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Abstract

In this paper, we examine and evaluate the effect of changes in the Bank of Japan (BOJ)'s current account balance (CAB) target variable on the term structure of interest rates during the quantitative monetary easing policy (QMEP) period. We employ an autoregressive-exponential generalized autoregressive conditional heteroskedasticity (AR-EGARCH) model and reach two main conclusions. First, the introduction of the QMEP reduced the short-term yield spread and the increase in the CAB target extended the short-, middle-, and long-term yield spreads. Second, the additional expansion of the CAB target lowered the volatility of the short-, middle-, and long-term yield spreads.

JEL classification: E52

Keywords: Yield Spread; Quantitative Monetary Easing Policy

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1. Introduction

Starting in the first half of the 1990s, the Japanese economy experienced a large and substantial recession. The asset price bubble collapsed, and prices of stocks and land fell significantly.[1] The Japanese government implemented several large fiscal stimulation policies, but those seemed to be ineffective, increasing the budget deficit.[2] The Bank of Japan (BOJ) conducted a quantitative monetary easing policy (QMEP) after the cancellation of the zero interest rate policy (ZIRP) to further ease monetary policy from March 2001 to March 2006.[3] The BOJ purchased large quantities of long-term securities and set the policy interest rate to a low standard of nearly zero percent. The short-term interest rate dropped under one percent, and the Japanese economy has since been falling into a long-term liquidity trap.[4] Krugman (1998, 2000), Woodford (1999), Reifschneider and Williams (2000), and Eggertson and Woodford (2003) indicated the effect of expectation control in terms of the conduct of monetary policy from a theoretical viewpoint. In a liquidity trap, Woodford (1999) and Reifschneider and Williams (2000) argued that the BOJ should continue the ZIRP to improve economic

[1] The Nikkei Stock Average was approximately 40,000 yen (December 1989) during the bubble economy period, but it fell to 15,000 yen (December 1997) after the bubble burst. The Urban Land Price Index (commercial) of the bubble economy period was 151.3 (1989), which fell to 128.9 (1997) after the burst of the bubble.

[2] The government increased the public works and improvement of social infrastructure expenditures and reduced the income, individual income, and corporation taxes.

[3] The BOJ implemented the ZIRP from February 1999 to August 2000, which meant that the BOJ reduced the uncollateralized overnight call rate to virtually zero percent through the supply of ample funds that exceeded the required reserves.

[4] The call rate, which is the policy rate, was less than 0.5% after 1995.

performance, even if the nominal interest rate was over zero.

The QMEP was a new and non-traditional monetary policy framework for monetary easing in Japan. It was implemented from March 19, 2001 to March 9, 2006 by the BOJ. On March 19, 2001, the BOJ adopted the policy in response to the economic recession triggered by the burst of the world information technology bubble. Ugai (2006) introduced a survey of non-traditional Japanese monetary policy in detail.[5] The following three points are considered pillars of this policy. First, the BOJ changed the policy objective from uncollateralized overnight call rates (short-term interest rate) to the current account balance (CAB), and provided ample liquidity by increasing the CAB through a change of its policy target and a realization of the CAB target value in excess of the required reserves. Second, the BOJ is committed to maintaining the supply of ample liquidity until the consumer price index (CPI; excluding perishables for nationwide statistics, that is, core CPI) is stable at the zero percent level or shows an annual increase. Third, the BOJ increases the purchase of long-term Japanese government bonds (JGBs) required to facilitate smooth liquidity injection.

The BOJ expanded the CAB target value many times during this practice policy period. The BOJ assumed its first target level at approximately 5 trillion yen in March 2001. The upper and lower target levels were set at 35 trillion yen and 30 trillion yen, respectively, in January 2004. Figure 1 plots the actual value of the CAB and its target

[5] On February 12, 1999, the BOJ adopted the ZIRP. Japanese non-traditional monetary policy includes the ZIRP period. Some other studies introduce both the ZIRP and the QMEP (Fujiki and Shiratsuka (2002), Oda (2002), Okina and Shiratsuka (2004), Baba *et al*. (2006), Kimura and Small (2006), Kobayashi *et al*. (2006), Oda and Ueda (2007), Hanabusa (2009a, 2009b, 2010a, 2010b), Fukuda (2010)).

ranges.[6] The figure shows that the CAB level remained approximately at the upper target or exceeded this target from 2001 to early 2003. However, since late 2003, the BOJ has retained the monthly level within the announced ranges. On March 9, 2006, the BOJ terminated the QMEP and changed its policy objective to the uncollateralized overnight call rate from the CAB. The BOJ announced that the reduction of the CAB would be conducted over a period of several months, fully considering conditions in the short-term money market. The reduction plan in the CAB proceeded smoothly over a few months, and in July 2006, the BOJ terminated the ZIRP and increased the policy rate. Policy decisions regarding the QMEP are shown in Table 1. When the BOJ increased the CAB target, it explained the need for a liquidity injection to secure financial market stability.[7] Figures 2 and 3 show the movement of yield spreads from August 14, 2000 to March 9, 2006. The yield spreads between the 1-month interest rate and the 6-month, 1-year, 2-year, 3-year, and 10-year rates are termed r06, r1, r2, r3, and r10, respectively.

Balduzzi *et al*. (2001) and Goyenko *et al*. (2011) study the relationship between economic shocks and liquidity dynamics. We focus on the influence of short-, middle-, and long-term structures of interest rates on positive shocks as increases in liquidity during the QMEP period. Our results indicate that the supply of liquidity under the low interest rate reduced the short-term yield spreads. This shows that the announcement of monetary policy regarding the target value of the CAB changed the expectation form of

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[6] This value of CAB was increased primarily through monthly purchases of JGBs in open market operation (see Oda and Ueda (2007)).

[7] For example, the war in Iraq started in March 2003, and the BOJ increased the CAB target from 17–22 trillion yen to 22–27 trillion yen in April 2003.

the shorter-term money market. This result is consistent with the relation between short-term money markets and monetary policy objectives.[8] Our analysis also indicates that the fluid graded supply reduced the volatility from the short-term to the long-term yield spreads. This implies that the BOJ supplied fluidity progressively, and, as a result, market interest rate changes were controlled. The BOJ conducted five expansions of the liquidity supply over 5 years. The concern present during this period, destabilization of the financial market, was not responsible for the tightening of fluidity; thus, the interest rate volatility was reduced.[9]

The remainder of this paper is structured as follows. Section 2 introduces the previous studies. Section 3 explains the empirical methodology. Section 4 describes the data, and Section 5 presents the empirical results. In Section 6, we re-estimate all models using the gradual changes with regard to liquidity. Section 7 presents a summary and conclusion.

[Insert Fig. 1 around here]

[Insert Fig. 2 around here]

[Insert Fig. 3 around here]

[Insert Table 1 around here]

2. Literature

[8] Fujiki and Shiratsuka (2002), Okina and Shiratsuka (2004), and Oda and Ueda (2007) also show the drop of the interest rates of this period and support the effect of non-traditional monetary policy.

[9] Oda and Ueda (2007), Hanabusa (2009b, 2010b), and Fukuda (2010) discuss the stabilization of the money market.

The BOJ reduced the short-term interest rate from the late 1990s and supplied a large quantity of fluidity, which was a novel policy for Japan. The BOJ supplied fluidity mainly through purchases of long-term JGBs, causing its balance sheet to spread. Because of the financial economy's unease after the Lehman shock, most major countries enforced non-traditional monetary policies. In this paper, we discuss the effect of the policies conducted by the BOJ from 2001 to 2006. Under the QMEP, the monetary policy operational target was changed from the uncollateralized overnight call rate to the CAB held by financial institutions at the BOJ. In total, 542 financial institutions (e.g., banks, securities companies, and Tanshi companies) have BOJ CABs. The BOJ committed to maintain the balance levels well above required reserves until the core CPI inflation passed zero on a sustainable basis. Because there is no interest rate, the bank loans its funds, and as a result, funds are supplied to the financial market.[10]

Several researchers have attempted to investigate the effects of this non-traditional monetary policy that includes the ZIRP and QMEP in Japan (Fujiki and Shiratsuka (2002), Oda (2002), Okina and Shiratsuka (2004), Baba *et al*. (2006), Kimura and Small (2006), Kobayashi *et al*. (2006), Honda *et al*. (2007), Oda and Ueda (2007), Hanabusa (2009b, 2010b), Fukuda (2010)). These studies mainly examined the effects of non-traditional monetary policies on the financial and capital markets. These markets are examined because there are insufficient samples for an analysis of macroeconomic variables (e.g., output and inflation): The QMEP lasted approximately 5 years, for a

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[10] After November 2008, the BOJ has paid an interest rate on excess reserve balances (see Complementary Deposit Facility).

total of only 60 monthly data points.[11] Green (2004) examined the effects of the announcements of the Federal Reserve Board in the U.S. bond market and indicated the point of information arrival. In this paper, we include the Japanese QMEP enforcement period comprehensively and analyze bond markets in both the short and long terms, because monetary policy is conducted in consideration of the past several years' economic conditions.

Fujiki and Shiratsuka (2002), Okina and Shiratsuka (2004), and Oda and Ueda (2007) supported the use of a policy duration effect throughout the flatness of the yield curve. Kimura and Small (2006) and Honda *et al*. (2007) examined the portfolio rebalancing effect, which was confirmed by their results. Oda and Ueda (2007) also examined the portfolio rebalancing and signaling effects, the results of which supported the signaling effect but not the portfolio rebalancing effect. Oda (2002), Baba *et al*. (2006), Kobayashi *et al*. (2006), Hanabusa (2009b, 2010b), and Fukuda (2010) investigated the financial system under low interest rates and suggested that the QMEP lowers financial and liquidity risks. These papers showed that the QMEP caused further easing effects through policy commitments, and that they produced policy duration and financial stability effects. However, few studies have empirically investigated the effects of policy targets on the financial market. Honda and Kuroki (2006) examined the effects of monetary shocks before the QMEP.

In this paper, we empirically investigate the daily level and volatility of the yield spreads under the QMEP. If the BOJ expands the supply of liquidity and affects the

[11] However, Honda *et al.* (2007) conducts an analysis using monthly data and the changes in the BOJ CABs and indices of industrial production. They show the stock price channel that implies that the BOJ CABs affect the stock prices and that the indices of industrial production change thereafter.

expected future course of the short-term interest rate, the variance of the yield spreads falls. We employ the autoregressive-exponential generalized autoregressive conditional heteroskedasticity (AR-EGARCH) model, and our findings are broadly consistent with previous studies regarding the effects of the QMEP. In addition, we find that the interest rates on loans with terms shorter than 1 year decrease after the introduction of the QMEP, but those on loans with terms greater than 2 years cannot confirm this influence. Ample liquidity lowers the volatility of the monetary market on interest rates for loans with terms both shorter than 1 year and greater than 2 years. Moreover, the gradual changes in the CAB targets also play an important role in the financial market.

3. Effect of liquidity supply on yield spread

The BOJ provided ample liquidity through purchases of JGBs, the amount of which was 0.4 trillion yen per month in March 2001. This amount was gradually increased to 1.2 trillion yen per month starting in October 2002, a limit that sustained throughout the policy period. We test whether the increase in liquidity affects the level and volatility of yield spreads and explain the effects of this action on the expectation forms on the short-, medium-, and long-term money markets.

3.1. The pre-QMEP period

In August 2001, the BOJ began increasing its CAB target and maintaining ample liquidity supply for the monetary market. The increase in the CAB target occurred multiple times after the introduction of the QMEP and is therefore the focus of our study.

We employ the AR (q)-EGARCH (1, 1) model following Nelson (1991),[12] which is specified as follows:

$$r_{n,t} = c_{n,1} + d_{n,1} D_{1,t} + d_{n,2}\, CAB_{j,t} + \sum_{p=1}^{q} \omega_{n,p} r_{n,t-p} + \varepsilon_{n,t}, \qquad (1)$$

$$\varepsilon_{n,t} = \sqrt{h_{n,t}}\, u_{n,t}\,.$$

$$\log\,(h_{n,t}) = c_{n,2} + \alpha_{n,1} \left|\frac{\varepsilon_{n,t-1}}{\sqrt{h_{n,t-1}}}\right| + \alpha_{n,2} \frac{\varepsilon_{n,t-1}}{\sqrt{h_{n,t-1}}} + \beta_{\mathrm{n}} \log(h_{n,t-1}) + d_{n,3}\, CAB_{j,t}\,, \quad (2)$$

$$\varepsilon_{n,t} | \mathrm{I}_{\mathrm{t-1}} \sim N\left(0, h_{n,t}\right), \quad n = 0.5,1,2,3,10, \;\; j = u,\, b.$$

where

$$D_t = \begin{cases} 0 & (t \le 2001/3/16), \\ 1 & (t \ge 2001/3/19), \end{cases}$$

$$CAB_{u,t} = \begin{cases} reserve & (t \le 2001/8/13), \\ 6 & (2001/8/14 \le t \le 2001/12/18), \\ 15 & (2001/12/19 \le t \le 2002/10/29), \\ 20 & (2002/10/30 \le t \le 2003/4/29), \\ 27 & (2003/4/30 \le t \le 2003/5/19), \\ 30 & (2003/5/20 \le t \le 2003/10/9), \\ 32 & (2003/10/10 \le t \le 2004/1/19), \\ 35 & (2004/1/20 \le t), \end{cases}$$

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[12] The ARCH model is based on a principle discovered by Engle (1982) and is extended by Bollerslev (1986), termed the GARCH model. A GARCH model specifies that the variance depends on past volatilities and variances of the dependent variable (see Bollerslev et al. (1992, 1994)). The EGARCH model does not need to constrain the nonnegative condition in the variance equation.

$$
CAB_{b,t} = \begin{cases} reserve \quad (t \leq 2001/8/13), \\ 6 \quad (2001/8/14 \leq t \leq 2001/12/18), \\ 10 \quad (2001/12/19 \leq t \leq 2002/10/29), \\ 15 \quad (2002/10/30 \leq t \leq 2003/4/29), \\ 22 \quad (2003/4/30 \leq t \leq 2003/5/19), \\ 27 \quad (2003/5/20 \leq t \leq 2004/1/19), \\ 30 \quad (2004/1/20 \leq t). \end{cases}
$$

Equations (1) and (2) provide the mean and variance, respectively. The mean equation has q autoregressive terms in the dependent variable. The lag length of the term is selected using the Akaike information criterion (AIC). The error term ($\varepsilon_{n,t}$) is assumed to have a conditional normal distribution with a zero mean and conditional variance $h_{n,t}$. I_{t-1} denotes the information set. $r_{n,t}$ represents the yield spread. n denotes the year of maturity of the interest rate. The sample period is from August 14, 2000 to March 9, 2006. The BOJ implemented the ZIRP from February 1999 to August 2000. Our sample starts after the end of the ZIRP.

$D_{1,t}$ represents the variable for the introduction of the QMEP, $CAB_{u,t}$ and $CAB_{b,t}$ denote the upper and bottom limits of the CAB targets, respectively. The term of reserve denotes the value of required reserves,[13] which was approximately five trillion yen (2000/8/14 ≤ t ≤ 2001/8/13). The CAB target value ranged from 6 trillion yen to 30-35 trillion yen (2001/8/14 ≤ t ≤ 2006/3/9). Table 1 presents these values. The announcement on March 19, 2001 is considered the sign of monetary policy easing. Announcements typically affect the money market, reducing the expected short-term

[13] Reserves show average figures from the 16th of the stated month to the 15th of the following month.

interest rates and the risk of a liquidity crisis. Thus, the negative sign of $d_{n,1}$ implies a policy duration effect because of the reduction of uncertainty. The increase in the liquidity supply under the ZIRP means a retention of the easing policy on the money market. The BOJ raised the CAB target and showed a positive effect of the monetary policy. Thus, the negative sign of $d_{n,2}$ implies an easing effect, which includes the signaling and portfolio effects throughout the expansion of liquidity; that of $d_{n,3}$ denotes the effect on stabilizing financial market throughout the liquidity provision term.

In the EGARCH (1,1) model, the persistence of variance is measured by the magnitude of β_n, and the asymmetric effect of the residual is measured by the magnitude of $\alpha_{n,2}$.When the value of β_n approaches 1, the persistence of the shock concerning volatility is high. When the value of $\alpha_{n,2}$ is a negative and significant, a negative shock greatly affects the volatility. We report asymptotic standard errors for the parameters that are robust to departures from normality using the consistent variance–covariance estimator of Bollerslev and Wooldridge (1992).

3.2. The QMEP period

In 3.1, we setup the model, which included the period before the QMEP. Moreover, to investigate the effect of the liquidity supply, we conduct a robustness check using the QMEP period. Therefore, we examine the effects of an increase in the CAB target on interest rates using data from March 19, 2001 to March 9, 2006. The model is specified as follows:

$$r_{n,t} = c_{n,1} + d_{n,2}\,CAB_{j,t} + \sum_{p=1}^{q} \omega_{n,p} r_{n,t-p} + \varepsilon_{n,t}, \qquad (3)$$

$$\varepsilon_{n,t} = \sqrt{h_{n,t}}\, u_{n,t}\,.$$

$$\log\,(h_{n,t}) = c_{n,2} + \alpha_{n,1} \left| \frac{\varepsilon_{n,t-1}}{\sqrt{h_{n,t-1}}} \right| + \alpha_{n,2} \frac{\varepsilon_{n,t-1}}{\sqrt{h_{n,t-1}}} + \beta_{\mathrm{n}} \log(h_{n,t-1}) + d_{n,3}\,CAB_{j,t}\,, \quad (4)$$

$$\varepsilon_{n,t} | \mathrm{I}_{\mathrm{t-1}} \sim N\left(0, h_{n,t}\right).$$

The notation of these equations is same as those in the previous subsection. Because we focus on the period of the QMEP, we cannot analyze the effects of an introduction of the QMEP. However, we can investigate the liquidity effect throughout the CAB target changes.

4. Data

We use the data on daily interest rates, required reserves, and CAB targets (upper and lower target ranges) in Japan. Interest rates include 6-month and 1-year Tokyo Interbank Offered Rates (TIBORs), 2-year, 3-year, and 10-year JGBs yields, and the call rate (uncollateralized 1-month loan).[14] The sample period is from August 14, 2000 to March 9, 2006. The data source is the BOJ homepage and Thomson Reuters Datastream. In addition, the *n*-year yield spread ($r_{n,t}$) is calculated using the difference between $R_{n,t}$ and CR_t. $R_{n,t}$ and CR_t are the original data series for TIBORs and

[14] TIBORs are in Japanese Yen. The pricing of JGB depends crucially on their convenience, reflecting the market liquidity and the differences in the characteristics of each issue (i.e., outstanding volume and coupon rate; see Shigemi *et al.* (2001) and Fukuta *et al* (2002)). Moreover, during 1998–2000, some problems regarding market liquidity occurred (including the Y2K problem). Thus, we used both TIBORs and JGBs.

JGBs and for the call rate, respectively, at time *t*. Tables 2 and 3 show the summary statistics on the yield spreads. Table 2 denotes the summary statistics from August 14, 2000 to March 9, 2006 (including the pre-QMEP). Table 3 provides the summary statistics from March 19, 2001 to March 9, 2006 (QMEP period only).

We examine whether the unit root exists in the yield spreads by applying the DF-GLS test and PP test. The DF-GLS test was proposed by Elliott et al. (1996),[15] and the PP test was proposed by Phillips (1987) and Phillips and Perron (1988). The lag length is selected using the AIC. The stationarity of the variable is required to obtain reliable parameter estimates and statistical inferences. These results are shown in Tables 2 and 3. Because the null hypothesis of the existence of a unit root is rejected, they are stationary variables.

[Insert Table 2 around here]

[Insert Table 3 around here]

5. Empirical results

We provide the empirical results for the AR-EGARCH models. First, we analyze the effect of increasing the liquidity supply on the short-, medium-, and long-term money markets using the data from August 14, 2000, to March 9, 2006. Next, to check robustness, we use the sample from March 19, 2001, to March 9, 2006.

5.1. The effect of an increase in the CAB targets on interest rates

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15 This test is more powerful than the ADF test proposed by Dickey and Fuller (1979, 1981).

We provide the empirical results, which include the sample before the introduction of the QMEP, using $D_{1,t}$ and $CAB_{j,t}$ variables in Equation (1) and (2). Because the $D_{1,t}$ variable represents the introduction period of the QMEP, the estimated $d_{n,1}$ regression coefficient is negative if the policy duration effect exists. Because the $CAB_{j,t}$ variable in the mean equation represents the effect of the liquidity supply on the yield spread level, the estimated $d_{n,2}$ coefficient is negative if the QMEP lowers the expected future path of interest rates or the risk premium. Because the $CAB_{j,t}$ variable in the variance equation represents the effect of the liquidity supply on the volatility of the yield spread, the estimated $d_{n,3}$ coefficient is negative if the QMEP reduces the variance of the expected future path of interest rates and risk premiums.

The BOJ set the target range of CAB from December 19, 2001. We examine the effects of the upper and bottom targets (Tables 4 and 5). The persistence measures (β_n) for each yield spread is in the range 0.47–0.54. These values are positive and statistically significant in all maturities. The persistence is not high, and the value of the short-term yield spread is higher than that of the middle- and long-term yield spreads.

The asymmetric effect measures ($\alpha_{n,2}$) for each yield spread range between -0.09 and -0.23. These values are negative and statistically significant in maturities except for the 10-year yield spread. Because the absolute value of the short-term yield spread is higher than that of the middle- and long-term yield spreads, the negative shock strongly affects the volatility of the short-term interest rate.

5.1.1. Policy duration effect

From Table 4, the estimated values of $d_{n,1}$ for the 6-month, 1-year, 2-year, 3-year, and

10-year yield spreads are -0.023, -0.023, -0.009, -0.009, and -0.011, respectively. All estimated values are negative. The estimate of the short-term yield spread is statistically significant at the 5% level. However, 2-year, 3-year, and 10-year yield spreads are not statistically significant at the 10% level. From Table 5, the estimates of $d_{n,1}$ for the 6-month, 1-year, 2-year, 3-year, and 10-year yield spreads are -0.022, -0.022, -0.008, -0.008, and -0.009, respectively. All values are negative, but the two-year, three-year, and ten-year yield spreads are statistically insignificant at the 10% level. This result is consistent with the analysis of the upper CAB targets. It is evident that the introduction of the QMEP flattens the short-term yield curve. Thus, the policy duration effect exists in the short term but not in the middle and long term during the QMEP period.[16] The announcement of the QMEP reduced the short-term yield spread by 2.2–2.3 basis points. This short-term yield spread result is consistent with the conclusions of Okina and Shiratsuka (2004). However, the results in the middle- and long-term yield spreads are not consistent with those by Okina and Shiratsuka (2004) and Oda and Ueda (2007), whose findings supported the policy duration effect on the long-term interest rate.

5.1.2. Easing effect on the term structure of interest rates

From Table 4, to test the effect of an increase in the CAB targets, we checked the estimated values of $d_{n,2}$ for each yield spread. The $d_{n,2}$ value of the 6-month, 1-year, 2-year, 3-year, and 10-year yield spreads is 0.001. These values are positive and statistically significant at the 5% level. Table 5 shows that the estimates of $d_{n,2}$ for all

[16] Hanabusa (2009b, 2010b) provided that the policy duration effect does not exist in the money market. However, because this paper uses both $D_{1,t}$ and $CAB_{j,t}$ in the mean equation, its findings support the effect.

yield spreads are 0.001. These values are positive and statistically significant in all maturities. This result is consistent with the analysis of the upper CAB targets. We consider that the easing effect is the reduction of yield spreads through an increase in the liquidity supply. However, we find that the changes in the CAB targets affect and increase the yield spreads. Thus, the easing effect did not exist during the QMEP period, a result that is not consistent with that of Honda *et al.* (2007) and Oda and Ueda (2007). Oda and Ueda (2007) used a macro finance model and estimated the term structure of interest rates with and without the ZIRP statement. They suggested that the signaling effect is the influence of the difference in interest rates with or without the CAB statement. In this case, the result depends on the calculation of the interest rate without the statement. By contrast, we regard the easing effect as the influence of money market rates through the change in the CAB targets, and our result depends on the market rates. Figure 3 shows that yield spreads increased from June 2003, because of an increase in worldwide interest rates and because of domestic factors. Figure 4 plots the growth rate of the gross domestic product (GDP), and Figure 5 plots that of the price index. These figures show that the economy began to recover in 2003, and that inflation has since also increased. This implies that deflationary concerns began to be dispelled, and that the expected future course of short-term interest rates increased beginning in 2003. The market expected the QMEP to be terminated by the BOJ in the middle term. This expectation caused an increase in the middle- and long-term interest rates starting in 2003.[17]

[17] In October 2003, the BOJ assured that a zero interest rate would be maintained until core CPI inflation was stably above zero. This view affected the expectation forms in the money market.

5.1.3. Effect of an increase in the CAB targets on the stability of the financial market

We examine the effectiveness of an increase in the CAB targets on the volatility of yield spreads. From Table 4, the estimated values of $d_{n,3}$ for the 6-month, 1-year, 2-year, 3-year, and 10-year yield spreads are -0.040, -0.040, -0.038, -0.038, and -0.033, respectively. These values are negative and statistically significant at the 5% level. The range is approximately -0.04. From Table 5, the estimates of $d_{n,3}$ for each yield spread are -0.046, -0.045, -0.043, -0.044, and -0.037, respectively. These values are negative and statistically significant in all maturities, and the range is approximately -0.04. These empirical results show that the increase in CAB targets lowers the variability of the yield spreads. The influence is strong for the short-term interest rates. Thus, the effect on the stability of the financial market can be seen in the entire money market. These results are consistent with that of Hanabusa (2009b, 2010b). Hanabusa (2009b) showed that the increase in the CAB targets lowers the volatility of the rate of change in the short-term interest rate. Hanabusa (2010b) found that an increase in the upper CAB targets lowers the volatility of the yield spread. Fukuda (2010) noted that the QMEP narrows the spread between the intraday high and low of the call rates and removes almost all risk premiums from trading on the call market. Baba *et al*. (2006) showed that an increase in the CAB does not affect the variance of the risk premium on the short-term interest rates (i.e., those less than 30, 60, and 90 days). However, they argued that the increase may affect long-term maturity data, which is confirmed by our results. Hanabusa (2009a, 2010a) concluded that the ZIRP does not reduce the volatility of short-term interest rates. Therefore, these results indicate that the QMEP may reduce the uncertainty for unexpected fundraising throughout, thus providing ample liquidity. Honda and Kuroki (2006) investigated the announcement effect of the BOJ using data pre-QMEP. In this paper, we show that the announcement of the BOJ under the QMEP affects the term structure of interest rates.

[Insert Table 4 around here]

[Insert Table 5 around here]

[Insert Fig. 4 around here]

[Insert Fig. 5 around here]

5.2. Robustness check

We confirm that the supply of liquidity by the BOJ increases yield spreads and reduces volatilities in the entire money market. In this subsection, we verify these results and clarify the robustness. Tables 6 and 7 report the empirical results for the effects of an increase in the CAB targets on yield spreads. We employ a sample from the introduction to the termination of the QMEP. Table 6 shows the result of the upper CAB targets, and Table 7 shows that of the bottom CAB targets. First, these tables show that the persistence of volatility is approximately 0.5, which is consistent with the pre-examination. However, the value of short-term yield spreads is lower than that of the middle- and long-term yield spreads, which implies that the persistence of the short-term money market was high and that of the middle- and long-term money market was low during 2000–2001.

Second, the estimated value of the asymmetric effect of volatility is negative but not statistically significant at the 10% level. From this analysis, we do not confirm the existence of the effect, and we consider that this is related to the sample period.

Third, the effect of an increase in the CAB targets on the yield spreads is the same as that shown by the analysis of the period from the pre-QMEP. The estimate is 0.001 and statistically significant in the two cases. Thus, we find that the increase in the CAB targets raised the yield spreads.

Finally, the effect of an increase in the CAB targets on the volatility of the yield spreads is the same as that indicated in the analysis of the period starting pre-QMEP. The estimate is approximately -0.04 and statistically significant in both cases. Thus, we find that the increase in the CAB targets lowers the volatility of yield spreads, which strongly affects the volatility of short-term interest rates.

[Insert Table 6 around here]

[Insert Table 7 around here]

6. Effects of a gradual increase in CAB targets on yield spread

In March 2001, the BOJ implemented the QMEP, which did not cause an immediate increase in the CAB target (which was on August 14, 2001). The upper limit of the CAB increased seven-fold, and the bottom limit increased six-fold. These changes were decided by the BOJ's Monetary Policy Meetings. Members of the policy board set guidelines for market operations based on recent developments in financial markets, overseas economic and financial developments, and domestic economic and financial developments. The amount of change in the CAB target was set depending on each event and economic situation, and the expansion was not always constant.[18] In this

[18] For example, the BOJ expanded the target value of CAB from 17–22 trillion yen to 22–27 trillion yen on April 30, 2001. However, on January 20, 2004, the BOJ expanded its target value from 27-32 trillion yen to 30-35 trillion yen. The former expansion increased the target by five trillion yen, and

segment, we focus on the effect of the difference in the expansion of CAB targets and analyze the effect of additional liquidity supply on the volatility of yield spreads on the money market.

6.1. The period starting pre-QMEP

In August 2001, the BOJ changed the CAB target and kept ample liquidity supply. The CAB target amount increased gradually from the introduction of the QMEP. Our study focuses on the further increases in the CAB target. We employ the AR (q) - EGARCH (1, 1) model, which is specified as follows:

$$r_{n,t} = c_{n,1} + d_{n,1} D_{1,t} + d_{n,2}\, CAB_{j,t} + \sum_{p=1}^{q} \omega_{n,p} r_{n,t-p} + \varepsilon_{n,t}, \qquad (5)$$

$$\varepsilon_{n,t} = \sqrt{h_{n,t}}\, u_{n,t}\,.$$

$$\log\,(h_{n,t}) = c_{n,2} + \alpha_{n,1}\left|\frac{\varepsilon_{n,t-1}}{\sqrt{h_{n,t-1}}}\right| + \alpha_{n,2}\frac{\varepsilon_{n,t-1}}{\sqrt{h_{n,t-1}}} + \beta_{\mathrm{n}}\log(h_{n,t-1}) + \sum_{\tau=1}^{\varphi} \gamma_{n,\tau}\, CAB^{\mathrm{j}}_{\tau,t}\,, \quad (6)$$

$$\varepsilon_{n,t}|\mathrm{I}_{t-1} \sim N\left(0, h_{n,t}\right), \quad n = 0.5,1,2,3,10, \;\; j = u, b, \;\; \varphi = 6, 7,$$

where

$$CAB^{u}_{1,t} = \begin{cases} 1.6 & (2001/8/14 \le t \le 2001/12/18), \\ 0 & (t = \text{otherwise})\,, \end{cases} \quad CAB^{u}_{2,t} = \begin{cases} 9 & (2001/12/19 \le t \le 2002/10/29), \\ 0 & (t = \text{otherwise})\,, \end{cases}$$

$$CAB^{u}_{3,t} = \begin{cases} 5 & (2002/10/30 \le t \le 2003/4/29), \\ 0 & (t = \text{otherwise})\,, \end{cases} \quad CAB^{u}_{4,t} = \begin{cases} 7 & (2003/4/30 \le t \le 2003/5/19), \\ 0 & (t = \text{otherwise})\,, \end{cases}$$

---

the latter increased it by trillion yen.

$$CAB^{u}_{5,t}=\begin{cases}3 & (2003/5/20 \le t \le 2003/10/9),\\ 0 & (t=\text{otherwise})\,,\end{cases}\quad CAB^{u}_{6,t}=\begin{cases}2 & (2003/10/10 \le t \le 2004/1/19),\\ 0 & (t=\text{otherwise})\,,\end{cases}$$

$$CAB^{u}_{7,t}=\begin{cases}3 & (2004/1/20 \le t),\\ 0 & (t=\text{otherwise})\,,\end{cases}$$

$$CAB^{b}_{1,t}=\begin{cases}1.6 & (2001/8/14 \le t \le 2001/12/18),\\ 0 & (t=\text{otherwise})\,,\end{cases}\quad CAB^{b}_{2,t}=\begin{cases}4 & (2001/12/19 \le t \le 2002/10/29),\\ 0 & (t=\text{otherwise})\,,\end{cases}$$

$$CAB^{b}_{3,t}=\begin{cases}5 & (2002/10/30 \le t \le 2003/4/29),\\ 0 & (t=\text{otherwise})\,,\end{cases}\quad CAB^{b}_{4,t}=\begin{cases}7 & (2003/4/30 \le t \le 2003/5/19),\\ 0 & (t=\text{otherwise})\,,\end{cases}$$

$$CAB^{b}_{5,t}=\begin{cases}5 & (2003/5/20 \le t \le 2004/1/19),\\ 0 & (t=\text{otherwise})\,,\end{cases}\quad CAB^{b}_{6,t}=\begin{cases}3 & (2004/1/20 \le t),\\ 0 & (t=\text{otherwise})\,.\end{cases}$$

Regarding the additional notation, $CAB^{u}_{1,t},\ldots,CAB^{u}_{7,t}$ denote the change of the upper limit of the CAB target, and $CAB^{b}_{1,t},\ldots,CAB^{b}_{6,t}$ denote that of the bottom limit of the CAB target. That is to say, $CAB^{\mathrm{j}}_{\tau,t}$ is the additional liquidity supply. Because the $CAB^{\mathrm{j}}_{\tau,t}$ variable represents the effect of additional liquidity supply on the volatility of yield spreads, the coefficient, $\gamma_{n,\tau}$ is negative if each change of the CAB target affects the variance of the expected future path of the interest rate or the risk premium.

6.1.1. EGARCH model

We examine the effects of both upper and bottom targets. Table 8 shows the result of the upper target, and Table 9 shows that of the bottom target. From Tables 8 and 9, the persistence measures for the 6-month, 1-year, 2-year, 3-year, and 10-year yield spreads are approximately 0.46–0.54. These values are statistically significant at the 5% level. The persistence is not high, and these results are consistent with Tables 4 and 5.

From Tables 8 and 9, the asymmetric effect measures for each yield spread ranges between -0.20 and -0.07. These values are negative and statistically significant at the 10% level, except for the 3-year yield spread. The absolute value of the short-term yield spread is higher than that of the middle- and long-term yield spreads. These results are consistent with Tables 4 and 5.

6.1.2. Policy duration effect

From Table 8, the estimated values of $d_{n,1}$ for the 6-month, 1-year, 2-year, 3-year, and 10-year yield spreads are -0.023, -0.023, -0.010, -0.009, and -0.009, respectively. All estimated values are negative. The estimate of the short-term yield spread is statistically significant at the 5% level, but the middle- and long-term yield spreads are not statistically significant at the 10% level. From Table 9, the estimates of $d_{n,1}$ for each yield spread are -0.021, -0.020, -0.008, -0.007, and -0.008, respectively. All values are negative, and the 2-year, 3-year, and 10-year yield spreads are statistically insignificant at the 10% level. These results are consistent with Tables 4 and 5. It is evident that the introduction of the QMEP flattens the short-term yield curve, and thus, we confirm the existence of the policy duration effect on the short-term money market.

6.1.3. Easing effect on the term structure of interest rates

The estimated values of $d_{n,2}$ for the 6-month, 1-year, 2-year, 3-year, and 10-year yield spreads are 0.001, according to Table 8. The estimated values of $d_{n,2}$ for each yield spread are also 0.001, as shown in Table 9. These values are positive and statistically significant at the 5% level in all maturities, and these results are consistent with Tables 4 and 5. Thus, we do not confirm that the signaling and portfolio effects exist on the money market.

6.1.4. The effect of an increase in the CAB targets on stabilizing the financial market

We examined the effectiveness of additional increases in the CAB targets on the volatility of yield spreads. We analyzed the additional changes in the upper CAB targets. From Table 8, we checked the estimated values of $\gamma_{n,\tau}$ for each yield spread, which are all negative. First, we consider the influence of the short-term yield spread. The estimated values from $\gamma_{n,2}$ to $\gamma_{n,7}$ (i.e., the values describing the volatility of yield spreads to the change in CAB targets) are statistically significant and are larger toward the end of the QMEP. However, the change in the CAB target on August 14, 2001 was insignificant. Second, in the case of the middle- and long-term yield spreads, the estimated values are statistically significant for the estimated values of $\gamma_{n,3}$ to those of $\gamma_{n,7}$, but they are not statistically significant for values of $\gamma_{n,1}$ and $\gamma_{n,2}$. The effect is the largest at the change in the CAB targets on October 10, 2003.

Next, we examine the effect of an additional change in the bottom CAB targets on the volatility of yield spreads. Table 9 reports the estimated values of $\gamma_{n,\tau}$ for each yield spread. This result is consistent with Table 8. The estimated values of $\gamma_{n,1}$ for the short-term yield spread are not statistically significant, but values from $\gamma_{n,2}$ to $\gamma_{n,6}$ are negative and statistically significant at the 10% level. The estimated values of $\gamma_{n,1}$ and $\gamma_{n,2}$ for middle- and long-term yield spreads are not statistically significant, but these values from $\gamma_{n,3}$ to $\gamma_{n,6}$ are negative and statistically significant at the 10% level. The estimate of $\gamma_{n,6}$ is the largest during the period of the increases in the lower CAB target under the QMEP.

Therefore, we find that the money market responds significantly to the announcement of the BOJ, and that the additional change in the CAB targets lowers the volatility of all yield spreads. Moreover, the effect continued after the latter half of 2003, when liquidity was supplied in large quantities.

[Insert Table 8 around here]

[Insert Table 9 around here]

6.2. The QMEP period

In this section, we analyze the effect of an increase in the additional CAB targets on the volatility of yield spreads. The model is specified as follows:

$$r_{n,t} = c_{n,1} + d_{n,2}\, CAB_{j,t} + \sum_{p=1}^{q} \omega_{n,p} r_{n,t-p} + \varepsilon_{n,t}, \qquad (7)$$

$$\varepsilon_{n,t} = \sqrt{h_{n,t}}\, u_{n,t}\,.$$

$$\log(h_{n,t}) = c_{n,2} + \alpha_{n,1}\left|\frac{\varepsilon_{n,t-1}}{\sqrt{h_{n,t-1}}}\right| + \alpha_{n,2}\frac{\varepsilon_{n,t-1}}{\sqrt{h_{n,t-1}}} + \beta_{\mathrm{n}}\log(h_{n,t-1}) + \sum_{\tau=1}^{\varphi} \gamma_{n,\tau}\, CAB_{\tau,t}^{\mathrm{j}}\,, \qquad (8)$$

$$\varepsilon_{n,t}|\mathrm{I}_{\mathrm{t-1}} \sim N\left(0, h_{n,t}\right).$$

The notation of these equations is same as that in Equations (5) and (6). We clarify the liquidity effect throughout the changes of the CAB targets.

6.2.1. EGARCH model

In the previous subsection, it is evident that the liquidity supply by the BOJ reduces the volatility on all yield spreads. Using a similar approach, we examine the empirical results. Tables 10 and 11 show the empirical results of additional changes in CAB targets regarding yield spreads. We use the subsample from the introduction to the termination of the QMEP. Table 10 provides the estimation result of the upper CAB targets, and Table 11 denotes that of the bottom CAB targets. These tables show that the persistence measures for the yield spreads is approximately 0.43–0.58. These values are statistically significant in all maturities, and the persistence is not high. These results are consistent with Tables 6 and 7.

Tables 10 and 11 show that the asymmetric effect is the range between -0.18 and -0.06 for each yield spread. These values are negative and statistically insignificant at the 10% level, except for those of the 10-year yield spread. The absolute value of the short-term yield spread is smaller than that of the middle- and long-term yield spreads. These results are consistent with Tables 6 and 7. From this analysis, we do not confirm the existence of the effect during the QMEP. We consider that this is related to the sample period.

6.2.2. Robustness check

Next, we check the robustness of the empirical results. First, we check the easing effect. The effect of an increase in the CAB target on the yield spreads is the same as that indicated in the analysis of the period starting pre-QMEP. The estimate is 0.001 and statistically significant in both cases. Thus, we find that the increase in the CAB targets raises the yield spread in all maturities.

Second, we check the effect on the stabilization of the financial market. The effect of additional changes in the CAB targets on the volatility of yield spreads is the same as that indicated in the analysis of the period starting pre-QMEP. From the estimated values of $\gamma_{n,3}$ to those of $\gamma_{n,7}$ in the upper limit of the CAB targets, values are negative and statistically significant for all yield spreads. In the case of the bottom limit of the CAB targets, the estimated values from $\gamma_{n,3}$ to $\gamma_{n,6}$ are negative and statistically significant for all yield spreads. From the results of the upper and bottom limit of the CAB targets, the effect continued until the termination of the QMEP. Thus, we find that the additional change in the CAB targets lowers the volatility of yield spreads, and that the volatility of the yield spreads in response to the additional change in CAB targets is lower during the expansion of the CAB targets under the QMEP.

Therefore, from these empirical results, we find that there is no easing effect. However, we find that additional expansion of the CAB targets reduces the uncertainty for the future short-term interest rate or the risk premium throughout, thereby providing ample liquidity. This is consistent with Oda's (2002) findings, implying that the increase in the CAB reduces the risk of unexpected fundraising.

[Insert Table 10 around here]

[Insert Table 11 around here]

7. Conclusion

In this paper, we examined the effect of the supply of ample liquidity by the BOJ using the daily yield spread data. Using the information about changes in the upper and lower limits of the CAB targets at the BOJ, we examined the effects of monetary policy shocks on yield spreads in Japan for the period March 2001–March 2006. Because the yield spread provides information for the anticipated future interest rate path and risk premium, we can investigate the change on the expectation forms on the money market.

By applying the AR-EGARCH model and using the sample period of August 14, 2000 to March 9, 2006, we presented the empirical results of the relationship between an increase in liquidity and the reaction of the monetary market.

We created the variables for monetary policy shocks under the QMEP and investigated the effects of policy shocks on the market interest rates. First, we found that the BOJ's commitment to maintain a zero interest rate level affected the short-term yield spread. However, the BOJ's commitment did not affect the middle- and long-term yield spreads. We clarified that the policy duration effect throughout the reduction in yield spread exists on the short-term money market.

Second, the phased increase in the CAB targets affected the level of the short-, middle-, and long-term yield spreads. This magnitude regarding the effect of changes in the CAB targets was 0.001. The effect was not changed for the sample period and variables. The provision of liquidity and the maintenance of easy monetary policy did not decrease yield spreads. In other words, the easing effect was not found.

Third, it was found that the phased increase in the CAB targets reduced the volatility of yield spreads at all maturities. This magnitude regarding the effect of changes in the CAB targets on the short-term yield spread was the largest in the market. The effect was not changed for the sample period and for the alteration of variables.

Finally, we found that additional changes in the CAB targets reduced the volatility of yield spreads across all maturities. However, the additional change in the CAB targets was effective from October 30, 2002. The change in the CAB targets on October 10, 2003 was the most effective announcement. In this period, the BOJ clarified its commitment. Therefore, the actions of the additional increase in the CAB targets and the clarification of the commitment affected the volatility of the yield spreads throughout and caused a reduction in risk for the future economy.

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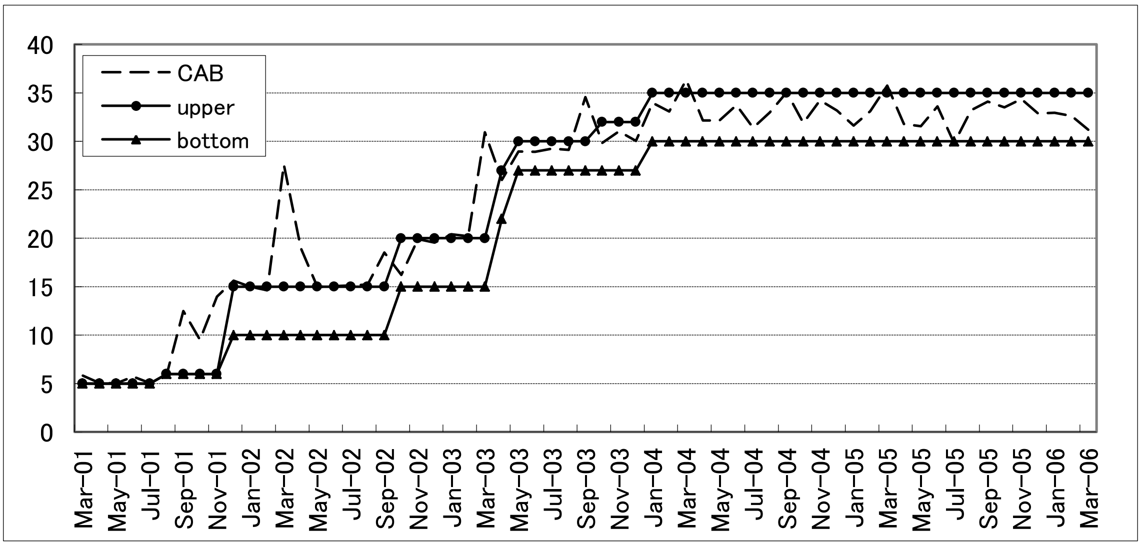
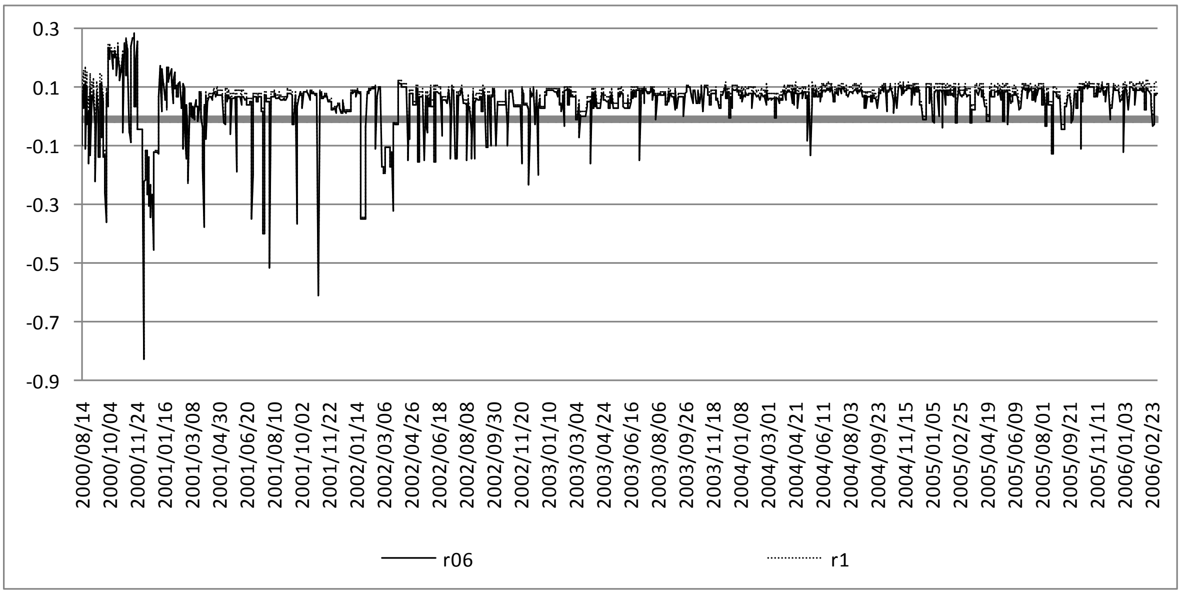
Figure 1: Current account balances



Note: Current account balance and upper and bottom target ranges (trillion yen).

Source: Bank of Japan.

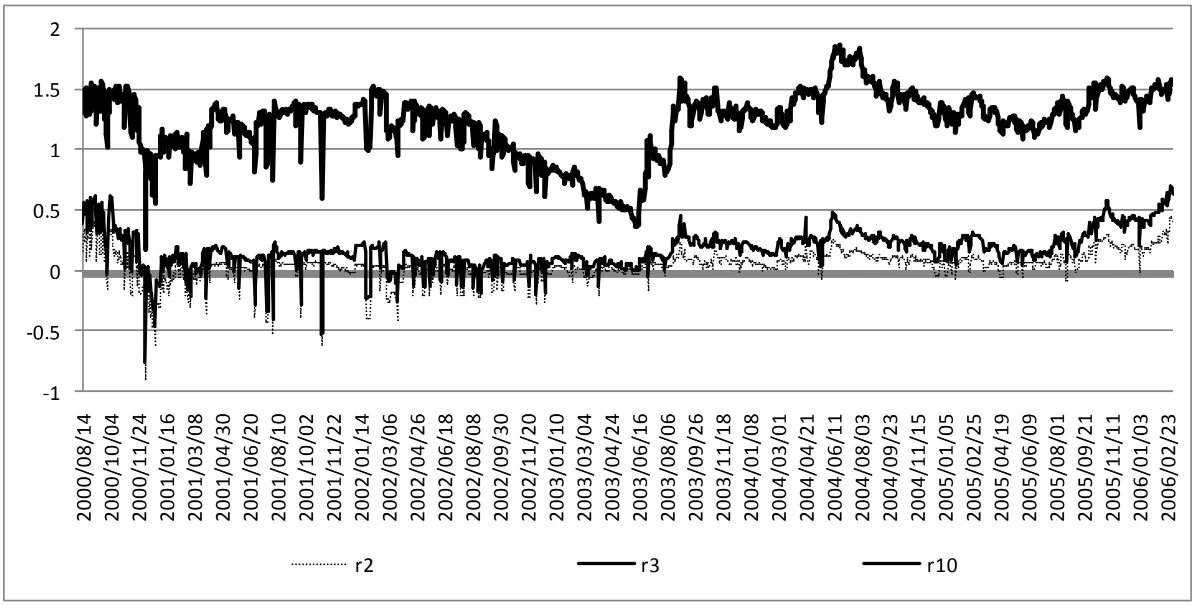
Figure 2: Yield spreads (short-term)



Note: r06 and r1 denote the six-month and one-year yield spreads.

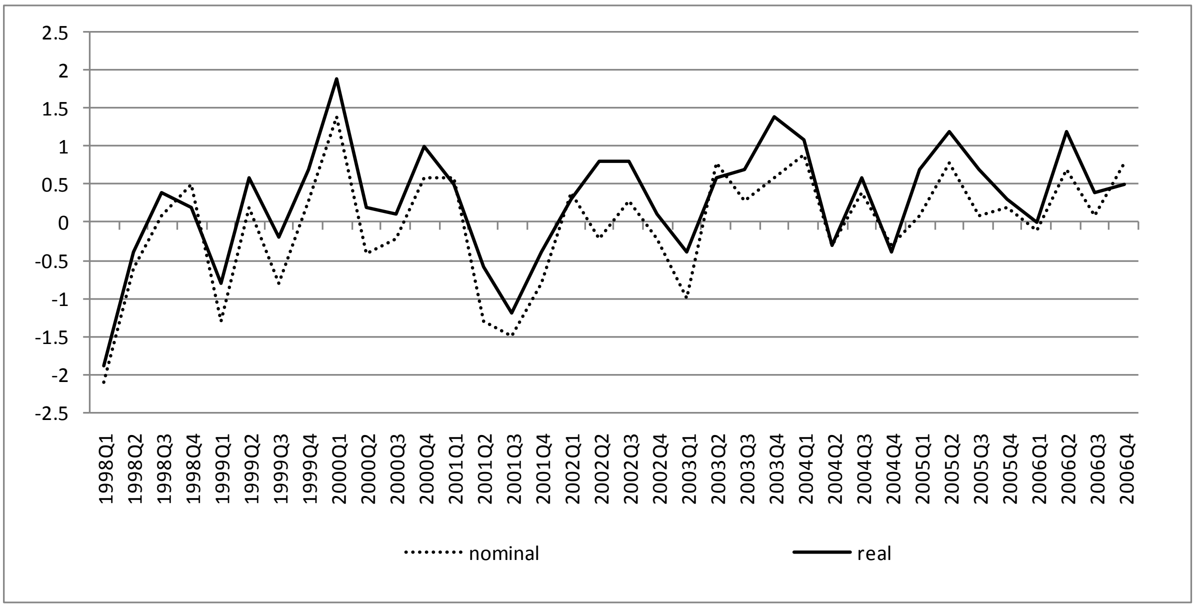
Source: Thomson Reuters Datastream.

Figure 3: Yield spreads (medium and long-term)



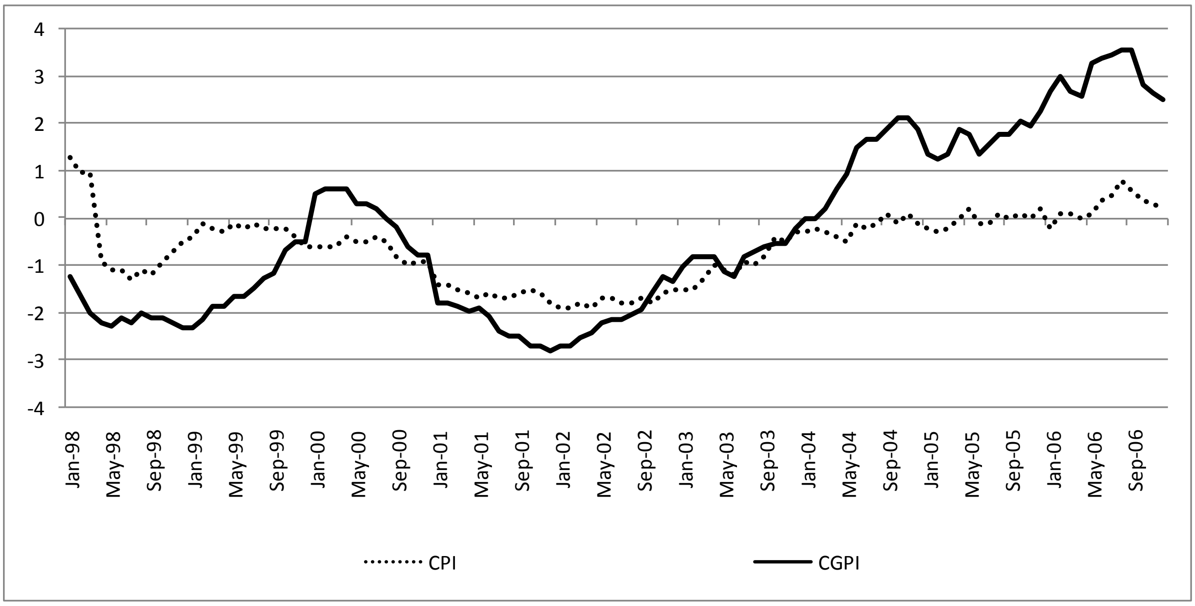
Note: r2, r3, and r10 denote the two-year, three-year, and ten-year yield spreads.
Source: Thomson Reuters Datastream.

Figure 4: GDP (nominal and real)



Note: GDP is real and nominal (y/y % chg.).
Source: Cabinet Office.

Figure 5: Price index



Note: CPI denotes the consumer price index (excluding fresh food) and CGPI denotes the corporate goods price index (excluding consumer tax) (y/y % chg.).

Source: Ministry of Internal Affairs and Communications and Bank of Japan.

Table 1: Policy events about the quantitative monetary easing policy

Date	CAB	JGB
2001/3/19	Introduction of quantitative monetary easing policy	Introduction of quantitative monetary easing policy
	-	Increase in the purchase of JGB
	-	(0.4 trillion yen per a month)
2001/8/14	Increase in the target of CAB	Increase in the purchase of JGB
	(5 trillion yen→6 trillion yen)	(0.4 trillion yen per a month→ 0.6 trillion yen per a month)
2001/9/18	Increase in the target of CAB	-
	(6→above 6 trillion yen)	-
2001/12/19	Increase in the target of CAB	Increase in the purchase of JGB
	(above 6 trillion yen→10-15 trillion yen)	(0.6 trillion yen per a month→ 0.8 trillion yen per a month)
2002/2/28	-	Increase in the purchase of JGB
	-	(0.8 trillion yen per a month→ 1 trillion yen per a month)
2002/10/30	Increase in the target of CAB	Increase in the purchase of JGB
	(10-15 trillion yen→15-20 trillion yen)	(1 trillion yen per a month→ 1.2 trillion yen per a month)
2003/3/20	Installation of Governor Fukui, Bank of Japan	Installation of Governor Fukui, Bank of Japan
2003/4/30	Increase in the target of CAB	-
	(17-22 trillion yen→22-27 trillion yen)	-
2003/5/20	Increase in the target of CAB	-
	(22-27 trillion yen→27-30 trillion yen)	-
2003/10/10	Increase in the target of CAB	-
	(27-30 trillion yen→27-32 trillion yen)	-
2004/1/20	Increase in the target of CAB	-
	(27-32 trillion yen→30-35 trillion yen)	-
2006/3/9	Termination of quantitative monetary easing policy	Termination of quantitative monetary easing policy
		(Maintenance of 1.2 trillion yen per a month)

Note: The target current account balance rises from 15-20 trillion yen to 17-22 trillion yen on April 1, 2003. This increase is necessary adjustment due to the establishment of the Japan Post.

Table 2: Summary statistics on yield spreads (the period from pre-QMEP)

	$r_{0.5,t}$	$r_{1,t}$	$r_{2,t}$	$r_{3,t}$	$r_{10,t}$
Mean	0.047	0.060	0.046	0.176	1.231
Standard Deviation	0.088	0.089	0.125	0.156	0.272
Skewness	-3.171	-3.233	-1.129	-0.030	-0.851
Kurtosis	19.992	20.151	8.829	5.315	3.694
Jarque-Bera	19927.880	20354.060	2367.220	324.920	204.547
P-value	0.000	0.000	0.000	0.000	0.000
DF-GLS	-4.007**	-5.176**	-3.808**	-2.534*	-2.858*
lag	5	5	5	5	5
PP	-22.806**	-22.834**	-16.553**	-11.324**	-4.393**

This table reports mean, standard deviation, skewness, kurtosis, and Jarque-Bera statistic for yield spread series.

Sample period is from August 14, 2000 to March 9, 2006.

P-value is the probability value associated with the Jarque-Bera test statistic.

DF-GLS and PP correspond to the regression including a constant term.

Lag length is selected by the AIC (max=5).

† shows that null hypothesis of a unit root is rejected 10 % significance level.

* shows that null hypothesis of a unit root is rejected 5 % significance level.

** shows that null hypothesis of a unit root is rejected 1 % significance level.

Table 3: Summary statistics on yield spreads (the period of QMEP)

	$r_{0.5,t}$	$r_{1,t}$	$r_{2,t}$	$r_{3,t}$	$r_{10,t}$
Mean	0.049	0.062	0.051	0.176	1.236
Standard Deviation	0.074	0.075	0.107	0.142	0.273
Skewness	-3.990	-3.980	-1.129	0.068	-0.906
Kurtosis	24.587	24.411	8.935	5.244	3.818
Jarque-Bera	28669.930	28242.980	2182.544	273.567	213.886
P-value	0.000	0.000	0.000	0.000	0.000
DF-GLS	-12.698**	-11.300**	-3.406**	-1.932†	-1.700†
lag	3	3	3	5	5
PP	-20.668**	-20.778**	-15.825**	-9.803**	-4.632**

This table reports mean, standard deviation, skewness, kurtosis, and Jarque-Bera statistic for yield spread series.

Sample period is from March 19, 2001 to March 9, 2006.

P-value is the probability value associated with the Jarque-Bera test statistic.

DF-GLS and PP correspond to the regression including a constant term.

Lag length is selected by the AIC (max=5).

† shows that null hypothesis of a unit root is rejected 10 % significance level.

* shows that null hypothesis of a unit root is rejected 5 % significance level.

** shows that null hypothesis of a unit root is rejected 1 % significance level.

Table 4: Estimation Result: the period from pre-QMEP

	$r_{0.5,t}$	(P-value)	$r_{1,t}$	(P-value)	$r_{2,t}$	(P-value)	$r_{3,t}$	(P-value)	$r_{10,t}$	(P-value)
$c_{n,1}$	0.018	(0.051)	0.022	(0.019)	-0.010	(0.236)	-0.003	(0.733)	0.009	(0.449)
$d_{n,1}$	-0.023	(0.011)	-0.023	(0.011)	-0.009	(0.346)	-0.009	(0.425)	-0.011	(0.380)
$d_{n,2}$	0.001	(0.000)	0.001	(0.000)	0.001	(0.003)	0.001	(0.019)	0.001	(0.037)
$\omega_{n,1}$	0.545	(0.000)	0.539	(0.000)	0.690	(0.000)	0.726	(0.000)	0.813	(0.000)
$\omega_{n,2}$	-0.027	(0.323)	-0.031	(0.269)	0.015	(0.635)	0.021	(0.510)	0.000	(0.995)
$\omega_{n,3}$	0.037	(0.273)	0.038	(0.265)	0.080	(0.014)	0.088	(0.005)	0.092	(0.004)
$\omega_{n,4}$	0.032	(0.141)	0.030	(0.168)	0.057	(0.047)	0.048	(0.077)	0.053	(0.047)
$\omega_{n,5}$	-	-	-	-	0.069	(0.011)	0.074	(0.007)	0.027	(0.284)
$c_{n,2}$	-2.007	(0.006)	-1.968	(0.004)	-2.115	(0.001)	-2.290	(0.000)	-2.285	(0.002)
$\alpha_{n,1}$	0.186	(0.192)	0.179	(0.183)	0.371	(0.000)	0.386	(0.000)	0.328	(0.000)
$\alpha_{n,2}$	-0.213	(0.083)	-0.216	(0.069)	-0.143	(0.045)	-0.123	(0.035)	-0.102	(0.087)
β_n	0.530	(0.002)	0.540	(0.001)	0.528	(0.001)	0.488	(0.003)	0.479	(0.011)
$d_{n,3}$	-0.040	(0.013)	-0.040	(0.010)	-0.038	(0.008)	-0.038	(0.006)	-0.033	(0.016)
Q (40)	26.342	(0.953)	25.433	(0.965)	28.865	(0.904)	27.642	(0.931)	22.279	(0.989)
Q (50)	37.539	(0.903)	36.225	(0.928)	40.105	(0.840)	39.412	(0.859)	39.006	(0.870)
$Q^2(40)$	31.416	(0.832)	31.130	(0.841)	21.285	(0.993)	23.895	(0.980)	28.290	(0.917)
$Q^2(50)$	33.262	(0.967)	32.799	(0.971)	24.762	(0.999)	26.497	(0.997)	34.149	(0.958)
ARCH (5)	58.815	(0.000)	58.736	(0.000)	83.969	(0.000)	90.661	(0.000)	90.943	(0.000)

This table shows the result of the period from pre-QMEP. This table reports the estimation of upper CABs target. Sample period is from August 14, 2000 to March 9, 2006. Q (γ) is the Ljung-Box statistics with γ lags for the standardized residuals. $Q^2(\gamma)$ is the Ljung-Box statistics with γ lags for the standardized residual squares. ARCH (5) shows the ARCH-LM test with 5 lags for the own squared returns.

Table 5: Estimation Result: the period from pre-QMEP

	$r_{0.5,t}$	(P-value)	$r_{1,t}$	(P-value)	$r_{2,t}$	(P-value)	$r_{3,t}$	(P-value)	$r_{10,t}$	(P-value)
$c_{n,1}$	0.019	(0.032)	0.022	(0.013)	-0.009	(0.278)	-0.003	(0.777)	0.009	(0.446)
$d_{n,1}$	-0.022	(0.010)	-0.022	(0.009)	-0.008	(0.396)	-0.008	(0.463)	-0.009	(0.453)
$d_{n,2}$	0.001	(0.000)	0.001	(0.000)	0.001	(0.003)	0.001	(0.023)	0.001	(0.029)
$\omega_{n,1}$	0.546	(0.000)	0.544	(0.000)	0.693	(0.000)	0.726	(0.000)	0.814	(0.000)
$\omega_{n,2}$	-0.027	(0.329)	-0.031	(0.281)	0.014	(0.663)	0.022	(0.486)	0.000	(0.995)
$\omega_{n,3}$	0.035	(0.300)	0.039	(0.276)	0.079	(0.015)	0.085	(0.006)	0.091	(0.004)
$\omega_{n,4}$	0.031	(0.154)	0.026	(0.235)	0.057	(0.047)	0.052	(0.062)	0.053	(0.046)
$\omega_{n,5}$	-	-	-	-	0.069	(0.014)	0.073	(0.010)	0.028	(0.275)
$c_{n,2}$	-2.052	(0.008)	-1.972	(0.004)	-2.155	(0.001)	-2.319	(0.000)	-2.322	(0.002)
$\alpha_{n,1}$	0.176	(0.216)	0.151	(0.243)	0.373	(0.000)	0.393	(0.000)	0.344	(0.000)
$\alpha_{n,2}$	-0.216	(0.081)	-0.228	(0.050)	-0.139	(0.056)	-0.117	(0.052)	-0.095	(0.123)
β_n	0.527	(0.004)	0.543	(0.001)	0.526	(0.001)	0.490	(0.003)	0.481	(0.012)
$d_{n,3}$	-0.046	(0.017)	-0.045	(0.012)	-0.043	(0.011)	-0.044	(0.008)	-0.037	(0.020)
Q (40)	27.985	(0.924)	26.466	(0.951)	29.340	(0.893)	28.231	(0.919)	23.732	(0.981)
Q (50)	39.225	(0.864)	37.253	(0.909)	40.324	(0.834)	39.742	(0.850)	40.016	(0.843)
$Q^2(40)$	29.100	(0.899)	28.710	(0.908)	21.477	(0.993)	24.691	(0.973)	29.591	(0.886)
$Q^2(50)$	31.061	(0.984)	30.461	(0.987)	24.637	(0.999)	26.954	(0.997)	34.789	(0.950)
ARCH (5)	58.521	(0.000)	58.405	(0.000)	83.376	(0.000)	90.180	(0.000)	90.975	(0.000)

This table shows the result of the period from pre-QMEP. This table reports the estimation of bottom CABs target. Sample period is from August 14, 2000 to March 9, 2006. Q (γ) is the Ljung-Box statistics with γ lags for the standardized residuals. $Q^2(\gamma)$ is the Ljung-Box statistics with γ lags for the standardized residual squares. ARCH (5) shows the ARCH-LM test with 5 lags for the own squared returns.

Table 6: Estimation Result: the period of QMEP

	$r_{0.5,t}$	(P-value)	$r_{1,t}$	(P-value)	$r_{2,t}$	(P-value)	$r_{3,t}$	(P-value)	$r_{10,t}$	(P-value)
$c_{n,1}$	-0.003	(0.632)	0.001	(0.831)	-0.019	(0.006)	-0.012	(0.126)	-0.003	(0.736)
$d_{n,2}$	0.001	(0.000)	0.001	(0.000)	0.001	(0.003)	0.001	(0.025)	0.001	(0.039)
$\omega_{n,1}$	0.505	(0.000)	0.496	(0.000)	0.697	(0.000)	0.736	(0.000)	0.831	(0.000)
$\omega_{n,2}$	-	-	-	-	0.001	(0.969)	-0.001	(0.983)	-0.017	(0.628)
$\omega_{n,3}$	-	-	-	-	0.093	(0.011)	0.107	(0.002)	0.110	(0.001)
$\omega_{n,4}$	-	-	-	-	0.047	(0.141)	0.037	(0.218)	0.038	(0.206)
$\omega_{n,5}$	-	-	-	-	0.075	(0.016)	0.080	(0.009)	0.027	(0.328)
$c_{n,2}$	-2.180	(0.014)	-2.171	(0.012)	-1.893	(0.005)	-2.073	(0.003)	-1.976	(0.010)
$\alpha_{n,1}$	0.240	(0.169)	0.242	(0.159)	0.366	(0.000)	0.376	(0.000)	0.309	(0.000)
$\alpha_{n,2}$	-0.162	(0.261)	-0.162	(0.259)	-0.114	(0.130)	-0.091	(0.127)	-0.064	(0.280)
β_{n}	0.495	(0.021)	0.498	(0.017)	0.577	(0.000)	0.538	(0.001)	0.549	(0.005)
$d_{n,3}$	-0.044	(0.032)	-0.044	(0.028)	-0.035	(0.019)	-0.035	(0.015)	-0.030	(0.037)
Q (40)	27.601	(0.931)	27.589	(0.932)	27.224	(0.938)	23.730	(0.981)	22.193	(0.990)
Q (50)	38.473	(0.882)	38.014	(0.893)	39.287	(0.862)	35.323	(0.942)	36.649	(0.920)
$\mathrm{Q}^2(40)$	32.182	(0.806)	32.423	(0.797)	20.245	(0.996)	23.144	(0.985)	28.544	(0.912)
$\mathrm{Q}^2(50)$	34.029	(0.959)	34.074	(0.959)	23.954	(0.999)	26.234	(0.998)	34.890	(0.948)
ARCH (5)	21.739	(0.000	21.649	(0.000)	20.443	(0.000)	20.464	(0.000)	20.227	(0.000)

This table shows the result of the period of QMEP. This table reports the estimation of upper CABs target. Sample period is from March 19, 2001 to March 9, 2006. Q (γ) is the Ljung-Box statistics with γ lags for the standardized residuals. $\mathrm{Q}^2(\gamma)$ is the Ljung-Box statistics with γ lags for the standardized residual squares. ARCH (5) shows the ARCH-LM test with 5 lags for the own squared returns.

Table 7: Estimation Result: the period of QMEP

	$r_{0.5,t}$	(P-value)	$r_{1,t}$	(P-value)	$r_{2,t}$	(P-value)	$r_{3,t}$	(P-value)	$r_{10,t}$	(P-value)
$c_{n,1}$	-0.001	(0.890)	0.004	(0.488)	-0.018	(0.008)	-0.011	(0.139)	-0.001	(0.902)
$d_{n,2}$	0.001	(0.000)	0.001	(0.000)	0.001	(0.004)	0.001	(0.027)	0.001	(0.035)
$\omega_{n,1}$	0.503	(0.000)	0.497	(0.000)	0.697	(0.000)	0.736	(0.000)	0.832	(0.000)
$\omega_{n,2}$	-	-	-	-	0.001	(0.966)	0.000	(0.996)	-0.018	(0.617)
$\omega_{n,3}$	-	-	-	-	0.092	(0.013)	0.104	(0.002)	0.108	(0.002)
$\omega_{n,4}$	-	-	-	-	0.048	(0.136)	0.040	(0.191)	0.036	(0.230)
$\omega_{n,5}$	-	-	-	-	0.076	(0.017)	0.080	(0.010)	0.029	(0.298)
$c_{n,2}$	-2.312	(0.023)	-2.280	(0.019)	-1.955	(0.007)	-2.127	(0.004)	-2.061	(0.013)
$\alpha_{n,1}$	0.225	(0.200)	0.208	(0.216)	0.364	(0.000)	0.376	(0.000)	0.321	(0.000)
$\alpha_{n,2}$	-0.162	(0.263)	-0.172	(0.223)	-0.105	(0.169)	-0.083	(0.180)	-0.055	(0.372)
β_n	0.479	(0.046)	0.484	(0.036)	0.574	(0.001)	0.539	(0.002)	0.543	(0.008)
$d_{n,3}$	-0.050	(0.048)	-0.050	(0.043)	-0.039	(0.027)	-0.039	(0.020)	-0.033	(0.047)
Q (40)	27.196	(0.939)	26.787	(0.946)	27.306	(0.937)	23.962	(0.979)	23.175	(0.985)
Q (50)	37.701	(0.900)	36.789	(0.918)	38.951	(0.871)	34.978	(0.947)	36.982	(0.914)
$Q^2(40)$	29.703	(0.883)	29.164	(0.897)	20.477	(0.996)	24.236	(0.977)	29.968	(0.876)
$Q^2(50)$	31.649	(0.980)	30.892	(0.985)	23.980	(0.999)	27.209	(0.996)	35.894	(0.933)
ARCH (5)	21.712	(0.000)	21.619	(0.000)	20.378	(0.000)	20.388	(0.000)	20.274	(0.000)

This table shows the result of the period of QMEP. This table reports the estimation of bottom CABs target. Sample period is from March 19, 2001 to March 9, 2006. Q (γ) is the Ljung-Box statistics with γ lags for the standardized residuals. $Q^2(\gamma)$ is the Ljung-Box statistics with γ lags for the standardized residual squares. ARCH (5) shows the ARCH-LM test with 5 lags for the own squared returns.

Table 8: Estimation Result: the period from pre-QMEP

	$r_{0.5,t}$	(P-value)	$r_{1,t}$	(P-value)	$r_{2,t}$	(P-value)	$r_{3,t}$	(P-value)	$r_{10,t}$	(P-value)
$c_{n,1}$	0.019	(0.031)	0.022	(0.013)	-0.010	(0.252)	-0.003	(0.740)	-0.002	(0.893)
$d_{n,1}$	-0.023	(0.016)	-0.023	(0.015)	-0.010	(0.331)	-0.009	(0.388)	-0.009	(0.430)
$d_{n,2}$	0.001	(0.000)	0.001	(0.000)	0.001	(0.001)	0.001	(0.013)	0.001	(0.016)
$\omega_{n,1}$	0.536	(0.000)	0.534	(0.000)	0.689	(0.000)	0.718	(0.000)	0.821	(0.000)
$\omega_{n,2}$	-0.027	(0.328)	-0.032	(0.255)	0.016	(0.605)	0.025	(0.411)	0.008	(0.809)
$\omega_{n,3}$	0.043	(0.190)	0.047	(0.173)	0.085	(0.008)	0.093	(0.003)	0.092	(0.004)
$\omega_{n,4}$	0.028	(0.179)	0.024	(0.268)	0.058	(0.037)	0.049	(0.065)	0.044	(0.095)
$\omega_{n,5}$	-	-	-	-	0.065	(0.015)	0.072	(0.008)	0.027	(0.282)
$c_{n,2}$	-2.286	(0.005)	-2.141	(0.004)	-2.307	(0.001)	-2.466	(0.000)	-2.149	(0.001)
$\alpha_{n,1}$	0.183	(0.182)	0.146	(0.248)	0.361	(0.000)	0.386	(0.000)	0.233	(0.001)
$\alpha_{n,2}$	-0.204	(0.080)	-0.223	(0.045)	-0.138	(0.046)	-0.111	(0.065)	-0.164	(0.003)
β_{n}	0.510	(0.003)	0.537	(0.001)	0.522	(0.000)	0.484	(0.002)	0.535	(0.001)
$\gamma_{n,1}$	-0.057	(0.800)	-0.051	(0.808)	-0.060	(0.802)	-0.063	(0.805)	-0.042	(0.837)
$\gamma_{n,2}$	-0.039	(0.059)	-0.037	(0.046)	-0.034	(0.115)	-0.037	(0.103)	-0.027	(0.151)
$\gamma_{n,3}$	-0.136	(0.032)	-0.131	(0.025)	-0.129	(0.038)	-0.143	(0.030)	-0.120	(0.036)
$\gamma_{n,4}$	-0.255	(0.005)	-0.238	(0.003)	-0.250	(0.002)	-0.269	(0.001)	-0.236	(0.004)
γ_{n5}	-0.384	(0.010)	-0.363	(0.007)	-0.360	(0.012)	-0.377	(0.006)	-0.134	(0.057)
$\gamma_{n,6}$	-0.759	(0.008)	-0.720	(0.005)	-0.688	(0.005)	-0.699	(0.004)	-0.411	(0.011)
$\gamma_{n,7}$	-0.414	(0.009)	-0.391	(0.006)	-0.373	(0.005)	-0.380	(0.003)	-0.305	(0.009)
Q (40)	27.697	(0.930)	26.541	(0.950)	30.587	(0.858)	28.852	(0.905)	22.374	(0.989)
Q (50)	37.934	(0.895)	36.457	(0.924)	41.388	(0.802)	40.009	(0.843)	35.573	(0.939)
(Q^2(40)	26.898	(0.944)	26.330	(0.953)	20.062	(0.996)	22.620	(0.988)	35.267	(0.683)
Q^2(50)	29.656	(0.990)	28.894	(0.993)	23.953	(0.999)	25.632	(0.998)	41.828	(0.788)

This table shows the result of the period from pre-QMEP. This table reports the estimation of upper CABs target changes. Sample period is from August 14, 2000 to March 9, 2006. Q (γ) is the Ljung-Box statistics with γ lags for the standardized residuals. $Q^2(\gamma)$ is the Ljung-Box statistics with γ lags for the standardized residual squares.

Table 9: Estimation Result: the period from pre-QMEP

	$r_{0.5,t}$	(P-value)	$r_{1,t}$	(P-value)	$r_{2,t}$	(P-value)	$r_{3,t}$	(P-value)	$r_{10,t}$	(P-value)
$c_{n,1}$	0.019	(0.036)	0.022	(0.015)	-0.009	(0.265)	-0.003	(0.744)	-0.001	(0.963)
$d_{n,1}$	-0.021	(0.027)	-0.020	(0.031)	-0.008	(0.413)	-0.007	(0.496)	-0.008	(0.484)
$d_{n,2}$	0.001	(0.000)	0.001	(0.000)	0.001	(0.001)	0.001	(0.017)	0.001	(0.017)
$\omega_{n,1}$	0.540	(0.000)	0.540	(0.000)	0.686	(0.000)	0.714	(0.000)	0.815	(0.000)
$\omega_{n,2}$	-0.027	(0.320)	-0.032	(0.255)	0.016	(0.598)	0.028	(0.358)	0.009	(0.779)
$\omega_{n,3}$	0.038	(0.247)	0.043	(0.216)	0.082	(0.010)	0.088	(0.004)	0.094	(0.003)
$\omega_{n,4}$	0.028	(0.191)	0.021	(0.325)	0.058	(0.035)	0.052	(0.053)	0.046	(0.082)
$\omega_{n,5}$	-	-	-	-	0.069	(0.010)	0.076	(0.007)	0.028	(0.256)
$c_{n,2}$	-2.406	(0.008)	-2.267	(0.006)	-2.407	(0.001)	-2.545	(0.000)	-2.353	(0.002)
$\alpha_{n,1}$	0.179	(0.192)	0.134	(0.285)	0.372	(0.000)	0.406	(0.000)	0.283	(0.000)
$\alpha_{n,2}$	-0.209	(0.075)	-0.233	(0.036)	-0.131	(0.066)	-0.099	(0.124)	-0.133	(0.024)
β_n	0.482	(0.013)	0.508	(0.004)	0.500	(0.001)	0.468	(0.003)	0.494	(0.004)
$\gamma_{n,1}$	-0.065	(0.786)	-0.061	(0.788)	-0.064	(0.797)	-0.064	(0.812)	-0.044	(0.849)
$\gamma_{n,2}$	-0.092	(0.068)	-0.086	(0.054)	-0.082	(0.113)	-0.087	(0.101)	-0.066	(0.159)
$\gamma_{n,3}$	-0.144	(0.040)	-0.139	(0.033)	-0.135	(0.039)	-0.147	(0.029)	-0.130	(0.042)
$\gamma_{n,4}$	-0.268	(0.008)	-0.250	(0.006)	-0.262	(0.002)	-0.280	(0.001)	-0.259	(0.004)
γ_{n5}	-0.269	(0.006)	-0.256	(0.004)	-0.247	(0.004)	-0.256	(0.002)	-0.128	(0.019)
$\gamma_{n,6}$	-0.436	(0.013)	-0.414	(0.010)	-0.390	(0.006)	-0.393	(0.003)	-0.335	(0.010)
Q (40)	28.459	(0.914)	26.925	(0.943)	30.250	(0.868)	28.369	(0.916)	22.504	(0.988)
Q (50)	39.388	(0.860)	37.446	(0.905)	41.686	(0.792)	40.170	(0.838)	35.205	(0.944)
$Q^2(40)$	23.750	(0.981)	23.073	(0.985)	19.159	(0.998)	22.495	(0.988)	33.299	(0.764)
$Q^2(50)$	25.907	(0.998)	25.047	(0.999)	22.777	(1.000)	25.410	(0.999)	39.540	(0.856)

This table shows the result of the period from pre-QMEP. This table reports the estimation of bottom CABs target changes. Sample period is from August 14, 2000 to March 9, 2006. Q (γ) is the Ljung-Box statistics with γ lags for the standardized residuals. $Q^2(\gamma)$ is the Ljung-Box statistics with γ lags for the standardized residual squares.

Table 10: Estimation Result: the period of QMEP

	$r_{0.5,t}$	(P-value)	$r_{1,t}$	(P-value)	$r_{2,t}$	(P-value)	$r_{3,t}$	(P-value)	$r_{10,t}$	(P-value)
$c_{n,1}$	-0.002	(0.762)	0.002	(0.724)	-0.020	(0.003)	-0.012	(0.087)	-0.010	(0.209)
$d_{n,2}$	0.001	(0.000)	0.001	(0.000)	0.001	(0.001)	0.001	(0.018)	0.001	(0.026)
$\omega_{n,1}$	0.492	(0.000)	0.488	(0.000)	0.694	(0.000)	0.729	(0.000)	0.840	(0.000)
$\omega_{n,2}$	-	-	-	-	0.004	(0.908)	0.002	(0.943)	-0.017	(0.627)
$\omega_{n,3}$	-	-	-	-	0.099	(0.006)	0.113	(0.001)	0.113	(0.001)
$\omega_{n,4}$	-	-	-	-	0.046	(0.134)	0.038	(0.195)	0.028	(0.336)
$\omega_{n,5}$	-	-	-	-	0.071	(0.017)	0.079	(0.010)	0.029	(0.283)
$c_{n,2}$	-2.603	(0.015)	-2.542	(0.014)	-2.090	(0.006)	-2.261	(0.003)	-1.994	(0.010)
$\alpha_{n,1}$	0.255	(0.126)	0.232	(0.162)	0.357	(0.000)	0.377	(0.000)	0.228	(0.002)
$\alpha_{n,2}$	-0.139	(0.307)	-0.155	(0.255)	-0.106	(0.140)	-0.079	(0.208)	-0.124	(0.025)
β_{n}	0.453	(0.042)	0.463	(0.031)	0.566	(0.000)	0.531	(0.001)	0.571	(0.001)
$\gamma_{n,1}$	-0.068	(0.813)	-0.064	(0.821)	-0.066	(0.783)	-0.052	(0.843)	-0.033	(0.878)
$\gamma_{n,2}$	-0.042	(0.215)	-0.041	(0.198)	-0.033	(0.198)	-0.032	(0.224)	-0.024	(0.297)
$\gamma_{n,3}$	-0.145	(0.090)	-0.146	(0.080)	-0.121	(0.059)	-0.128	(0.052)	-0.109	(0.070)
$\gamma_{n,4}$	-0.291	(0.015)	-0.285	(0.013)	-0.233	(0.004)	-0.248	(0.003)	-0.221	(0.010)
γ_{n5}	-0.436	(0.035)	-0.427	(0.030)	-0.336	(0.017)	-0.346	(0.010)	-0.133	(0.105)
$\gamma_{n,6}$	-0.855	(0.023)	-0.839	(0.019)	-0.642	(0.010)	-0.637	(0.007)	-0.380	(0.027)
$\gamma_{n,7}$	-0.456	(0.030)	-0.449	(0.026)	-0.348	(0.011)	-0.346	(0.007)	-0.282	(0.024)
Q (40)	29.459	(0.890)	29.301	(0.894)	29.489	(0.889)	25.076	(0.969)	20.804	(0.995)
Q (50)	39.366	(0.860)	38.779	(0.875)	41.043	(0.813)	36.064	(0.931)	32.069	(0.977)
$Q^2(40)$	27.709	(0.929)	27.203	(0.939)	18.919	(0.998)	21.837	(0.991)	35.683	(0.665)
$Q^2(50)$	30.426	(0.987)	29.687	(0.990)	23.115	(1.000)	25.456	(0.998)	43.243	(0.739)

This table shows the result of the period of QMEP. This table reports the estimation of upper CABs target changes. Sample period is from March 19, 2001 to March 9, 2006. Q (γ) is the Ljung-Box statistics with γ lags for the standardized residuals. $Q^2(\gamma)$ is the Ljung-Box statistics with γ lags for the standardized residual squares.

Table 11: Estimation Result: the period of QMEP

	$r_{0.5,t}$	(P-value)	$r_{1,t}$	(P-value)	$r_{2,t}$	(P-value)	$r_{3,t}$	(P-value)	$r_{10,t}$	(P-value)
$c_{n,1}$	0.000	(0.977)	0.005	(0.363)	-0.017	(0.004)	-0.011	(0.113)	-0.009	(0.206)
$d_{n,2}$	0.001	(0.000)	0.001	(0.000)	0.001	(0.002)	0.001	(0.020)	0.001	(0.023)
$\omega_{n,1}$	0.494	(0.000)	0.491	(0.000)	0.690	(0.000)	0.726	(0.000)	0.836	(0.000)
$\omega_{n,2}$	-	-	-	-	0.004	(0.908)	0.004	(0.911)	-0.016	(0.634)
$\omega_{n,3}$	-	-	-	-	0.095	(0.008)	0.109	(0.001)	0.113	(0.001)
$\omega_{n,4}$	-	-	-	-	0.048	(0.115)	0.040	(0.175)	0.030	(0.312)
$\omega_{n,5}$	-	-	-	-	0.076	(0.011)	0.082	(0.008)	0.031	(0.247)
$c_{n,2}$	-2.683	(0.019)	-2.623	(0.020)	-2.170	(0.006)	-2.324	(0.002)	-2.139	(0.009)
$\alpha_{n,1}$	0.238	(0.151)	0.201	(0.213)	0.365	(0.000)	0.393	(0.000)	0.275	(0.000)
$\alpha_{n,2}$	-0.148	(0.278)	-0.171	(0.206)	-0.098	(0.194)	-0.067	(0.318)	-0.094	(0.111)
β_{n}	0.434	(0.070)	0.444	(0.060)	0.548	(0.001)	0.518	(0.001)	0.543	(0.002)
$\gamma_{n,1}$	-0.065	(0.828)	-0.061	(0.835)	-0.070	(0.780)	-0.052	(0.848)	-0.033	(0.889)
$\gamma_{n,2}$	-0.095	(0.228)	-0.092	(0.217)	-0.079	(0.196)	-0.076	(0.220)	-0.057	(0.303)
$\gamma_{n,3}$	-0.149	(0.099)	-0.148	(0.092)	-0.127	(0.061)	-0.133	(0.052)	-0.116	(0.073)
$\gamma_{n,4}$	-0.299	(0.019)	-0.291	(0.019)	-0.244	(0.004)	-0.257	(0.002)	-0.237	(0.009)
γ_{n5}	-0.295	(0.025)	-0.288	(0.021)	-0.230	(0.008)	-0.234	(0.005)	-0.119	(0.041)
$\gamma_{n,6}$	-0.468	(0.036)	-0.459	(0.034)	-0.363	(0.012)	-0.356	(0.007)	-0.303	(0.021)
Q (40)	28.422	(0.915)	28.036	(0.923)	28.956	(0.902)	24.597	(0.973)	21.232	(0.994)
Q (50)	38.724	(0.876)	37.824	(0.897)	41.235	(0.807)	36.205	(0.928)	32.024	(0.978)
$Q^2(40)$	24.461	(0.975)	23.650	(0.981)	17.885	(0.999)	21.612	(0.992)	33.481	(0.757)
$Q^2(50)$	26.592	(0.997)	25.595	(0.998)	21.748	(1.000)	25.069	(0.999)	40.580	(0.827)

This table shows the result of the period of QMEP. This table reports the estimation of bottom CABs target changes. Sample period is from March 19, 2001 to March 9, 2006. Q (γ) is the Ljung-Box statistics with γ lags for the standardized residuals. $Q^2(\gamma)$ is the Ljung-Box statistics with γ lags for the standardized residual squares.