Analysis of Interest Rate Control Policy in Japan

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Abstract. Since the zero-interest rate policy was implemented in 1999, Japanese government has constantly made innovations and changed monetary policies as well as operational targets for more than 20 years. In this process, quantitative easing has been gradually upgraded and intensified. In the short term, however, Japan has failed to achieve its desired goal, aided by ultra-loose interest-rate controls. This has been questioned by many scholars around the world. By analyzing current situations of CPI and GDP in Japan over the past 20 years and establishing VAR model for empirical research, the results show that the effectiveness of Japan's interest rate control policy is insufficient and fails to achieve expected goal of restraining deflation and yen depreciation no matter in the short or long term. Based on Japan's experience and lessons, this paper provides suggestions for monetary policy making in other countries with similar situations.

Keywords: Interest Control; Quantitative Easing; Monetary Policy; Monetary Base.

1 Introduction

Since the Bank of Japan first implemented zero interest rate policy in 1999, it has guided the long-term interest rate downward, stabilized interest rate expectation and promoted economic growth through unconventional monetary policy means. As an

unconventional monetary policy tool, yield curve control can send clear signals to the market. When the yield of national bonds approaches the upper limit of the target interest rate and the market believes the policy commitment of the central bank, it will spontaneously buy national bonds to lower the yield, forming a "self-fulfilling" effect. This "self-fulfilling" effect could ease the pressure on central banks to expand their balance sheets too quickly. In this sense, yield curve control can be a partial substitute for quantitative easing (QE), achieving interest rate targets with lower bond purchases.

In recent years, affected by the COVID-19 pandemic, economies of many developed countries have fallen into recession, and the financial markets have been rocked. In this paper, VAR model is adopted. The overall policy practice of Japan's quantitative and qualitative monetary easing policy (QQE) policy and negative interest rate policy during the parallel period from January 2016 to December 2022 is taken as the research object. This paper uses this research object to make an empirical analysis of the policy effect of this unconventional monetary policy and study the effect of yield curve control (YCC) policy on inflation and exchange rate in Japan. Combined with the experience and lessons of Japan, this paper reviews theoretical basis of yield curve control policy, summarizes the historical experience of yield curve control. Additionally, this paper analyzes its implementation background, policy effects, advantages and disadvantages, which has implications for monetary policy practices of other countries.

Due to the short implementation time of Japan's yield curve control policy, domestic and foreign scholars have limited studies on Japan's YCC policy, and most of them have expressed negative attitudes towards this policy. In this paper, a total of 11 literature at home and abroad are selected and classified. It is found that most foreign scholars focus on analyzing the impact of interest rate control on Japan's inflation through monetary means, while domestic scholars focus on analyzing Japan's interest rate control policy from the perspective of interest rate regulation. This paper lists the main viewpoints and design methods of these literature and puts forward own opinions according to commonness and individuality of these academic achievements.

After sorting out and analyzing research results of foreign scholars on the impact of YCC on Japan's inflation rate, it has been found that most of which are analyzed through monetary means. Beckmann analyzed the impulse response of interest rate control to Japan's inflation rate through Bayesian var model. Beckmann concluded that the uncertainty effect of monetary policy played a decisive role in inflation rather than interest rate control [1]. Focusing on interest rate adjustments by the European Central Bank (ECB), the Federal Reserve and the Bank of England, Masciandaro compared it

with Japan's interest rate controls. This scholar found a similar relationship between stock market volatility and sovereign yields and concluded that interest rate controls were not a decisive factor in maintaining stable development of financial markets [2]. Picault began to focus on the direct impact of monetary policy on the financial market. Through the prediction of bond yield, Picault proposed that monetary policy and interest rate control have the same validity, that is, monetary policy can replace interest rate control [3]. Ozdagli evaluated the dynamic interaction between monetary policy and financial market and used quarterly time series data of 7 years to conduct Bayesian var modeling. The conclusion was that the control of the yield curve has a direct negative impact on inflation [4]. Kawaguchi pointed out in the Bank of Japan paper that Japan's interest rate control policy has a significant impact on domestic inflation. This kind of inflation is mainly reflected in the impact on various enterprises and the delayed impact on the national economy, and finally affects the inflation level from various perspectives such as consumption [5]. Christensen pointed out that YCC policy had no substantial effect on solving inflation, since Japan's expected, and actual inflation rate had been lower than the bank's setting. Additionally, expansionary fiscal policy implemented in Japan during the COVID-19 pandemic had no significant effect on arbitrage-free inflation expectation [6]. Yamada pointed out that existence of a large number of "zombie companies" during this period showed the inadequacy of YCC policy in dealing with debt and pointed out the unfriendly and other negative effects of interest rate control on small and medium enterprises [7].

In terms of the domestic scholars in this area of research, most of them focused on the interest rate adjustment on the impact of inflation. Wan built a theoretical framework, analyzed the overall policy effect of zero and negative interest rates in Japan. This scholar also established VAR model and conducted empirical research. The results showed that Japan's monetary policy did not achieve the expected goal of restraining deflation and yen depreciation [8]. Lu reviewed the practice of the financial market after the implementation of the YCC policy in Japan. At the same time, Lu analyzed the background, content, characteristics and effects of the yield curve control policy of the Bank of Japan, explored the possibility of the policy going global, and turned the individuation into a common one [9]. Niu, through a more comprehensive review of yield curve control, analyzed the interest rate control policies of different countries and regions at different stages. Niu compared YCC with other monetary policies to get the deep reasons for Japan's implementation of YCC [10].

To sum up, most domestic and foreign scholars held a negative attitude towards Japan's interest rate control policy. Additionally, a few scholars believed that interest rate control can alleviate Japan's domestic inflation in certain circumstances and ensure the relative stability of Japanese exchange rate. This paper uses VAR model to empirically test YCC policy by referring to the method experience of these scholars. It is found that its effectiveness is insufficient in the short and long term, and it does not complete the expected inflation target.

2 Data Analysis

After the collapse of the economy in the 1990s, Japan's inflation rate began to fall and has continued to stabilize. From the 1990s to the early 20th century, when Japan implemented zero interest rate policy, the overall Consumer Price Index (CPI) in Japan showed a downward trend, as shown in Fig. 1. It had little effect on boosting the economy, and the deflation of inflation intensified instead.

Fig. 1. 1998-2022 Japanese CPI (2020-base) and GDP (original series)

Since 2006, zero interest rate and QE policy were in parallel, and the Bank of Japan changed operational target and increased purchase of long-term government bonds. During this period, the trend of Japanese CPI was relatively controllable and moderate, showing a sustainable trend, and reached a new peak in 2009. From 2013 to 2016, Japan implemented an indefinite and open-ended QQE policy to increase the supply of

base money. Fig. 2 shows that after the implementation of QQE policy in 2013, the release of base money increased significantly, and both Japan's CPI and Gross Domestic Product (GDP) increased significantly after 2013. Until 2017, the CPI growth rate rose slowly. In 2020, due to the outbreak of the global epidemic, Japan's CPI began to decline, and its GDP fell precipitously, resulting in a tense national economy. However, the sharp rise of CPI from 2021 to 2022 indicates that the hidden long-term boost effect of Japan's QQE policy has begun to appear, but whether it can provide long-term support needs more data and policy assistance in the future. Based on the above data, this paper analyzes the explicit and implicit relationship between Japan's economic level and interest rate policy in recent years and conducts research design based on this trend.

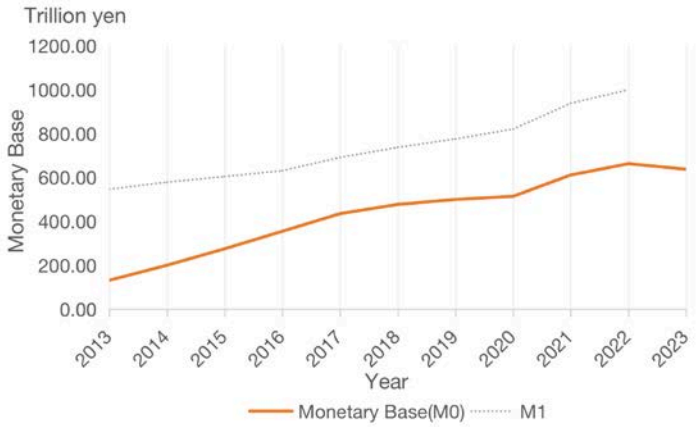

Fig. 2. 2013-2023 Japanese Monetary Base / Coins in Circulation / Average Amounts Outstanding (M0 and M1)

Fig. 3 shows that the Japanese exchange rate depreciated for a long time from 2013 to 2016, but after the implementation of YCC policy in 2016, the yen appreciated, and the yen exchange rate was relatively stable in the following years. It shows that the YCC policy has a relatively obvious effect on stabilizing the exchange rate.

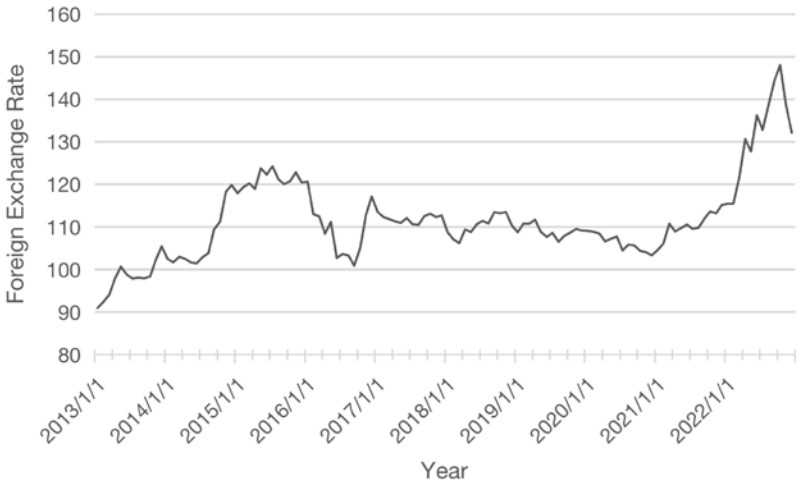

Fig. 3. 2013-2022 Japanese Foreign Exchange Rate

3 Empirical Test

3.1 Stationary Test

Before VAR model estimation, the stability test of selected financial time series data should be carried out. Choosing trendless items with intercepts to test can avoid fallacy regression and "meaningless" problems. The test results are shown in Table 1. Original sequences of all variables in the model are not stable, after differential processing, however, they are all first-order integral sequence I (1).

Table 1. ADF Test of the Variables

Variable	Dickey-Fuller	Lag order	P-value	Alternative Hypothesis
lnBC	-1.7703	4	0.6699	Unstable
RC	-2.2688	4	0.4657	Unstable
CPI	0.3480	4	0.9900	Unstable
lnER	1.1267	4	0.9900	Unstable

Four adf. Tests show that the original data are not stable, and differential processing is required. Table 2 shows the results after unit root text.

Table 2. Unit Root Text of Variables

Variable	Type	Select lags	P-value	Conclusion
D(lnBC)	none	AIC	0.0408	Stationary
D(RC3)	none	AIC	1.662e-15	Stationary
D(CPI3)	none	AIC	3.897e-09	Stationary
D(lnER)	none	AIC	2.95e-07	Stationary

After difference processing, the four variables are all first-order unitary sequence, which can be preliminarily determined to establish VAR model analysis. Theoretically, the regression analysis of the above two groups of variables is meaningful, and the pseudo-regression problem will not appear. The model is stable and there is a long-term stable relationship between variables. The following is further explored by establishing VAR model and using Granger causality test, impulse response analysis and variance decomposition technology.

3.2 The VAR Model and Related Tests

Lag length selection

This paper determines the order by using select function in VAR, and the total lag order selected by minimizing each of the four criteria (Akaike, Hannan-Quinn, Schwarz, and Final Prediction Error). The values of the four intermediate information criteria within the fourth order of two VAR models constructed in this paper (VAR1 and VAR2) are as follows (See Table 3 and Table 4).

Table 3. VAR1 Model Order and Its Four Information Criteria Results

	1	2	3	4
AIC(n)	-2.328e+01	-2.318e+01	-2.322e+01	-2.307e+01
HQ(n)	-2.313e+01	-2.291e+01	-2.284e+01	-2.258e+01
SC(n)	-2.29e+01	-2.251e+01	-2.227e+01	-2.183e+01
FPE(n)	7.77e-11	8.621e-11	8.247e-11	9.665e-11

Table 4. VAR2 Model Order and Its Four Information Criteria Results

	1	2	3	4
AIC(n)	-2.924e+01	-2.917e+01	-2.914e+01	-2.91e+01
HQ(n)	-2.909e+01	-2.891e+01	-2.876e+01	-2.858e+01
SC(n)	-2.886e+01	-2.85e+01	-2.818e+01	-2.783e+01
FPE(n)	1.994e-13	2.143e-13	2.233e-13	2.38e-13

It can be seen from the tables above, under the principle of minimum of the four information criteria, the optimal order of two VAR models is order 1, so we finally determine that the order of these two models is 1. Then view the fitting graphs (Fig. 4 and Fig. 5), where the top two are trend graph and residual graph respectively, and the bottom two are ACF and PACF respectively. It is notable that the fitting effect is better.

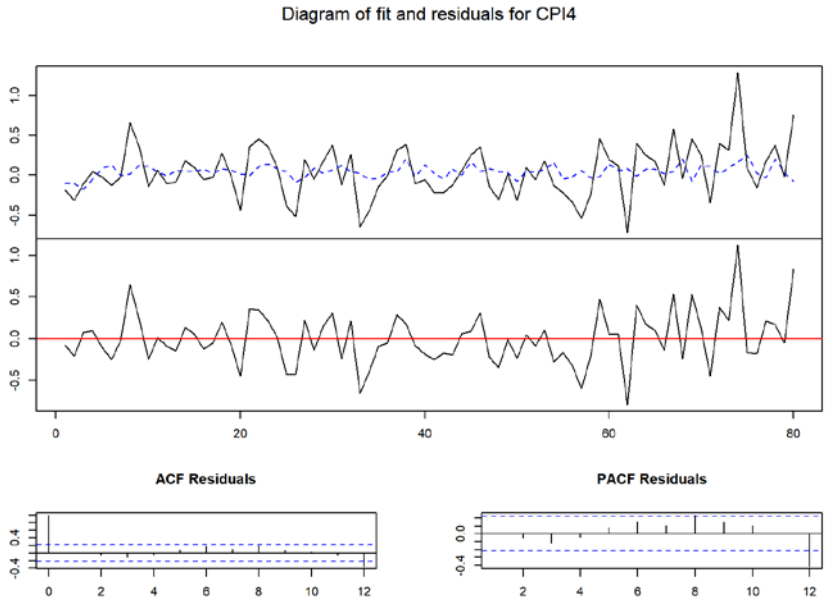

Fig. 4. Diagram of fit and residuals for CPI

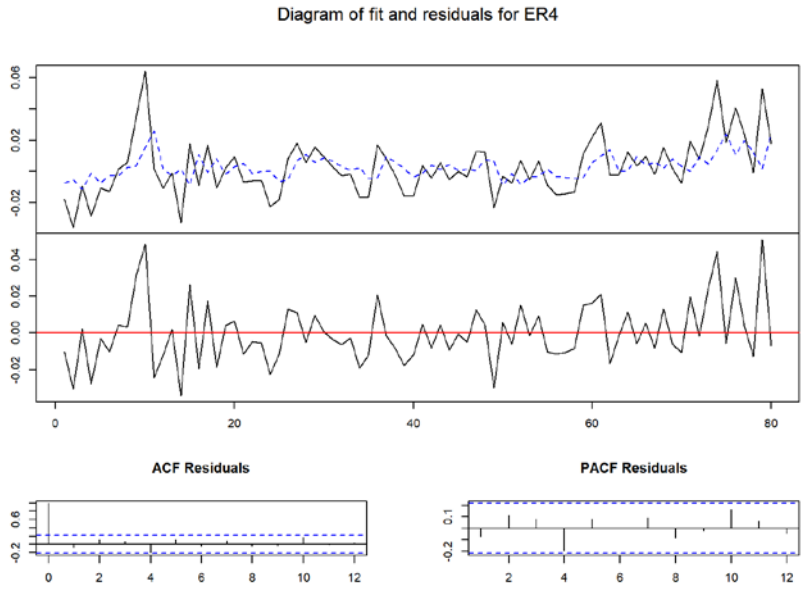

Fig. 5. Diagram of fit and residuals for lnER

Unit root test

Through the AR root feature circle test (Fig. 6 and Fig. 7), the feature roots are located in the unit circle, most of the coefficients are significant, and the goodness of fit is good. Therefore, through this test, the model can be preliminarily considered stable.

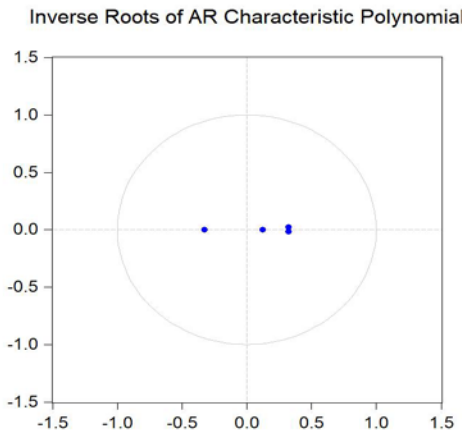

Fig. 6. Stationary Test of VAR Model (CPI)

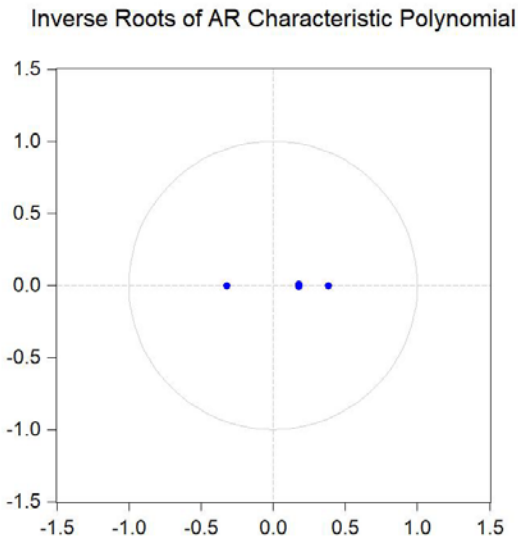

Fig. 7. Stationary Test of VAR Model (lnER)

Estimation results

The estimation results of the VAR model are shown in Table 5 and Table 6. It can be seen that in these two models, the p-value in T-test statistic of the coefficient of intermediate variable is less than 0.05, indicating that the coefficient of intermediate variable in two models is significantly not 0.

Table 5. Results of the VAR Model (CPI)

Group	Term	Estimate	Std.error	Statistic	P-value
CPI4	BC4.l1	0.6770	0.0841	8.0500	8.70e-12
CPI4	RC4.l1	0.0122	0.0184	0.6650	5.08e- 1

Table 6. Results of the VAR Model (lnER)

Group	Term	Estimate	Std.error	Statistic	P-value
ER4	BC4.l1	0.6830	0.0847	8.0700	8.16e-12
ER4	RC4.l1	0.0149	0.0187	0.7980	4.27e- 1

3.3 Impulse Response Analysis

In order to further characterize the influence of each variable, relevant impulse response charts (Fig. 8 and Fig. 9) are constructed. The vertical axis represents Japan's base money, unsecured call rate, CPI year-on-year index and spot exchange rate of USD/yen respectively. The horizontal axis represents the number of periods, and the two dashed lines represent deviation bands of plus or minus 0.1 times of standard deviation. The solid line represents dynamic response process of each variable to intermediate variable.

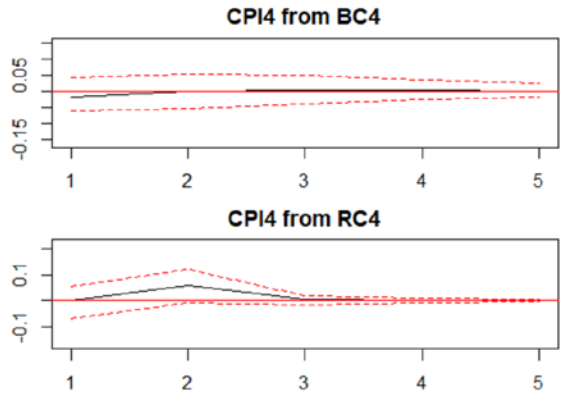

Fig. 8. Impulse Test Plot of D(CPI) on D(BC) and D(RC)

The first is analysis of the impact of monetary policy on CPI. Fig. 8 shows the impact of CPI on base money and unsecured call rate. It can be seen clearly that after lnBC is hit, the first two periods have positive impact on CPI, and the effect is gradually enhanced. Then the positive impact becomes weaker and weaker, indicating that in the short term, the selection of base money as the operation target has a positive impact on the suppression of deflation, which is constantly enhanced. This effect, however, diminishes over time. Although RC has a positive impact on CPI, it has a small effect and decreases to 0 in the long run. To sum up, the negative interest rate policy did not achieve the expected goal of suppressing deflation, and Japan's inflation rate did not rise.

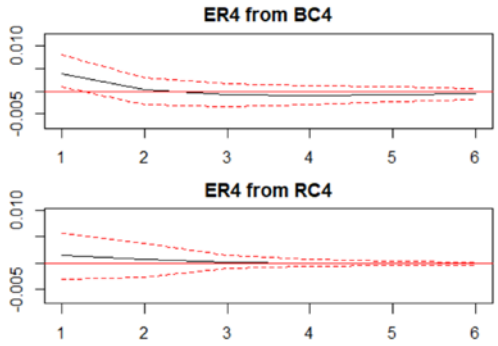

Fig. 9. Impulse Test Plot of D(ER) on D(BC) and D(RC)

The second is impact of monetary policy on exchange rate analysis. Fig. 9 shows lnER's impact on base money and unsecured call rate. When lnBC is hit by one standard deviation, the first two periods have positive impact on lnER. After stabilizing to the fourth period, the impact weakens to close to 0. After a shock to RC, it has a positive impact on lnER all the time, and the effect is becoming more and more stable, which can be said to play a role in restraining the appreciation of the exchange rate to a certain extent.

3.4 Variance Decomposition

The results of related shocks show that the effectiveness of Japan's zero interest rate and negative interest rate policies is particularly insufficient in both short and long term, and the two expected targets are difficult to achieve. Variance decomposition technology is used to analyze the contribution rates of lnBC, RC impact to CPI and lnER respectively to verify this conclusion. As shown in Table 7 and Table 8: The impact of changes in lnBC and RC can hardly explain changes of CPI in either short or long term. The influence of CPI itself is very significant, which means that expected goal of monetary policy to curb deflation is far from being realized. On the contrary, the impact of long-term RC changes can explain 7% of lnER, and it has been on an upward trend, which is the main influencing factor of exchange rate changes. In the long run, lnBC's

explanation of lnER only accounts for 1%, which is hardly effective. The results of variance decomposition and impulse response analysis are consistent and corroborate each other.

Table 7. Variance Decomposition of DBC

Period	S.E.	DBC	DRC
1	0.0050	100	0
2	0.0059	99.8897	0.1103
3	0.0062	99.8899	0.1101
4	0.0062	99.8910	0.1090
5	0.0062	99.8905	0.1095
6	0.0062	99.8905	0.1095
7	0.0062	99.8905	0.1095
8	0.0062	99.8905	0.1095
9	0.0062	99.8905	0.1095
10	0.0062	99.8905	0.1095

Table 8. Variance Decomposition of DRC

Period	S.E.	DBC	DRC
1	0.0142	6.3588	93.6412
2	0.0145	6.2278	93.7722
3	0.0146	6.2967	93.7024
4	0.0146	6.2930	93.7070
5	0.0146	6.2952	93.7048
6	0.0146	6.2952	93.7048
7	0.0146	6.2952	93.7048
8	0.0146	6.2952	93.7048
9	0.0146	6.2952	93.7048
10	0.0146	6.2952	93.7048

4 Conclusion

The empirical analysis results of VAR model in this paper show that the effectiveness of Japanese YCC policy is insufficient in both short and long term, and it fails to achieve the expected goal of restraining deflation and yen depreciation. The zero-interest rate policy targeting unsecured call rate and YCC policy have played a role in restraining the appreciation of exchange rate to some extent. However, it remains to be seen whether the policy will have desired effects over the long term. Combined with the practice and experience of Japan's unconventional monetary policies such as zero and negative interest rates, it can provide inspiration for monetary policies of other countries. Some enlightenments are summarized as follows.

First, at present, most countries should not easily adopt unconventional monetary policies such as zero interest rate policies and negative interest rate policies. These countries can appropriately reduce interest rates and other means and measures instead. For some countries where conventional monetary policies still have some room for maneuver, flexible and relatively stable monetary policies are more conducive to economic development. Monetary policy should not be used independently from economic market. It should be used in coordination with fiscal policies and exchange rate policies. Only by strengthening communication between policies and constantly promoting information transparency can the effectiveness of policies be better enhanced. Additionally, when the Bank of Japan implemented QE policy and then implemented QQE policy and YCC policy simultaneously, its policy operation target also changed from unsecured call rate to base money. The empirical results of this paper show that this adjustment is improper and cannot achieve the goal of restraining deflation and yen depreciation. Countries with economies in transition can consider taking short-term interest rate as the operational target of monetary policy to improve indicative effect of the policy.

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