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

Hiroshi Ugai

This paper surveys the empirical analyses that examine the effects of the Bank of Japan's (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 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.

Keywords: Zero interest rate policy; Quantitative easing policy; Commitment; Zero bound constraint on interest rates; Deflation

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

Monetary Affairs Department, Bank of Japan (currently, General Manager, Okayama Branch) (E-mail: hiroshi.ugai@boj.or.jp)

The author would like to thank Kosuke Aoki, London School of Economics, and many Bank of Japan (BOJ) colleagues including Kunio Okina, Hideo Hayakawa, Shigenori Shiratsuka, Nobuyuki Oda, Takeshi Kimura, Koichiro Kamada, Naohiko Baba, Ippei Fujiwara, and Tomohiro Sugo for their valuable comments. All remaining errors are the author's responsibility. Views expressed in this paper are those of the author and do not necessarily reflect the official views of the BOJ.

I. Introduction

A. The Quantitative Easing Policy (QEP): Overview

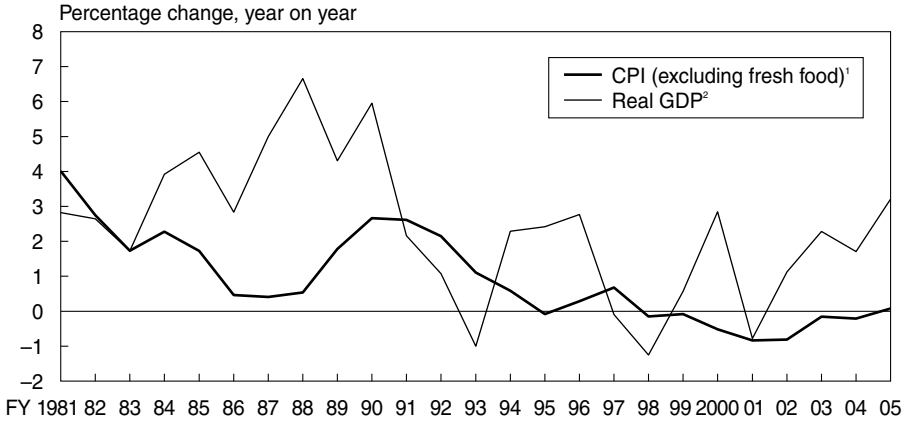
Japan's economy experienced prolonged stagnation following the burst of the asset price bubble in the early 1990s, despite several short-lived recovery phases. During this period, general prices measured by the consumer price index (CPI) gradually reduced their growth rate, followed by a continuous and modest decline from 1998 to the autumn of 2005. Over this period, the CPI dropped by a total of about 3 percentage points (Figure 1). In addition, the broad-based influence of the generation and bursting of the bubble spread to firms and financial institutions.

In this economic environment and as Japan's economy headed toward recession triggered by the bursting 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 three pillars:

(1) 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;

(2) to make the commitment that the above ample liquidity provision would continue to stay in place until the CPI (excluding perishables, hereafter "core CPI") registered stably at zero percent or an increase year on year; and

Figure 1 CPI and Real GDP



Notes: 1. Real GDP figures previous to and including fiscal 1994 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."

(3) 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 started in March 2001 with a CAB target of ¥5 trillion, a level higher than the required reserve level of ¥4 trillion.[1] 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 the target was raised in January 2004 to ¥30 trillion to ¥35 trillion. Reflecting the ample liquidity provision under the QEP, the uncollateralized overnight call rate declined to 0.001 percent, a level below the 0.02–0.03 percent that was realized from 1999 to 2000 under the zero interest rate policy (ZIRP). To meet smoothly the CAB target, the BOJ gradually increased its purchases of long-term JGBs from the initial pace of ¥400 billion 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 base[2] worth ¥117 trillion, 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. Furthermore, from July 2003 to March 2006, as a limited-time measure, the 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.[3] The BOJ further clarified its commitment (item [2] of the commitment above) in October 2003.[4] 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 was 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.

B. Purposes of This Paper

The QEP generated extensive debate both in Japan and abroad even before its adoption. For example, there was active debate over whether the BOJ should increase funds

1. For details, see the Appendix.
2. 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.
3. Other than these measures, the BOJ determined to purchase stocks held by commercial banks from October 2002 to end-September 2003, to overcome the nonperforming-loan (NPL) problem and ensure financial system stability.
4. Specifically, the BOJ clarified that its commitment to maintaining the QEP until the CPI registered 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 stated that these conditions were the necessary conditions, and there might be cases in which the BOJ judged it appropriate from an economic and price standpoint to continue with the QEP even if these two conditions were fulfilled.

provision beyond interest rate manipulation when the BOJ adopted the ZIRP in 1999.[5] 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 to exit from deflation to whether new measures should be introduced.[6] At the Monetary Policy 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."[7] 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 seem to have gradually converged with the views in academia. Meanwhile, the BOJ assessed the effects of the QEP in its October 2005 *Outlook for Economic Activity and Prices* as follows:[8]

> 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.[9]

To reach such an assessment, various empirical analyses have been conducted within and outside the BOJ. Arguably, several difficult issues are 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 not necessarily sufficient at this juncture. Nevertheless, it is useful to survey the previous empirical analyses.[10]

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,

5. For detailed discussions, see Bernanke (2000), Iwata (2000), Kuttner and Posen (2001), Svensson (2001), Okina (1999a, b), McKinnon (1999), Meltzer (1999a), and Oda and Okina (2001).
6. Such discussions are presented in Svensson (2003), Coenen and Wieland (2003), Bernanke (2003), Iwata (2001), Fukao (2002), Shirakawa (2002), and Komiya (2002).
7. Bank of Japan (2001, p. 80).
8. Fukui (2006) also assesses the effects of the QEP.
9. Bank of Japan (2006a, pp. 63–64).
10. In the latter stage of the QEP, Ueda (2005) tried to summarize Japan's monetary policy under a zero bound constraint of interest rates.

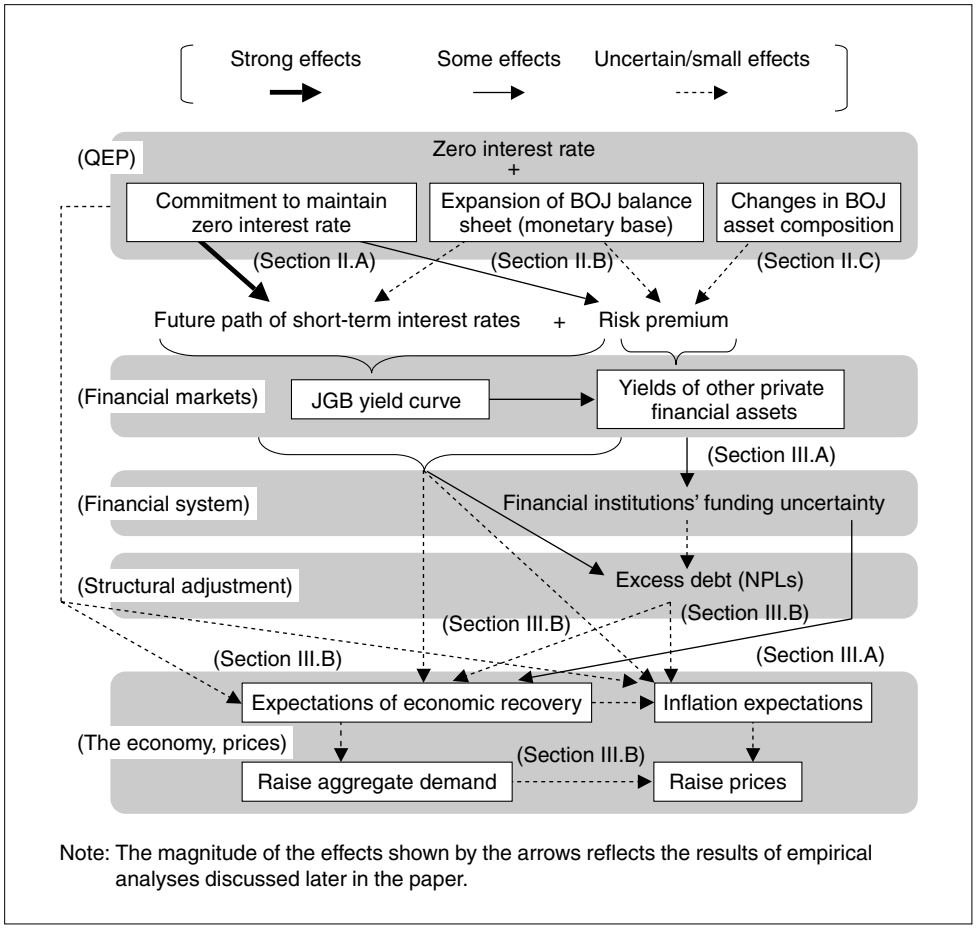
this paper examines the transmission mechanism of the QEP's effects. The effects are classified into three types based on operational measures, and three questions are posed for the effects through each specific transmission channel.[11] The first question is, among the effects of the QEP, what is the extent of the effect of the commitment to maintain the QEP on the expected future path of short-term interest rates observed (Section II.A). The second question is through which channel and to what extent are the effects of expanding the size of the BOJ's balance sheet by increasing the CABs identified (Section II.B). The third question is through which channel and to what extent are the effects of altering the composition of the BOJ's balance sheet by increasing purchases of long-term JGBs identified (Section II.C). 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.[12] In taking up the effects according to individual operational measures, this paper adopts the 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 III.A). 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 III.B). 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 IV).

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.

11. There are several possible ways to classify the transmission channels of the policy effects; the classification adopted here 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.
12. 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.

Figure 2 Effects of the QEP: Conceptual Diagram



Note: The magnitude of the effects shown by the arrows reflects the results of empirical analyses discussed later in the paper.

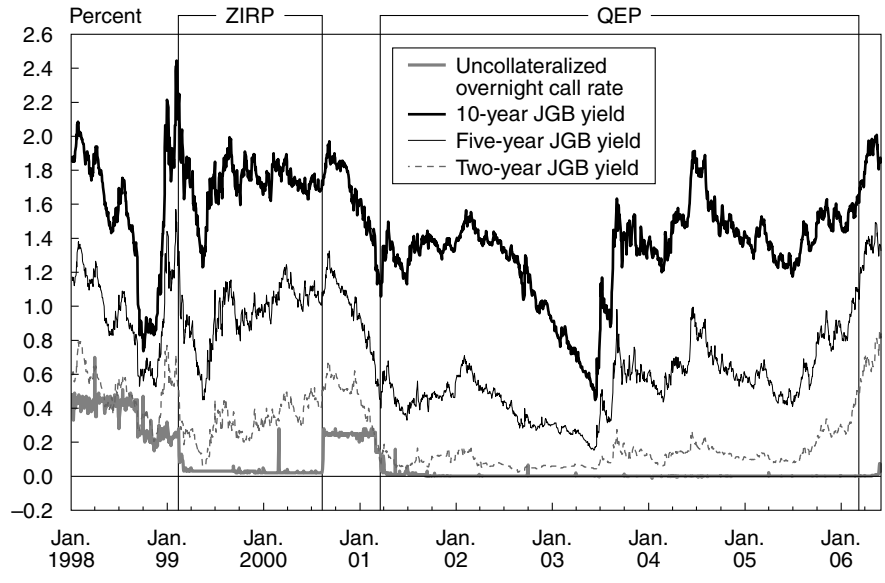
II. Transmission Channels of QEP Effects

A. Effect of the Commitment

1. Theoretical channel from the commitment, and verification

The most important transmission channel of the commitment to "maintain the QEP until the 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 picked up in the future, thereby stimulating the economy by lowering the present short- to medium-term interest rates. The actual developments in 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

Figure 3 Policy Rate and Medium- to Long-Term Interest Rates



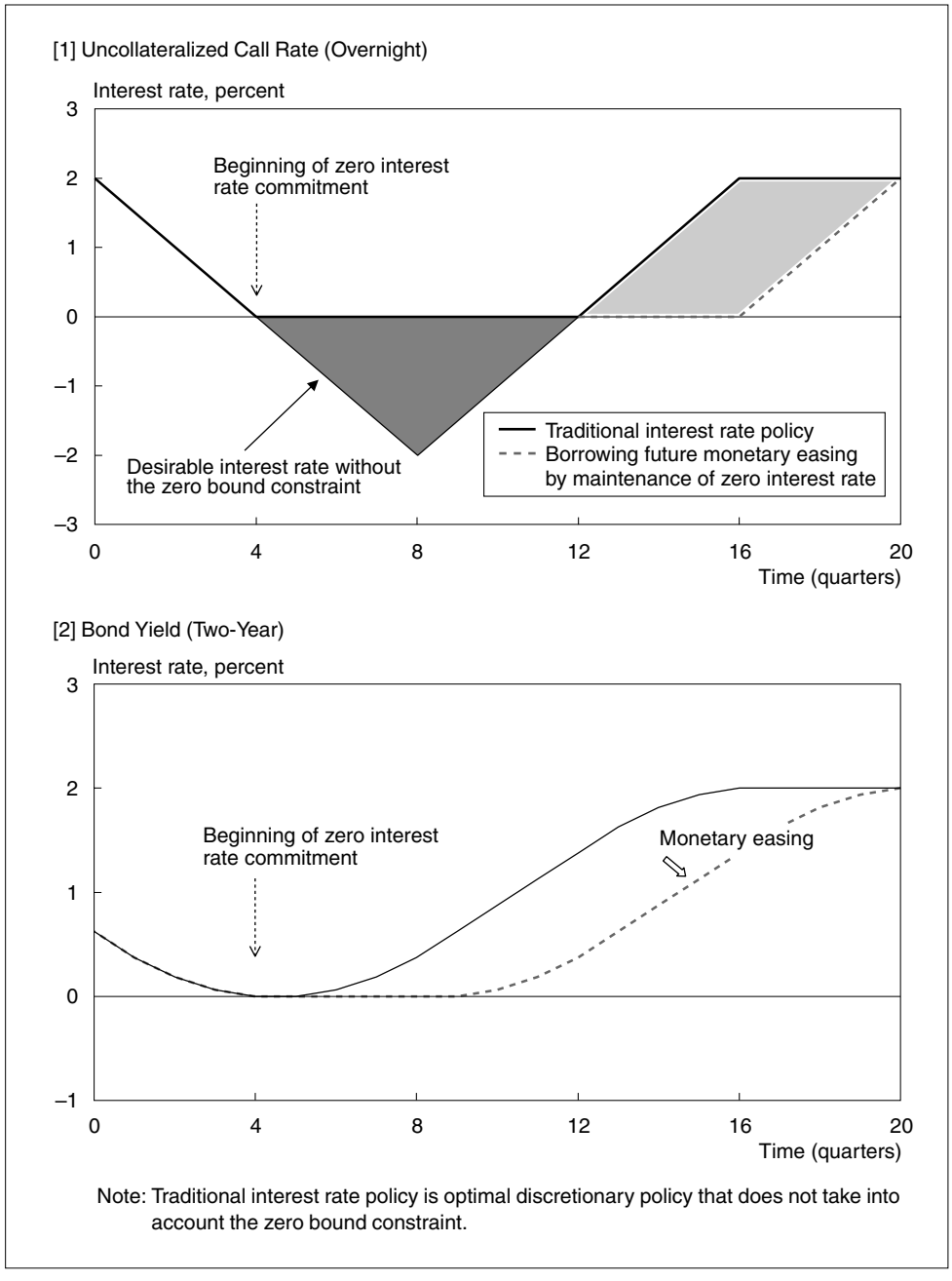
Sources: Bloomberg; Bank of Japan.

maintained for some time even after the economy entered a recovery phase were because the market (1) expected that the QEP would only be lifted when the published core CPI growth exceeded zero percent,[13] and (2) considered that the CPI tends to respond to real economic indicators with a certain lag.

This idea is shown in the conceptual diagram (Figure 4), which is a modified version of the idea presented in Reifschneider and Williams (2000). Figure 4 [1] shows the development of policy interest rates. When reducing the policy interest 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. 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 Figure 4 [2], long-term interest rates will decline by factoring in this expected path of

13. 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 should not be expected to register below zero percent.

Figure 4 Conceptual Diagram of the Effects of the Zero Interest Rate Commitment under a Zero Bound Constraint on Interest Rates



Note: Traditional interest rate policy is optimal discretionary policy that does not take into account the zero bound constraint.

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.

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.[14] 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 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,[15] 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.[16]

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 the extent to which future short-term 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

14. Miyao (2006) examines in detail how the arguments of Krugman (1998) can be applied to Japan's case.
15. 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 territory (Jung, Teranishi, and Watanabe [2005]). This effect implies that the central bank "borrows" future monetary easing (Jung, Teranishi, and Watanabe [2005]).
16. 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.

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 unlike 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 previous 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 to reduce overshooting even as it takes history dependence into account, rather than imposing strong history dependence like price level targeting (Steinsson [2003] and 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 to 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.

2. 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 *et al.* (2005), Oda and

Ueda (2005), Marumo *et al.* (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 *et al.* (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 three-year and five-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 percent, and of about 0.2 percent 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 such as that since 2003 when the economy has gradually recovered and the possibility that interest rates will be raised within several years increases that the effect of the CPI-linked commitment strengthens. 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. Furthermore, a certain allowance should be attached to the levels of estimated results owing partly to the assumption of the model, such as the robustness of the natural rate of interest.

In addition to the expected future path of short-term interest rates, the authors 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 2003/II for the three-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 five- 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 have been lifted.

Marumo *et al.* (2003) construct a term-structure yield curve model with the short-term interest rates following the traditional Vasicek (1977) 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 2.5 years as of the end of 2002. Contrary to Baba *et al.* (2005), Okina and Shiratsuka (2004) 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. The difference in these papers' interpretations may turn on whether the empirical analyses fully include the data for 2003.

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 *et al.* (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 1 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) 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 *et al.* (2005). They show that, during the periods immediately after the adoption of the ZIRP and QEP, the actual yield curves became lower than the expected yield curves estimated from past economic variables under a zero bound constraint on interest rates.[17]

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 (Table 1).

17. 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.

Table 1 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 percentage point for three-year and five-year yields.)	Detected for three-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, Reinhart, and Sack (2004)	Detected (No differentiation among transmission channels)	—	Similar during the period immediately after policy adoption

B. Effects of Expanding the Size of the BOJ's Balance Sheet

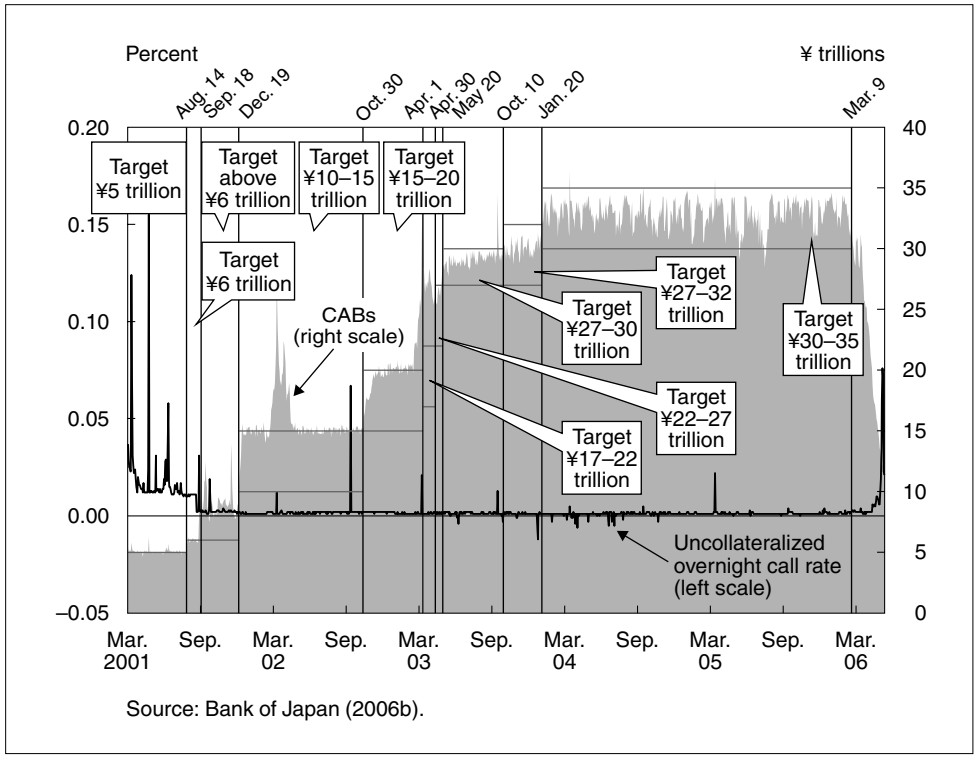
1. Theoretical channels from the increase in CABs at the BOJ, and verification

This section examines the effects of repeated increases in CABs at the BOJ, as shown in Figure 5, as well as those of the associated increase in the monetary base in light of the specific transmission channels.

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 the 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. 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.

For this proposition to hold true, two assumptions are necessary: (1) 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 (2) 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 (1) does not hold, and

Figure 5 CABs at the BOJ and the Uncollateralized Overnight Call Rate



Source: Bank of Japan (2006b).

the effect of altering private-sector expectations regarding future monetary or fiscal policy will appear if (2) 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 asset (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 (1) (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.[18] 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).[19] 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, 1999b, 2001]).[20] 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]).[21] In addition, there is 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 Kiyotaki and Moore (2001), the supply of the 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

18. 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, would be like replacing US$1 billion worth of US$5 bills with US$1 billion worth of US$10 bills, which, to an approximation, has no effect.
19. 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 III.A.
20. Mishkin (1995) referred to such effects identified by Meltzer as "asset price effects."
21. The theoretical background is according to Kiyotaki and Moore (2001).

the concepts advocated by Andrés, López-Salido, and Nelson (2004), economic activity will be stimulated through a decline in long-term interest rates rather than rates estimated from the expected future path of short-term interest rates.

Next, in considering whether assumption (2) of the irrelevance proposition holds, 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, in many cases it 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 subsection, this paper reviews empirical analyses that attempt to determine whether the QEP's easing effects were strengthened because the implementation of the 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 in Section II.A.

As another channel not discussed so far, effects through the fiscal channel have 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.

2. 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 *et al.* (2003) use data from 1978/I to 2002/I 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 II.A for the methodology) that was extracted in Baba

et al. (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/I to 2003/IV, they find that the regression results for three-, five-, 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).[22] 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-U.S. 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 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 raise their portfolio risk, increased their demand for financial assets with countercyclical returns such as JGBs. However, even when the CABs were increased by ¥10 trillion, 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.[23]

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 Table 2, 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

22. The details of the CAPM are explained in chapter 1 of Cochrane (2001).
23. It should be noted that, for assets with procyclical returns, the risk premium on equities and the credit spread of low-grade corporate bonds increased in a statistically significant manner.

Table 2 Portfolio Rebalancing Effect and Signaling Effect of Increase in the 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 of CABs, 0.19 percent for three-year yield, 0.17 percent for five-year yield)
Takeda, Komaki, and Yajima (2005)	Significant (at the time of introduction)	—	—	—	—	—
Kimura and Small (2006)	—	Significant (with additional ¥10 trillion of CABs, 1–4 basis points for Aa grade)	Somewhat (some measurements insignificant)	Significant with opposite sign	Significant with opposite sign	—
Sadahiro (2005)	—	—	Insignificant	—	—	—
Fujiki, Okina, and Shiratsuka (2004)	—	—	—	—	—	Significant for certain phases (May 2003)

Note: In exact terms, Sadahiro (2005) uses the monetary base instead of the BOJ's CABs as an explanatory variable.

the JGB yield curve if one considers the magnitude of the portfolio rebalancing effect in the context of the CABs increasing by ¥28 trillion (about seven times) and the monetary base increasing ¥46 trillion (an approximately 70 percent increase) over the five-year period of the QEP. In addition, it should be noted that the analyses which 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 rate 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 the three-, five-, and 10-year bond yields, the coefficient of the CABs is statistically significant with the correct sign. Specifically, the effect of a ¥10 trillion increase in the CABs is 0.19 percent for the three-year bond yield and 0.17 percent for the five-year bond yield. From this result, they draw the tentative conclusion[24] that the increase in the

24. Oda and Ueda (2005) caution that the strength of the signaling effect depends on the extent to which 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 CAB targets were changed, for example, such as by the BOJ Governor's comments at regular press conferences, and state that the validity of the tentative conclusions requires further verification.

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 Tokyo Interbank Offered Rate (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 the other cases.

As a whole, empirical analyses show that, when the BOJ increased the CAB targets, there were some phases in which this brought about a signaling effect (Table 2). The existence and magnitude of a signaling effect seems to depend on the extent to which 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 CAB targets may not have any additional signaling effect.

C. Effects of Altering the BOJ's Asset Composition

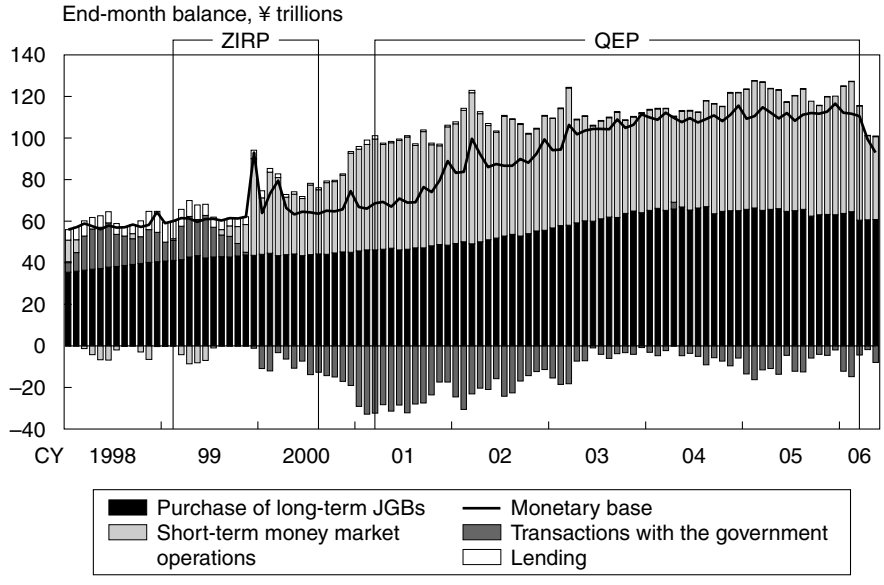
1. Theoretical channels from purchases of long-term JGBs, and verification

In the process of continuing the QEP, the BOJ purchased long-term JGBs, asset-backed securities, and other assets (Table 3). 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 CAB target (see the Appendix), and this resulted in substantial changes to the BOJ's asset composition (Figure 6).

Table 3 Changes in the 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 debt	Purchase of corporate debt	Purchase of stocks
Implementation	Implemented	Implemented	Not implemented	Purchased asset-backed securities (until Mar. 2006)	Limited implementation for banks' holdings (to overcome the NPL problem) (until Sep. 2004)
Substitutability with the monetary base (effect of providing liquidity through purchase of assets)	High ←				→ Low
	(Low) ←				→ (High)

Figure 6 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 Table 3, the purchase of corporate debt 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 in 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 *et al.* [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 of long-term JGBs and long-term interest rates reach 5 percent as a result of economic recovery, the BOJ would incur a capital loss of about ¥12 trillion if it sold the purchased long-term JGBs in 1–2 years.[25] 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 debt, the private sector's holdings of government debt 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.

2. 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—three-year, five-year, and 10-year JGBs.

25. 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 predetermined. Therefore, the results of Fujiki, Okina, and Shiratsuka (2001) need to be interpreted with some discount in that the actual level of capital loss differs substantially depending on the assumptions.

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 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 increase in the purchase of long-term JGBs. In addition, they 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.[26]

Consequently, portfolio-rebalancing effects by way of an increase in the purchase of long-term JGBs (Table 4) 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

Table 4 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 increase of long-term JGB balance, 6–8 basis points for Aa grade)	Somewhat (some measurements insignificant)	Significant with opposite sign	Significant with opposite sign	—
Takeda, Komaki, and Yajima (2005)	—	—	—	—	—	Significant for a certain phase in the opposite direction (inflation expectation)

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

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 per month to ¥600 billion 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.

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 (Table 4).

III. 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.

A. Effects on Stabilizing Financial Markets

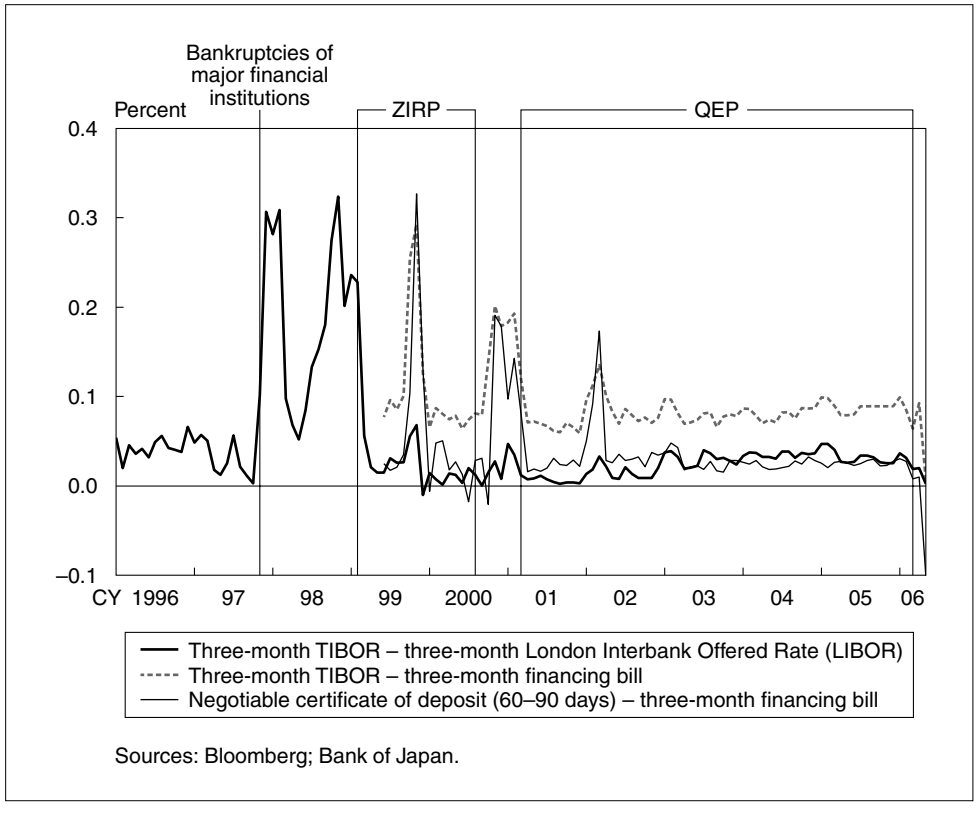
1. The relationship between the financial system and aggregate demand/prices, and verification

Corporate balance-sheet adjustments after the bursting of the bubble and, as the other side of the same coin, the nonperforming-loan (NPL) problem of financial institutions that 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 and Hokkaido Takushoku Bank in November 1997, financial institutions' funding costs surged amid the rapidly heightened uncertainty regarding financial institutions' management (Figure 7).

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 lending due to liquidity concerns, and the economy was at risk of tumbling into a deflationary spiral (Hayakawa and Maeda [2000] and Bank of Japan [2000]).[27]

27. 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-sized firms (Motonishi and Yoshikawa [1999]). Second, even those firms that were not facing funding constraints experienced intensified uncertainty regarding the investment environment in view of the heightened financial system uncertainty, and thus deferred their business fixed investments to some extent (Bank of Japan [1998]).

Figure 7 Financial Institutions' Market Yen Funding Cost



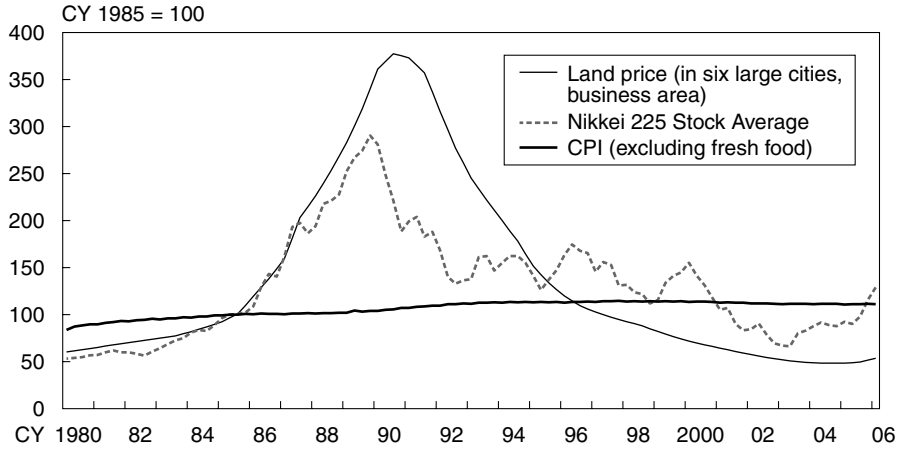
Sources: Bloomberg; Bank of Japan.

Subsequently, the economy slowed down again in early 2001, an event that was triggered by the bursting of the IT bubble worldwide while Japan's NPL problem had not yet been 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 8).

If the liquidity constraints of financial institutions had intensified during this period, the effects might not have remained at the level of financial institution management. Developments could have affected the lending stance of financial institutions and, if many firms felt the risk that the financial system instability experienced in 1997–98 might recur, such firms might have become reluctant to lock in their funds in the form of business fixed investment.[28] 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.[29]

28. This view can be derived from applying real option theory when investment has both irreversibility and uncertainty. See Dixit and Pindyck (1994).
29. This line of thinking under concerns over future liquidity constraints was introduced in Hori, Saito, and Ando (2004).

Figure 8 Asset Prices and the CPI



Note: CPI is adjusted to exclude the effects of consumption tax hikes.

Capital Gains/Losses

Percentage of nominal GDP

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

Note: Nominal GDP is 1995 base previous to and including 1995 and 2000 base for the ensuing 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*.

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 reduced the possibility of future funding risk from occurring and thus reduced risk premiums.

In the meantime, some note the channel whereby, as the QEP flattens the yield curve, financial institutions that 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 that had arisen due to the NPL problem.

2. 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 *et al.* (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 1997–98. In addition, Suzuki and Kobayashi (2005) conclude that the BOJ's ample liquidity provision to the market had a preventive effect on financial institutions' funding concerns.

While a few studies measure quantitatively the QEP's effects on the funding costs of financial institutions, Baba *et al.* (2006) report that during the QEP phase the dispersion of issuance rates of negotiable certificates of deposit (NCDs) by major banks (city banks and trust banks), the volume of which accounts for about 30 percent 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 spreads[30] for 1997, 1999, 2002, 2004, and 2005 (up to the 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, almost flattening out in 2004–05, indicating that the differences in credit ratings were then barely reflected. Furthermore, after controlling for the difference in creditworthiness by the spread of the 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 imply the changes in 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 funding risks were mitigated by the clarification of the BOJ's stance to continue providing ample liquidity. Therefore, Baba *et al.* (2006) 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

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

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 shrank 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.

B. Effects of Raising Aggregate Demand and Prices

1. Generation mechanism of continuous price declines, and verification

This section analyzes the extent to which the QEP, after exerting effects to contain the risk of a deflationary spiral stemming from financial system instability (as shown in the previous subsection), 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.[31] Corporations' prolonged suffering from their balance-sheet adjustments may also be described as a situation in which the economy lagged in its response to negative demand shocks, or in which negative demand shocks were continuously imposed on the economy. This paper now examines the extent to which the QEP exerted its easing effect and 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: (1) measuring broadly without specifying the transmission channel; (2) measuring the effects in shifting the yield curve downward, mainly bearing in mind the policy duration effect; and (3) 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 asset yields adopted in Section II.

2. Verification method and results

a. 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,

31. Another interpretation of deflation is that it will persist under zero interest rates even if the natural rate of interest continues to be positive (a "deflationary trap") (Benhabib, Schmitt-Grohé, and Uribe [2002] and Iwamoto [2005]).

and enables one to gauge the QEP's comprehensive effects on the economy, not only including 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 1978–95, 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, the 10-year JGB yield, and the monetary policy proxy—and conduct vector autoregressive (VAR) analysis[32] to identify changes in the policy stance, by attaching minimum theoretical constraints on the monetary policy proxy and the foreign exchange rate 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 (Table 5). In addition, when they estimate the point of structural change generated in the monetary policy transmission channel,[33] they find structural

Table 5 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 three years)	Effects on real economy (after three years)
Kamada and Sugo (2006)	Sign-restriction VAR	Five	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

32. More strictly, they used the sign-restriction VAR model. See Uhlig (2005) for details.
33. They apply a Bayesian statistics method called the Markov chain Monte Carlo method to the sign-restriction VAR in their verification.

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 bursting of the asset price bubble with the VAR model that described Japan's economy before the bursting, 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 which amplifies economic activity limited the effects of monetary easing.

b. 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 *et al.* (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 and the monetary easing effect did not spill over to outside the financial system. Baba *et al.* (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,[34] and interpret that this offset the effects of lowering the yield curve. At the same time, however, as discussed in Section II.A, they point out the possibility that the effect of the commitment on lower interest rates contributed to produce some higher inflation expectations when viewed from a long-term perspective, since this lowering effect was lower for 10-year bonds than for three- and five-year bonds.

On the other hand, Suzuki and Kobayashi (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 separate the effects of lowering the policy interest rate to zero percent and the policy duration effects.

c. Verification measured from the effects of the monetary base increase

Sections II.B and II.C 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

34. This effect is referred to as the financial accelerator (Bernanke, Gertler, and Gilchrist [1999]). For an analysis of Japan's prolonged stagnation using this effect, see Fuchi, Muto, and Ugai (2005).

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 9, amid a substantial increase in the monetary base the growth of M2+CDs was relatively small, and the growth of real GDP and the CPI even smaller. This subsection now summarizes the empirical analyses that rigorously treat the relationships between such financial quantitative indicators and economic indicators.

Verification of effects that do not factor in the policy regime change

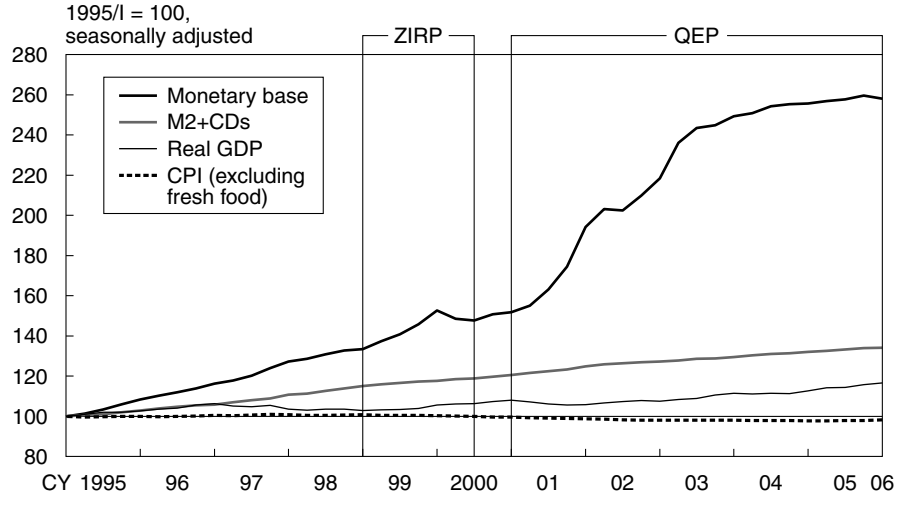
Before the QEP was adopted, it was often argued that if the BOJ were to expand its monetary base, the money stock (M2+CDs is the representative indicator in Japan) would increase, and deflation would be stopped. Tracing the background logic of this argument, it seems that the argument is based on the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

$$MV = PY,$$

where M = money, V = velocity, P = prices, and 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

Figure 9 Quantitative Monetary Indicators, Real GDP, and the CPI



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

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]).[35] In addition, there is an empirical analysis based on the VAR model that 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, 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 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/I–2001/IV in Harada and Okamoto (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, the Bank of Japan (2002) shows that the monetary base and the 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,[36] for example, Kuttner (2004) states that if the long-run relationship is extended between M2+CDs and real GDP and prices measured from before 1990 until 2004, the relationship

35. 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 (Hetzel [2004]).
36. 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 one uses the function in the form of double-log specification that depicts both money demand and interest rates in logarithms.

still exists, although it becomes weak. On the other hand, 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 (VECM) 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 real GDP, the GDP deflator, or nominal GDP if data during 1993–2003 are used.[37] As to why the relationship between the money stock and economic activity has become fragile, several reasons have been pointed out: the NPL 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 the substantial decline in the opportunity cost of liquidity service provided by M2+CDs under zero interest rates, which induced a substantial funds shift among financial assets (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 the 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 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 Table 6 for a list of the results).

Kimura *et al.* (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 model[38] with time-varying coefficients for the sample period of 1971/II–2002/I. They find that the impulse response to an increase in the monetary base was in the direction of an inflation rise as of 1985 (II), while there was no response against either the inflation rate or the GDP gap as of 2002 (I). 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 a VAR[39] analysis that does 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

37. Sugihara *et al.* (2000), while based on data up to the ZIRP period, also find similar instability of money demand.
38. They use a Bayesian VAR model.
39. They use the Markov switching VAR model.

Table 6 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	Four	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	Three	Until 1998	CPI: significant	Industrial production: significant (positive)
			After 1998	CPI: insignificant (close to zero)	Industrial production: insignificant (slightly positive)
		Four	Until 2000	CPI: insignificant (positive)	Industrial production: significant (positive)
			After 2000	CPI: insignificant (slightly positive)	Industrial production: insignificant (slightly positive)
Sadahiro (2005)	VECM	Six	Jan. 1986–Apr. 1995	CGPI rate of change: yes (positive)	Industrial production: yes (positive)
		Six	Jan. 1996–Sep. 2004	CGPI rate of change: yes in opposite sign (negative)	Industrial production: small (slightly positive)

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 (2006) 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 VECM 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 six variables—the Japan/U.S. monetary base ratio, the yen/U.S. dollar exchange rate, the Japan/U.S. inflation rate differential (the difference between the Corporate Goods Price Index rate of change and the Producer Price Index rate of change), the Japan/U.S. short-term interest rate differential, the Japan/U.S. 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 (2005) concludes that the effectiveness of the increase in the monetary base was lost during the period when interest rates were zero.

There is another study that analyzes what effects other than lowering short-term interest rates can be observed in 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"). Kimura *et al.* (2003) use a structural model that incorporates the transmission channels explained in Section II.B. They show that 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 regression analysis of the aggregate demand curve is conducted 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 United Kingdom and United States. 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/I are included. Consequently, Kimura *et al.* (2003) tentatively conclude that the effects of an increase in the monetary base are very uncertain and small, if any.

The analyses introduced here 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 that find few portfolio rebalancing effects interpret that the effects of an increase in the monetary base are small to begin with. However, studies that do not deny the possibility of effective portfolio rebalancing—for example, Horiuchi (2004) and Kimura *et al.* (2003)—interpret that the limited effects of monetary policy reflect 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 that was still underway. In particular, Horiuchi (2004) emphasizes the point that financial institutions which faced critical situations triggered by the NPL problem were reluctant to extend loans.

IV. 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, as for the transmission mechanism of the effects of the QEP, empirical analyses clearly confirm the effect of the commitment that the expectation that the zero interest rate would be maintained for some time into the future lowered the yield curve, centering on the short to medium term (the policy duration effect). This also implies that the commitment policy secured market confidence. In addition, the

QEP, which committed to the actual performance of the CPI, had stronger effects on lowering the yield curve than the ZIRP, which 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. The empirical analyses present mixed results as to whether the portfolio rebalancing, which affects the premium portion of the yields of financial assets that are imperfect substitutes for the monetary base, had any effect on narrowing the premium portion of bond yields, 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 signaling effect, which affects the private sector's expectations for the future path of short-term interest rates, at least the effect from an increase in the BOJ's CABs on bolstering expectations that the monetary easing would continue into the future was detected during certain phases. On the other hand, no such effects were identified from increased purchases of long-term JGBs, and, in one phase, inflation premiums temporarily increased.

Third, bearing these points in mind and taking up studies that empirically analyze the QEP's overall macroeconomic impact on Japan's economy through various transmission channels, many of these analyses in general observe that the QEP created an accommodative monetary environment. 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 NPLs shrank to the extent that they no longer reflected credit rating differentials. According to analyses of the economic situation during this period, if firms had heightened anxieties regarding their funding over fear of the stability of the financial system, further deterioration of economic and price developments resulting from the likes of deferring their business fixed investment might have occurred. Therefore, this observation implies that the QEP had the effects of maintaining financial market stability and an accommodative monetary environment by removing financial institutions' funding uncertainties, and thereby preventing further deterioration of the economy reviewed above.

Fourth, as for the QEP's effects in raising aggregate demand and prices, the effects solely 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, many studies 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 of raising aggregate demand and prices nevertheless turned out to be limited. Analytical results and interpretations are presented to indicate that, in addition to the zero bound constraint of the interest rate, major roles were played by 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.

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 result suggests that when a central bank conducts monetary policy with due recognition of the zero bound constraint on interest rates, information dissemination concerning monetary policy from the central bank to the private sector is critical to manifesting the 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 accumulated results of further studies.

The second issue is the multifaceted 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 effecting economic recovery substantially in the future when the natural interest rate turns positive is theoretically expected to raise aggregate demand and prices through four channels: (1) 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; (2) by stimulating current spending by reducing real interest rates by generating inflation expectations; (3) by stimulating current spending from expectations that future income will increase; and (4) 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 (1), studies have not quantitatively clarified the extent to which each of the other channels 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 the demand shock and price shock to the economy and the structure of Japan's economy,[40] 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 had not gone 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

40. 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.

such studies as Kamada and Sugo (2006) recently on this question, their 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.

The fourth issue concerns 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.[41] On the other hand, some consider such phenomena to be 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 accumulated results of future studies are awaited.

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

APPENDIX: QUANTITATIVE EASING POLICY (QEP)

Date	The BOJ's view on economic activity and prices	Reasons for policy change	Changes		
			BOJ CABs	Outright purchases of long-term JGBs (amount)	Others
Mar. 19, 2001 (introduction of the QEP)	Present: Japan's economic recovery has recently come to a pause. Prices have been showing weak developments. 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.	To prevent prices from declining continuously as well as to prepare a basis for sustainable economic growth.	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 BOJ. From an average of ¥4 trillion to around ¥5 trillion. Should there be a risk of financial market instability, the BOJ will provide ampler liquidity irrespective of the guideline above.	Increase from ¥400 billion per month.	Committing that the QEP continues to be in place until the CPI (excluding perishables) registers stably a zero percent or an increase year on year.
Aug. 14, 2001	Present: Economic adjustments are deepening. The CPI continues to be somewhat weak. Outlook: Adjustments in economic activities will continue for the time being. Attention should be paid to the risk of adjustments in economic activities spreading 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.	To further strengthen support for economic recovery.	From around ¥5 trillion to around ¥6 trillion.	From ¥400 billion per month to ¥600 billion per month.	—

Date	The BOJ's view on economic activity and prices	Reasons for policy change	Changes		
			BOJ CABs	Outright purchases of long-term JGBs (amount)	Others
Sep. 18, 2001	Present: Adjustments in economic activity are becoming more severe. The CPI is weakening. 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.	To secure proper functioning of financial markets and to enhance the effective permeation of monetary easing effects.	From around ¥6 trillion to above ¥6 trillion.	—	Reduction in the official discount rate from 0.25 percent to 0.10 percent. Increase in the maximum number of business days for using the Lombard-type lending facility.
Dec. 19, 2001	Present: The economy is deteriorating broadly. The CPI is weakening. 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.	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 to around ¥10–15 trillion.	From ¥600 billion per month to ¥800 billion per month.	Measures to strengthen money market operations.
Feb. 28, 2002	Present: The economy continues to deteriorate. The CPI is declining somewhat faster. 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.	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 per month to ¥1 trillion 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.
Oct. 30, 2002	Present: The economy has stopped deteriorating but has not yet shown clear signs of recovery. The CPI remains on a gradual downtrend. 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.	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 to around ¥15–20 trillion.	From ¥1 trillion per month to ¥1.2 trillion per month.	Extending maturities for bills purchased.

Date	The BOJ's view on economic activity and prices	Reasons for policy change	Changes		
			BOJ CABs	Outright purchases of long-term JGBs (amount)	Others
Dec. 17, 2002	Present: The economy has stabilized as a whole, but there is still substantial uncertainty toward recovery. The CPI remains on a gradual downtrend. 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.	(Policy unchanged) To secure smooth corporate financing.	—	—	Acceptance of a broader range of loans on deeds as eligible collateral. Relaxation of standards for asset-backed commercial paper as eligible collateral.
Mar. 25, 2003	Present: Economic activity remains flat. The CPI has been declining gradually. 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.	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 to around ¥17–22 trillion from Apr. 1. (Due to the establishment of the Japan Post)	—	As a temporary measure, the Bank will apply the official discount rate to the Lombard-type lending facility on any business day.
Apr. 30, 2003	Present: Economic activity remains flat. The CPI has been declining gradually. 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.	To maintain financial market stability, thereby strengthening support for economic recovery.	From around ¥17–22 trillion to around ¥22–27 trillion.	—	Decided to accept loans on deeds to the Industrial Revitalization Corporation of Japan with government guarantee as eligible collateral.
May 20, 2003	Present: Economic activity remains flat but uncertainties about future prospects have recently been increasing. The CPI has been declining gradually. 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.	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 to around ¥27–30 trillion.	—	—
June 11, 2003	Present: Economic activity remains virtually flat as a whole. The rate of decline in the CPI has diminished. 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.	(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.

Date	The BOJ's view on economic activity and prices	Reasons for policy change	Changes		
			BOJ CABs	Outright purchases of long-term JGBs (amount)	Others
Oct. 10, 2003	Present: The foundation for a gradual recovery is being laid. The year-on-year rate of decline of the CPI diminished. 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. The CPI is basically projected to continue falling gradually.	To further ensure the recent movement toward an economic recovery.	From around ¥27–30 trillion to around ¥27–32 trillion.	—	Extension of the maturity of the purchase of Japanese government securities with repurchase agreements. Enhancement of monetary policy transparency. 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. More detailed description of the commitment to maintaining the QEP.
Jan. 20, 2004	Present: The economy is recovering gradually. The year-on-year rate of change in the CPI has been close to zero percent. Outlook: The economy is anticipated to continue recovering, although the pace of recovery is expected to remain moderate. The CPI is projected to be on a slightly declining trend.	Developments in financial and foreign exchange markets and their impact warrant close monitoring. To reaffirm the policy stance to overcome deflation.	From around ¥27–32 trillion to around ¥30–35 trillion.	—	Modification of the conditions regarding the purchases of asset-backed securities.
Apr. 9, 2004	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. 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.	(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.

Date	The BOJ's view on economic activity and prices	Reasons for policy change	Changes		
			BOJ CABs	Outright purchases of long-term JGBs (amount)	Others
May 20, 2005	Present: The economy continues a recovery trend. The CPI has been declining slightly on a year-on-year basis. Outlook: The economy is expected to continue to recover. The CPI is projected to continue falling 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.	—	—
Mar. 9, 2006 (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. Outlook: The economy is expected to be a sustained recovery. Year-on-year changes in the CPI are expected to remain positive.	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 BOJ 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 BOJ will be reduced toward 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. The 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.

References

Andrés, J., J. D. López-Salido, and E. Nelson, "Tobin's Imperfect Asset Substitution in Optimizing General Equilibrium," *Journal of Money, Credit and Banking*, 36 (4), 2004, pp. 665–690.

Auerbach, A. J., and M. Obstfeld, "The Case for Open-Market Purchases in a Liquidity Trap," *American Economic Review*, 95 (1), 2005, pp. 110–137.

Baba, N., M. Nakashima, Y. Shigemi, and K. Ueda, "The Bank of Japan's Monetary Policy and Bank Risk Premiums in the Money Market," *International Journal of Central Banking*, 2 (1), 2006, pp. 105–135.

———, S. Nishioka, N. Oda, M. Shirakawa, K. Ueda, and H. Ugai, "Japan's Deflation, Problems in the Financial System and Monetary Policy," *Monetary and Economic Studies*, 23 (1), Institute for Monetary and Economic Studies, Bank of Japan, 2005, pp. 47–111 (presented at *Understanding Low Inflation and Deflation: A Conference Organized by the Bank for International Settlements* on June 18–19, 2004).

Bank of Japan, "Annual Review of Monetary and Economic Developments in Fiscal 1997," *Annual Review 1998*, 1998, pp. 57–154.

———, Research and Statistics Department, "Price Developments in Japan—A Review Focusing on the 1990s," *Bank of Japan Quarterly Bulletin*, 9 (2), 2000, pp. 153–228.

———, "Minutes of the Monetary Policy Meeting on March 19, 2001," *Bank of Japan Quarterly Bulletin*, 9 (2), 2001, pp. 72–87 (also available at http://www.boj.or.jp/en/type/release/teiki/giji/g010319.htm).

———, Policy Planning Office, "How Should the Recent Increase in Japan's Monetary Base Be Understood?" *Bank of Japan Quarterly Bulletin*, 10 (4), 2002, pp. 139–172.

———, ———, "The Role of the Money Stock in Conducting Monetary Policy," *Bank of Japan Quarterly Bulletin*, 11 (2), 2003, pp. 151–202.

———, "Outlook for Economic Activity and Prices October 2005," *Bank of Japan Quarterly Bulletin*, 14 (1), pp. 62–65, 2006a (also available at http://www.boj.or.jp/en/type/release/teiki/tenbo/gor0510.htm).

———, Financial Markets Department, "Money Market Operations in Fiscal 2005," 2006b (also available at http://www.boj.or.jp/en/type/ronbun/ron/research/ron0608b.htm).

Benhabib, J., S. Schmitt-Grohé, and M. Uribe, "Avoiding Liquidity Traps," *Journal of Political Economy*, 110 (3), 2002, pp. 535–563.

Bernanke, B. S., "Japanese Monetary Policy: A Case of Self-Induced Paralysis?" in A. Posen and R. Mikitani, eds. *Japan's Financial Crisis and Its Parallels to US Experience*, Special Report 13, Institute for International Economics, Washington, D.C., 2000, pp. 149–166.

———, "Some Thought on Monetary Policy in Japan," Address to the Japan Society of Monetary Economics, 2003.

———, M. Gertler, and S. Gilchrist, "The Financial Accelerator in a Quantitative Business Cycle Framework," in J. B. Taylor and M. Woodford, eds. *Handbook of Macroeconomics*, Vol. 1C, Amsterdam: North-Holland, 1999, pp. 1341–1393.

———, and V. R. Reinhart, "Conducting Monetary Policy at Very Low Short-Term Interest Rates," *American Economic Review*, 94 (2), 2004, pp. 85–90.

———, ———, and B. P. Sack, "Monetary Policy Alternatives at the Zero Bound: An Empirical Assessment," *Brookings Papers on Economic Activity*, 2, 2004, pp. 1–78.

Clouse, J., D. Henderson, A. Orphanides, D. H. Small, and P. A. Tinsley, "Monetary Policy When the Nominal Short-Term Interest Rate Is Zero," *Topics in Macroeconomics*, 3 (1), article 12, 2003.

Cochrane, J. H., *Asset Pricing*, Chapter 1, Princeton, New Jersey: Princeton University Press, 2001.

Coenen, G., and V. Wieland, "The Zero-Interest-Rate Bound and the Role of the Exchange Rate for Monetary Policy in Japan," *Journal of Monetary Economics*, 50 (5), 2003, pp. 1071–1101.

Dixit, A., and R. Pindyck, *Investment Under Uncertainty*, Princeton, New Jersey: Princeton University Press, 1994.

Eggertsson, G., and M. Woodford, "The Zero Bound on Interest Rates and Optimal Monetary Policy," *Brookings Papers on Economic Activity*, 1, 2003, pp. 139–211.

Fuchi, H., I. Muto, and H. Ugai, "A Historical Evaluation of Financial Accelerator Effects in Japan's Economy," Bank of Japan Working Paper No. 05-E-8, Bank of Japan, 2005.

Fujiki, H., K. Okina, and S. Shiratsuka, "Monetary Policy under Zero Interest Rate: Viewpoints of Central Bank Economists," *Monetary and Economic Studies*, 19 (1), Institute for Monetary and Economic Studies, Bank of Japan, 2001, pp. 89–130.

———, ———, and ———, "Comments on 'Price Stability and Japanese Monetary Policy' (1)," *Monetary and Economic Studies*, 22 (3), Institute for Monetary and Economic Studies, Bank of Japan, 2004, pp. 25–36.

———, and S. Shiratsuka, "Policy Duration Effects under the Zero Interest Rate Policy in 1999–2000: Evidence from Japan's Money Market Data," *Monetary and Economic Studies*, 20 (1), Institute for Monetary and Economic Studies, Bank of Japan, 2001, pp. 1–32.

———, and K. Watanabe, "Japanese Demand for M1 and Demand Deposits: Cross-Sectional and Time-Series Evidence from Japan," *Monetary and Economic Studies*, 22 (3), Institute for Monetary and Economic Studies, Bank of Japan, 2004, pp. 47–78.

Fujiwara, I., "Evaluating Monetary Policy When Nominal Interest Rates Are Almost Zero," *Journal of the Japanese and International Economies*, 20 (3), 2006, pp. 434–453.

Fukao, M., "Defure, Furyo Saiken Mondai to Kin'yu Seisaku (Deflation, the NPL Problem and Monetary Policy)," in R. Komiya and Japan Center for Economic Research, eds. *Kin'yu Seisaku Rongi no Soten—Nichigin Hihan to Sono Hanron* (Main Issues of Monetary Policy Debates), Nihon Keizai Shimbunsha, 2002, pp. 11–80 (in Japanese).

Fukui, T., "Opening Speech," *Monetary and Economic Studies*, 24 (S-1), Institute for Monetary and Economic Studies, Bank of Japan, 2006, pp. 9–12.

Goodfriend, M., "Overcoming the Zero Bound on Interest Rate Policy," *Journal of Money, Credit and Banking*, 32 (4), Part 2, 2000, pp. 1007–1035.

Harada, Y., and S. Okamoto, "Ginko Kashidashi, Money, Sonota no Shikin Chotatsu Shudan no Yuisei (Comparison among Bank Loans, Money Supply, and Other Fund Procurement Methods)," in K. Hamada, Y. Harada, and Economic and Social Research Institute, Cabinet Office, eds. *Choki Fukyo no Riron to Jissho* (Theories and Empirical Analyses of Prolonged Stagnation), Toyo Keizai Shimposha, 2004, pp. 101–123 (in Japanese).

Hayakawa, H., and E. Maeda, "Understanding Japan's Financial and Economic Developments since Autumn 1997," Research and Statistics Department Working Paper No. 00-1, Bank of Japan, 2000.

Hetzel, R. L., "Price Stability and Japanese Monetary Policy," *Monetary and Economic Studies*, 22 (3), Institute for Monetary and Economic Studies, Bank of Japan, 2004, pp. 1–24.

Hori, K., M. Saito, and K. Ando, "1990 Nendai no Setsubi Toshi Teimei no Haikei ni tsuite (On the Cause of Fixed Investment Stagnation during the 1990s in Japan: Evidence from Panel Data of the Financial Statements)," *Keizai Keiei Kenkyu* (Economics Today), 25 (4), Research Institute of Capital Formation, Development Bank of Japan, 2004 (in Japanese).

Horiuchi, A., "Choki Teitai no Gen'in to Taiosaku (Causes and Measures against Prolonged Stagnation)," in K. Hamada, A. Horiuchi, and Economic and Social Research Institute, Cabinet Office, eds. *Ronso Nihon no Keizai Kiki—Choki Teitai no Shin'in wo Kaimeisuru* (Japan's Economic Crisis), Nihon Keizai Shimbunsha, 2004, pp. 289–318 (in Japanese).

International Monetary Fund, "Japan: Financial System Stability Assessment and Supplementary Information," IMF Country Report No. 03/287, 2003.

Iwamoto, Y., "Monetary and Fiscal Policy to Escape from a Deflationary Trap," *Monetary and Economic Studies*, 23 (1), Institute for Monetary and Economic Studies, Bank of Japan, 2005, pp. 1–46.

Iwata, K., *Zero Kinri no Keizaigaku* (Zero Interest Rate Policy), Diamondsha, 2000 (in Japanese).

———, *Defure no Keizaigaku* (Economics of Deflation), Toyo Keizai Shimposha, 2001 (in Japanese).

Jung, T., Y. Teranishi, and T. Watanabe, "Optimal Monetary Policy at the Zero-Interest-Rate Bound," *Journal of Money, Credit and Banking*, 37 (5), 2005, pp. 813–835.

Kamada, K., and T. Sugo, "Evaluating Japanese Monetary Policy under the Non-Negativity Constraint on Nominal Short-Term Interest Rates," Bank of Japan Working Paper No. 06-E-17, Bank of Japan, 2006.

Kimura, T., H. Kobayashi, J. Muranaga, and H. Ugai, "The Effect of the Increase in the Monetary Base on Japan's Economy at Zero Interest Rates: An Empirical Analysis," in Monetary Policy in a Changing Environment, *Bank for International Settlements Conference Series*, 19, 2003, pp. 276–312.

———, and T. Kurozumi, "Effectiveness of History-Dependent Monetary Policy," *Journal of the Japanese and International Economies*, 18 (3), 2004, pp. 330–361.

———, and D. Small, "Quantitative Monetary Easing and Risk in Financial Asset Markets," *The B.E. Journal of Macroeconomics*, 6 (1), 2006.

King, M., "No Money, No Inflation: The Role of Money in the Economy," *Bank of England Quarterly Bulletin*, Summer, 2002, pp. 162–177.

Kiyotaki, N., and J. Moore, "Liquidity, Business Cycles, and Monetary Policy," mimeo, London School of Economics, 2001.

Komiya, R., "Nichigin Hihan no Ronten no Kento (Examining the Point of Criticism for the Bank of Japan's Monetary Policy)," in R. Komiya and Japan Center for Economic Research, eds., *Kin'yu Seisaku Rongi no Soten—Nichigin Hihan to Sono Hanron* (Main Issues of Monetary Policy Debates), Nihon Keizai Shimbunsha, 2002, pp. 235–312 (in Japanese).

Krugman, P., "It's Baaack: Japan's Slump and the Return of the Liquidity Trap," *Brookings Papers on Economic Activity*, 2, 1998, pp. 137–187.

———, "Thinking about the Liquidity Trap," *Journal of the Japanese and International Economies*, 14 (4), 2000, pp. 221–237.

Kuttner, K. N., "Comments on 'Price Stability and Japanese Monetary Policy' (2)," *Monetary and Economic Studies*, 22 (3), Institute for Monetary and Economic Studies, Bank of Japan, 2004, pp. 37–46.

———, and A. S. Posen, "The Great Recession: Lessons for Macroeconomic Policy from Japan," *Brookings Papers on Economic Activity*, 2, 2001, pp. 93–160.

Marumo, K., T. Nakayama, S. Nishioka, and T. Yoshida, "Extracting Market Expectations on the Duration of the Zero Interest Rate Policy from Japan's Bond Prices," Financial Markets Department Working Paper No. 03-E-2, Bank of Japan, 2003.

McCallum, B. T., "Theoretical Analysis Regarding a Zero Lower Bound on Nominal Interest Rates," *Journal of Money, Credit and Banking*, 32 (4), Part 2, 2000, pp. 870–904.

———, "Japanese Monetary Policy Again," Shadow Open Market Committee, 2001.

———, "Japanese Monetary Policy 1991–2001," *Federal Reserve Bank of Richmond Economic Quarterly*, 89 (1), Federal Reserve Bank of Richmond, 2003, pp. 1–31.

McKinnon, R., "Comments on 'Monetary Policy under Zero Inflation,'" *Monetary and Economic Studies*, 17 (3), Institute for Monetary and Economic Studies, Bank of Japan, 1999, pp. 183–188.

Meltzer, A., "Monetary, Credit and (Other) Transmission Processes: A Monetarist Perspective," *Journal of Economic Perspectives*, 9 (4), 1995, pp. 49–72.

———, "Comments: What More Can the Bank of Japan Do?" *Monetary and Economic Studies*, 17 (3), Institute for Monetary and Economic Studies, Bank of Japan, 1999a, pp. 189–191.

———, "Commentary: Monetary Policy at Zero Inflation," in *New Challenges for Monetary Policy: A Symposium Sponsored by the Federal Reserve Bank of Kansas City*, 1999b, pp. 261–276.

———, "Monetary Transmission at Low Inflation: Some Clues from Japan in the 1990s," *Monetary and Economic Studies*, 19 (S-1), Institute for Monetary and Economic Studies, Bank of Japan, 2001, pp. 13–34.

Meyer, L. H., "Does Money Matter?" *Federal Reserve Bank of St. Louis Review*, 83 (5), Federal Reserve Bank of St. Louis, 2001, pp. 1–15.

Mishkin, F. S., "Symposium on the Monetary Transmission Mechanism," *Journal of Economic Perspectives*, 9 (4), 1995, pp. 3–10.

Miyao, R., "Liquidity Traps and the Stability of Money Demand: Is Japan Really Trapped at the Zero Bound?" RIEB Discussion Paper No. 127, Kobe University, 2002.

———, "Use of the Money Supply in the Conduct of Japan's Monetary Policy: Re-Examining the Time-Series Evidence," *The Japanese Economic Review*, 56 (2), 2005, pp. 165–187.

———, *Macro Kin'yu Seisaku no Jikeiretsu Bunseki: Seisaku Koka no Riron to Jissho* (Time Series Analysis of Macro Monetary Policy: Theories and Empirical Analyses of Policy Effects), Chapter 3, Nihon Keizai Shimbunsha, 2006 (in Japanese).

Motonishi, T., and H. Yoshikawa, "Causes of the Long Stagnation of Japan during the 1990s: Financial or Real?" *Journal of the Japanese and International Economies*, 13 (3), 1999, pp. 181–200.

Nelson, C. R., and A. F. Siegel, "Parsimonious Modeling of Yield Curves," *Journal of Business*, 60 (4), 1987, pp. 473–489.

Oda, N., and T. Nagahata, "On the Function of the Zero Interest Rate Commitment: Monetary Policy Rules in the Presence of the Zero Lower Bound on Interest Rates," Bank of Japan Working Paper No. 05-E-1, Bank of Japan, 2005.

———, and K. Okina, "Further Monetary Easing Policies under the Non-Negativity Constraints of Nominal Interest Rates: Summary of the Discussion Based on Japan's Experience," *Monetary and Economic Studies*, 19 (S-1), Institute for Monetary and Economic Studies, Bank of Japan, 2001, pp. 323–360.

———, and K. Ueda, "The Effects of the Bank of Japan's Zero Interest Rate Commitment and Quantitative Monetary Easing on the Yield Curve: A Macro-Finance Approach," Bank of Japan Working Paper No. 05-E-6, Bank of Japan, 2005.

Okina, K., "Monetary Policy under Zero Inflation: A Response to Criticisms and Questions Regarding Monetary Policy," *Monetary and Economic Studies*, 17 (3), Institute for Monetary and Economic Studies, Bank of Japan, 1999a, pp. 157–182.

———, "Rejoinder to Comments Made by Professors McKinnon and Meltzer," *Monetary and Economic Studies*, 17 (3), Institute for Monetary and Economic Studies, Bank of Japan, 1999b, pp. 192–198.

———, and S. Shiratsuka, "Policy Commitment and Expectation Formation: Japan's Experience under Zero Interest Rates," *North American Journal of Economics and Finance*, 15 (1), 2004, pp. 75–100.

Reifschneider, D., and J. C. Williams, "Three Lessons for Monetary Policy in a Low Inflation Era," *Journal of Money, Credit and Banking*, 32 (4), Part 2, 2000, pp. 936–966.

Sadahiro, A., *Sengo Nihon no Macro Keizai Bunseki* (Macroeconomic Analysis of the Postwar Japanese Economy), Chapter 9, Toyo Keizai Shimposha, 2005 (in Japanese).

Shinpo, S., "Defure wo Motarashita nowa Kozo Yoin ka, Kin'yu Seisaku ka (Which Is the Cause of Deflation, the Structural Adjustment Factor or Monetary Policy?)," in R. Komiya and Japan Center for Economic Research, eds. *Kin'yu Seisaku Rongi no Soten—Nichigin Hihan to Sono Hanron* (Main Issues of Monetary Policy Debates), Nihon Keizai Shimbunsha, 2002, pp. 81–120 (in Japanese).

Shirakawa, M., "One Year Under 'Quantitative Easing,'" IMES Discussion Paper No. 2002-E-3, Bank of Japan, 2002.

———, "Panelists' Remarks," *Monetary and Economic Studies*, 24 (S-1), Institute for Monetary and Economic Studies, Bank of Japan, 2006, pp. 252–261.

Steinsson, J., "Optimal Monetary Policy in an Economy with Inflation Persistence," *Journal of Monetary Economics*, 50 (7), 2003, pp. 1425–1456.

Sugihara, S., T. Mihira, T. Takahashi, and M. Takeda, "Kin'yu Seisaku no Hakyu Keiro to Seisaku Shudan (Monetary Policy in Japan—Instruments, Transmission Mechanisms, and Effects)," *Economic Analysis Series*, 162, Economic and Social Research Institute, Cabinet Office, 2000, pp. 115–435 (in Japanese).

Suzuki, A., and S. Kobayashi, "Ryoteki Kanwa Seisaku no Hyoka to Korekara no Kin'yu Seisaku (The Effects of Quantitative Easing Policy and the Next Monetary Policy)," *Soken Chosa* (UFJ Economic Report), 4, UFJ Institute Ltd., 2005 (in Japanese).

Svensson, L. E. O., "The Zero Bound in an Open Economy: A Foolproof Way of Escaping from a Liquidity Trap," *Monetary and Economic Studies*, 19 (S-1), Institute for Monetary and Economic Studies, Bank of Japan, 2001, pp. 277–312.

———, "Escaping from a Liquidity Trap and Deflation: A Foolproof Way and Others," *Journal of Economic Perspectives*, 17 (4), 2003, pp. 145–166.

Takeda, Y., Y. Komaki, and K. Yajima, *Kitai Keisei no Ishitsusei to Macro Keizai Seisaku: Keizai Shutai wa Dokomade Goriteki ka* (Heterogeneity of Expectation Formation and Macro Economic Policy), Chapter 8, Toyo Keizai Shimposha, 2005 (in Japanese).

Ueda, K., "The Transmission Mechanism of Monetary Policy near Zero Interest Rates: The Japanese Experience, 1998–2000," in L. Mahadeva and P. Sinclair, eds. *Monetary Transmission in Diverse Economies*, Cambridge University Press, 2002.

———, "The Bank of Japan's Struggle with the Zero Lower Bound on Nominal Interest Rates: Exercises in Expectations Management," *International Finance*, 8, 2005, pp. 329–350.

Uhlig, H., "What Are the Effects of Monetary Policy on Output? Result from an Agnostic Identification Procedure," *Journal of Monetary Economics*, 52 (2), 2005, pp. 381–419.

Vasicek, O., "An Equilibrium Characterization of the Term Structure," *Journal of Financial Economics*, 5 (2), 1977, pp. 177–188.

Watanabe, T., and M. Iwamura, *Atarashii Bukka Riron* (Price Level Dynamics in a Liquidity Trap), Chapter 3, Iwanami Shoten, 2004 (in Japanese).

Woodford, M., *Interest and Prices: Foundations of a Theory of Monetary Policy*, Chapter 2, Princeton, New Jersey: Princeton University Press, 2003.

Yates, T., "Monetary Policy and the Zero Bound to Nominal Interest Rates," *Bank of England Quarterly Bulletin*, Spring, 2003, pp. 27–37.