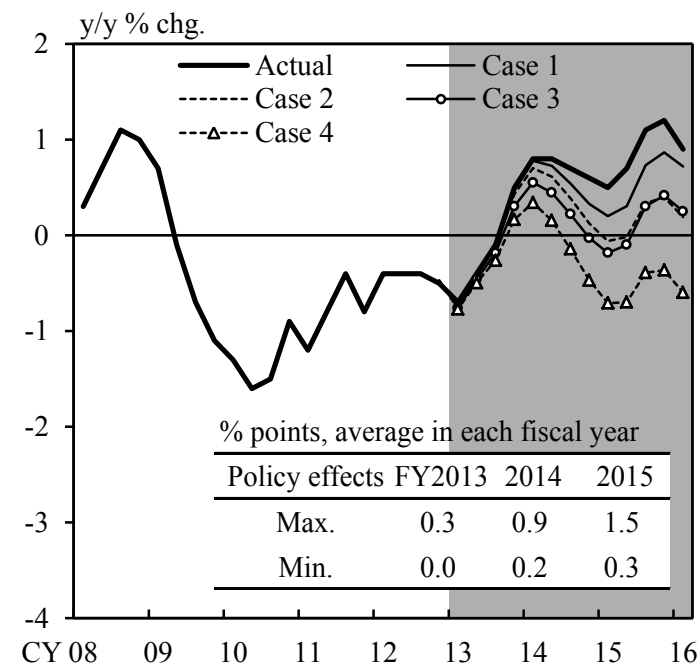
1. Counterfactual Simulations Using Q-JEM

Case 1: The decline in the real interest rate from 2013/Q2 onward is regarded as a policy effect.
 Case 2: The decline in the real interest rate, the depreciation of the yen, and the increase in stock prices from 2013/Q2 onward are regarded as policy effects.
 Case 3: The decline in the real interest rate from 2013/Q1 onward is regarded as a policy effect.
 Case 4: The decline in the real interest rate, the depreciation of the yen, and the increase in stock prices from 2013/Q1 onward are regarded as policy effects.

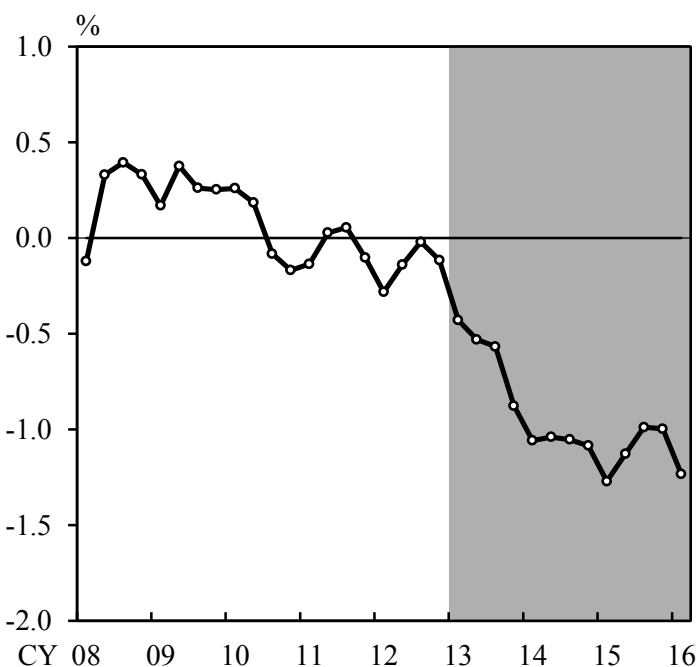
(1) Output Gap



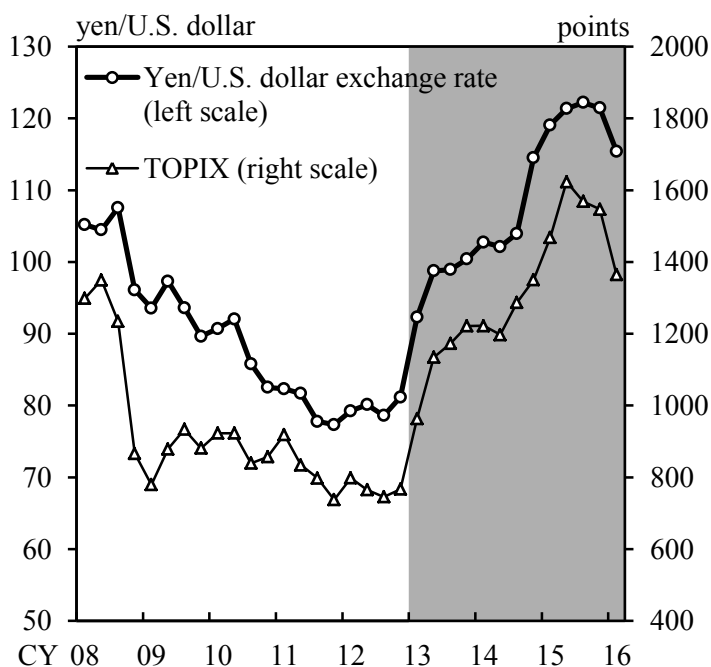
(2) CPI (All Items Less Fresh Food and Energy)



(3) Real Long-term Interest Rate (Actual)



(4) Exchange Rate and Stock Price (Actual)



Notes: 1. The policy effects are calculated as the difference between the simulation results and actual values.

2. Shaded areas indicate the simulation period.

3. Figures for the CPI (all items less fresh food and energy) are calculated by the Research and Statistics Department, Bank of Japan. The figures are adjusted to exclude the estimated effects of changes in the consumption tax rate.

Sources: Ministry of Internal Affairs and Communications; Cabinet Office; Bloomberg, etc.

Assessment of the Policy Effects Based on Macroeconomic Models (2)

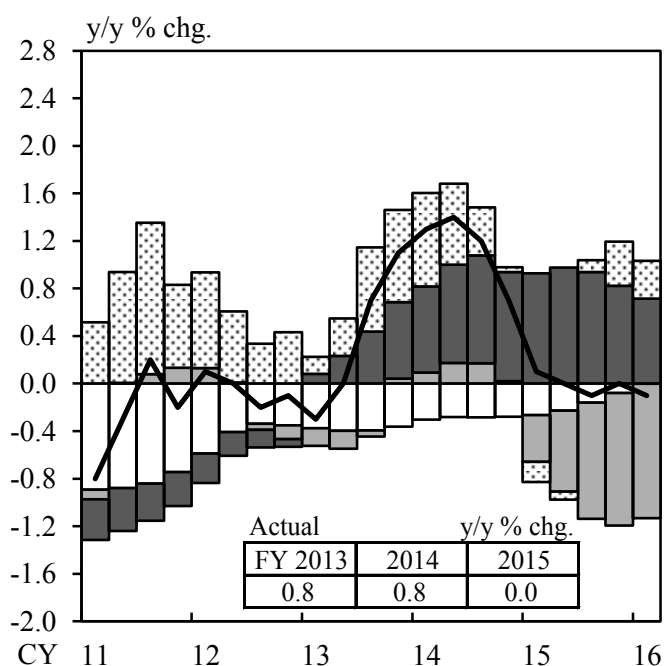
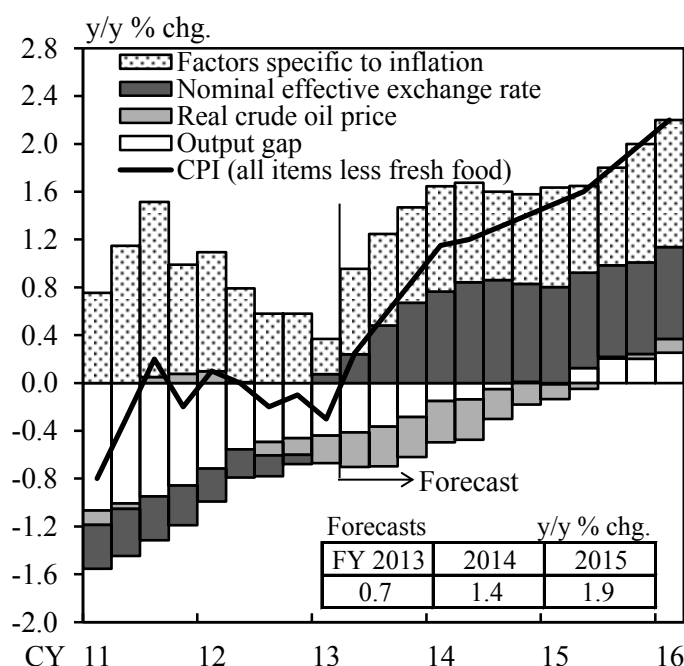
2. Decomposition of the Decline in Consumer Prices Using a VAR Model

Assumptions relating to policy board members' forecasts

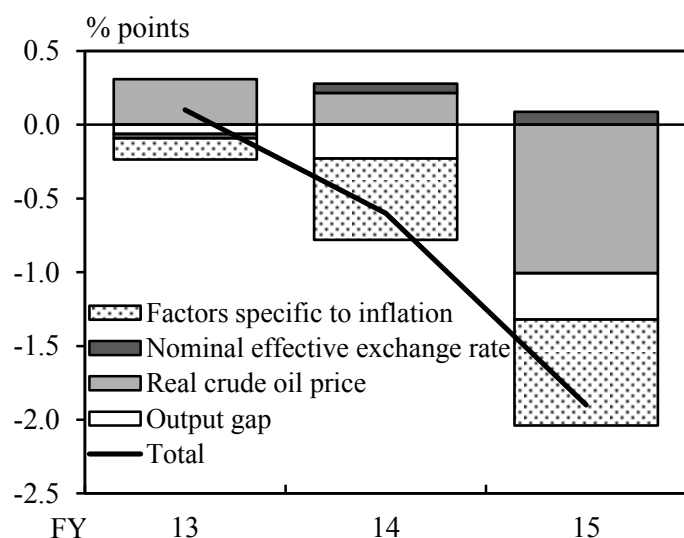
- (a) CPI (all items less fresh food): Forecasts in the April 2013 Outlook Report are converted into quarterly figures.
- (b) Output gap: Forecasts in the April 2013 Outlook Report are converted into quarterly figures and the output gap is calculated as the difference between the real GDP growth rate and the potential growth rate.
- (c) Exchange rate: The yen/U.S. dollar exchange rate is assumed to remain at 97.5 yen from 2013/Q2 onward.
- (d) Crude oil price: The Dubai crude oil price is assumed to remain at 100 U.S. dollars from 2013/Q2 onward.

(1) Historical Decomposition of CPI (All Items Less Fresh Food) Based on the VAR Model

- (a) Policy Board Members' Forecasts in April 2013 (Estimates) (b) Actual



(2) Difference between Policy Board Members' Forecasts (Median) and Actual



	y/y % chg.		
	FY 2013	2014	2015
Contribution of nominal effective exchange rate	-0.0	0.1	0.1
Contribution of real crude oil price	0.3	0.2	-1.0
Contribution of output gap	-0.1	-0.2	-0.3
Contribution of factors specific to inflation	-0.1	-0.6	-0.7
Total	0.1	-0.6	-1.9

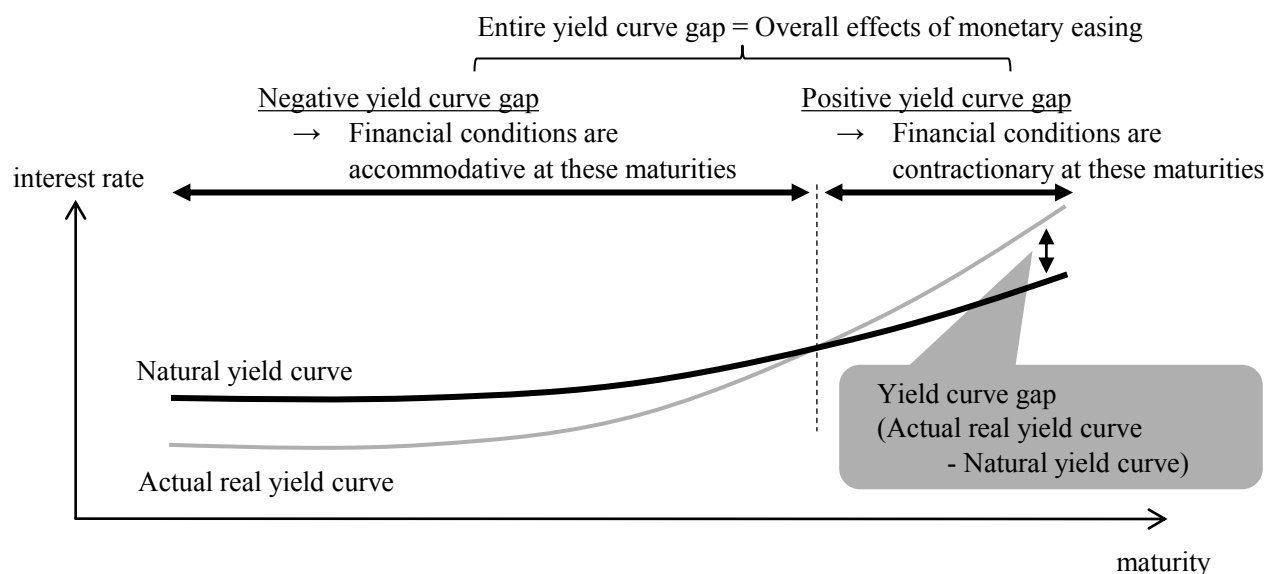
Note: The VAR model is estimated using the following variables: the real crude oil price, the nominal effective exchange rate, the output gap, and the CPI (all items less fresh food). The estimation period is 1984/Q1-2016/Q1. The real WTI price is used as the real crude oil price.

Sources: Ministry of Internal Affairs and Communications; Cabinet Office; BIS; Bloomberg, etc.

The Effect of the Yield Curve Gap on the Output Gap (1)

1. Concept of the Natural Yield Curve

(1) Illustration of the Yield Curve Gap



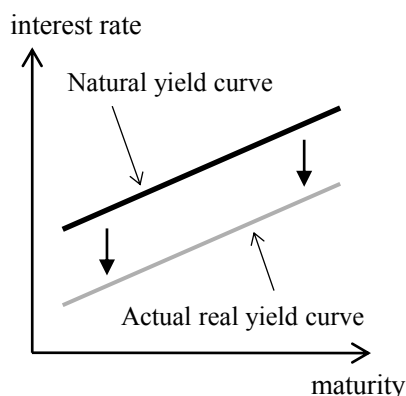
(2) Basic Form of Estimation Equation for IS Curve

$$\begin{aligned}
 \boxed{\text{Output gap}} &= \boxed{b \text{ (Constant)}} \times \boxed{\text{Yield curve gap}} \\
 &\quad \downarrow \text{Decomposed using Nelson and Siegel's model} \\
 &= \boxed{b_L \text{ (Constant)}} \times \boxed{\text{Level gap}} \\
 &\quad + \boxed{b_S \text{ (Constant)}} \times \boxed{\text{Slope gap}} \\
 &\quad + \boxed{b_C \text{ (Constant)}} \times \boxed{\text{Curvature gap}}
 \end{aligned}$$

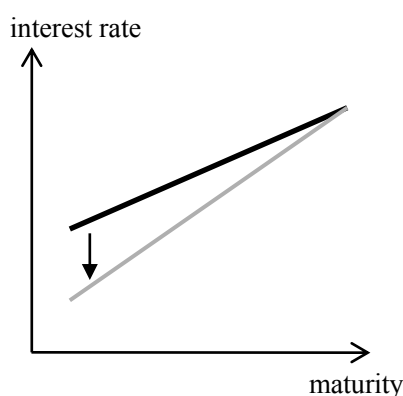
Note: This equation omits lagged terms of the output gap and a few other components for simplicity.

(3) Illustration of the Components of the Yield Curve Gap

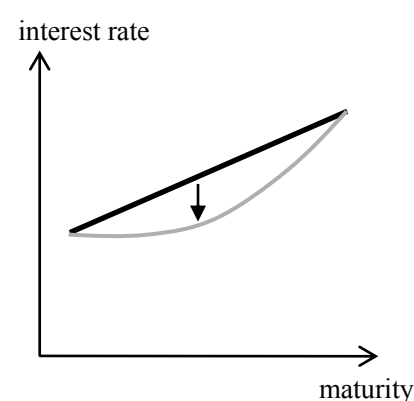
(a) Level Gap



(b) Slope Gap



(c) Curvature Gap



The Effect of the Yield Curve Gap on the Output Gap (2)

2. Estimated Results and Their Background

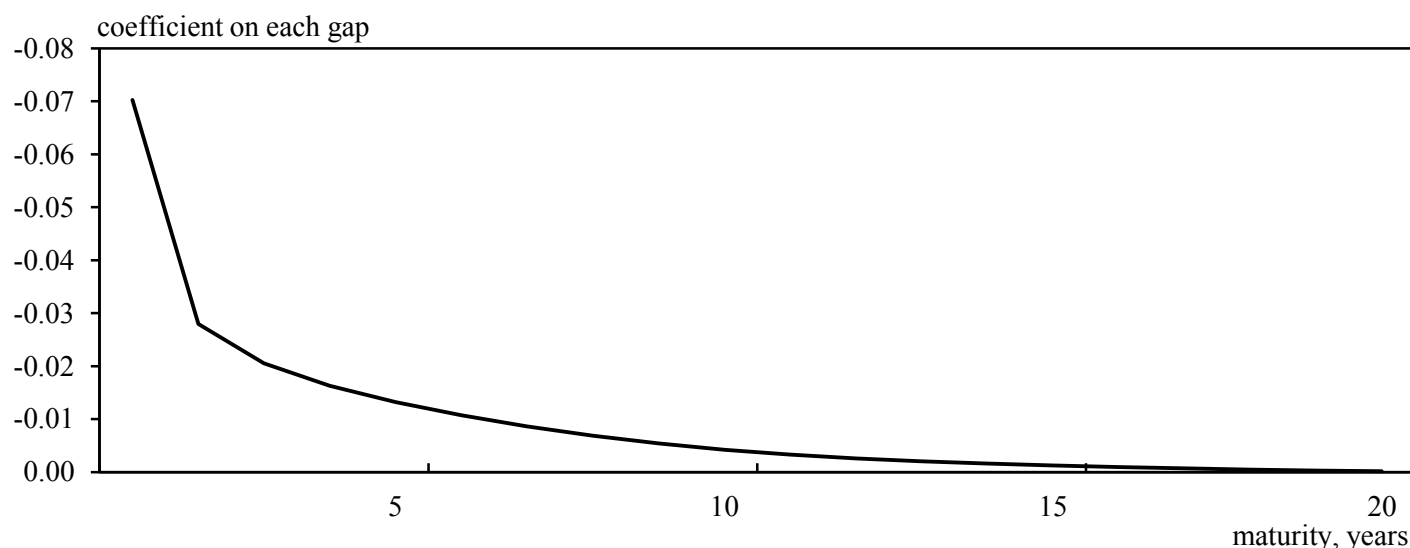
(1) Estimated Parameter for Each Component

	b_L Coefficient on level gap	b_S Coefficient on slope gap	b_C Coefficient on curvature gap
Estimates	-0.197	-0.120	-0.037

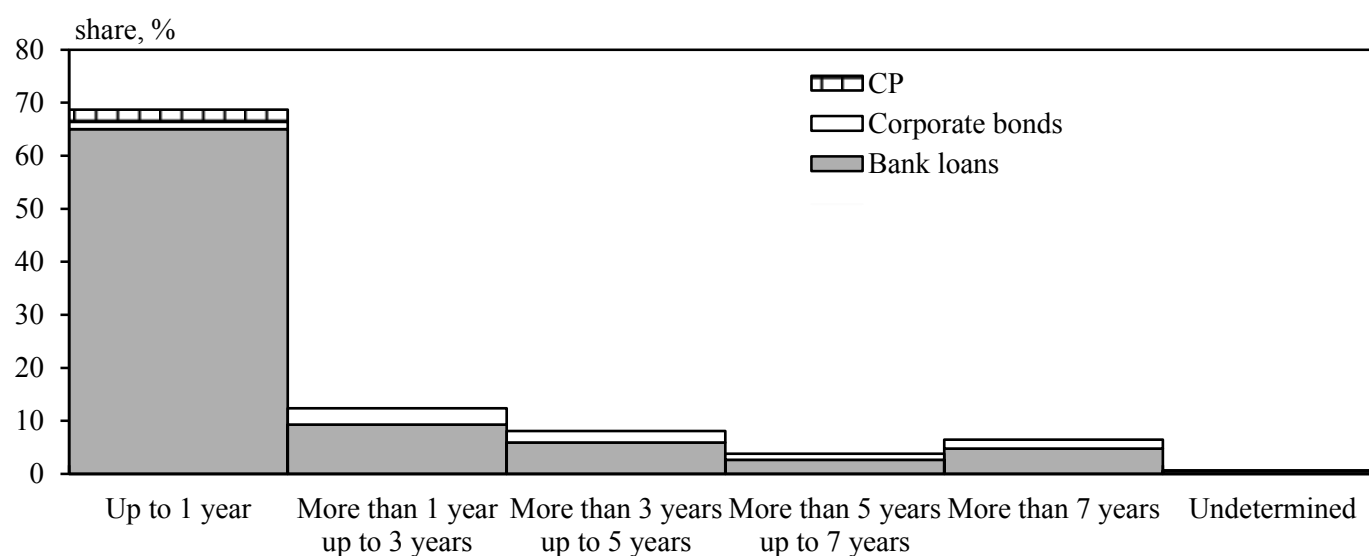
The estimation period is 1992/Q3-2016/Q1.

(2) Coefficient on the Yield Curve Gap for Each Maturity Consistent with (1)

(Assuming a Beta Mixture Distribution)



(3) Liabilities by Renewal Period of Interest Rate



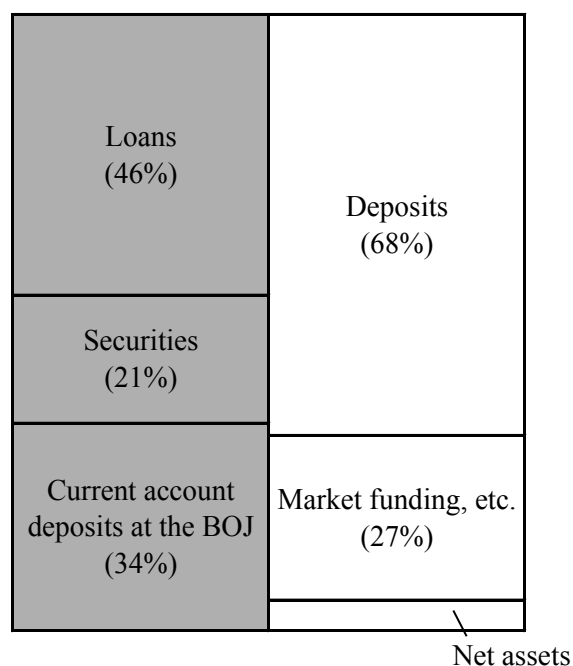
Notes: 1. Figures for CP exclude CP issued by banks, securities companies, and others such as foreign corporations; ABCP is included. Figures for corporate bonds are calculated by regarding the remaining maturity as the renewal period of interest rate and exclude those issued by banks and securities companies and samurai bonds.

2. Figures for bank loans are the sums of loans by major and regional banks as of March 2016. Figures for CP and corporate bonds are as of June 2016.

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

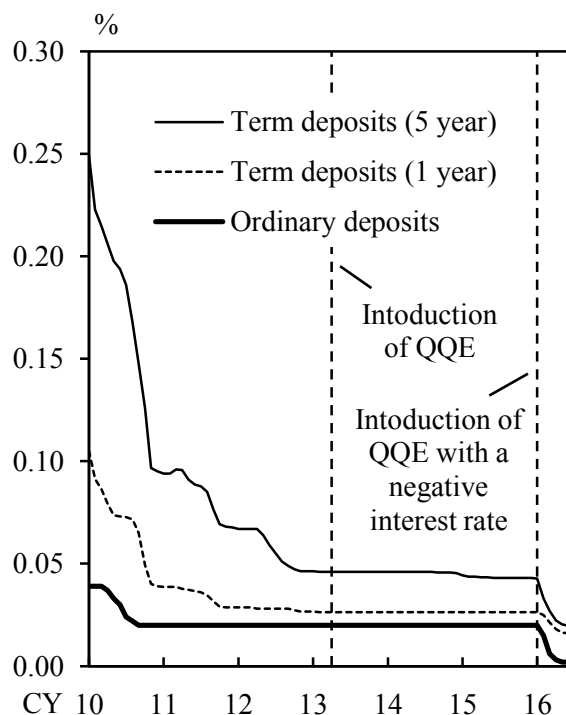
The Impact of the Negative Interest Rate on Financial Institutions' Profits (1)

(1) Breakdown of Domestically Licensed Banks' Domestic Branches' Assets and Liabilities



Notes: 1. Figures exclude the Japan Post Bank. (5%)
 2. Figures are as of the end of July 2016.

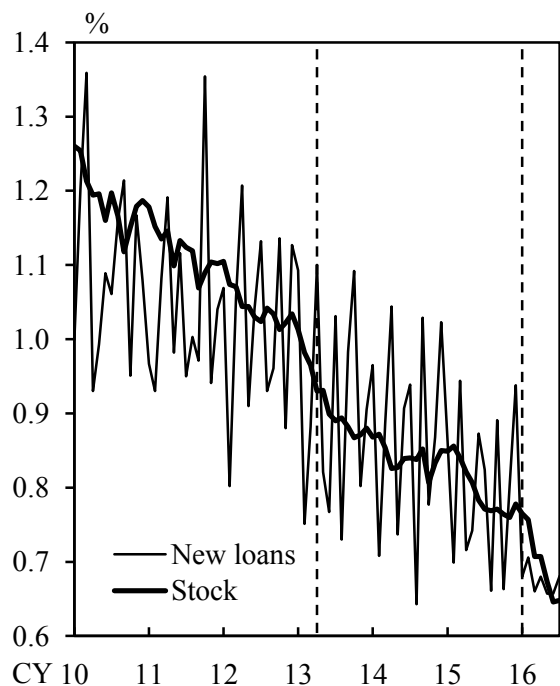
(2) Interest Rates on Deposits



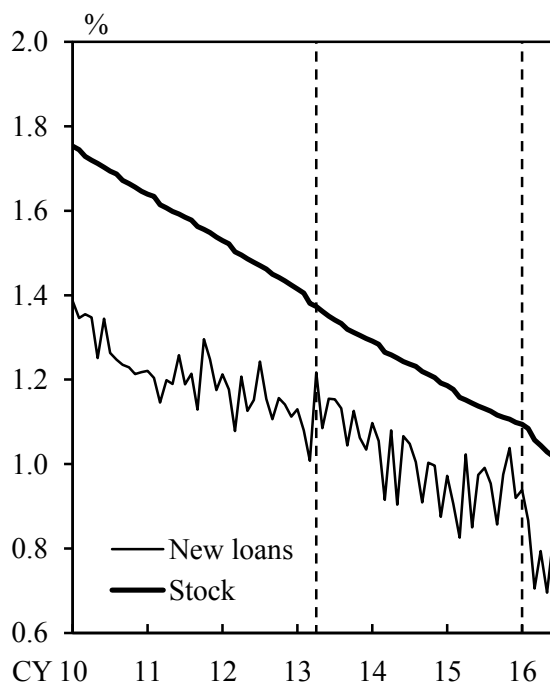
Notes: 1. Interest rates on term deposits are the simple averages of interest rates posted by financial institutions.
 2. Data cover domestically licensed banks (excluding several banks), all correspondent *Shinkin* banks and the Shoko Chukin Bank.

(3) Average Contract Interest Rates on Loans and Discounts (Domestically Licensed Banks)

(a) Short-Term



(b) Long-Term

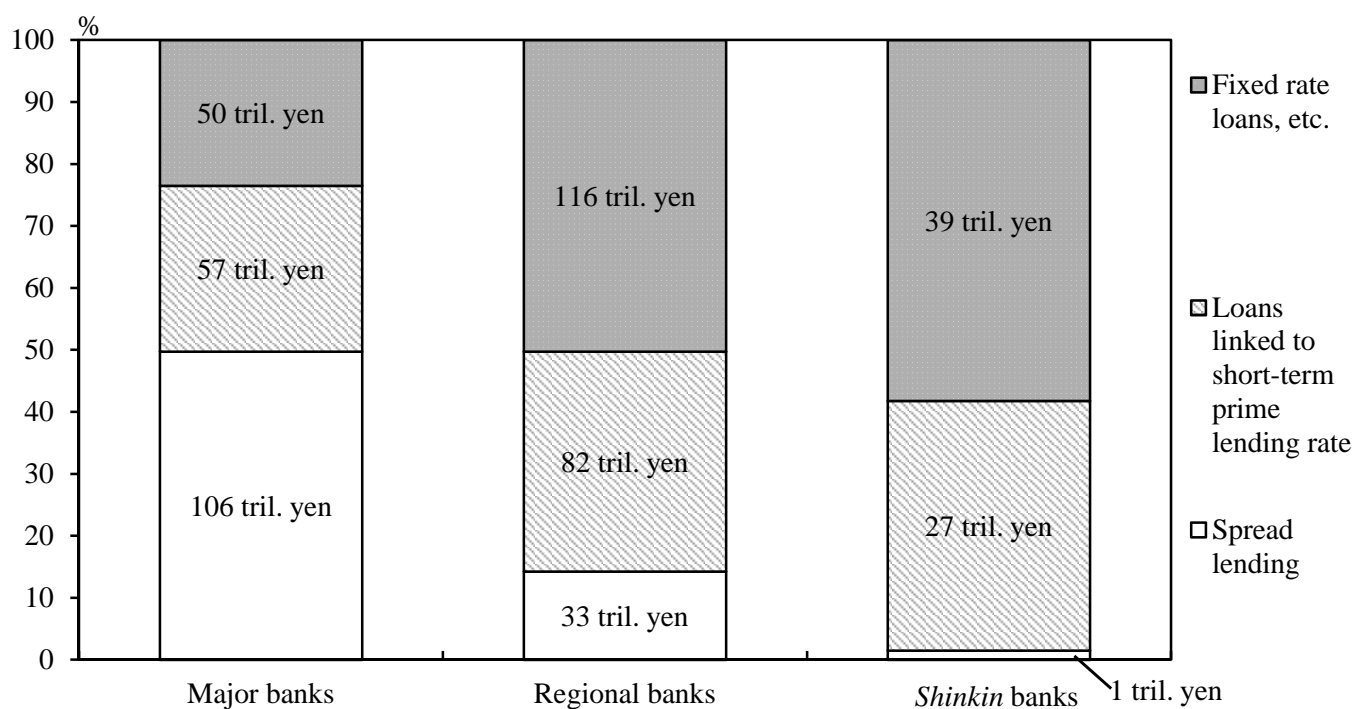


Note: Figures exclude the Resolution and Collection Corporation and the Japan Post Bank.

Source: Bank of Japan.

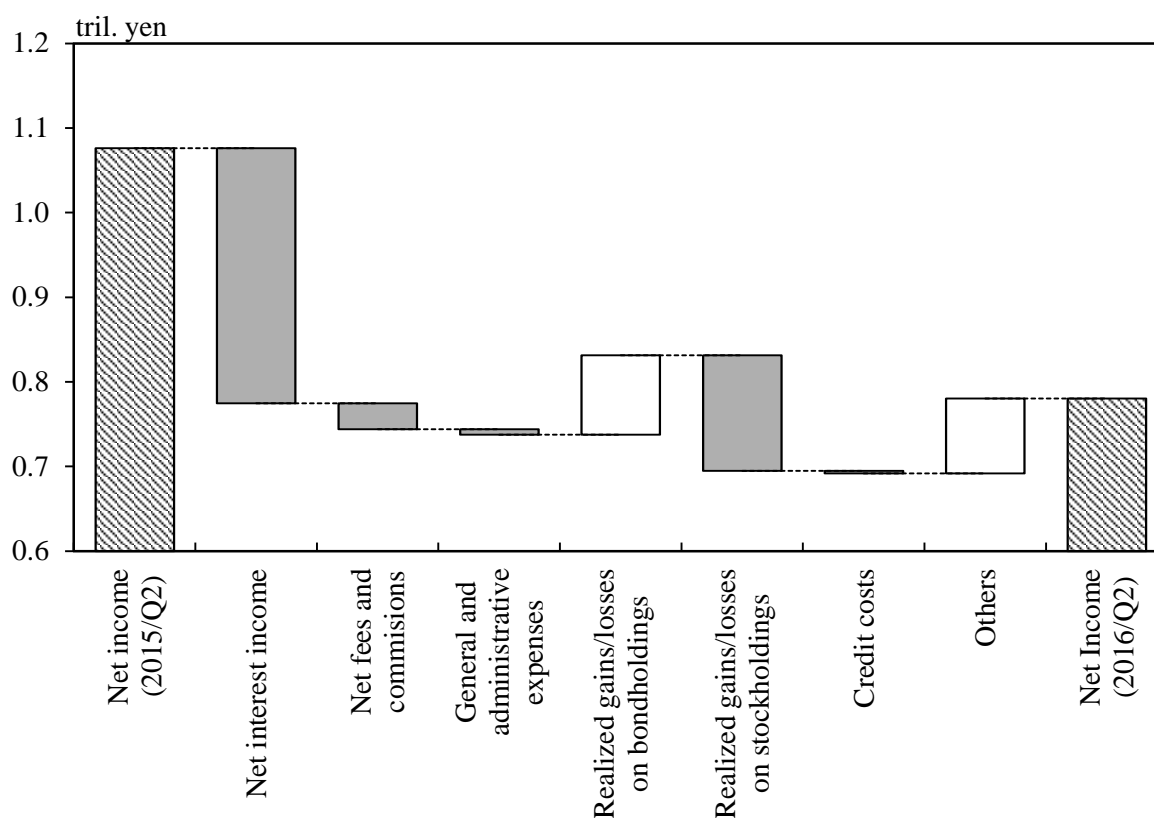
The Impact of the Negative Interest Rate on Financial Institutions' Profits (2)

(1) Breakdown of Loans by Financial Institutions' Domestic Branches



Note: Figures are JPY-denominated, as of the end of March 2016.

(2) Banks' Net Income (Year on Year Change in 2016/Q2)



Note: Figures are calculated by adding up figures for major banks and regional banks (non-consolidated basis).

Source: Bank of Japan.