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Effects of the Quantitative Easing Policy: A Survey of Empirical Analyses*

Hiroshi Ugai[†]

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Abstract

This paper surveys the empirical analyses that examine the effects of the Bank of Japan (BOJ)'s quantitative easing policy (QEP), which was implemented from March 2001 through March 2006. The survey confirms a clear effect whereby the commitment to maintain the QEP fostered the expectations that the zero interest rate would continue into the future, thereby lowering the yield curve centering on the short- to medium-term range. There were also phases in which an increase in the current account balances (CABs) held by financial institutions at the BOJ bolstered this expectation. While the results were mixed as to whether expansion of the monetary base and altering the composition of the BOJ's balance sheet led to portfolio rebalancing, generally this effect, if any, was smaller than that stemming from the commitment. When viewing the QEP's impact on Japan's economy through various transmission channels, many of the analyses suggest that the QEP created an accommodative environment in terms of corporate financing. In particular, the QEP contained financial institutions' funding costs from the market and staved off financial institutions' funding uncertainties. The QEP's effect on raising aggregate demand and prices was often limited, due largely to the then progressing corporate balance sheet adjustment, as well as the zero bound constraint on interest rates.

JEL Classifications: E43, E44, E51, E52, E58

Keywords: Zero interest rate policy, quantitative easing policy, commitment, zero bound constraint on interest rates, deflation.

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Executive Summary

This paper surveys the empirical analyses that examine the effects of the Bank of Japan (BOJ)'s quantitative easing policy (QEP), which was implemented for five years from March 2001 through March 2006. While the stock of empirical analyses on the effects of the QEP has yet to accumulate sufficiently, this paper aims at comprehensively summarizing the literature that is presently available (as of June 2006) which verifies the effects of the QEP on Japan's economy.

The QEP consisted of three pillars: (i) shifting the BOJ's main operating target from the uncollateralized overnight call rate to the current account balances (CABs) at the Bank, and supplying ample liquidity in an amount substantially in excess of the required reserves; (ii) being committed to maintain the policy until the CPI registers stably zero percent or an increase year-on-year (hereafter referred to as "the commitment"); and (iii) increasing the purchase of long-term JGBs if deemed necessary to facilitate meeting the targeted CABs. Under the QEP, the uncollateralized overnight call rate, formerly the main operating target, declined to zero percent. However, a zero interest rate is not an effect exclusive to the QEP, but could also be realized under the traditional interest rate regime. So in order to verify the effects of the QEP, the effects derived from a current interest rates of zero percent and those not captured by the current zero interest rates should be differentiated clearly. For the latter, the quantity and expectations effects must be identified clearly, and the extent of each properly assessed.

This paper first summarizes the empirical analyses on the effects of the QEP according to transmission channels, and then proceeds to summarize the QEP's macroeconomic effects on Japan's economy.

First, this paper takes up the transmission mechanism of the effects of the QEP. After classifying the QEP's effects into three types according to operating measures, that is, "effect of the commitment to maintain the QEP on the expected future path of short-term interest rates," "effects of expanding the size of the BOJ's balance sheet by increasing CABs," and "effects of altering the composition of the BOJ's balance sheet by increasing the purchases of long-term JGBs," this paper examines the empirical analyses specifically to find to what extent and through which transmission channel each effect was realized. The results are summarized as follows.

The effect of the commitment that lowered future short-term interest rates worked through a mechanism whereby the expectation of the zero interest rate being maintained for some time into the future affected various expectations for interest rates with longer terms and the yields of other financial assets in financial markets. Empirical analyses clearly confirm this effect in lowering the yield curve, centering on the short to medium term (the policy duration effect).

The effects from expanding the size of the BOJ's balance sheet (expansion of the monetary base) by increasing the CABs can be divided into (i) the portfolio rebalancing effect, which affects the premium portion of the yields of financial assets that are imperfect substitutes for the monetary base; and (ii) the signaling effect, which affects the private sector's expectations for the future path of short-term interest rates. The empirical analyses present mixed results for the former as to whether there was such an effect or not, and even among those that detect such an effect, many generally conclude that the magnitude of this effect was smaller than that from the commitment. With respect to the latter, at least the effect of bolstering expectations that the monetary easing would continue into the future was detected during certain phases.

To consider the effects from altering the composition of the BOJ's balance sheet by increasing purchases of long-term JGBs, this paper divides these effects into the portfolio rebalancing effect and the signaling effect for expectations regarding the future path of short-term interest rates. The results are mixed for the former, as is the case for the effect from an increase in CABs. With respect to the latter, the effect of bolstering expectations that monetary easing would continue into the future was not detected, and, in one phase, inflation premiums temporarily increased.

As far as previous empirical analyses are concerned, the largest easing effect from the QEP was through the channel of influencing the expected future path of short-term interest rates. From this result, it is suggested that when a central bank conducts monetary policy with the zero interest rate bound in mind, information dissemination concerning monetary policy from the central bank to the private sector is critical to manifest the policy effects.

Bearing these points in mind, the paper then proceeds to take up studies that empirically analyze the QEP's overall macroeconomic impact on Japan's economy

through various transmission channels. In general, many of these analyses view that the QEP created an accommodative environment and thus supported the recovery of the corporate sector.

Looking at the contents of the macroeconomic impact, while the transmission channels are not specified, these macroeconomic analyses verify that because of the QEP, the premiums on market funds raised by financial institutions carrying substantial non-performing loans (NPLs) shrank to the extent that they no longer reflected credit rating differentials. This observation implies that the QEP was effective in maintaining financial system stability and an accommodative monetary environment by removing financial institutions' funding uncertainties, and by averting further deterioration of economic and price developments resulting from corporations' uncertainty about future funding.

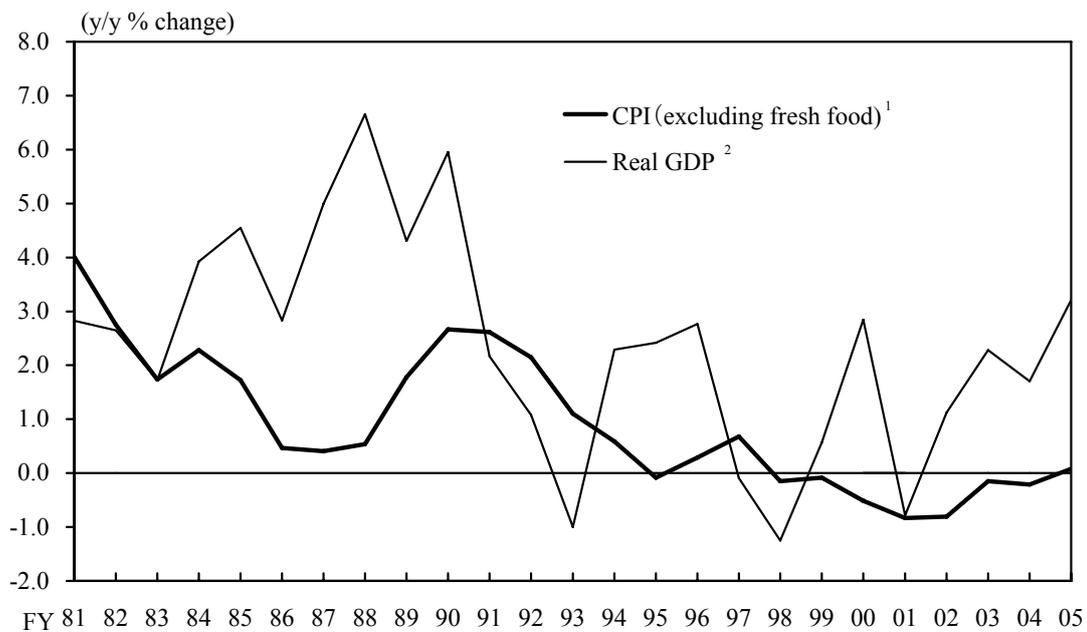
Granted the positive above effects of preventing further deterioration of the economy reviewed above, many of the macroeconomic analyses conclude that the QEP's effects in raising aggregate demand and prices were limited. In particular, when verified empirically taking into account the fact that the monetary policy regime changed under the zero bound constraint of interest rates, the effects from increasing the monetary base were not detected or smaller, if anything, than during periods when there was no zero bound constraint. The studies generally show that the QEP had a greater monetary easing effect than that stemming from merely lowering the uncollateralized overnight call rate to zero percent, while the effects in raising aggregate demand and prices nevertheless turned out to be limited. Many of these analyses present analytical results and interpretations indicating that in addition to the zero bound constraint of the interest rate, the substantial decline in responsiveness to monetary easing on the part of corporations and financial institutions resulting from their deteriorated core capital due to a plunge in asset prices played a major roles.

1. Introduction

(1) The Quantitative Easing Policy (QEP): Overview

Japan's economy experienced prolonged stagnation following the burst of the asset price bubble in the early 1990s, despite several short-lived recovery phases. During this period, general prices measured by the consumer price index (CPI) gradually reduced its growth rate, followed by a continuous modest decline from 1998 to the autumn of 2005. Over this period, the CPI dropped by a total of about 3 percent. In addition, the broad-based influence of the generation and burst of the bubble spread over to firms and financial institutions.

(Figure 1) CPI and Real GDP



Notes: 1. Real GDP figures previous to and including FY1994 are based on referential series.

2. CPI (excluding fresh food) figures are adjusted to exclude the effects of consumption tax hikes.

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

Under this economic environment and as Japan's economy headed toward recession triggered by the burst of the global IT bubble, on March 19, 2001 the Bank of Japan (BOJ) adopted a new monetary easing framework, the so-called quantitative easing policy (QEP), with a view to stemming the continuous price decline and setting the basis

for sustainable economic growth. The QEP under a zero interest rate, a policy unprecedented worldwide, consisted mainly of the following three pillars:

- (i) to change the main operating target for money market operations from the uncollateralized overnight call rate to the outstanding current account balances (CABs) held by financial institutions at the BOJ, and provide ample liquidity to realize a CAB target substantially in excess of the required reserves.
- (ii) to make the commitment that the above ample liquidity provision would continue to stay in place until the consumer price index (excluding perishables, hereafter “core CPI”) registers stably at zero percent or an increase year on year.

and

- (iii) to increase the amount of outright purchases of long-term Japanese government bonds (JGBs), up to a ceiling of the outstanding balance of banknotes issued, should the BOJ consider such an increase to be necessary for providing liquidity smoothly.

The transition of the QEP (see the Appendix for details) started in March 2001 with a CAB target of five trillion yen, a level higher than the required reserve level of four trillion yen. The target was then progressively raised in response to the deterioration of the economy, and was left unchanged until the BOJ exited the QEP after being raised to 30 to 35 trillion yen in January 2004. Reflecting the ample liquidity provision under the QEP, the uncollateralized overnight call rate declined to 0.001%, a level below the 0.02-0.03% that was realized from 1999 to 2000 under the zero interest rate policy (ZIRP). In order to meet smoothly the targeted CABs, the BOJ gradually increased its purchases of long-term JGBs from the initial pace of 400 billion yen per month, and set the amount at 1,200 billion per month beginning in October 2002. As of the end of 2005, the BOJ provided a monetary base¹ worth 117 trillion yen, as its liability, in the form of CABs and cash. On the asset side, the BOJ’s holdings of long-term JGBs reached 63 trillion yen (Figure 2). Furthermore, from July 2003 to March 2006, as a limited time measure, the

¹ The monetary base is the sum of the BOJ CABs, banknotes, and coins in circulation (although in a strict sense, coins in circulation are not included in the BOJ’s liabilities), and it is a concept that synthesizes the currency provided by the BOJ.

BOJ purchased asset-backed securities with a view to supporting the development of the asset-backed securities market and strengthening the transmission mechanism of monetary policy.² The BOJ further clarified its commitment <item (ii) above> in October 2003.³ While the BOJ was also committed during 1999-2000 under the ZIRP to “continue the ZIRP until deflationary concern is dispelled,” the commitment of the QEP differed from that of the ZIRP in that it linked the commitment with the actual track record of the CPI.

The core CPI growth turned positive from November 2005, and the rate for January 2006 announced in early March was 0.5 percent. On March 9, 2006, the BOJ stated that the year-on-year growth in the core CPI is expected to remain positive, and judged that the conditions laid out in the commitment under the QEP had been fulfilled. Consequently, the BOJ exited the QEP and decided to change the operating target of money market operations back to the uncollateralized overnight call rate, and to encourage the rate to remain at effectively zero percent.

(2) Purposes of this paper

The QEP drew extensive debate both in Japan and abroad even before its adoption. For example, there was an active debate over whether the BOJ should increase fund provision beyond interest rate manipulation when the BOJ adopted the ZIRP in 1999.⁴ Furthermore, debates continued after the BOJ adopted the QEP ranging from what effects could be expected from the QEP, and whether the BOJ should further increase the CABs

² Other than these measures, the BOJ also determined to purchase stocks held by commercial banks from October 2002 to end-September 2003; this was aimed at overcoming the non-performing loan (NPL) problem and ensuring financial system stability.

³ Specifically, the BOJ clarified that its commitment to maintaining the QEP until the CPI registers stably zero percent or an increase year on year was underpinned by two conditions: the recent core CPI should register zero percent or above over a few months on average, and the prospective core CPI would not be expected to register below zero percent. In addition, the BOJ also stated that these conditions were the necessary conditions, and there might be cases that the BOJ judges it appropriate from an economic and price standpoint to continue with the QEP even if these two conditions are fulfilled.

⁴ For detailed discussions, see Bernanke (2000), Iwata (2000), Kuttner and Posen (2001), Svensson (2001), Okina (1999), Mckinnon, Melzer, and Okina (1999), and Oda and Okina (2001).

in order to exit from deflation, to whether new measures should be introduced.⁵ At the BOJ Board meeting that decided on the introduction of the QEP, the BOJ revealed, upon referring that the effects of an increase in quantity were uncertain, that the Bank would “continue examining what would be the effects of increasing the outstanding balance of current accounts at the Bank as well as the possibility of a further easing through an increase in the outstanding balance.”⁶ While these debates have yet to reach any theoretical or empirical consensus, the data obtained and theoretical and empirical research conducted during the five-year period of the QEP nevertheless seems to have gradually converged the views in economics academia. Meanwhile, the BOJ assessed the effects of the QEP in its October 2005 “Outlook for Economic Activity and Prices” as follows:⁷

When there were strong concerns over the stability of the financial system, the ample provision of liquidity by the Bank, which met financial institutions' liquidity demand, stabilized financial markets and maintained accommodative financial conditions, and contributed to averting a contraction in economic activity. In financial markets, the Bank's ample provision of liquidity pushed short-term interest rates to practically zero percent. Longer-term interest rates have stably remained at low levels because the commitment by the Bank has led the market to expect that short-term interest rates will remain at zero percent when prices continue to decline slightly. (Bank of Japan (2005))

To reach such an assessment, various empirical analyses have been conducted within and outside the BOJ. Arguably, there are several difficult issues involved in gauging the effects of the QEP compared with those of normal interest rate policy. For example, there is a need to differentiate the effects associated with lowering the policy rate to zero and those manifested through expectations and changes in monetary aggregate indicators. In addition, there are constraints in that there has never been any previous experience of the QEP either in Japan or abroad. Given such constraints, the stock of empirical research is

⁵ Such discussions are presented in Svensson (2003), Coenen and Wieland (2003), Bernanke (2003), Iwata (2001), Fukao (2002), Shirakawa (2002), and Komiya (2002).

⁶ Bank of Japan (2001).

⁷ Fukui (2006) also assesses the effects of the QEP.

not necessarily sufficient at this juncture. Nevertheless, it is useful to survey the previous empirical analyses.⁸

This paper examines the previous empirical analyses on the effects of the QEP by specifying the transmission channels through which the effects work and identifying their magnitudes, and by capturing the QEP's overall effects on the economy. First, this paper examines the transmission mechanism of the QEP's effects. The effects are classified into three types based on operational measures, and three questions are posed for the effects through each specific transmission channel.⁹ The first question is, among the effects of the QEP, to what extent is "effect of the commitment to maintain the QEP on the expected future path of short-term interest rates" observed (Section 2 (1)). The second question is through which channel and to what extent are "effects of expanding the size of the BOJ's balance sheet by increasing the CABs" identified (Section 2 (2)). The third question is through which channel and to what extent are "effects of altering the composition of the BOJ's balance sheet by increasing purchases of long-term JGBs" identified (Section 2 (3)). The reason why one can consider the effects of the QEP in these three classifications based on operational measures is that each operational measure is not necessarily a precondition for the other operational measure to become effective, and this makes it possible to grasp the effects independently. For example, the commitment referred to in the first question could be fulfilled just by committing to maintain a zero interest rate over time even if the BOJ did not provide ample liquidity far in excess of the required reserves. Altering the composition of the BOJ's balance sheet, referred to in the third question, could take place without expanding the size of the balance sheet through an increase in the purchase of long-term JGBs and a decrease in the purchase of short-term JGBs.¹⁰ In taking up the effects according to individual operational measures, this paper adopts the

⁸ In the latter stage of the QEP, Ueda (2005) tried to summarize Japan's monetary policy under a zero bound constraint of interest rates.

⁹ There are several possible ways to classify the transmission channels of the policy effects; the classification adopted here is one of those, and is consistent with that in Bernanke and Reinhart (2004). While various paths in terms of economic theory could have been weaved into each classification, the judgment here is that the most useful way is to link the policy effects with the policy measures.

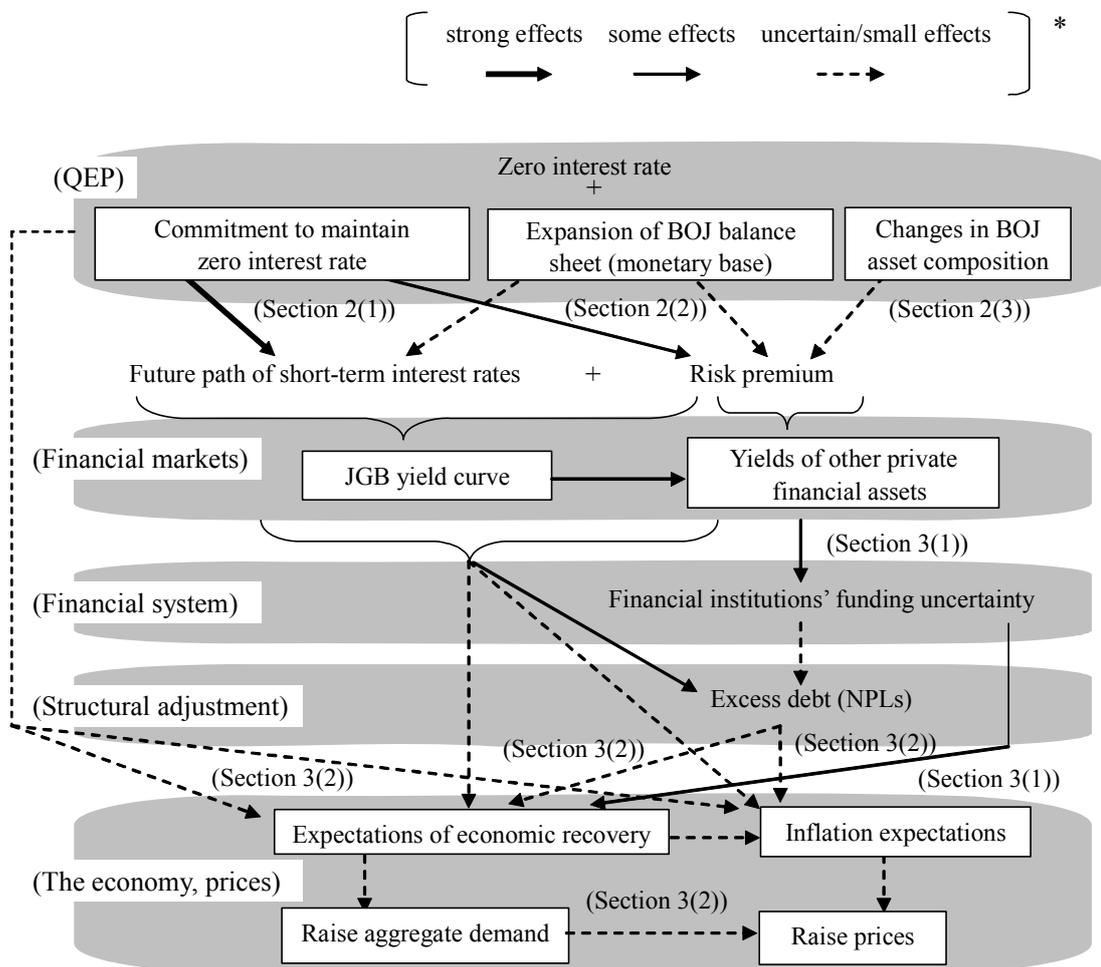
¹⁰ However, there might be a case where increasing the quantity of CABs could not be achieved without an increase in the purchase of long-term JGBs.

approach of judging whether the transmission channels exist by measuring the extent of the effects on the yields of various financial assets in financial and capital markets.

The paper then reviews the extent to which the QEP affected the economy through the identified transmission mechanism. Specifically, the paper poses several questions with respect to the comprehensive effects of the QEP. The first question is whether the QEP had the effect of containing the financial system uncertainty that had destabilized the economy (Section 3 (1)). This question is asked because financial system uncertainty is considered to have played some role, while opinions vary as to the extent, behind the prolonged stagnation of Japan's economy from the 1990s, and that further deterioration of financial system uncertainty could have, through contraction of business activity, sharply worsened the economic and price situation. The second question is to what extent the QEP contributed to raising aggregate demand and prices (Section 3 (2)). If the analyses indicate that this effect in raising aggregate demand and prices was weak, the paper will consider whether that was because the transmission channel itself was weak or because Japan's economic structure had become less sensitive to monetary easing amid mounting adjustment pressures. Finally, the paper summarizes the conclusions that emerge from the survey, and points out issues for future research (Section 4).

Figure 2 presents a conceptual diagram of the transmission channels and effects of the QEP on which the examinations in the following sections are based.

(Figure 2) Effects of the QEP: Conceptual Diagram



* The magnitude of the effects shown by arrows reflects the results of empirical analyses discussed below.

2. Transmission channels of QEP effects

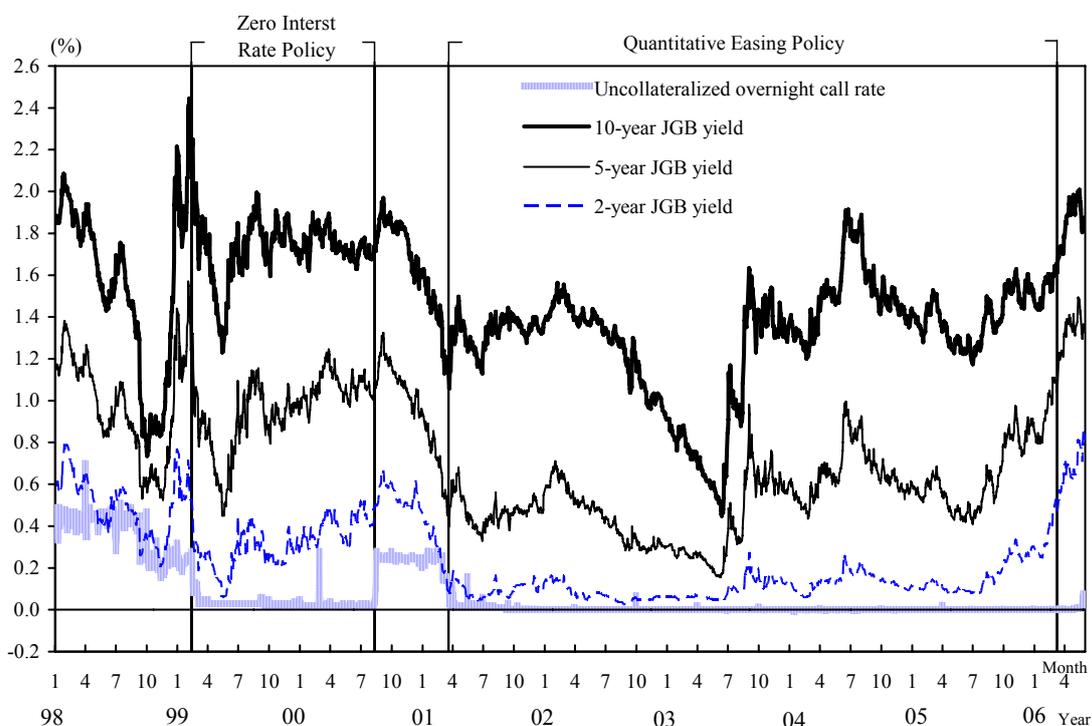
(1) Effect of the commitment

a. Theoretical channel from the commitment, and verification

The most important transmission channel of the commitment to “maintain the QEP until core CPI registers stably zero percent or an increase year-on-year” was to foster the expectation among the private sector that short-term interest rates would be maintained at zero percent until the inflation rate fulfilled this condition in the future. In other words,

this effect was meant, when present short-term interest rates were facing a zero bound constraint, to guide the private sector to expect that the zero interest rate would be maintained until the conditions of the commitment were satisfied even if the economy picks up in the future, thereby stimulating the economy by lowering the present short- to medium-term interest rates. The actual developments of the short- to long-term interest rates are shown in Figure 3. The reasons why it was possible for the yield curve to reflect expectations that zero interest rates would be maintained for some time even after the economy entered a recovery phase were because the market (i) expected that the QEP would only be lifted when the published core CPI growth exceeded zero percent¹¹, and (ii) considered that the CPI tends to respond to real economic indicators with a certain lag.

(Figure 3) Policy rate and medium- to long-term interest rates



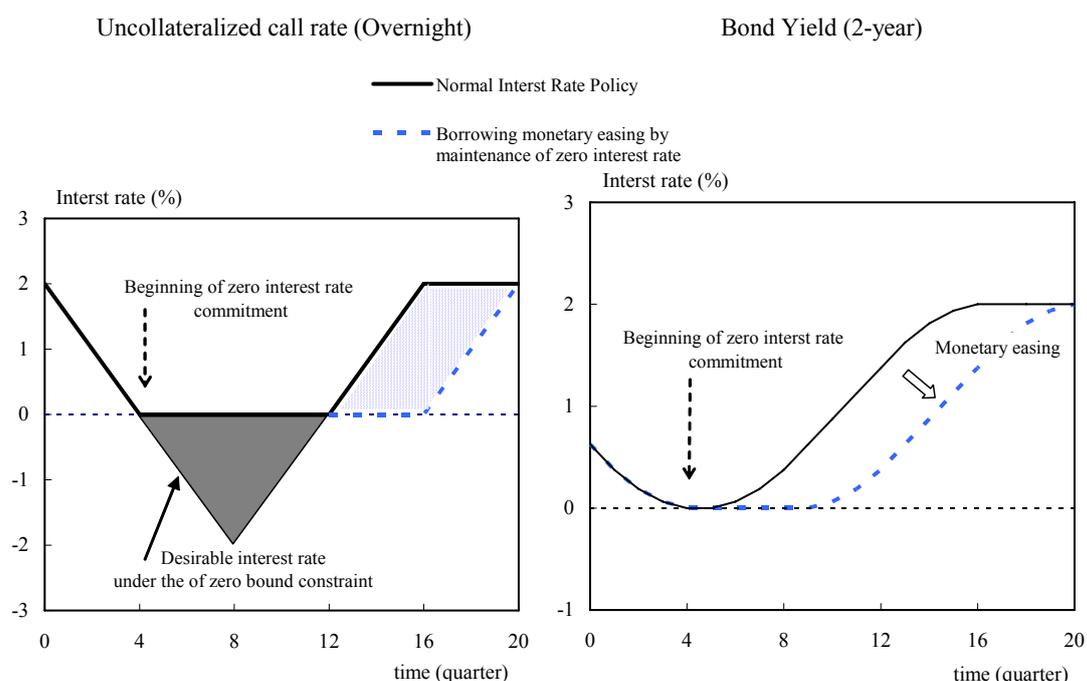
Sources: Bloomberg, Bank of Japan

This idea is shown in the following conceptual diagram (Figure 4), which is a modified version of the idea presented in Reifschneider and Williams (2000). The box on the left shows the development of policy interest rates. When reducing the policy interest

¹¹ This is because the CPI commitment requires not only that the published core CPI growth rate should be zero or above on average for several months, but also that the prospective core CPI growth not be expected to register below zero percent.

rate in response to the deterioration of the economy and prices at the present moment (time=0), that rate faces a zero bound constraint in the fourth quarter. Subsequently, even if the policy rate is held at zero, the economy in practice faces a situation in which monetary easing is lacking. In order to compensate for this, for example, the central bank makes a commitment in the fourth quarter that it will maintain monetary easing by not raising the policy rate even when the economy and prices enter a recovery phase, a situation that warrants a raise in the policy rate under normal policy rules, in the 12th quarter. Through such a commitment, the central bank mitigates the shortage of monetary easing under the zero interest rate bound, and returns to the policy rate desirable under normal conditions at a point when monetary easing would not excessively overheat the economy and price developments. If the central bank can preemptively convince the private sector of such a policy stance, then, as shown in the box on the right, long-term interest rates will decline by factoring in this expected path of future short-term interest rates, and this results in generating a further a monetary easing effect following the fourth quarter when the policy rate hits zero. The monetary easing effect explained here has often been referred to as the “policy duration effect” (Ueda 2002), focusing on the effect on the yield curve.

(Figure 4) Conceptual diagram of the effects of the zero interest rate commitment under a zero bound constraint on interest rates



Studies that explicitly advocate effects that utilize expectations under the zero interest rate bound as economic theory can first be found in Krugman (1998, 2000). Almost overlapping with the advent of this discussion, the BOJ also adopted for the first time a policy aimed at factoring in the market expectation that monetary easing would be maintained over time by explaining that the BOJ would “continue the ZIRP until deflationary concern is dispelled” in launching the ZIRP in 1999. Krugman stated that additional monetary easing would lose its effectiveness when interest rates are almost zero percent and that thus the monetary base and bonds become perfect substitutes, and he judged that Japan’s economy had fallen into such a liquidity trap. He argued that the level of the natural rate of interest had become negative in Japan, and, given the decline in prices, there would be no easing effects even if the BOJ temporarily increased the money stock because nominal interest rates could not be reduced below zero percent. He argued that, when it is recognized that the natural rate of interest will most likely become positive in the future, a permanent increase in the money stock would raise inflation expectations and thus increase current spending, enabling the economy to exit from the liquidity trap. Eggertsson and Woodford (2003) refined the argument from the framework of New Keynesian economics,¹² and proposed that even if the economy tumbles into a liquidity trap, the commitment to expand the economy and tolerate inflation when the natural rate of interest turns positive at a certain point in the future would stimulate aggregate demand and mitigate deflationary pressures. Both views, while differing in operational measures, have aspects similar to the BOJ’s idea of commitment in that they borrow future monetary easing effects from after the economic recovery in advance.¹³

Bearing these considerations in mind, this paper considers the transmission process of the policy duration effect by examining empirical analyses on the range of the downward shift of the yield curve, from the viewpoint of to what extent future short-term

¹² Even in the framework of New Keynesian economics, which deals with the private sector’s optimizing behavior and forward-looking expectations underpinned by price rigidity, the central bank’s optimal commitment policy under which the central bank determines the future policy path by taking into account all economic developments and policy effects under the zero interest rate bound and conducts policy by assuming that the private sector will behave by factoring in such a policy path, would entail features such as that the timing of the exit from a zero interest rate depends on past inflation rates and GDP gaps, and it would lag the timing when the natural interest rate has returned to positive (Jung, Teranishi, and Watanabe (2005)). This effect implies that the central bank “borrows” future monetary easing. (Jung, Teranishi, and Watanabe (2005)).

¹³ For example, Krugman (1998) also argued that, when viewing monetary policy in terms of nominal interest rates, one way to raise the inflation rate in an economy confronting a liquidity trap is for the central bank to promise not to raise interest rates even if the economy has started to expand and prices have started to rise.

interest rates were expected to decline compared with what had been expected under normal monetary policy management. If such an effect were present, it not only lowered the anticipated value of the expected future path of short-term interest rates, but also, in theory, reduced the private sector's uncertainty in expectations of the future course of monetary policy. This point is also examined by checking whether there was any reduction in the term premiums of interest rates.

Next, the paper compares the strength of the QEP's commitment with that of the ZIRP, which was adopted from 1999 to 2000. In considering the strength of the effect of the commitment on the formation of private sector expectations, the extent of history dependence whereby the central bank determines current policy in relation to past economic conditions becomes a key. In theory, if there is a forward-looking element included in inflation expectations, a commitment that adequately incorporates history dependence could strengthen the private sector's formation of expectations about future monetary easing more than a commitment without history dependence. History dependent monetary policy is, quite different from its literal image, a policy that tries to strengthen its effect on future expectations by strengthening the link between current and future policy through history dependence.

The BOJ's QEP could be interpreted as history dependent in that it tried to compensate to some extent for the shortage of monetary easing under the zero interest bound constraint by committing to future monetary easing while linking the policy with the past several months' average CPI performance. Of course, it might not have as strong a history dependence as price level targeting, which requires the central bank to completely recover the price level that has diverged from the past target, or what New Keynesian economics assumes in the so-called optimal commitment. However, it should be noted that the optimal extent of history dependence concerning prices depends partly on the actual strength of inertia of price changes such as inflation and deflation. Price level targeting could lead to a one-time substantial overshoot of prices and GDP gap if there is such inertia as prices continue to rise (fall) reflecting past price developments once they begin to rise (fall). In the case of Japan, the hypothesis that there is no inertia in price changes is not supported empirically. It has been generally pointed out that, in cases where such inertia exists, it would be desirable for a central bank from the viewpoint of maximizing economic welfare to aim at partial trend-reversion of the price level so as to reduce overshooting even as it takes history dependence into account, rather than imposing strong history dependence like price level targeting (Steinsson (2003), Kimura and Kurozumi (2004)). One specific example of partial adjustment is average inflation

targeting, which targets the backward-moving average of inflation rates from the past several periods up to the present (Kimura and Kurozumi (2004)). Given that the BOJ's commitment entailed a condition to maintain the QEP until the core CPI growth became equal or above zero percent on average over several months, it could be interpreted to have, from the limited viewpoint of history dependence, an effect on expectations similar to average inflation targeting.

The QEP had clarity in that the commitment was expressed numerically. The extent to which the central bank was expected by the private sector to cautiously judge the trend based on the backward moving CPI average affected the extent of monetary easing.

In contrast, while the commitment under the ZIRP adopted during 1999-2000 is also interpreted as one type of policy duration effect (Ueda (2005)), it is pointed out that this commitment was linked to the future economic outlook and thus did not have history dependence (Watanabe and Iwamura (2004)). In addition, the commitment of the ZIRP entailed ambiguity in that it was not expressed numerically (Ueda (2002)). Bearing these things in mind, this paper also compares the strength of both commitments in light of empirical analyses.

b. Verification method and results

Empirical analyses about how the commitment to maintain the QEP linked to the core CPI actually affected the yield curve can be found in Baba, Nishioka, Oda, Shirakawa, Ueda, and Ugai (2005), Oda and Ueda (2005), Marumo, Nakayama, Nishioka, and Yoshida (2003), and Okina and Shiratsuka (2004). All these papers use the approach of decomposing yield curves derived from JGB yields or yen-swap interest rates to try and extract the effects of the commitment. Here, even when the yield curve declines, it is important to distinguish whether that resulted from the effect of the BOJ's commitment which was perceived to have an easing effect, or if it merely reflected spreading expectations that deflation would persist.

Baba, Nishioka, Oda, Shirakawa, Ueda, and Ugai (2005) combine a small macro-structural model — which formulates the expected future path of short-term interest rates by using a modified Taylor rule with a zero bound constraint on the interest rate — with an interest-rate term structure model based on the no-arbitrage condition to develop a macro-finance model. By using this model, they derive the effect of the commitment to maintain a zero interest rate on the yield curve calculated from JGB yields

as the difference between the estimated expected future path of short-term interest rates under the actual yield curve with the commitment, and the estimated expected future path of short-term interest rates under the virtual yield curve without the commitment. The results show that the differential for 3-year and 5-year bond yields increased after the second half of 2002. This difference increased conspicuously from 2003, to reach a maximum of 0.4-0.5%, and of about 0.2% for the 10-year bond yield. As an interpretation of these results, the authors suggest that, rather than during periods when the market appears extremely pessimistic about the economic outlook, it is during periods like that since 2003 when the economy has gradually recovered and the possibility that interest rates will be raised within several years becomes higher that the effect of the CPI-linked commitment becomes strong. The authors also point out the possibility that the differential for the 10-year bond yield did not increase as much as those of medium-term bond yields because the market might have expected that the future inflation rate would become higher due to the effect of lowering the yield curve.

In addition to the expected future path of short-term interest rates, the authors also measure how the effect of the commitment reduced the term premium of interest rates by reducing uncertainty with respect to the future course of monetary policy. This effect was detected from the second quarter of 2003 for the 3-year bond yield in terms of the difference between the risk premium components of the yield curves with and without the commitment. However, the difference for previous periods and the cases for 5- and 10-year bond yields were not obvious. These results are consistent with the logical inference that uncertainty about the duration of the zero interest rate should virtually disappear in the distant future when the QEP is most likely to be lifted.

Marumo, Nakayama, Nishioka, and Yoshida (2003) construct a term structure yield curve model with the short-term interest rates following the traditional Vasicek (1997) model, which assumes that the instantaneous spot rate follows the mean-reverting process and a normal distribution for errors, augmented by incorporating the probability of policy duration of the ZIRP, with the long-term interest rates being adjusted by risk prices perceived in the markets. Monthly data from January 1992 to January 1999 were used for the model estimate. By treating the duration of the ZIRP as a stochastic variable and estimating how market participants assumed the length of policy duration based on data after 1999, they find that it grew longer following adoption of the QEP toward the end of 2002.

Okina and Shiratsuka (2004) break down the forward rate derived from daily Euroyen and yen swap interest rates data by using an extended version of the Nelson and

Siegel (1987) model, and estimate how the length of the policy duration effect changes in different phases. They show that the policy duration effect strengthened once in the first half of 2001 when the QEP was adopted, and strengthened again from the spring of 2002, and estimate the expected duration of the policy to be some two and a half years as of the end of 2002. Contrary to Baba, Nishioka, Oda, Shirakawa, Ueda, and Ugai (2005), Okina and Shiratsuka attribute the strengthening of the effect to the strengthening of market participants' expectations that deflation would be protracted for years given the decline in average long-term forward rates, on which the policy duration effect would have little impact.

Based on the above-mentioned empirical analyses, this paper now proceeds to compare the strength of the commitment effect under the QEP with that under the ZIRP, and to check whether the core CPI commitment had a stronger effect on lowering the yield curve than the commitment linked to dispelling future deflationary concerns.

Baba, Nishioka, Oda, Shirakawa, Ueda, and Ugai (2005) and Oda and Ueda (2005) calculate the expected core CPI growth rates that the market expected the central bank to judge as satisfying the commitment, and find that those rates remained only slightly positive during the ZIRP period, but then gradually rose during the QEP period to reach about one percent from 2003, suggesting a considerable easing of expectations. This implies a strong effect of the commitment on the expected future path of short-term interest rates under the QEP. In addition, the decrease in the yield curve was apparently greater under the QEP than under the ZIRP. Okina and Shiratsuka (2004) also show that while expectations of the duration of zero interest rates only lengthened to about six months during the ZIRP period, they extended by more than one year over the course of the QEP. In addition, during the QEP period, the average expected short-term interest rates when the zero interest rate policy was expected to continue were lower than during the ZIRP period, and remained stable until 2003. Aside from this literature, Bernanke, Reinhart, and Sack (2004) also conduct an examination using a macro-finance model similar to that of Baba, Nishioka, Oda, Shirakawa, Ueda, and Ugai (2005). They show that, during the periods immediately after the adoption of the ZIRP and QEP, the actual yield curve lowered in a manner similar to the expected yield curves estimated from past economic variables under a zero bound constraint on interest rates.¹⁴

¹⁴ It should be noted that Bernanke, Reinhart, and Sack (2004) did not specify the effect through which channel lowered the yield curve in the case of the QEP. In combination with their separate event study under the QEP, they withheld their conclusions as to whether the QEP had any effects other than lowering interest rates to zero.

Consequently, every empirical analysis detects the effect whereby the QEP's commitment linked to actual core CPI performance lowered the yield curve, centering on the short- to medium-term. And this effect was stronger than under the ZIRP commitment linked to future dispelling of deflationary concerns. These results are almost the same among all the analyses (Figure 5).

(Figure 5) Policy duration effect of the QEP

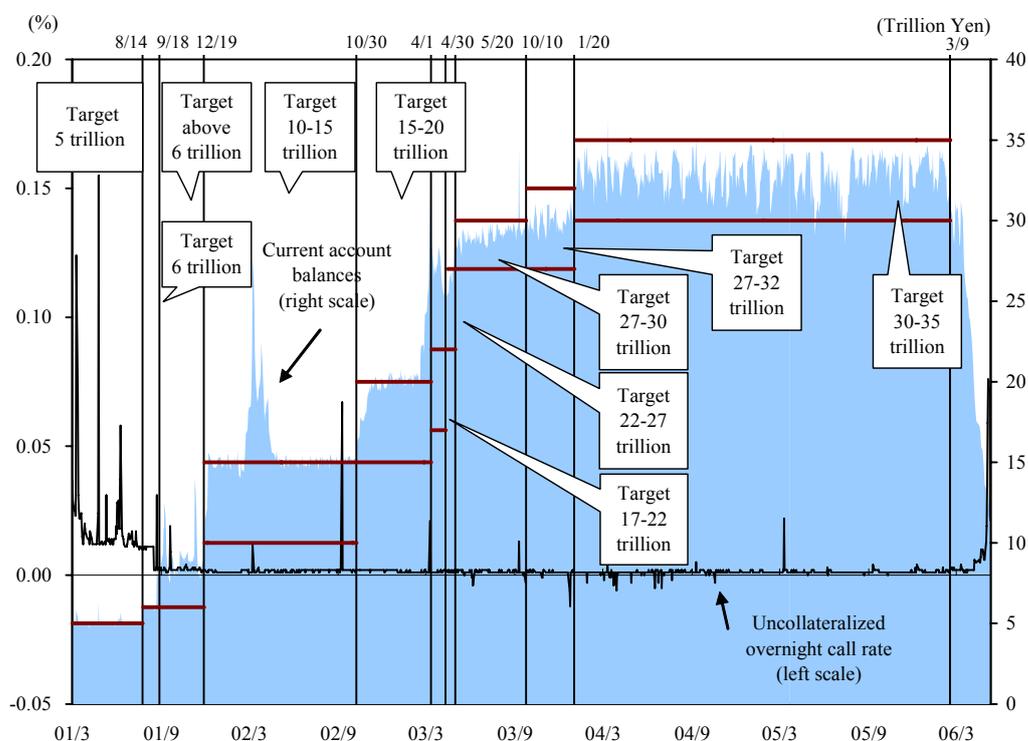
	Effect in lowering the yield curve from the policy duration effect	Effect in containing policy uncertainty	Comparison with policy duration effect under the ZIRP
Baba et al. (2005) Oda and Ueda (2005)	Detected (Increased from the second half of 2002. Reduced by as much as 0.4-0.5% for 3-year and 5-year yields)	Detected for 3-year yield (from 2003)	Strengthened
Marumo et al. (2003)	Detected (Policy duration lengthened toward the end of 2002)	—	—
Okina and Shiratsuka (2004)	Detected (Policy duration lengthened from 2002. About 2.5 years at the end of 2002)	—	Strengthened
Bernanke et al. (2004)	Detected (No differentiation among transmission channels)	—	Similar during the period immediately after policy adoption

(2) Effects of expanding the size of BOJ's balance sheet

a. Theoretical channels from the increase in CABs at the BOJ, and verification

This section examines the effects of repeated increases in CABs at the BOJ, as shown below in Figure 6, as well as those of the associated increase in the monetary base in light of the specific transmission channels.

(Figure 6) CABs at the BOJ and uncollateralized overnight call rate



Source: Bank of Japan, Financial Markets Department (2006)

Since these transmission channels' specific mechanisms have not gained consensus in economic theory, their effects are difficult to verify. In particular, under monetary policy theories with a micro foundation such as New Keynesian economics, which have been receiving increasing support in academia, the interest rates of financial assets are derived as the expected future path of short-term interest rates, and mechanisms that generate premiums and their effects on the economy are not consistently addressed. Applying this idea to monetary policy under the zero bound constraint on nominal interest rates is the "irrelevance proposition for open-market operations." (Eggertsson and Woodford (2003)). The irrelevance proposition, under certain assumptions, states that under zero nominal interest rates, neither an increase in the monetary base nor diversification of the central bank's measures to supply it (that is, the nature of the assets that central bank purchases through open-market operations), have any effect on the equilibrium of the economy. If this proposition holds, a policy to increase the CABs or monetary base would have no effect on the economy. In order to verify the effects from the increase in the CABs, let us see to what extent this proposition appears in practice, and if some effects could be expected.

In order for this proposition to hold true, two assumptions are necessary: (i) the marginal utility to the representative agent of additional income does not depend on the variance in financial asset prices, in other words, does not depend on the aggregate payoff of its asset portfolio, and (ii) an increase in the monetary base or diversification of central bank operational measures to supply it at present does not influence the expected future conduct of monetary or fiscal policy. When the CABs at the BOJ are increased, a portfolio rebalancing effect will be expected if (i) does not hold, and the effect of altering private sector expectations regarding future monetary or fiscal policy will appear if (ii) does not hold.

While the definition might differ among analysts, the portfolio rebalancing effect is often considered to be an effect whereby the reduction in the private portfolio risk through central bank operations generates room for private sector entities, which behave to maximize their objective function subject to containing total risk below a certain limited amount, to take new risks, and thus part of the monetary base is exchanged for some type of risk assets (Oda and Okina (2001)). Whether this effect exists or not depends on whether the assumption of the utility function of the representative agent in the irrelevance proposition is valid or not.

Under a view that advocates assumption (i) (Eggertsson and Woodford (2003)), the interest rate becomes zero when the real money balance exceeds a certain threshold (satiation level), and the marginal utility gained from liquidity service due to money provision becomes zero. In other words, this view considers that when the interest rate becomes zero, the additional provision of real money does not affect the utility of the representative agent. Based on this view, portfolio rebalancing would not occur in principle no matter how much the monetary base is increased when short-term interest rates are already at zero. In addition, as long as the representative agent's utility does not depend on the financial assets' price variance, the representative agent will not adjust its portfolio even if the central bank reduces the interest rate variance by exchanging parts of the monetary base for financial asset holdings, which are an imperfect substitute for the monetary base. Because the portfolio rebalancing effect would be theoretically rejected, proponents of this viewpoint do not attempt to empirically verify this effect in the first place.

In contrast, if the assumption of its utility and budget constraint is relaxed, there is room for the portfolio rebalancing effect to take place. Even so, there would be no effect if the central bank were to increase the monetary base by purchasing short-term government bonds, which are an almost perfect substitute for the monetary base under

zero interest rates.¹⁵ However, there is a view that, even when short-term interest rates become zero and the monetary base and short-term JGBs become a perfect substitute, given the existence of many financial assets that are not perfect substitutes for the monetary base, raising the prices of imperfect substitute assets could generate a monetary easing effect even under zero interest rates (McCallum (2000, 2003) and others).¹⁶ There are two views about which component of the premium of yields of financial assets that are imperfect substitutes the portfolio rebalancing could affect. Bearing in mind the two views that draw attention to the imperfect substitutability of financial assets, the paper now proceeds to verify the past empirical research to identify whether such portfolio rebalancing effects exist, focusing on the effects on the yields of various financial assets.

The first view is that portfolio rebalancing works through a mechanism whereby the monetary base supply alters the supply-demand relationship of various financial assets, thereby raising their prices (reducing their premiums) (Meltzer (1995, 1999, 2001)).¹⁷ Since this interpretation does not take into account what economic fundamentals would change behind that, the component of the premiums that changes is not specified. This reduction of premiums is understood to affect business fixed investment through changes in stock prices, which leads to changes in Tobin's q , and consumption through the wealth effect.

The second view theorizes imperfect substitutability among financial assets from the viewpoint of the liquidity premium. Namely, since there is a qualitative difference in terms of liquidity between money, which is always usable, and bonds or capital, only a portion of which can be liquidated at one time, the exchange between them could increase the liquidity of the private sector (Yates (2003)).¹⁸ In addition, there is also the view that the cost of lost liquidity from the purchase of long-term bonds and the transaction costs stemming from trading long-term bonds adds premiums onto the term structure of interest rates (Andrés, López-Salido, and Nelson (2004)). Under the concepts presented by

¹⁵ McCallum (2001) notes that for the central bank to conduct open market operations under zero interest rates by exchanging monetary base for short-term government bonds, which, at the margin, become perfect substitutes, is like replacing a billion dollars worth of \$5 bills with a billion dollars worth of \$10 bills, which, to an approximation, has no effect.

¹⁶ Other than altering the prices of financial assets that are not perfect substitutes for the monetary base, there is an argument for considering the portfolio-rebalancing effects in a broader context, from the viewpoint that money has different functions. See Section 3 (1).

¹⁷ Mishkin (1995) referred to such effects identified by Meltzer as “asset price effects.”

¹⁸ The theoretical background is according to Kiyotaki and Moore (2001).

Kiyotaki and Moore (2001), the supply of monetary base mitigates liquidity constraints by altering the amount of liquidity in the economy, and is thus expected to reduce liquidity premiums, bring changes in the flow of funds from a savings entity to an investing entity, and thereby stimulate investment. Under the concepts advocated by Andrés, López-Salido, and Nelson (2004), economic activity will be stimulated through a decline in long-term interest rates than from the expected future path of short-term interest rates.

Next, in considering whether assumption (ii) of the irrelevance proposition holds or not, this paper specifically examines the issue of whether an increase in the monetary base or diversification of measures to supply this monetary base through market operations at present would affect the private sector's expectations on the future course of monetary policy. As shown in the Appendix, when the BOJ raised its CAB target, it in many cases cited preventing deterioration of the economy and price declines as reasons for the raise. If increases in the CABs or monetary base actually make the private sector expect that monetary easing will continue longer than previously envisaged, these increases will reduce present nominal long-term interest rates (Meyer (2001)). In the following section, this paper reviews empirical analyses that attempt to determine whether the QEP's easing effects were strengthened because the implementation of commitment to maintain the QEP was endorsed in the visible format of an increase in the CABs. The analysis here is considered to augment the policy duration effect of the commitment surveyed above in Section 2 (1).

As another channel not discussed so far, effects through the fiscal channel has been noted. This is the assertion that when the central bank conducts its QEP aggressively and the private sector recognizes that the monetary base will permanently increase by way of JGB purchases, the private sector comes to expect government debt interest payments to decline over time, consequently reducing the private sector's tax burden (Auerbach and Obstfeld (2005)). This channel has not been verified empirically. To realize positive interest rates while maintaining a permanent increase in the monetary base after the economy returns to normal would require high nominal economic growth by way of massive inflation. The reason for not verifying this channel may be that it is deemed unrealistic to try to convince the private sector of this scenario.

b. Verification method and results

As a premise for examining whether the portfolio rebalancing effect exists, this paper looks into the demand for the real monetary base under zero interest rates. Under the QEP, if the interest rate elasticity of demand for the real monetary base becomes infinite when short-term interest rates are zero, the monetary base will be passively absorbed regardless of the amount provided, and thus effects from an increase in the monetary base cannot be expected. In this regard, Kimura, Kobayashi, Muranaga, and Ugai (2003) use data from 1978 1Q to 2002 1Q and, with the reservation that data under the zero-interest rate period are not necessarily sufficient and any conclusions should be treated as preliminary, they reject the null hypothesis that the interest rate elasticity of demand for the real monetary base becomes infinite when short-term interest rates are zero.

Oda and Ueda (2005) and Kimura and Small (2006) explicitly analyze the existence and magnitude of the portfolio rebalancing effect. While both try to grasp the effect on premiums included in financial assets that are imperfect substitutes for the monetary base, the question of exactly which premium will be affected is not within the scope of their analyses.

Oda and Ueda (2005) conduct regression analysis on the risk premium component of the yield curve (see Section 2 (1) for the methodology) that was extracted in Baba, Nishioka, Oda, Shirakawa, Ueda, and Ugai (2005) by using variables that denote the CABs at the BOJ and the magnitude of the BOJ's outright purchases of the long-term JGBs as explanatory variables. Based on data from 1995 1Q to 2003 4Q, they find that the regression results for 3-, 5-, and 10-year rates were statistically insignificant for the BOJ's CABs.

On the other hand, Kimura and Small (2006) examine the existence of portfolio rebalancing effects through changes in the supply and demand of financial assets based on the Capital Asset Pricing Model (CAPM).¹⁹ Specifically, they express the difference in risks reflected in the rate of return of each financial asset as the differences in parameter β (the sensitivity of each financial asset's return against the market portfolio's return). The market portfolio consists of the monetary base, equities (the Nikkei stock average), foreign government bonds (the yen-dollar exchange rate), high- and low-grade corporate bonds, and long-term JGBs. They alter the composition of the market portfolio by way of changes in the CABs through the BOJ's market operations, and consider that portfolio

¹⁹ The details of the CAPM are explained in Chapter 1 of Cochrane (2001).

rebalancing exists if the risk premiums of individual financial assets change, reflecting the change in their supply and demand. Using data from January 2000 to March 2004, they conduct regression analysis with changes in the risk premiums of individual financial assets' yields as dependent variables and the CABs at the BOJ as an explanatory variable, and find that the credit spread of high-grade corporate bonds narrowed in a statistically significant manner. They interpret that the spread narrowed because investors, in order not to increase their portfolio risk, increased their demand for financial assets with counter-cyclical returns such as JGBs. However, even when the CABs were increased by 10 trillion yen, the credit spread of Aa grade corporate bonds narrowed only by 1-4 basis points. They also conclude that an increase in the CABs decreased the forward exchange risk premium somewhat once the indirect effect through implied volatility is taken into account, while their estimations of the direct effect on the risk premium present mixed results.²⁰

Takeda, Komaki, and Yajima (2005) conduct studies that focus on the liquidity premiums of JGBs. They appraise the finite difference among the one-year forward rates of JGBs at each future point as marginal changes in term premiums, and statistically test whether these declined before and after the change of policies. They conclude that, at least at the time of the adoption of the QEP in March 2001, the decline in liquidity premiums was statistically significant.

Sadahiro (2005) focuses on the effects on the foreign exchange rate. By using monthly data from March 2001, when the QEP started, to September 2004, he conducts regression analysis on the effect of the Japan-U.S. monetary base ratio on the yen-dollar exchange rate, and confirms that the effect was statistically insignificant.

Consequently, as shown in Figure 7, the prior studies present mixed results as to the effect of portfolio rebalancing on JGB yields. The effect on financial assets other than JGBs is found to be statistically significant in the case of high-grade corporate bonds. The findings on the effect on the foreign exchange rate are split between some effect and no effect. As a whole, even in the analyses that detect the portfolio rebalancing effect to a certain extent, this effect was smaller than the effect of the commitment on the JGB yield curve if one considers the magnitude of the portfolio rebalancing effect in the context of the CABs increasing by 28 trillion yen (about seven times) and the monetary base increasing 46 trillion yen (an approximately 70 percent increase) over the five-year

²⁰ It should be noted that, for assets with pro-cyclical returns, the risk premium on equities and the credit spread of low-grade corporate bonds increased in a statistically significant manner.

period of the QEP. In addition, it should be noted that the analyses that find no effect on the JGB yield implicitly presume that there would be little effect on other financial assets without actually measuring them, because the effects on the JGB yield serve as the starting point for spreading the effects to other financial assets.

Let us now proceed to review the empirical evidence on the QEP's signaling effect for future monetary easing. Oda and Ueda (2005) conduct regression analysis on the effect of the zero rate commitment on the expected future path of the short-term interest rates component of the yield curve, using variables that express the CABs and long-term JGB operation as explanatory variables, and find that for each of 3-, 5-, and 10-year bond yields, the coefficient of the CABs is statistically significant with the correct sign. Specifically, the effect of a 10 trillion increases in CABs is 0.19% for the 3-year bond yield and 0.17% for the 5-year bond yield. From this result, they draw the tentative conclusion²¹ that the increase in the CABs during the QEP period may have made the private sector recognize more firmly the policy duration effect whereby the BOJ would continue monetary easing for years to come.

On the other hand, Fujiki, Okina, and Shiratsuka (2004) conduct a case study about the effect of the BOJ's decisions to increase the CAB target in April, May, and October 2003 and January 2004 on the yield curve, using the Euroyen TIBOR and the yen swap interest rate. They conclude that while the May 2003 decision affected the expectations of market participants, no clear effects could be detected in other cases.

As a whole, empirical analyses show that, when the BOJ increased the CABs targets, there were some phases in which this brought about a signaling effect (Figure 7). The existence and magnitude of a signaling effect seems to depend on to what extent the private sector understands precisely in advance the commitment to maintain the zero interest rate. Even in cases where the commitment to maintain the zero interest rate may not be believed at the beginning, once the private sector becomes certain about the policy stance through comments at press conferences or an increase in the CABs, then changes in the CABs targets may not have any additional signaling effect.

²¹ Oda and Ueda (2005) caution that the strength of the signaling effect depends on to what extent the private sector precisely understands the monetary policy stance in the zero interest rate environment in advance. In addition, they refer to the possibility that the signal was generated by a different communication path as the CABs targets were changed, for example, such as the Governor's comments at regular press conferences, and state that the validity of the tentative conclusions needs further verification.

(Figure 7) **Portfolio rebalancing effect and signaling effect of increase in BOJ's CABs**

	Portfolio rebalancing effect					Signaling effect
	JGBs	High grade corporate bonds	Foreign exchange rate	Stocks	Low grade corporate bonds	
Oda and Ueda (2005)	Insignificant	—	—	—	—	Significant (With additional 10 trillion yen of CABs, 0.19% for 3-year yield, 0.17% for 5-year yield)
Takeda et al. (2005)	Significant (at the time of introduction)	—	—	—	—	—
Kimura and Small (2006)	—	Significant (with additional 10 trillion yen of CABs, +1-4b.p. for Aa grade)	Somewhat (Some measurements insignificant)	Significant with opposite sign	Significant with opposite sign	—
Sadahiro (2005) ²²	—	—	Insignificant	—	—	—
Fujiki et al. (2004)	—	—	—	—	—	Significant for certain phases (May 2003)

(3) Effects of altering the BOJ's asset composition

a. Theoretical channels from purchases of long-term JGBs, and verification

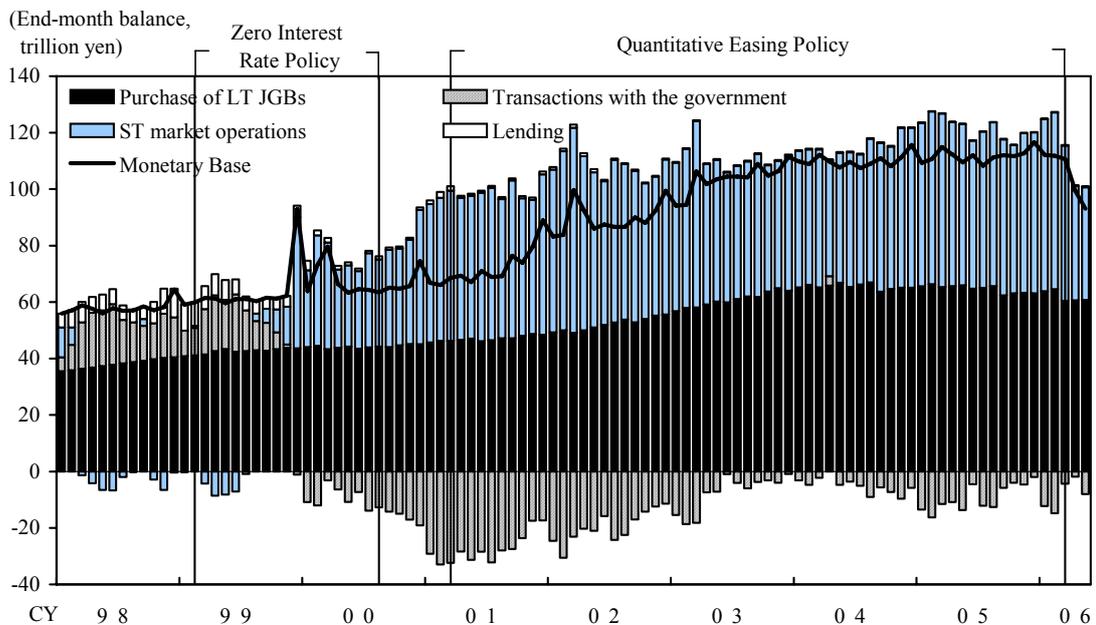
In the process of continuing the QEP, the BOJ purchased long-term JGBs, asset-backed securities, and other assets (Figure 8). Of these, the largest item in terms of both the amount of holdings and the amount of increase was long-term JGBs. The BOJ increased purchases of long-term JGBs whenever it considered it necessary to smoothly meet the CABs target (see Appendix), and this resulted in substantial changes to the Bank's asset composition (Figure 9).

²² To be exact, Sadahiro uses monetary base instead of the BOJ's CABs as an explanatory variable.

(Figure8) Changes in BOJ's asset composition

	Increase in purchase of short-term JGBs	Increase in purchase of long-term JGBs	Increase in purchase of foreign currency denominated government debts	Purchase of corporate debts	Purchase of stocks
Implementation	Yes	Yes	No	Purchased asset-backed securities <until March 2006>	Limited implementation for banks' holdings (to overcome NPL problem) <until September 2004>
Substitutability with monetary base (effect of providing liquidity by purchase of assets)	High (Low)				Low (High)

(Figure 9) Monetary base and breakdown of BOJ transactions



Source: Bank of Japan

Like the consequences from expanding the BOJ's balance sheet, changes in the BOJ's asset composition will have no effect if the above-mentioned irrelevance proposition holds true. However, if the BOJ directly purchases financial assets that are imperfect substitutes for the monetary base in exchange for CABs, this might have some effect on the economy by affecting the premium component of financial assets' yields. This point needs to be checked by examining empirical evidence. Of course, the nature of the risk to be absorbed differs depending on which asset the BOJ actually purchases. For example, of the various measures shown in Figure 8, the purchase of corporate debts means the central bank directly absorbs the credit risk premium. This section focuses on the effect from increased purchases of long-term JGBs, whose magnitude of purchases by the BOJ was the largest.

One of the portfolio rebalancing channels that stems from the exchange of monetary base for long-term JGBs is the effect of increasing liquidity in the financial market. Long-term government bonds are generally perceived as very highly liquid assets. However, Goodfriend (2000) shows that when the private sector uses long-term government bonds as collateral for external finance, their collateral value is lower than when more liquid cash is used, and that the bondholders are exposed to the increased risk of capital loss when long-term interest rates are already sufficiently low, thereby increasing their cost of sale. Therefore, he states that massive open market purchases of long-term government bonds by the central bank could have the effect of reducing liquidity premiums. This paper now examines whether the increase in the purchase of long-term JGBs by the BOJ actually led to a reduction of the premiums of JGB yields.

It should be noted that considerations of a channel whereby the central bank's purchases of specific financial assets affect the supply and demand of imperfect substitute assets and thereby reduce premiums are based on the segmented market hypothesis, that is, the understanding that economic entities have different preferences with respect to the maturity composition and types of financial assets. If the yields of the long-term JGBs purchased by the BOJ are significantly disconnected from the yields of JGBs with different maturities or those of corporate bonds, a decline in long-term JGB yields will not spread over to the yields of other financial assets, and thus significant economic effects may not occur (Bernanke and Reinhart (2004)). This point will also be examined in the analysis of the effects on financial assets other than JGBs.

Additionally, this paper examines the empirical evidence of the signaling effect of increased purchases of long-term government bonds on expectations regarding the future course of monetary policy. However, the signal cannot be determined in one direction a

priori. One possibility is that if the central bank increases its purchases of long-term government bonds, the credibility of expectations that zero interest rates will be maintained would be enhanced since the central bank would then incur capital losses if it did not continue the low interest rate policy for the foreseeable future (Clouse, Henderson, Orphanides, Small, and Tinsley (2003)). However, taking into account the relationship with fiscal policy, there could be other possibilities. For example, Fujiki, Okina, and Shiratsuka (2001) estimate that, even starting with the BOJ balance sheet before the QEP was adopted, if one assumes that the BOJ purchases 60 trillion yen of long-term JGBs and long-term interest rates reach 5% as a result of economic recovery, the BOJ will incur a capital loss of about 12 trillion yen if it sells the purchased long-term JGBs in 1-2 years.²³ In addition, they point out the possibility that if the BOJ tries to absorb the monetary base after exiting from deflation by way of selling government debts, the private sector's holdings of government debts could increase given the amount of capital loss the BOJ would incur when selling. Given the need to bear in mind these various possibilities, in the following, if any signaling effect is detected, its content must also be examined in light of the empirical evidence.

b. Verification method and results

To begin with, the effects of the BOJ's increased purchases of long-term JGBs on financial assets' premiums are estimated in Oda and Ueda (2005) and Kimura and Small (2006). As previously mentioned, Oda and Ueda (2005) conduct a regression analysis against the risk premium component of short- to medium-term interest rates, using variables that denote the BOJ's CABs and the magnitude of outright purchases of long-term JGBs as explanatory variables. As explanatory variables of the BOJ's outright purchases of long-term JGBs, they use the share of JGBs held by the BOJ in total JGBs outstanding and the amounts of long-term JGBs purchased by the BOJ, and obtain results that both variables are not statistically significant for all cases — 3-year, 5-year, and 10-year JGBs.

On the other hand, Kimura and Small (2006) use the same CAPM model as previously explained in discussing the effects of the increase in the BOJ's CABs while

²³ It should be noted that, in the current BOJ balance sheet, the duration of the long-term JGBs the BOJ holds is considerably shorter than the original maturity of 10 years and the timing to sell the bonds has not been pre-determined. Therefore, their results need to be interpreted with some discount in that the actual level of capital loss differs substantially depending on the assumptions.

changing the explanatory variable from the BOJ's CABs to the balance of the long-term JGBs held by the BOJ, and estimate the effects on financial assets' risk premiums. The results, similar to those in the case of having the BOJ's CABs as the explanatory variable, are that the credit spread of high-grade corporate bonds narrowed in a statistically significant manner, while the magnitude is small at 6-8 basis points for Aa grade corporate bonds from a 10 trillion yen increase in the purchase of long-term JGBs. In addition, they also conclude that the increased purchases of long-term JGBs somewhat decreased the forward exchange risk premium when the indirect effect through the influence on implied volatility is taken into account, while estimations of the direct effect on the risk premium present mixed results.²⁴

Consequently, portfolio-rebalancing effects by way of an increase in the purchase of long-term JGBs (Figure 10) are not detected on JGB yields. Some effects are detected on other financial assets, while the magnitude is small compared with that which the commitment exerted on JGB yields. In addition, it should be noted that the analyses that found no effect on JGB yields implicitly presume that there would be little effect on other financial assets, because the effects on JGB yields serve as the starting point to spread the effects to other financial assets.

With respect to the effects of the BOJ's increased purchases of long-term JGBs on expectations for the future course of monetary policy, Oda and Ueda (2005) conduct a regression analysis against the effect of the zero rate commitment on the expected future path of short-term interest rates within the yield curve, using the BOJ's CABs and the amount of long-term JGBs purchased as explanatory variables. They find the coefficient of long-term JGBs purchased is not necessarily statistically significant, with the opposite sign.

Takeda, Komaki, and Yajima (2005) use finite differences according to the maturities of JGB forward rates, and find that premiums, including the inflation premium, temporarily increased in a statistically-significant manner centering on the longer term maturities of 7-8 years only when the BOJ increased its purchase of long-term JGBs from 400 billion yen per month to 600 billion yen per month in August 2001. They interpret this result as implying the possibility that the market expected that the increase in the purchase of long-term JGBs would lead to a loss of fiscal discipline and thereby fostered inflation expectations.

²⁴ On the other hand, they find that risk premium on equities and the credit spread of low-grade corporate bonds increased in a statistically significant manner.

As such, no empirical evidence to date has verified that the BOJ's increased purchases of long-term JGBs had any effect on strengthening expectations for monetary easing (Figure 10).

(Figure 10) Portfolio rebalancing effect and signaling effect from increased purchases of long-term JGBs

	Portfolio rebalancing effect					Signaling effect
	JGBs	High-grade corporate bonds	Foreign exchange rate	Stock prices	Low-grade corporate bonds	
Oda and Ueda (2005)	Insignificant	—	—	—	—	Insignificant
Kimura and Small (2006)	—	Significant (with 10 trillion yen increase of long-term JGB balance, 6-8b.p. for Aa grade)	Somewhat (Some measurements insignificant)	Significant with opposite sign	Significant with opposite sign	—
Takeda et al. (2005)	—	—	—	—	—	Significant for a certain phase in the opposite direction (inflation expectation)

3. Effects of the QEP on macro financial and economic variables

So far, this paper has examined the effects of the QEP separately according to transmission channels. Here, the effects of the QEP on Japan's economy overall are examined by linking the various transmission channels analyzed above.

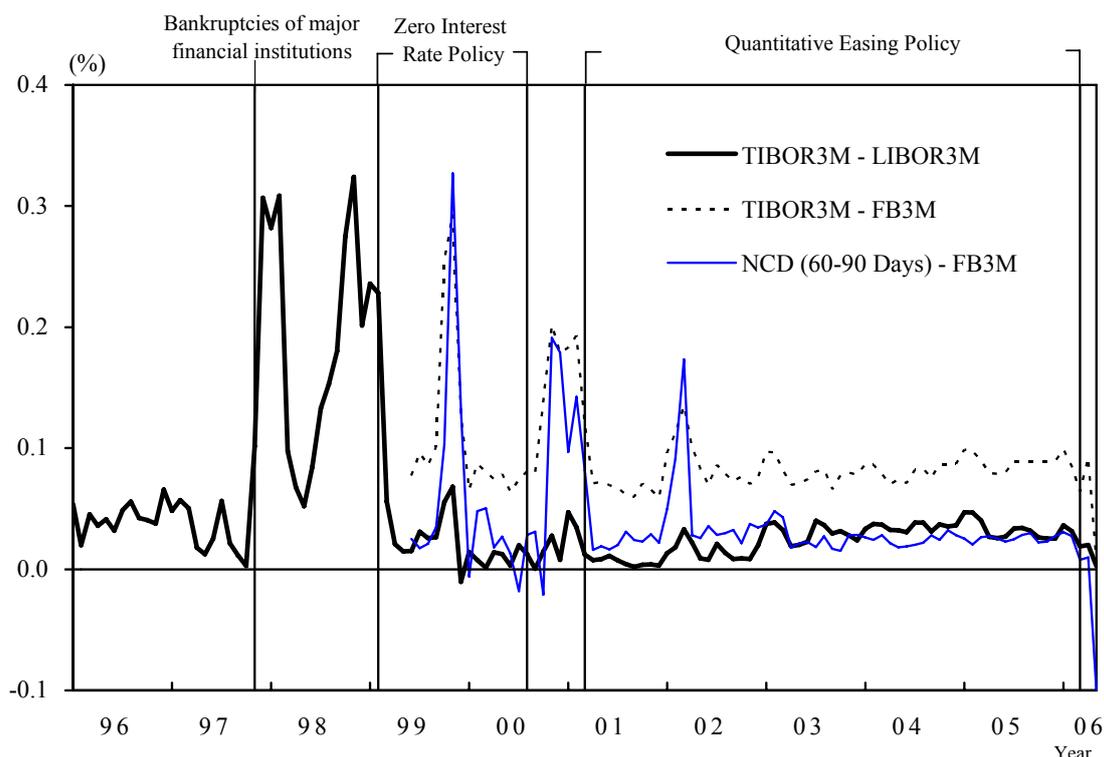
(1) Effects on stabilizing financial markets

a. The relationship between the financial system and aggregate demand/prices, and verification

Corporate balance sheet adjustments after the burst of the bubble and, as the other side of the same coin, the NPL problem of financial institutions which led to insufficient functioning of financial intermediation are considered to be major factors behind the

prolonged stagnation of Japan's economy that began in the early 1990s and lasted until about 2003. In particular, after the failures of Yamaichi Securities Company and Hokkaido Takusuhoku Bank in November 1997, financial institutions' funding costs surged amid the rapidly heightened uncertainty regarding financial institutions' management (Figure 11).

(Figure 11) Financial institutions' market ven funding cost



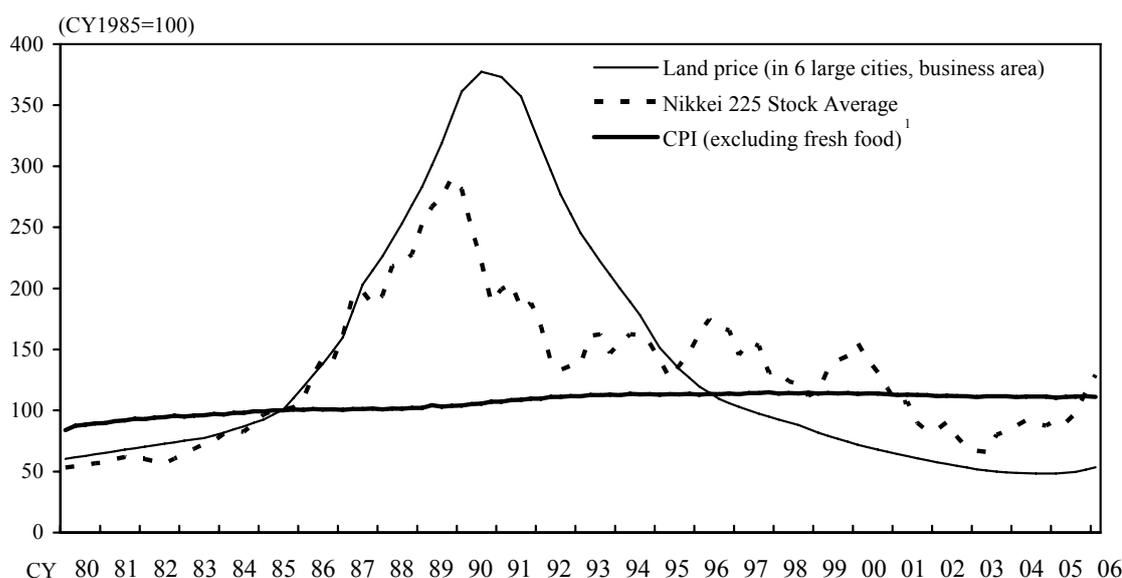
Sources: Bloomberg, Bank of Japan

It has been pointed out that from the end of 1997 to 1998 nominal GDP declined amid a credit contraction. There were phases in which firms had heightened uncertainty regarding their funding over fear that financial institutions were reducing their lending due to liquidity concerns, and the economy was at risk of tumbling into a deflationary spiral (Hayakawa and Maeda (2000), Research and Statistics Department, Bank of Japan (2000))²⁵.

²⁵ Specifically, empirical analyses show that the following two channels were at work. First, the decline in business fixed investment can be attributed to financial institutions' becoming extremely cautious in their lending stance toward firms, especially small- and medium-size firms (Motonishi and Yoshikawa (1999)). Second, even those firms that were not facing funding constraints had intensified uncertainty regarding the investment environment in view of the heightened financial system

Subsequently, the economy slowed down again in early 2001, triggered by the burst of IT bubble worldwide while Japan's NPL problem was yet to be resolved. In addition, financial institutions' core capital declined again, reflecting the decline in stock prices toward 2002 which became a destabilizing factor for financial institution management (Figure 12).

(Figure 12) Asset prices and CPI



Note: 1. Adjusted to exclude the effects of consumption tax hikes.

Capital Gains / Losses

(in percent of nominal GDP)

Land ¹		Stock ¹	
1986-90	365.3	1986-89	147.2
1991-2004	-260.0	1990-2004	-89.6

Note: 1. 1995-base previous to and including 1995 and 2000-base for ensuring years.

Sources: Cabinet Office, "Annual Report on National Accounts"; Ministry of Internal Affairs and Communications, "Consumer Price Index"; Japan Real Estate Institute, "Real Estate Indexes"; *Nihon Keizai Shimbun*.

If the liquidity constraints of financial institutions had intensified during this period, its effects might not have remained at the level of financial institution management. Developments could have affected the lending stance of financial institutions and, if

uncertainty, and thus deferred their business fixed investments to some extent (Bank of Japan (1998)).

many firms felt the risk that the financial system instability experienced in 1997-1998 might recur, such firms might have become reluctant to lock in their funds in the form of business fixed investment.²⁶ In addition, if firms were likely to face funding constraints in the future, they would face the risk of being unable to take advantage of profitable investment opportunities in the future, and might have found it preferable to invest current cash flows in liquid assets and defer their business fixed investment.²⁷

Therefore, in examining the QEP's effects on stabilizing the financial system, the viewpoint of whether the QEP forestalled such spillovers into the real economy is important. Bearing this in mind, this paper now examines empirical analyses focusing exclusively on what direct effects the QEP had on financial institutions and financial markets. As the transmission channels of the effects, one could apply the hypothesis presented in King (2002) that when the central bank provides more money than necessary for households and firms to conduct smooth economic activity consistent with the current level of income, this provision of liquidity service by money reduces the transaction costs not only of goods but also of financial assets in the financial market, thereby mitigating the cash-flow constraints of the private sector. While the theoretical interpretation of this hypothesis is yet to be established, it could be considered as one of the portfolio rebalancing effects in the future. In addition, one can think of a transmission channel whereby the commitment to maintain the QEP reduces the possibility of future funding risk from occurring and thus reduces risk premiums.

In the meantime, some note the channel whereby as the QEP flattens the yield curve, financial institutions which conduct short-term funding and long-term investment can make little profit out of maturity transformation, thereby exerting side effects on the banking system (IMF (2003)). However, empirical analyses have not yet been conducted on this aspect because, through the periods after the adoption of the QEP, the profits of financial institutions actually depended substantially on changes in the credit costs which had arisen due to the NPL problem.

²⁶ This view can be derived from applying real option theory when investment has both irreversibility and uncertainty. See Dixit and Pindyck (1994).

²⁷ This line of thinking under concerns over future liquidity constraints was introduced in Hori, Saito, and Ando (2004).

b. Verification method and results

Of the qualitative analyses that dealt with the QEP's effects on dispelling the liquidity concerns of financial institutions, by comparing the changes in policy actions with the developments in financial markets, Baba, Nishioka, Oda, Shirakawa, Ueda, and Ugai (2005) assess that the QEP prevented the generation of risk premiums when financial institutions raised funds in financial markets, and avoided recurrence of the liquidity crisis that occurred during 1997-1998. In addition, Suzuki and Kobayashi (2005) also conclude that the BOJ's ample liquidity provision to the market had a preventive effect on financial institutions' funding concerns.

While there are a few studies that measure quantitatively the QEP's effects on the funding costs of financial institutions, Baba, Nakashima, Shigemi, and Ueda (2006) report that during the QEP phase the dispersion of issuance rates of negotiable certificates of deposits (NCDs) by major banks (city banks and trust banks), which share about 30% of their market funding needs, fell to or below the level of October 1997, when the difference in creditworthiness among individual banks drew little attention. They also pool the single year data of the NCD credit spreads²⁸ for 1997, 1999, 2002, 2004, and 2005 (up to beginning of May), respectively, and run regressions of the credit spreads on dummy variables corresponding to sample banks' credit ratings for each year to estimate credit spreads for each credit rating category (credit curves). The results show that the slope of the credit curve started to flatten after introduction of the ZIRP in 1999 and maintained this trend under the QEP, to become almost flattened out in 2004-2005, indicating that the differences in credit ratings were then barely reflected. Furthermore, after controlling for the difference in creditworthiness by the spread of bank bond yield over the yield of JGBs with the same maturity, they conduct a panel analysis to estimate to what extent monetary policy-related variables have contributed to the behavior of individual financial institutions' NCD issuance rates. The findings indicate that the introduction of both the ZIRP and the QEP were statistically significant, and that clarification of the commitment was sometimes statistically significant, although minor. While the BOJ's CABs were not statistically significant as an explanatory variable, the maturity length of the BOJ's bill-purchasing operations was statistically significant. While these results do not change the credit risks that represent the solvency of financial institutions, it may be interpreted that credit risks in a broad sense were reduced in that

²⁸ They defined the credit spread for a bank as the interest rate on NCDs issued by the bank with each maturity (less than 30 days, 60 days, and 90 days) minus the weighted average of the uncollateralized overnight call rate over all banks.

funding risks were mitigated by the clarification of the BOJ's stance to continue providing ample liquidity. Therefore, they conclude that the BOJ's commitment to policy duration had the effect of reducing the credit spread, and that the lengthening of the BOJ's operation maturity might have had some effects.

Fujiki and Shiratsuka (2001) use the relationship whereby the stronger the demand for liquidity, the lower the profitability of securities with short maturity and the steeper the slope of the yield curve, and consider the effects on financial institutions' liquidity constraints during the ZIRP period. Specifically, they find that the term spreads of Euroyen (1-3 months) in terms of the difference over overnight interest rates shrunk markedly during 1999-2000. From this observation, they conclude that, by way of the policy duration effect, the range of zero-interest rate financial assets that were substitutes for the monetary base expanded and thus increased liquidity substantially, and this resulted in mitigating the liquidity constraints of financial institutions. Since the range of financial assets that were substitutes for the monetary base further expanded under the QEP compared with the ZIRP period, it is possible to assume that this liquidity effect remained in place.

(2) Effects of raising aggregate demand and prices

a. Generation mechanism of continuous price declines, and verification

This section analyzes to what extent the QEP, after exerting effects to contain the risk of a deflationary spiral stemming from financial system instability (as shown in the previous section), is considered to have further contributed to raising Japan's aggregate demand and prices based on empirical analyses.

While a decline in productivity also contributed to the prolonged stagnation of Japan's economy after the 1990s, a drop in the natural rate of interest due to negative demand shocks seems to have played a major role in the modest but continuous price decline over that time.²⁹ Corporations' prolonged suffering from their balance sheet adjustments may also be described as that the economy lagged in its response to negative demand shocks, or that negative demand shocks were continuously imposed on the economy. This paper now examines to what extent the QEP exerted its easing effect and

²⁹ Another interpretation of deflation is that it will persist under zero interest rates despite the natural rate of interest continues to be positive (a "deflationary trap") (Benhabib, Schmitt-Grohé, and Uribe (2002) and Iwamoto (2004)).

raised aggregate demand and prices under this situation where the impact from the decline in Japan's natural rate of interest continuously affected the economy.

Since the verification results differ depending on which QEP transmission channel is measured, this paper considers three types of approaches: (i) measuring broadly without specifying the transmission channel, (ii) measuring the effects in shifting the yield curve downward, mainly bearing in mind the policy duration effect, and (iii) measuring the effects of an increase in the monetary base, mainly bearing in mind the portfolio rebalancing effect. Here, this paper comprehensively captures the effects on the economy, including the direct effects on aggregate demand and price expectations that could not necessarily be measured by the approach of assessing the transmission channel in terms of the effect on financial assets yields adopted in Section 2.

b. Verification method and results

b-1. Verification that broadly measures the effects of the QEP

This subsection begins by introducing a study that does not specify the transmission channel of the QEP, but rather broadly grasps and measures the QEP's effects on Japan's economy. The merit of this approach is that it avoids underestimating the policy effects resulting from imposing in advance too strong a constraint on the transmission channel, and enables one to gauge the QEP's comprehensive effects on the economy, including not only those through such transmission channels as the commitment or the changes in the yields of various financial assets, but also conceptually incorporating other channels such as even the positive effect of dispelling the funding anxieties of the financial institutions.

Kamada and Sugo (2006) try to identify changes in the policy stance by using, instead of the uncollateralized overnight call rate, private banks' financial intermediary function represented by the combination of lending rate and lending attitude, which are "intermediate variables" not directly influenced by the zero bound constraint on the policy rate, as a monetary policy proxy that distills the various transmission channels of monetary policy. They approximate the monetary policy proxy to economic performance during 1978-1995, a period in which short term interest rates were not faced with the zero bound constraint, and then extrapolate this to the following period. They find that, as a result of the BOJ's various policy responses as short-term interest rates could not be reduced below zero, the monetary policy proxy can be considered as negative if converted to the overnight call rate after the adoption of the QEP. This can be interpreted

as indicating that corporate financing during that time was that accommodative.

They next use five variables — the CPI, industrial production, the foreign exchange rate, 10-year JGB yield, and the monetary policy proxy — and conduct Vector Autoregressive (VAR) analysis³⁰ to identify changes in policy stance, by attaching minimum theoretical constraints on the monetary policy proxy and the foreign exchange rate so as to capture policy effects broadly without limiting transmission channels. When they calculate the impulse responses of prices and production against monetary easing, the policy effects decline as they include the QEP period at the end of the data sample (Figure 13). In addition, when they estimate the point of structural change generated in the monetary policy transmission channel,³¹ they find structural change around the end of 1990, which corresponds to the peak of the asset price bubble, but identify no subsequent structural changes. When they conduct a counterfactual simulation by combining monetary easing after the burst of the asset price bubble with the VAR model that described Japan’s economy before the burst of the asset price bubble, the result indicates an increase in prices. From this, they conclude that, in addition to the zero bound constraint on interest rates and the erosion of banks’ financial intermediary functions, the worsening of corporate balance sheet problems and the breakdown of the mechanism that amplifies economic activity limited the effects of monetary easing.

(Figure 13) Effects of policy stance change under a zero bound constraint on interest rates
(VAR analysis)

		Variables	Sample period (Beginning: Feb.1978)	Effects on prices (After 3 years)	Effects on real economy (After 3 years)
Kamada and Sugo (2006)	Sign-restriction VAR	5	Until Dec. 1995	CPI: positive	Industrial production: positive
			Until Jan. 1999	CPI: positive, but slight decline	Industrial production: positive, but substantial decline
			Until Feb. 2001	CPI: positive, but further decline	Industrial production: positive, but further decline
			Until Apr. 2005	CPI: positive, but further decline	Industrial production: positive, but further decline

³⁰ More strictly, they used the sign-restriction VAR model. See Uhlig (2005) for details.

³¹ They apply a Bayesian statistics method called the Markov chain Monte Carlo method to the sign-restriction VAR in their verification.

b-2. Verification measured from the effects of lowering yield curve

As previously shown, the analyses that verified the policy duration effect as the QEP's transmission channel found that the QEP had the effect of flattening the yield curve. This apparently recognizes that an accommodative environment had been generated in terms of the extent of corporate financing. While the effects on aggregate demand and prices were mixed, as shown below, in general more papers find that the QEP did not lead to raising aggregate demand and prices because of insufficient functioning of financial intermediation and corporate balance sheet adjustment.

For example, Okina and Shiratsuka (2004) and Baba, Nishioka, Oda, Shirakawa, Ueda, and Ugai (2005) argue that, although the QEP lowered the yield curve mainly through the policy duration effects, its effects on prices and the economy were limited. Similar reasons are cited in both studies. Based on the observation that the implied forward rate for longer terms did not rise, Okina and Shiratsuka (2004) conclude that the QEP did not have the effect of reversing the financial market's expectations that deflation would persist. They say this is because the transmission mechanism from lender to borrower was blocked up and the monetary easing effect did not spill over to outside the financial system. Baba, Nishioka, Oda, Shirakawa, Ueda, and Ugai (2005) show, by way of structural model analysis, that the reduction of net assets of both lenders and borrowers raised funding costs through information asymmetry between them,³² and interpret that this offset the effects of lowering the yield curve. At the same time, however, as discussed on Section 2 (1), they also point out the possibility that the effect of the commitment on lower interest rates could have contributed to produce some higher inflation expectations when viewed from the long-term perspective, since this lowering effect was lower for 10-year bonds than for 3- and 5-year bonds.

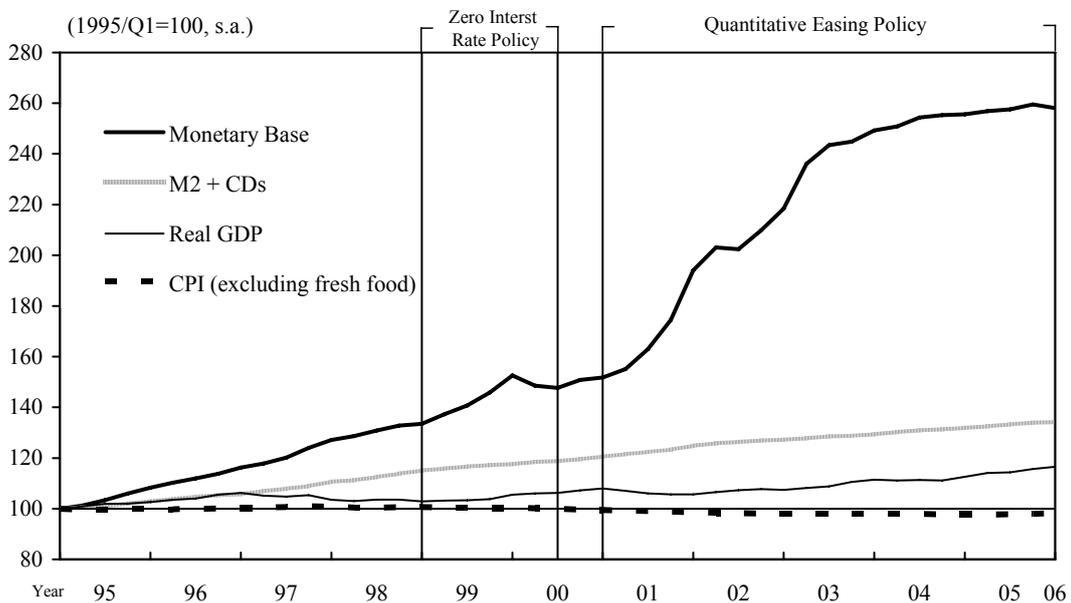
On the other hand, Kobayashi and Suzuki (2005) made a positive assessment about the monetary easing effect by showing that, with the combination of the zero policy interest rate and the policy duration effect, long-term real funding rates declined centering on the manufacturing industry from 2002 and the lending attitude of financial institutions became accommodative, which was effective to a certain extent in raising firms' funds demand, with some lag. However, they do not make their assessment dividing the effects of lowering the policy interest rate to zero percent and the policy duration effects.

³² This effect is referred to as the financial accelerator (Bernanke, Gertler, and Gilchrist (1999)). For an

b-3. Verification measured from the effects of the monetary base increase

Section 2 (2), (3) showed that the effects through the transmission channels of the increase in the BOJ's CABs and the increase in the purchase of long-term JGBs were mixed in terms of statistical significance and small, if any, compared with the effects of the commitment. However, as long as the detected effects depend on how the transmission channels are specified, the overall assessment of the effects needs to be made upon examining the relationship between increases in the BOJ's CABs and the monetary base vis-à-vis aggregate demand and prices. In this regard, when viewing the development of financial and economic indicators as shown in Figure 14, amid a substantial increase in the monetary base the growth of M2+CD was relatively small, and the growth of real GDP and the CPI even smaller. This section now summarizes the empirical analyses that rigorously analyze the relationships between such financial quantitative indicators and economic indicators.

(Figure 14) Quantitative monetary indicators, real GDP, and CPI



Sources: Cabinet Office, "Annual Report on National Accounts"; Ministry of Internal Affairs and Communications, "Consumer Price Indexes"; Bank of Japan.

analysis of Japan's prolonged stagnation using this effect, see Fuchi, Muto, and Ugai (2005).

Verification of effects that do not factor in policy regime change

Before the QEP was adopted, it was often argued that if the BOJ were to expand its monetary base, the money stock (M2+CDs is the representative indicator in Japan) would increase, and deflation would be stopped. Tracing the background logic of this argument, it seems that the argument is based on the following quantity equation which replaces the transaction amount with GDP.

$$MV = PY$$

M : money, V : velocity, P : prices, Y : real GDP

This view interprets that the quantity equation shows causality, in that when M is increased, P or Y rises or increases stably. Typically, the argument starts by conducting a regression on M2+CDs using the monetary base, the declining trend of the money multiplier (M2+CDs/monetary base), and the lending attitude of financial institutions, and, upon showing that the monetary base is statistically significant as an explanatory variable, then estimates a function whereby nominal GDP/M2+CDs explains the inflation rate, and concludes that an increase in the monetary base would raise inflation via the money stock (Shinpo (2002)).³³ In addition, there is an empirical analysis based on the VAR model which shows that among money stock, bank lending, and funding other than that from banks, money stock has the largest effect on economic activity (Harada and Okamoto (2004)).

However, Woodford (2003) presents an influential view that the money quantity equation shows the state of economic equilibrium, and not causality as described above; and that therefore money could not affect prices independent of interest rates under a specific monetary policy even if one takes into account the mechanism whereby money reduces transaction costs. From this standpoint, even if there were a stable relationship between an increase in the money stock and economic activity when interest rates are positive, this relationship would disappear once interest rates become zero. Consequently, in order to accept that the quantity equation shows causality and monetary easing which increases money stock is effective, one must assume that the relationship between the monetary base and money stock, and their relationship with nominal GDP, would in fact

³³ There are arguments that go further to propose that the price level could be raised if the BOJ determines the amount of the monetary base to increase and adjusts the CABs to realize that amount (Hetzl (2004)).

be stable when the monetary base is intentionally increased under zero interest rates. However, the data used in the studies here, covering fiscal 1974-2000 in Shinpo (2002) and 1980 1Q-2001 4Q in Harada and Okamaoto (2004), are long-term time series data and hardly cover the periods of the ZIRP and QEP. So assessment of the stability of the relationships among the monetary base, money stock, and nominal GDP under the QEP must await further data accumulation.

Also, when looking at empirical analyses on the stability of the relationship between the monetary base and money stock, many studies conclude that the relationship was unstable under zero interest rates. For example, Policy Planning Office, Bank of Japan [2002] shows that the monetary base and money stock are not linked by a fixed rate to begin with, that especially under an environment where interest rates are close to zero, the cash/bank deposits ratio and the BOJ's CABs/bank deposits ratio both fluctuate substantially, and that the money multiplier also becomes unstable and fluctuates in an unpredictable manner. Kuttner (2004) also judges, by viewing the developments between M2+CDs and the BOJ's CABs (the operating variable of the QEP) or the monetary base, that the link between them was weak.

In addition, many results show that the relationship between the money stock and economic activity has weakened. With respect to M2+CDs,³⁴ for example, Kuttner (2004) states that if you extend the long-run relationship between M2+CDs and real GDP and prices measured from before 1990 until 2004, the relationship still exists, but is becoming weak. On the other hand, Policy Planning Office, Bank of Japan (2003) verifies a long-run equilibrium relationship among real M2+CDs, real GDP, and the opportunity cost of holding money using the Vector Error Correction Model based on two sets of data from 1971 forward and from 1981 forward, and notes that the long-run equilibrium relationship was not identified if data since the end of 1997 when financial system concerns rapidly heightened were included. In addition, Miyao (2005) conducts a rigorous verification with respect to the long-run equilibrium relationship between M2 and economic activity. He shows that the long-run equilibrium relationship does not hold among M2, real GDP, and prices, and also that M2 does not have the power to forecast

³⁴ With respect to narrow money (M1), while Miyao (2002) and Fujiki and Watanabe (2004) show that money demand for interest rate levels has been unstable under an extremely low interest rate environment, they nevertheless conclude that the usefulness of velocity is not lost if you use the function in the form of double-log specification that depicts both money demand and interest rates in logarithms.

real GDP, the GDP deflator, or nominal GDP if data during 1993-2003 are used.³⁵ As to why the relationship between the money stock and economic activity has become fragile, several reasons have been pointed out: the nonperforming loan problem and progress of corporate restructuring (Miyao (2005)), financial system uncertainty with heightened precautionary demand for currency on the part of households and firms, and how the opportunity cost of liquidity service provided by M2+CDs declined substantially under zero interest rates, which induced a substantial fund shift among financial assets (Policy Planning Office, Bank of Japan (2003)).

As such, much empirical evidence indicates that the relationships between the monetary base and money stock, and between the monetary base and nominal GDP have been extremely unstable, at least when interest rates were zero.

Verification of effects that factor in policy regime change

This paper now proceeds to examine the analyses that explicitly factor in the changes of policy regime under the zero bound constraint on interest rates. Especially in the recent analyses VAR models that take into account changes of policy regimes under the zero bound constraint on interest rates are being adopted in order to extract objectively from the data the relationships among the monetary base, the real economy, and the inflation rate. Three specific examples are cited below (see Figure 15 for a list of the results).

Kimura, Kobayashi, Muranaga, and Ugai (2003) use four variables — the CPI rate of change, the GDP gap, the monetary base rate of increase, and the overnight call rate — and estimate a VAR model³⁶ with time-varying coefficients for the sample period of 1971 2Q-2002 1Q. They find that the impulse response to an increase in the monetary base was in the direction of an inflation rise as of 1985 (2Q), while there was no response against either the inflation rate or the GDP gap as of 2002 (1Q). Based on these findings, they conclude that, given the structural changes in the economy under a zero bound constraint on interest rates, they could not extract a function whereby the monetary base channel raised prices or the economy.

Fujiwara (2006) tries to grasp the policy effects using the VAR³⁷ analysis that does

³⁵ Sugihara, Mihira, Takahashi, and Takeda (2000), while based on data up to ZIRP period, also find similar instability of money demand.

³⁶ They use a Bayesian VAR model.

³⁷ They use the Markov Switching VAR model.

factor in a structural break in monetary policy effects, but does not impose constraints a priori on the timing of such a break. Specifically, he uses monthly data from 1985-2004 and conducts analyses using three variables — the CPI, industrial production, and the monetary base — and then using four variables, adding the new issuance rate for a 10-year JGBs. The analyses using three variables suggest a regime change before and after 1998. The impulse responses of the economy and prices to an increase in the monetary base declined from 1998, and the confidence interval shows that they then became statistically insignificant. The analyses using four variables suggest a regime change around 2000, which is close to the time of the adoption of the QEP. The economy and prices responded in a positive direction and the long-term interest rate in a negative direction, but these developments became statistically insignificant after 2000. From these results, Fujiwara concludes that the increase in the monetary base had, under zero interest rates, some slightly positive effects on the economy and prices to an extent that is statistically insignificant, and that such effects became considerably smaller after the regime change occurred under zero interest rates.

Sadahiro (2005) conducts Vector Error Correction Model analysis that factors in the long-term equilibrium relationship among variables exclusively for the period deemed to face a zero bound constraint on interest rates. Specifically, for 6 variables — the Japan/US monetary base ratio, the yen/dollar exchange rate, the Japan/US inflation rate differential (the difference between the CGPI rate of change and the PPI rate of change), the Japan/US short-term interest rate differential, the Japan/US industrial production index ratio, and the money multiplier, he estimates an error correction model using the monthly data during January 1996-September 2004. The impulse responses of the inflation rate and industrial production to the increase in the monetary base through this model were that production does increase although the magnitude is minimal, and the inflation rate responds in a negative direction. From these results, Sadahiro concludes that the effectiveness of the increase in the monetary base was lost during the period when interest rates were zero.

(Figure 15) Effects of an increase in the monetary base under the zero interest rate constraint
(VAR analysis)

		Variables	Period	Effects on prices	Effects on real economy
Kimura et al. (2003)	Bayesian VAR	4	1985	CPI rate of change: yes (positive)	GDP gap: uncertain (slightly positive)
			2002	CPI rate of change: no	GDP gap: no
Fujiwara (2006)	Markov Switching VAR	3	Until 1998	CPI: significant	Industrial-production: significant (positive)
			After 1998	CPI: insignificant (close to zero)	Industrial-production: insignificant (slightly positive)
		4	Until 2000	CPI: insignificant (positive)	Industrial-production: significant (positive)
			After 2000	CPI: insignificant (slightly positive)	Industrial-production: insignificant (slightly positive)
Sadahiro (2005)	Vector Error Correction Model	6	Jan.1986-April 1995	CGPI rate of change: yes (positive)	Industrial-production: yes (positive)
		6	Jan.1996-Sep.2004	CGPI rate of change: yes in opposite sign (negative)	Industrial-production: small (slightly positive)

Another study that analyzes what effects other than lowering short-term interest rates could be observed on the economy and prices if the central bank actively provides a monetary base greater than that which equilibrates with the current economic activity level (hereafter, the difference between the two is referred to “as excess money”) using a structural model that incorporates the transmission channels explained in Section 2 (2). According to Kimura, Kobayashi, Muranaga, and Ugai (2003), the explanatory power of such excess money (the difference between the real monetary base growth and the long-run desired growth rate) on the GDP gap has been extremely unstable. When conducting regression analysis of the aggregate demand curve by gradually extending the measurement period, the relationship is positive in a statistically significant manner for data up to 1997 and up to about 2000, while it becomes statistically insignificant for data up to 1998-99, and would become negative if data after 2001 were included. Even in cases where values are positive, the size of the parameters is considerably smaller than in previous studies in the UK and US. When looking at the explanatory power of excess money (the difference between the real monetary base and that consistent with monetary

equilibrium) on the inflation rate, statistically significant positive parameters are obtained for data up to approximately 1997, while the parameters become small as data after 1997 are included, and become almost zero when data up to 2002 1Q are included. Consequently, they tentatively conclude that the effects of an increase in the monetary base are very uncertain and small, if any.

The analyses introduced so far present many cases in which effects indicating that an increase in the monetary base raises the real economy, the inflation rate and price levels have not been identified, or are small. As for the reasons why, studies which find little portfolio rebalancing effects interpret that the effects of an increase in the monetary base are small to begin with. However, studies which do not deny the possibility of effective portfolio rebalancing, for example, Horiuchi (2004) and Kimura, Kobayashi, Muranaga, and Ugai (2003), interpret that at the root of monetary easing remaining insufficient were such factors as the insufficient recovery of the financial intermediary function, although monetary policy and prudential policy staved off its further deterioration, and the structural adjustment in the corporate sector which was still underway. In particular, Horiuchi (2004) emphasizes the point that financial institutions which faced critical situations triggered by the nonperforming loan problem were reluctant to extend loans.

4. Concluding remarks

This paper has reviewed the effects of the BOJ's QEP. The preliminary conclusions obtained from this survey of empirical analyses can be summarized in the following four points.

First, many studies show the obvious effect of the commitment to maintain zero interest rates on the expected future path of short-term interest rates, with lower-than-expected interest rates over the short- to medium-term range. This also implies that the commitment policy secured market confidence. In addition, the QEP that committed to the actual performance of CPI had stronger effects on lowering the yield curve than the ZIRP that committed to future dispelling of deflationary concerns.

Second, the effects from expanding the BOJ's balance sheet (expansion of the monetary base) through an increase in the BOJ's CABs and the effects from altering the BOJ's asset composition through increased purchases of long-term JGBs can be assessed in line with the transmission channels as follows. Views are mixed as to whether portfolio rebalancing had any effect on narrowing the premium portion of bond yields, and many

find that the effects, if any, were small compared with the effects of the commitment. There were some phases in which the BOJ's CABs were identified to at least have a signaling effect, while no such effects were identified from increased purchases of long-term JGBs.

Third, the results show that the QEP had macro effects on Japan's economy in that it generated an accommodative financial environment. While the transmission channels cannot be specified, analyses find that the QEP had the effects of dispelling the funding concerns of financial institutions. This finding implies that the QEP had the effects of maintaining financial market stability and an accommodative financial environment, and thereby avoiding further deterioration of the economy and prices stemming from corporations' anxieties regarding future funding.

Fourth, effects from increasing the monetary base under the zero bound constraint on interest rates were not detected or were small, if any, compared with the periods without the zero bound constraint on interest rates. When gauging the effects of the QEP broadly, the results show limited effects on raising aggregate demand and prices, despite realizing more monetary easing than from merely reducing the uncollateralized overnight call rate to zero percent. Other than the zero bound constraint on interest rates, the major factors behind these limited effects were the erosion of the financial intermediary functions of banks burdened by nonperforming loans and corporate balance sheet adjustments, which diminished the manifestation of policy effects.

The largest effect of the QEP identified in this survey was through the channel that works on the expected future path of short-term interest rates. This suggests that, in conducting monetary policy with due recognition of the zero bound constraint on interest rates, communication from the central bank to the private sector about monetary policy is critical in manifesting policy effects.

Regardless, empirical analyses on the channels and magnitude of the QEP's effects are still not sufficient. It is expected that with many additional studies the validity of the preliminary conclusions presented here will be scrutinized from various angles in the future. This paper now ends by listing several issues that deserve further empirical studies.

The first is the portfolio rebalancing effects. This survey did not find that these effects were strongly manifested. However, this area has yet to find a consensus of macroeconomic understanding, and thus lacks sufficient empirical analyses. For example, there has been no empirical verification that as the BOJ's CABs increased, the yields on

financial assets abroad declined by way of the carry trade utilizing yen, with extremely low funding costs, or that the real estate-related securities market was affected, and the transmission channels are not theoretically clear. As represented by these examples, whether the QEP had subtle and broad-based effects on various asset markets awaits the accumulation of further studies.

The second issue is the multi-faceted examination of the commitment effect. According to the classification of Eggertsson and Woodford (2003), even when an economy has tumbled into a liquidity trap, the central bank's credible commitment to recover the economy substantially in the future when the natural interest rate turns positive is theoretically expected to raise aggregate demand and prices through four channels: (i) by stimulating current spending even when current nominal interest rates face a zero bound constraint by maintaining nominal interest rates at a lower level for longer in the future than would normally be expected; (ii) by stimulating current spending by reducing real interest rates by generating inflation expectations; (iii) by stimulating current spending from expectations that future income will increase; and (iv) expectations that the inflation rate will rise in the future make it less likely for current prices to fall. While empirical analyses on the policy duration effect have focused especially on channel (i), studies have not quantitatively clarified the extent to which each other channel that does not especially mediate financial markets was effective. In addition, the extent to which the actual commitment diverges from the theoretical optimal commitment, which is derived from the magnitude of demand shock and price shock to the economy and the structure of Japan's economy,³⁸ would be an important contentious issue in assessing the effects of the commitment policy.

The third issue is to what extent the QEP could have been effective if Japan's economy did not go through a substantial decline in asset prices and the associated erosion of core capital and risk-taking ability on the part of corporations and financial institutions, as witnessed during the 1990s to early 2000s. While we have begun to see such studies as Kamada and Sugo (2006) recently, the number is still extremely few. In considering policy measures when short term interest rates face a zero bound constraint in the course of the normal business cycle, it is essential to have studies that explicitly differentiate the effects stemming from the QEP, structural adjustment, and the zero bound constraint on interest rates.

³⁸ Oda and Nagahata (2005) examined the costs and benefits of maintaining zero interest rates by committing only to inflation rates in relation to the magnitude of demand and price shocks.

The fourth issue is about the significance of normal financial transactions becoming unprofitable under the QEP. In this regard, market practitioners have often noted that declines in transactions in the short-term money market and declines in the credit spreads of corporate bonds influence the efficiency of resource allocation.³⁹ On the other hand, some consider such phenomena as transitory adjustment costs while financial schemes are unable to adapt to a zero interest rate environment (Bernanke and Reinhart (2004)). There have been almost no empirical analyses from these viewpoints, and the accumulation of future studies is awaited.

³⁹ Shirakawa (2006) introduces such market practitioners' viewpoints.

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Quantitative Easing Policy (QEP)

Appendix-1

Date	The Bank's views on economic activity and prices	Reasons for policy change	Changes		
			Bank of Japan CABs	Outright purchases of long-term JGBs (amount)	Others
2001/3/19 Introduction of the QEP	<p>Present: Japan's economic recovery has recently come to a pause. Prices have been showing weak developments.</p> <p>Outlook: The economy will likely remain stagnant for some time. There is concern about an increase in downward pressures on prices stemming from weak demand.</p>	To prevent prices from declining continuously as well as to prepare a basis for sustainable economic growth.	<p>The main operating target for money market operations changed from the uncollateralized overnight call rate to the outstanding balance of the current accounts at the Bank of Japan.</p> <p>From an average of 4 trillion yen to around 5 trillion yen.</p> <p>Should there be a risk of financial market instability, the Bank will provide ampler liquidity irrespective of the guideline above.</p>	Increase from 400 billion yen per month.	Committing that the QEP continues to be in place until the consumer price index (excluding perishables) registers stably a zero percent or an increase year on year.
2001/8/14	<p>Present: Economic adjustments are deepening. The CPI continues to be somewhat weak.</p> <p>Outlook: Adjustments in economic activities will continue for the time being. Attention should be paid to the risk of adjustments to spread even further, and the risk of a negative impact on the economy induced by developments in foreign and domestic capital markets. A weaker demand could intensify downward pressure on prices.</p>	To further strengthen support for economic recovery.	From around 5 trillion yen to around 6 trillion yen.	From 400 billion yen per month to 600 billion yen per month.	—
2001/9/18	<p>Present: Adjustments in economic activity are becoming more severe. The CPI is weakening.</p> <p>Outlook: Adjustments in economic activity will possibly be prolonged. Attention should be paid to the growing risks of a negative impact on the economy induced by developments in foreign and domestic capital markets. The possibility that weak demand will further intensify downward pressure on prices warrants careful monitoring.</p>	To secure proper functioning of financial markets and to enhance the effective permeation of monetary easing effects.	From around 6 trillion yen to above 6 trillion yen.	—	<p>Reduction in the official discount rate from 0.25% to 0.10%.</p> <p>Increase in the maximum number of business days for using the Lombard-type lending facility.</p>

Appendix-2

Date	The Bank's views on economic activity and prices	Reasons for policy change	Changes		
			Bank of Japan CABs	Outright purchases of long-term JGBs (amount)	Others
2001/ 12/19	Present: The economy is deteriorating broadly. The CPI is weakening.	To secure that the financial markets continue to work in a stable manner and to ensure that economic recovery will be effectively supported.	From above 6 trillion yen to around 10-15 trillion yen.	From 600 billion yen per month to 800 billion yen per month.	Measures to strengthen money market operations.
	Outlook: The economy will inevitably continue to deteriorate for a while. Continuous attention should be paid to the risk of a negative impact on the economy induced by developments in foreign and domestic financial markets. The possibility that weak demand will further intensify downward pressure on prices warrants careful monitoring.				
2002/ 2/28	Present: The economy continues to deteriorate. The CPI is declining somewhat faster.	A possibility that liquidity demand will increase further with the end of a fiscal year approaching. To take all possible measures to secure the financial market stability.	Providing more liquidity to meet a surge in demand towards the end of a fiscal year irrespective of the target of CABs.	From 800 billion yen per month to 1trillion yen per month.	Extending the days to apply the official discount rate on the use of the Lombard-type lending facility. Examining issues to broaden the range of eligible collateral.
	Outlook: The economy will continue to deteriorate, but the pace is expected to moderate gradually. Continuous attention should be paid to the risk of a negative impact on the economy from developments in foreign and domestic financial markets. The possibility that weak demand will further intensify downward pressure on prices warrants careful monitoring.				
2002/ 10/30	Present: The economy has stopped deteriorating but has not yet shown clear signs of recovery. The CPI remains on a gradual downtrend.	To take best measures to maintain the smooth functioning and stability of financial markets, thereby strengthening support for economic recovery.	From around 10-15 trillion yen to around 15-20 trillion yen.	From 1 trillion yen per month to 1.2 trillion yen per month.	Extending maturities for bills purchased.
	Outlook: The economy will gradually form foundations for recovery. Prospects for the economy have been facing increasing uncertainties. The CPI is expected to stay on a declining trend for the time being at the current gradual pace.				
2002/ 12/17	Present: The economy has stabilized as a whole, but there is still substantial uncertainty toward recovery. The CPI remains on a gradual downtrend.	(Policy unchanged) To secure smooth corporate financing.	—	—	Acceptance of a broader range of loans on deeds as eligible collateral. Relaxation of standards for ABCP as eligible collateral.
	Outlook: The foundations of Japan's economic recovery will gradually be made firmer. The downside risk continues to require attention. The CPI is expected to stay on a declining trend for the time being at the current gradual pace.				

Appendix-3

Date	The Bank's views on economic activity and prices	Reasons for policy change	Changes		
			Bank of Japan CABs	Outright purchases of long-term JGBs (amount)	Others
2003/3/25	Present: Economic activity remains flat. The CPI has been declining gradually.	Closely monitoring how the military action against Iraq will affect the economy, and standing ready to make every effort to ensure financial market stability.	From around 15-20 trillion yen to around 17-22 trillion yen from April 1.	—	As a temporary measure, the Bank will apply the official discount rate to the Lombard-type lending facility on any business day.
	Outlook: The momentum for a recovery will be initiated. The downside risk continues to require attention. The pace of year-on-year decline in the CPI is expected to become somewhat slower.		(Due to the establishment of the Japan Post)		
2003/4/30	Present: Economic activity remains flat. The CPI has been declining gradually.	To maintain financial market stability, thereby strengthening support for economic recovery.	From around 17-22 trillion yen to around 22-27 trillion yen.	—	Decided to accept loans on deeds to the Industrial Revitalization Corporation of Japan with government guarantee as eligible collateral.
	Outlook: The momentum for a recovery will be initiated. More uncertain factors warrant careful monitoring. The pace of year-on-year decline of the CPI is expected to become somewhat slower.				
2003/5/20	Present: Economic activity remains flat but uncertainties about future prospects have recently been increasing. The CPI has been declining gradually.	The government decided that injection of capital into Resona Bank was necessary. To show the BOJ's determination to ensure financial market stability.	From around 22-27 trillion yen to around 27-30 trillion yen.	—	—
	Outlook: The momentum for a recovery will be initiated, although there is greater uncertainty. The year-on-year decline in the CPI is projected to remain around the April level.				
2003/6/11	Present: Economic activity remains virtually flat as a whole. The rate of decline in the CPI has diminished.	(Policy unchanged) To promote smooth corporate financing. To strengthen the transmission mechanism of monetary easing.	—	—	Decided the outline of the scheme for outright purchases of asset-backed securities.
	Outlook: The momentum for a recovery will be initiated, although there continues to be substantial uncertainty. The CPI is projected to continue falling at the current moderate pace on a year-on-year basis.				

Appendix-4

Date	The Bank's views on economic activity and prices	Reasons for policy change	Changes		
			Bank of Japan CABs	Outright purchases of long-term JGBs (amount)	Others
2003/ 10/10	Present: The foundation for a gradual recovery is being laid. The year-on-year rate of decline of the CPI diminished.	To further ensure the recent movement toward an economic recovery.	From around 27-30 trillion yen to around 27-32 trillion yen.	—	<p>Extension of the maturity of the purchase of Japanese government securities with repurchase agreements.</p> <p>Enhancement of monetary policy transparency.</p> <p>Presenting the basic thinking on the conduct of monetary policy and the evaluation of the developments of the economy and prices in a more timely and lucid manner.</p> <p>More detailed description of the commitment to maintaining the QEP.</p>
	<p>Outlook: The economic recovery will gradually gather momentum. It is expected to take some more time before a self-sustaining recovery in domestic demand gains momentum.</p> <p>The CPI is basically projected to continue falling gradually.</p>				
2004/ 1/20	Present: The economy is recovering gradually. The year-on-year rate of change in the CPI has been close to zero percent.	<p>Developments in financial and foreign exchange markets and their impact warrant close monitoring.</p> <p>To reaffirm the policy stance to overcome deflation.</p>	From around 27-32 trillion yen to around 30-35 trillion yen.	—	Modification of the conditions regarding the purchases of asset-backed securities.
	<p>Outlook: The economy is anticipated to continue recovering, although the pace of recovery is expected to remain moderate.</p> <p>The CPI is projected to be on a slightly declining trend.</p>				

Appendix-5

Date	The Bank's views on economic activity and prices	Reasons for policy change	Changes		
			Bank of Japan CABs	Outright purchases of long-term JGBs (amount)	Others
2004/ 4/9	Present: The economy continues to recover gradually, and domestic demand is becoming firmer. The year-on-year rate of change in the CPI has been close to zero.	(Policy unchanged) To enhance liquidity and maintain the smooth functioning of Japanese government securities markets.	—	—	Introduction of the securities lending facility to provide the markets with a secondary source of Japanese government securities.
	Outlook: The economy is expected to gain further momentum gradually, as it continues to recover moderately. The CPI is projected to continue falling slightly on a year-on-year basis.				
2005/ 5/20	Present: The economy continues a recovery trend. The CPI has been declining slightly on a year-on-year basis.	(Policy unchanged)	When it is judged that liquidity demand is exceptionally weak, there may be cases where the balance of current accounts falls short of the target.	—	—
	Outlook: The economy is expected to continue to recover. The CPI is projected to continue falling slightly on a year-on-year basis.				
2006/ 3/9 Exit from the QEP	Present: The economy continues to recover steadily. Year-on-year changes in the CPI turned positive. The year-on-year rate of increase in the CPI rose in January.	Judged that the conditions laid out in the commitment are fulfilled.	Change the operating target of money market operations from the outstanding balance of current accounts at the Bank to the uncollateralized overnight call rate. Encourage the uncollateralized overnight call rate to remain at effectively zero percent. The outstanding balance of current accounts at the Bank of Japan will be reduced towards a level in line with required reserves.	Purchases will continue at the current amounts and frequency for some time.	Introduction of a new framework for the conduct of monetary policy. Review of the Bank's thinking on price stability. Lombard-type lending facility's loan rate will remain at the current level, and the temporary waiver of add-on rates for frequent users of the facility, will also be maintained.
	Outlook: The economy is expected to be a sustained recovery. Year-on-year changes in the CPI are expected to remain positive.				