How Does the Policy Rate Respond to Output and Prices in Thailand?

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Abstract

This paper attempts to examine how the policy rate as a monetary policy stance reacts to output and price level in Thailand during 2005Q1 and 2016Q2. An empirical relationship that characterizes the way the Bank of Thailand adjusts its policy rate to output growth and inflation is identified. Johansen ointegration technique and VAR methodology are used in the analysis. The results from the cointegration analysis show that there exists a long-run relationship of the policy rate with real GDP and prices. This long-run equation differs from the empirical Taylor-type rule. However, the result from short-run dynamics captures the short-run interest rate equation. The partial adjustment coefficient in the estimated interest rate equation is negative and highly significant, which indicates that any deviation of the policy rate from its equilibrium value is corrected by monetary policy actions. Furthermore, there is long-run causality running from inflation and economic growth to a change in policy rate. In the short run, economic growth negatively causes a change in the policy rate while inflation positively causes a change in the policy rate. Also, impulse response analysis from an unrestricted VAR model indicates that both output growth and inflation shocks cause fluctuation in the policy rate.

Keywords: Policy rate, output, prices, error correction mechanism, impulse responses
JEL Classification: C32, E52

1. Introduction

The Taylor rule proposed by Taylor (1993) is the simple rule that explains how the central bank of the United States adjusts the federal fund rate by using the current values of output gap and inflation in relation to their target values. In earlier empirical studies, researchers estimate monetary policy reaction functions for advanced countries. By pursuing monetary policy rule, the central banks conduct a sluggish partial adjustment of short-term policy interest rate. Clarida et al. (1998) estimate monetary reaction functions for Germany, Japan, the United States, France, Italy and the United Kingdom. They find that the success of monetary policy in Germany, Japan and the United States stems from an implicit adoption of inflation targeting. The central banks in these three countries respond to anticipated inflation rather than lagged inflation. For the other three countries, the central banks are heavily dominated by German monetary policy rule. Using the German central bank policy as a benchmark, they find that interest rate in these countries are higher than macroeconomic conditions when the European Monetary System collapse.

There are some arguments in the literature pertaining to the choice of interest rate and the functional form of estimated equation. Minford et al. (2003) argue that an interest rate relation with output and inflation does not identify a central bank reaction function because the central bank may follow different monetary policy rules. Mehra (2001) indicates that the United States Federal Reserve (Fed) reacts to long-term inflationary expectations in the post-1979 period. Therefore, the behavior of the long-term bond rate is more responsive to actual or expected inflation than the federal fund rate. Kim et al. (2005) investigate the nature of nonlinearity in the monetary policy rule of the Fed using the flexible approach to nonlinear inference. They find evidence of nonlinearity for the period to 1979, but little evidence for the subsequent period. Possible asymmetries in the Fed's reactions to inflation deviations from target and output gap occur in the 1960s and 1970s, but do not capture the entire nature of nonlinearity. Due to some problems with estimation of the Taylor rule, such as misspecification and inconsistency in time series analysis, Eleftheriou (2009) estimates the interest rate rule for Germany and finds evidence of a stable interest rate rule, which is similar to the Taylor rule. The long-run relationship of the policy rate with output and inflation is found. Fernandez et al. (2010) find that The Fed's partial adjustment of the federal fund rate toward an equilibrium rate depends on the unemployment rate and forward-looking inflation measures. Seip and McNown (2013) examine monetary policy in the United States for six periods. They find that the Fed changes interest rate in accordance with economic instability, i.e., movements in inflation and unemployment. Baxa et al. (2013) use recently developed monetary policy rule estimation methodology to be applied to the data of the United States, the United Kingdom, Australia, Canada and Sweden. They find that the central banks in these countries often change policy rates during the 2008-2009 global financial crisis. Most central banks respond to both stock-market stress and bank stress while they respond to exchange-rate stress when their economies are more open.

In theory, monetary policy can affect both real activity and price level. In conducting monetary policy, a central bank simply changes the size of money supply. The simple tool exercised by most central banks is open market operations. If cent banks buy securities from the public, the size of money supply will increase, and thus output and price level should increase. On the contrary, when central banks sell securities to the public, the size of money supply will be reduced, and thus output and price level should fall. The efficacy of monetary policy can be enhanced by an implementation of inflation targeting. Clarida et al. (1998) give evidence indicating that some form of inflation targeting can be a nominal anchor for monetary policy rather than fixing exchange rates. The Bank of Thailand is also associated with the concept of inflation targeting. However, its policy operationally involves the adjustment of policy rate. According to International Monetary Fund, the policy rate is the rate used by the central bank to implement or signal its monetary policy stance. In Thailand, the decisions on the policy rate are taken by the Bank of Thailand monetary policy committee. The committee will lower the policy rate when the growth rate of the country is low and inflation tends to fall. The committee will leave the policy rate unchanged when it considers that the current monetary policy is appropriate to support the economic recovery and does not pose risks to financial stability. The adjustment of policy rate is shown in Figure 1.

The plot of the policy rate as monetary policy stance of the bank of Thailand shows fluctuations in the rate. This rate increased from the first quarter of 2005 and decreased by the fourth quarter of 2006. The policy rate was lowest in the second quarter of 2009 and remained the same until the second quarter of 2010. The sharp drop of the policy rate was due to the impact of the global economic recession when the central banks worldwide cut policy rates sharply. Even though this rate increased from the third quarter of 2010, it started decreasing thereafter.

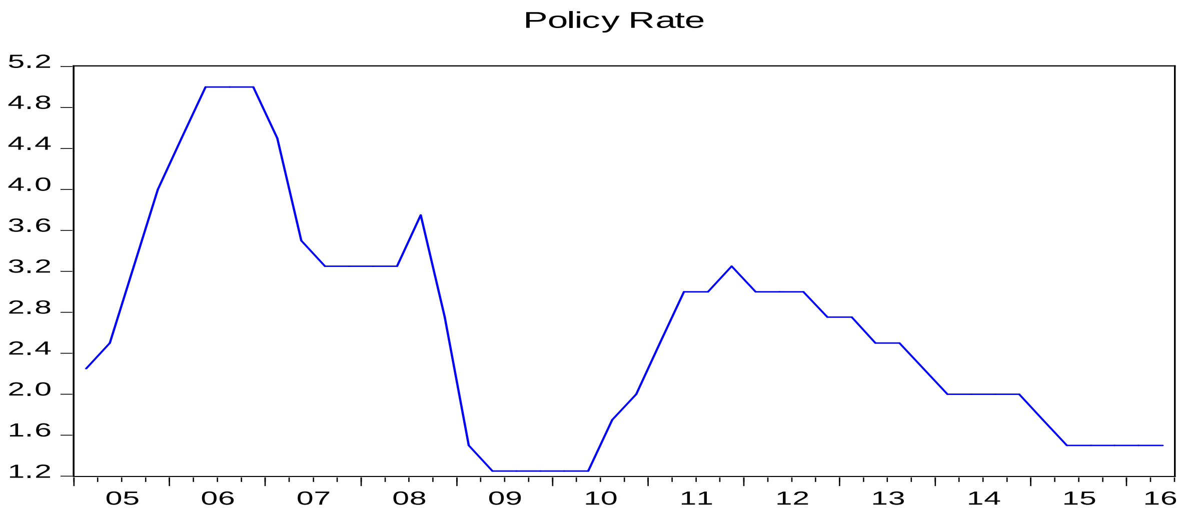

Figure 1. Movements in the Policy Rate.

The remainder of the paper is organized as follows: Section 2 describes the data, empirical model and estimations used in the analysis, Section 3 presents empirical results, and the last section draws conclusion.

2. Data and Methodology

2.1 Data

The dataset used in the analysis is quarterly time series. This dataset is retrieved from various sources. The policy rate as a measure of monetary policy stance is obtained from the Bank of Thailand website. Real GDP series is obtained from the Office of National Economic and Social Development Board while the consumer price index series is obtained from the website of Ministry of Commerce. The period of investigation is during 2005Q1 and 2016Q2, which is period of implementing inflation targeting. The number of observation is 46 because the policy rate series is available from 2005Q1 to 2016Q2, and thus the number of observations is limited by this series. The augmented Dickey-Fuller (ADF) test with constant only is used to test for unit root in all series, which are expressed in logarithmic series. The results of unit root tests for the three variables are reported in Table 1.

Table 1 Results of Unit Root Test.

Variable	ADF statistic
A.Level	
y (real GDP)	-0.459 [6]
p (consumer price index)	-1.792 [2]
r (policy rate)	-2.189 [1]
B. First Difference	
Δy	-4.108***[5]
Δp	-6.665***[1]
Δr	-3.632***[0]

Note: The number in bracket is the optimal lag length determined by Akaike Information Criterion (AIC). *** indicates significance at the 1% level.

The results in Table 1 show that all variables are integrated of order 1 or they are I(1) series because they contain unit root in level, but contain no unit root in first differences. The time series property of the data enables the conduct of cointegration test.

2.2 Methodology

2.2.1 Cointegration Analysis

An empirical model that identifis long-run relationship among the policy rate, real GDP and price level is expressed as:

$$r_t = a + by_t + cp_t + e_t \qquad (1)$$

where *r* is the log of policy rate, *y* is the log of real GDP, and *p* is the log of price level measured by CPI. Given that the variables are found to be integrated of order one, Johansen cointegration tests proposed by Johansen and Juselius (1990) and Johansen (1991) without deterministic trend are used. The tests employ the maximum likelihood procedure to determine the existence of cointegrating equations in nonstationary time series as a VAR model. The reduced form VAR model of order *p* is expressed as:

$$\Delta x_t = \mu + \Gamma_1 \Delta x_{t-1} + \Gamma_2 \Delta x_{t-2} + \ldots\ldots\ldots\ldots\ldots + \Gamma_{p-1} \Delta x_{t-p-1} + \alpha\beta' x_{t-1} + e_t \qquad (2)$$

where *x* is a vector of first differences of nonstationary variables, Γ_i is the matrix of short-run parameters, and $\alpha\beta'$ is the information coefficient matrix between the levels of nonstationary series. The relevant elements of the matrix *a* are adjusted coefficients while the matrix β contains cointetrating equations. There are two likelihood ratio test statistics for the number of cointegrating equations, i.e., trace and maximum eigenvalue statistics. If the two test statistics are greater than the critical values at the 5% level of significance, cointegrating equation(s) will exist.

2.2.2 Short-Run Dynamics

The existence of cointegration allows for an analysis of short-run dynamics. The ECM based on equation (1) is expressed as:

$$\Delta r_t = \mu + \sum_{i=1}^{k} [\beta_i \Delta r_{t-i} + \gamma \Delta y_{t-i} + \delta_i \Delta p_{t-i}] + \lambda e_{t-1} + u_t \qquad (3)$$

The coefficient of the error-correction term (e_{t-1}) captures the short-run adjustment while the short-run dynamics are depicted by the coefficients of the lagged values of first differences of all series. The optimal lag for the ECM model, *k*, can be selected by various criteria. However, the ECM model should pass diagnostic tests, specifically serial correlation test, heteroscedasticity and normality tests of the residual of the model. Equation (3) can be used to perform short-run and long-run causality analysis.

It should be noted that equation (1) does not represent the Taylor-type rule. However, partial adjustment can be perfectly captured by the dynamics of the model in equation (3) when only one cointegrating relation is found. In other words, equation (3) is the short-run interest rate equation (Eleftheriou, 2009).

3. Empirical Results

In this section, the results of cointegration tests, short-run dynamics, causality tests and impulse response analysis are presented.

3.1 Long-Run Relationship

Since all variables are I(1) series as shown by the results of unit root test reported in Table 1, Johansen cointegration tests without deterministic trend are performed with the lag of 2 determined by Schwarz Information Criterion (SIC). The simple model with three variables [r_t, y_t, p_t] is estimated. The results are reported in Table 2.

Table 2 Results of Cointegration Tests.

Coint. Rank	Trace statistic	5% Critical value	p-value
A: Trace Test			
None*	32.024	29.797	0.027
Almost 1	9.572	15.495	0.315
Almost 2	3.367	3.841	0.067
B: Max Eigenvalue Test			
Coint. Rank	Max-Eigen statistic	5% Critical value	p-value
None*	22.453	21.132	0.032
Almost 1	6.204	14.265	0.587
Almost 2	3.367	3.841	0.067

Note: * denotes rejection of the hull hypothesis of no cointegration at the 5% level, p-values are provided by MacKinnon et al. (1999).

The results in Table 2 show that there is one cointegrating relationship among the log of policy rate, the log of real GDP, and the log of price level.

The estimated long-run relationship between the policy rate and the other two macroeconomic variables is:

$$\underset{}{r_t} = \underset{\substack{(4.533)\\ [2.728]}}{12.367^{**}y_t} \underset{\substack{(0.076)\\ [-2.667]}}{-16.206^{**}p_t} \quad (4)$$

Note: Standard error is in parenthesis, t-statistic is in bracket, and ** indicates significance at the 5 percent level.

The long-run relationship between the policy rate and the two indicators (output and price level) does not bear a resemblance to a Taylor-type rule for the interest rate. The estimated long-run equilibrium equation shows that real GDP (*y*) is positively related to the policy rate (*r*). Equation (4) cannot be interpreted as an IS curve because output is not negatively related to interest rate. The estimated coefficient is large, which indicates that a 1 percent increase in real GDP causes the policy rate to increase by 12.37 percent. However, this positive relationship is consistent with the policy stance of the Bank of Thailand. Regarding the impact of price level, the price level is negatively related to the policy rate, i.e., a 1 percent increase in price level causes the policy rate to decrease by 16.21 percent. This phenomenon indicates the lack of the Fisher effect since nominal interest rate will not be positively adjusted to the rate of inflation

It should be noted that the positive relationship between real GDP and the policy rate might seem reasonable. As a matter of fact, the policy rate is used by the Bank of Thailand to signal its monetary stance. This rate is adjusted to accommodate economic growth. In other words, this rate is raised when the growth rate is high and vice versa. Therefore, the positive relationship between the two variables is observed.

3.2 Short-Run Dynamics

The finding of one cointegrating equation enables an estimation of short-run dynamics from the ECM framework. The partial adjustment that is captured by the dynamics of the estimated model representing the short-run interest rate equation is:

$$\begin{aligned}\Delta r_t = &\underset{\substack{(0.031)\\ [3.863]}}{- 0.121^{***} e_{t-1}} \underset{\substack{(0.144)\\ [2.162]}}{+ 0.310^{**} \Delta r_{r-1}} \underset{\substack{(0.120)\\ [1.225]}}{+ 0.148\, \Delta r_{t-2}} \underset{\substack{(0.383)\\ [-2.125]}}{- 0.814^{**} \Delta y_{t-1}} \underset{\substack{(0.349)\\ [-2.494]}}{- 0.871^{**} \Delta y_{t-2}} \\ &\underset{\substack{(1.139)\\ [6.836]}}{+ 7.784^{***} \Delta p_{t-1}} \underset{\substack{(1.572)\\ [1.473]}}{+ 0.316\, \Delta p_{t-2}} \underset{\substack{(0.019)\\ [-2.978]}}{- 0.056^{**}}\end{aligned} \qquad (5)$$

Adjusted $R^2 = 0.660$, $F = 12.642$
Diagnostic Tests:
Serial Correlation: LM Statistic = 9.133 (p-value = 0.289)
Heteroskedasticity: $\chi^2_{(2)} = 85.162$ (p-value = 0.444)
Normalilty: Jarque-Bera Statistic = 1.167 (p-value = 0.558)
Note: Standard error is in parenthesis, t-statistic is in bracket, and *** and ** indicates significance at the 1 and 5 percent level, respectively.

Since there exists one cointegrating relation, only one ECM model can be analyzed. As mentioned in Section 2, various criteria can be used to select the optimal lag order of the ECM model. Since the sample size is relatively small, the lag order of 2 determined by SIC is used, and necessary diagnostic tests are performed. The estimated ECM passes diagnostic tests for serial correlation because the LM statistic shows that the null hypothesis of no serial correlation cannot be rejected. The Chi-square statistic also reveals that the null hypothesis of no heteroskedasticity is accepted and thus the estimated model contains constant variances. In addition, the Jarque-Bera statistic indicates the absence of non-normality in the residuals.

The estimated coefficient of the error-correction term (e_{t-1}) in the interest rate equation captures the adjustment to the long-run equilibrium relationship. This coefficient is negative and significant at the 1% level. This coefficient has the absolute value of less than one, which indicating that any deviation from the long-run equilibrium will be corrected by monetary policy actions. Specifically, a negative 1 percent deviation from the equilibrium causes the policy rate to increase by 12 basis points in the next period. The significance of the estimated coefficient of the error-correction term also implies that the long-run relationship is stable. This finding is in line with the finding by Eleftheriou (2009) for the case of Germany.

There are causal relationships running from output growth and inflation to the policy rate. Since the results in equation (5) allow for causality tests in both long-run and short-run causations. The results of causality tests are reported in Table 3.

Table 3 Results of Causality tests.

Null Hypothesis	Wald F-statistic	p-value
Growth and inflation does not cause the policy rate.	14.924***	0.001
Growth does not cause the policy rate.	3.868**	0.030
Inflation does not cause the policy rate.	23.638***	0.000

Note: *** and ** indicate significance of the 1 and 5 percent level, respectively.

The results in Table 3 are obtained from Wald coefficient restriction tests on the coefficient of the error-correction terms and the coefficients of lagged independent variables in equation (5). There is a long-run causality running from growth and inflation to the policy rate adjustment. In the short run, output growth causes the policy rate to fall while inflation causes the policy rate to rise. It can be concluded that the short-run adjustment seems to be different from the long-run adjustment.

3.3 Impulse Responses

In performing the estimation of the unrestricted VAR model, all variables in their first differences are used. The results of the analysis of impulse responses are shown in Figure 2.

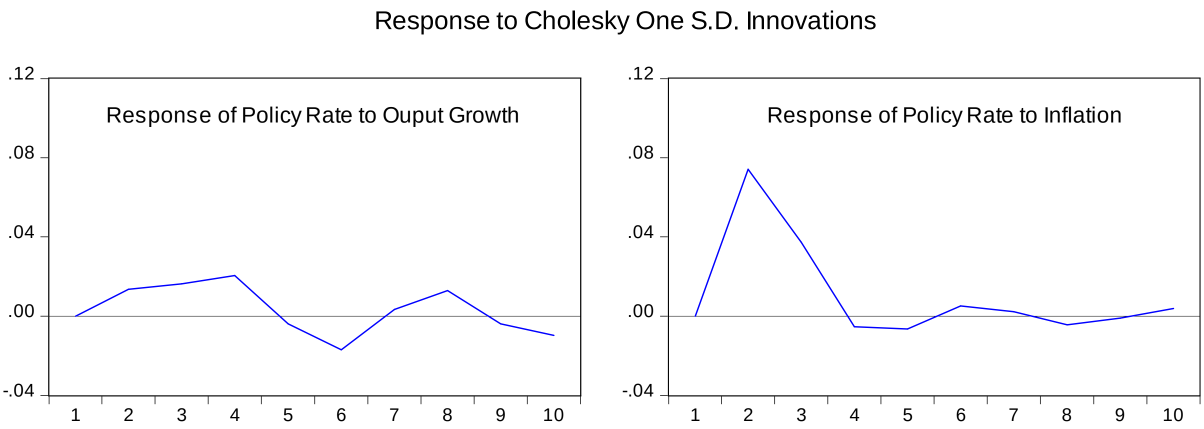

Figure 2. Impulse Responses of Policy Rate to Output Growth and Inflation.

In Figure 2, the solid lines are point estimates of the impulse responses of the policy rate due to a one standard deviation of output growth and inflation. The dashed lines contain the 95% error bands. The response horizon is in quarters. The response of the policy rate due to output shock shows that the policy rate increases with a lag of about one quarter. The rising of the policy rate does not last long enough because the policy rate starts falling in just four quarters and becoming negative. The output shock causes fluctuation in the policy rate. The response of the policy rate due to inflation shock shows that the policy rate also increases with a lag of about a quarter. The policy rate starts to decline within two quarters and becomes negative in the fourth quarter. However, the policy rate fluctuations seem to subside thereafter. As a result, the policy rate is affected by the shocks to growth rate and inflation. It should be noted that the implementation of inflation targeting by the Thai monetary authority might be a nominal anchor for monetary policy as mentioned by Clarida et al. (1998) because the impact of inflation shock seems to be less severe than the impact of growth shock.

3.4 Discussion

This paper shows that the estimated interest rate equation explains the importance of economic growth and inflation on the adjustment of the policy rate quite well. Therefore, nonlinear models as investigated by Kim et al. (2005) might not be needed. However, the exchange rate and foreign interest rate are cannot included be included in this study due to a relatively small sample size. Furthermore, stock market stress mentioned by Baxa et al. (2013) is not included in the model. Therefore this study has some limitations. A larger model for estimation is left for future research.

4. Conclusion

This paper employs cointegration technique and VAR model to investigate the impact of output and price level on the policy rate in Thailand during the period that inflation targeting has been implementing. The results show that there exists a long-run relationship of the policy rate with real GDP and price level. The estimated short-run interest rate equation is obtained from short-run dynamics. The estimated long-run equation seems to be stable because the coefficient of the error correction term has a negative sign with the absolute value of less than one. In addition, there are both short-run and long-run causations running from output growth and inflation to the policy rate adjustment. The impulse responses generated in this paper indicate that shocks to growth rate and inflation rate drive the policy rate cycle. Without inflation targeting, the variations of the policy rate might be larger. Therefore, policymakers should maintain the inflation targeting scheme for the success of monetary policy.

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