Policy Duration Effects, Quantitative Monetary Easing Policy and Economic Growth: Evidence from Japanese Time Series Data [†]

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Abstract

This paper examines the influences of policy duration effects and quantitative monetary easing policy (QMEP) implemented by the Bank of Japan from 2001-2006 on economic growth toward future periods. We employed a simple equation with the term spread explaining economic growth, and obtained the following results. The positive effects of the term spread on economic growth over the subsequent 21 and 24 months decreased in 2001. And the estimated coefficients on term spread were negative and significant after the shift in both cases. Thus, we conclude that the QMEP and policy duration effects in the 2000s aided economic growth in Japan to some extent.

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Keywords: term spread, zero interest rate policy, quantitative monetary easing policy, policy duration effects, economic growth

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1. Introduction

This paper verifies the impacts of quantitative monetary easing policy (hereafter, QMEP) and policy duration effects (forward guidance) on economic growth toward future periods in Japan with a sample from 1990 to 2008. We perform empirical analysis of the effects of the term spread and other variables on economic growth.

The QMEP is the monetary policy regime in which the central bank sets the quantity of reserve deposit as the policy target and was first put into effect from 2001-2006 by the Bank of Japan. After the Lehman shock, the Federal Reserve Board then adopted this policy. From April 2013, the Bank of Japan also adopted quantitative and qualitative monetary easing policies in order to eradicate deflation. In October 2014, the FRB announced the end of the quantitative monetary easing policy (QE3); however, several major countries and areas, including Japan, are in a recession. Therefore, it is important to reconsider the effects of QMEP by the Bank of Japan from 2001 to 2006.

Numerous studies have presented verification of the effects of the monetary policy by the Bank of Japan in the QMEP era[1]. Okina and Shiratsuka (2004), Oda and Ueda (2007) and other studies performed empirical analyses on term spread. Shiratsuka and Fujiki (2001) performed measurement of the yield curve in Japan, and they show that commitment could shorten the future path of short-run interest rate and achieved a reduced long-term interest rate. Okina and Shiratsuka (2004) and Oda and Ueda (2007) also show that the effect on term spread was valid: a reduction in term spread was achieved. However, Shiratsuka and Fujiki (2001) and Okina and Shiratsuka (2004) argue that this phenomenon could not invert the expectation of deflation; they mention that the effects on macroeconomics are not valid. The empirical study by Kimura and Small (2006) verifies the effects of QMEP on risk premiums and volatilities of financial assets. This study shows that the QMEP lowered the risk premium of corporate bonds with high rating and the exchange rate, but increased the credit spread of corporate bonds with low rating. It also shows that the QMEP increased the risk premiums of securities and lowered their volatilities.

[1] Detailed surveys on QMEP are shown in Ugai (2007).

Empirical analyses on the validity of the effect on macroeconomics variables have also been performed. Kamata and Sugo (2006) show empirical analysis with the sign-restriction VAR model utilizing the proxy of policy instrument that does not face zero bound restriction. They show that the effect of monetary policy on the price level was reduced in the zero interest rate era and QMEP era. In the empirical study by Kimura et al. (2002), the Bayesian VAR with 3 or 4-variable model was used. They show that the effect of base money on the CPI and GDP gap were not significant when the QMEP began. Fujiwara (2006) performs the empirical analysis utilizing the Markov Switching VAR model considering 4 variables, CPI, IIP, base money and return of long-term government bond. They showed that the effect of the growth of money on CPI and IIP is not significant or significant but negligible. In the empirical study by Braun and Shioji (2006), they analyze the effects of monetary policy on term structure with the sign restriction VAR. They set two hypotheses on how monetary policy affects the economy: the liquidity maintained hypothesis and costly price adjustment hypothesis. They assume the sign restrictions following these hypotheses, and compare the results. They show that the effects of monetary policy are transient ones under the former hypothesis, but permanent under the latter hypothesis. Honda et al. (2013) analyze the validity of the effect on macroeconomic variables with impulse response analysis considering several monetary variables, and show that QMEP had certain effects on output via the stock price.

In this paper, we employ a linear equation consisting of term spread (independent variable) and economic growth (dependent variable). In this equation, the sign of the coefficient can be both positive and negative following the mechanism described later. If it were *negative*, in quite another way, we can say that policy duration effects would work, and vice versa.

Then, a brief review of the QMEP and policy duration effects is presented. The central bank supplies a monetary base to the market and lowers the term spread; we call this *first* effect here. It is expected to have a positive effect on economic growth and price; we call this *second* effect here.

Economic growth is expected when the term spread is increased, and vice versa. This is caused by the intertemporal allocation mechanism[2]. However, the reduction in the term spread causes economic growth when there are two factors. One is a high natural rate of interest. When the term spread (or long-term interest rate) and the natural interest rate fall simultaneously, reduction in the term spread leads to an expectation of economic stagnation. This is because a fall in the natural rate of interest reflects worsening economic conditions in the future.

The other factor is commitment to a zero interest rate policy by the central bank.

As Reifschneider and Williams (2000) explain, even the zero interest rate is higher than the theoretically desirable level of the interest rate indicated by the ordinal Taylor rule, which is mostly negative, in a recession or weak recovery. If the zero interest rate policy is terminated with only weak recovery (i.e., nearly zero inflation rate), the second effect would not materialize. Then, the central bank has to announce the termination of the zero interest rate policy when robust recovery (i.e., a persistent positive inflation rate) is observed.

Here, let us contend that the commitment of the central bank to continue a monetary easing policy (namely a zero interest rate policy) is put into effect. Then, people might forecast a short-term zero interest rate in the future with *confidence* in the monetary easing policy, and the long-term interest rate would also diminish through the mechanism of term structure. And it promotes firms' investment and economic growth. These two effects—reduction in the term spread and its positive effects on economic growth—are called "policy duration effects." This type of policy is called "commitment for the duration of the zero interest rate policy."

Figure 1 outlines these effects. This need to classify these two effects is shown in Miyao (2007), and the description in this part follows this study.

Commitment to the duration of the zero interest rate policy was put into

[2] It is considered that the forecasted short-term interest rate contains the expectation of future economic conditions. For example, future economic growth is expected when the forecasted short-term interest rate increases. Then, the long-term interest rate also increases through the mechanism of term structure.

effect from April 1999 to August 2000 and from February 2001 to March 2006 in Japan.[3] In order to validate the commitments, the central bank conducts operations on a monetary basis. Figure 2 presents plots of the growth rate of the index of industrial production (IIP) and average balance of monetary base. Plots of the term spread are also presented. We utilize the non-collateral call rate as the short-term rate and the Japanese 10-year government bond as the long-term rate when we calculate the term spread.[4] It is shown that the monetary base increased after 2001 when QMEP was conducted. The spread seems to have fluctuated in response to the movement of the monetary base with a lag of about one year. The growth rate of IIP turned positive after 2002; however, the growth rate of IIP was not high.[5]

Here, as described previously, we perform empirical analysis with a simple linear equation consisting of term spread and economic growth in order to verify the *second* effect, the positive influence of QMEP on production. And we also perform the test for structural change in order to verify the shift of coefficient of spread. The sign of coefficient turns negative if QMEP and commitment for the duration of the zero interest rate policy have certain effects.

Estimation and verification of the simple equation with the term spread and economic growth can make significant contributions to this field.

In Section 2, we conduct estimation and discussion. Section 3 presents the conclusion.

2. Estimation

2.1 Equation and Data

In this paper, we perform empirical analysis following the simple model employed by Hamilton and Kim (2002) and Hamori and Bhar (2007). The model is

$$\Delta y_t^k = \alpha + \beta \times spread_t + u_t \cdots (1).$$

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[3] This policy was suspended from August 2000 to March 2001. And in October 2010, the Bank of Japan set the target rate for the collateralized call rate at 0-0.1%.

[4] Data on the average balance of base money are obtained from the web page of the Bank of Japan. The data source of the interest rate and IIP is IFS (International Financial Statistics) published by the International Monetary Fund in 2008 (CD-ROM version).

[5] In Oda and Ueda (2007), it is mentioned that the money multiplier decreased at that time.

Here, Δy_t^k is economic growth from period t toward t+k where k=6, 9, 12, 15, 18, 21, and 24. And $spread_t$ is the term spread, α is a constant, β is the coefficient on spread, and u_t is disturbance. β is the most important parameter in this study, representing the effects of the spread on economic growth.

We utilize the monthly data from January 1990 to December 2008: the non-collateral call rate as the short-term rate (cr_t), the Japanese 10-year government bond as the long-term rate (lr_t), and the index of industrial production (IIP) as production[6][7]. However, we employ data on economic growth over 24 months in advance at maximum, and can utilize data from January 1990 to December 2006. The definitions of the variables are

$$spread_t = lr_t - cr_t \cdots (3)$$

and

$$\Delta y_t^k = \frac{1200}{k} \ln \frac{y_{t+k}}{y_t} \cdots (4),$$

where k=6, 9, 12, 15, 18, 21, and 24.

2.2 Estimation and Test of Structural Change

We now estimate equation (1) using the generalized method of moments (GMM) in order to avoid the endogeneity problem. We set five instrumental variables for the model:

$$spread_{t-1}, spread_{t-2}, \Delta y_{t-4}^3, \Delta y_{t-5}^3, const..$$

Here, $const.$ denotes constant term. These settings are the same as those of the augmented terms in Hamilton and Kim (2002). For example, Δy_{t-4}^3 denotes the annual rate of quarterly economic growth at one month before. We performed

[6] The data source of the spread and IIP is the same as Figure 3: IIP is IFS (International

Financial Statistics) published by the International Monetary Fund in 2008 (CD-ROM version).

[7] We can utilize only monthly or quarterly data of IIP, though higher frequent data of the financial market can be obtained. Therefore, we perform empirical analysis with monthly data in order to ensure a sufficient sample size.

the unit root test of $spread_t$ and Δy_t^1 with the ERS test (with constant and trend) developed by Elliott, Rothenberg and Stock (1996). Each test statistic is -2.874 and -3.167. Each test statistic indicates rejection of null of unit root[8]. The critical value of the 10% significant level is -2.365 and that of 5% is -2.927. They are not robust; however, we assumed the instruments of each industry are strongly stationary here.

The results of GMM estimation for equations (1) are shown in Table 1. These results show that the effects of the term spread (the size of $\hat{\beta}$) lessen as we consider economic growth toward a longer horizon.

However, the *P*-value of *J*-statistics—test statistics for the over-identifying restriction—is between 0.05 and 0.25 except for the case with *k*=15. Considering the problem of power, these results may not be robust. In addition, the shift of parameter β is an important object of this study. Therefore, it is necessary to perform a test for structural change.

Here, in order to detect one unknown structural change point with GMM estimation, we employ the sup-predictive test developed by Ghysels et al. (1998). This test has its basis in the predictive test derived by Ghysels and Hall (1990). The results of the sup-predictive test show that there is a structural change with the model explained by equation (1) when we employ economic growth toward 21 months and 24 months in advance. The detected point of structural change is October 2001 (*k*=21) and September 2001 (*k*=24). The details are shown in Table 2.

2.3 Sign of the Coefficient after a Shift

Does the term spread truly have a negative effect on economic growth after a shift? In order to verify this point, we estimated equation (1) in the second subsample. The instrumental variables of the GMM estimation are the same as those employed in the previous estimation. The results of the estimation in the second subsample are shown in Table 3. These results show that the effects of the

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[8] We can rewrite Δy_t^k as $(1/k)\times(\Delta y_{t+k-1}^1 + \cdots + \Delta y_t^1)$. And thus, when Δy_t^1 is stationary, we can say that Δy_t^k is also stationary.

term spread are negative. With this model, the estimated coefficients of term spread are negative and significant in both cases, when $k = 21$ and 24. And in both cases, the J-statistics indicate that over-identifying restrictions are formed; the P-values are at least 0.278.

3. Conclusion

The empirical analyses performed in this paper reveal certain findings. Firstly, the model shown by equation (1) has a structural change in September (k=24) and October 2001 when k=21. And the results of estimation with the sample after the break show that the effects of the term spread are negative in both cases.

In March 2001, the quantitative monetary easing policy (QMEP) and policy duration were performed with the commitment of the Bank of Japan. The structural changes in the relation between the term spread and economic growth were, probably, caused by these monetary policies newly put into effect. It was also shown that the coefficients on the term spread with the simple model with equation (1) are negative and significant when we employ the second subsample, which begins in October 2001 (with economic growth toward the 21 months in advance) or September 2001 (with the 24 months in advance).

As described previously, there are two aspects to the policy duration effects: The first is the reduction in the term spread caused by a commitment to monetary easing policy and by an expectation of a continuous low (zero) interest rate, and the second is that the expectation of monetary easing and reduction in the term spread are effective in promoting economic growth. Following these results of the empirical analyses, we conclude that QMEP and policy duration effects (from 2001 to 2006) have some influence on the second aspect in the Japanese economy.

However, the empirical analysis performed in this paper is based on a simple equation consisting of economic growth, term spread and other financial variables. In order to verify the policy duration effects in Japan in detail, we have to consider other macroeconomic variables: stock price, exchange rate, and government expenditure. To verify the effects of these variables, approaches based on the VAR model are useful, as shown by Honda et al. (2013) and other studies. Several approaches applying the VAR model have been developed in many studies.

As future study, we will estimate utilizing factor-augmented VAR (FAVAR) or expectation-augmented VAR considering the other important variables[9].

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[9] For example, Shibamoto (2007) performs empirical analysis on the Bank of Japan's monetary policy with FAVAR approach.

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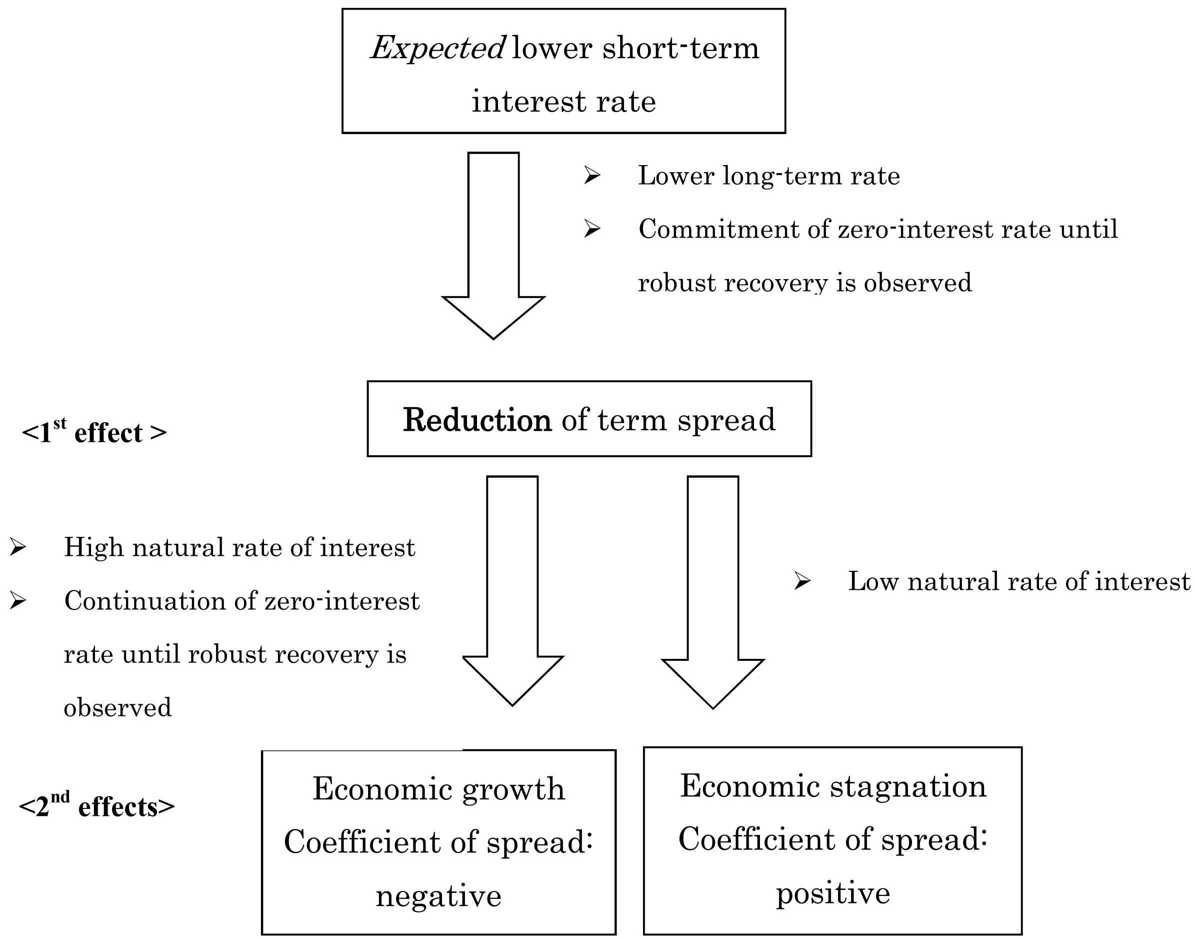
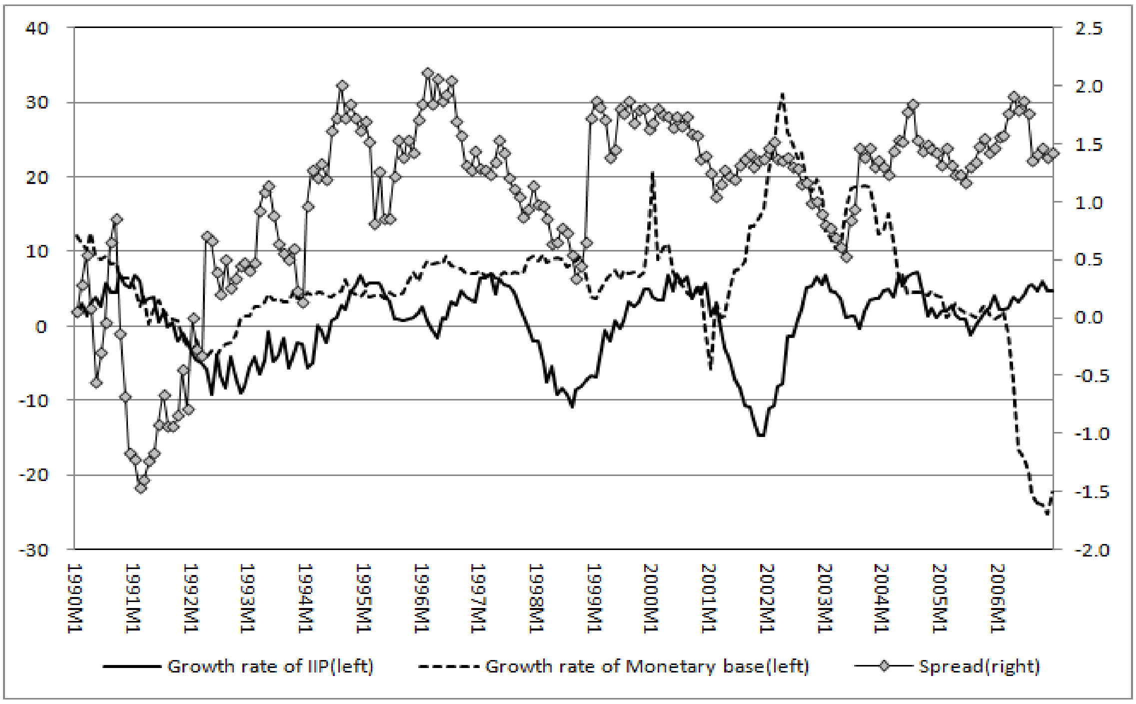
Figure 1 Policy duration effects



(Note) Based on Oda and Ueda (2005) and Miyao (2007), the author devises this figure. The *first* effect implies the reduction in term spread. The *second* effect is that on the economic growth. With the high natural rate of interest and commitment to zero interest rate policy by the time robust recovery is observed, the second effect would materialize. These two effects are called "policy duration effects."

Figure 2 Spread, IIP, and monetary base (unit: %)



Source: Data on the average balance of base money are obtained from the web page of the Bank of Japan. The data source of the interest rate and IIP is International Financial Statistics (IFS) published by the International Monetary Fund.

Table 1. GMM estimation

	β (Standard Error)	J-stat.[P-value]
k=6	2.451(0.700)***	6.813[0.078]
k=9	2.481(0.685)***	7.079[0.069]
k=12	2.406(0.608)***	5.596[0.133]
k=15	2.331(0.513)***	4.066[0.254]
k=18	1.996(0.494)***	5.492[0.139]
k=21	1.860(0.471)***	5.815[0.121]
k=24	1.653(0.475)***	5.744[0.125]

Note: *** denotes a 1% level of significance. J-statistics obey χ^2 distribution with DF=3.

Table 2. Sup-predictive test

	Sup-predictive Test Statistics	Detected Breakpoint
k=6	14.119	Nov. 1993
k=9	9.825	Sep. 2001
k=12	13.55	Sep. 2001
k=15	13.494	Sep. 2001
k=18	18.93	Sep. 2001
k=21	25.321***	Oct. 2001
k=24	34.883***	Sep. 2001

Note: Critical values of sup-predictive test are as follows: 5% (19.20), 1% (23.56) and *** denotes a 1% level of significance.

Table 3. Sub-sample estimation

(k=21,Oct. 2001–Dec. 2006)

β (Standard Error)	J-stat.[P-value]
−1.044(0.465)**	3.849[0.278]

(k=24,Sep. 2001–Dec. 2006)

β (Standard Error)	J-stat.[P-value]
−1.011(0.433)***	2.429[0.658]

Note: J-statistics obey χ^2 distribution with DF=3 (in base model). ** denotes a 5% level of significance and *** a 1% level of significance.