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THE PERFORMANCE OF THE TAYLOR RULE IN EMERGING ECONOMIES

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Abstract

Since 1990s, many emerging economies (EMEs) have decided on inflation targeting as an effort to reduce high inflation, establish a stable economy, and recover economic prosperity. Compared with the vast literature for advanced economies, the application of the Taylor rule has just increased recently in EMEs. Furthermore, there are limited number of studies investigating how Taylor rule can approximate the process of interest rate setting in EMEs. Considering the post-crisis period, studies investigating the performance of the Taylor rule in capturing the decision of monetary authorities in EMEs are scant.

The objective of this paper is to examine some crucial issues regarding how the interest rate instrument is set in EMEs. First, how can the setting of interest rate instrument be represented by a Taylor rule? Second, is the response of interest rate to inflation and output consistent with the Taylor principle? Third, are there any differences in the policy of interest rate before and after crisis? We apply the generalized method of moments (GMM) to estimate different specifications of Taylor rule because of the problem of endogeneity. The use of realized inflation as a proxy for expected inflation introduces the forecast error into the disturbance term, leading to the correlation between expected inflation and disturbance terms. Moreover, we apply Bartlett kernel procedure to the standard errors so that they are robust to the presence of heteroskedasticity and serial correlation. The choice of lagged instruments satisfies the overidentification test and the weak instrument test.

The paper found that the Taylor rule is a good approximation of the process of interest rate setting in EMEs. The interest rate positively responds to both inflation and output but the reaction does not follow the Taylor principle. Furthermore, the rule indicates weaker response to inflation and stronger response to output after the crisis. In addition, the implication of the exchange rate shows a reduction during the post-crisis period.

Keywords: monetary policy rule, interest rate, Taylor rule.

JEL classification: E52, E58

Introduction

In 1990s, the world experienced some crises such as Asian currency crisis in 1997 or the collapse of Russian ruble in 1998. Many economies, especially developing and emerging

ones, encountered episode of hyperinflation. Most countries adopted the inflation targeting framework for disinflation and economic recovery, thanking to the success of New Zealand and other advanced economies. Although the literature investigating different characteristics of the inflation targeting framework is vast for developed economies, the literature is rather limited for EMEs. There are not many studies examining how Taylor rule can approximate the process of interest rate setting. Furthermore, the unstable economic environment after crisis increases the cost of disinflation, it is more difficult for monetary authorities to maintain their commitment to manage price stability. Hence, it is pertinent to question the effectiveness of the interest rate instrument during the post-crisis period.

The objective of this paper is to examine some crucial aspects of the implementation of the inflation targeting in EMEs. First, can simple specifications of the Taylor rule approximate the setting of interest rate instrument? Second, does monetary policy rule satisfy the Taylor principle? Third, does the global financial crisis have impacts on the monetary policy rule? Finally, what is the implication of the exchange rate?

The paper contributes to the existing literature in several aspects. It investigates the effectiveness of the interest rate instrument in EMEs that target inflation. Moreover, it examines the influence of the global financial crisis on the implementation of monetary policy. It provides insight into the departure of monetary policy conduct from the Taylor rule over the last two decades, which is a condition for the delivery of sound policies.

The focus on EMEs is also important for several reasons. First, EMEs cope with challenges to maintain the credibility of the inflation targeting regime because it is difficult to maintain price stability commitment (Keefe and Rengifo, 2015). Their monetary authorities can relax the commitment when discretionary space increases. They are not obligatory to fulfill the inflation target when pre-announced exemptions happen. For instance, Czech National Bank applies escape clauses when there are sharp shocks in commodity or energy prices (Rusnok, 2018). Moreover, EMEs have larger exposure to external disturbances because of their reliance on international trade (Laxton and Pesenti, 2003), implying that their autonomy is low despite of the adoption of the inflation targeting framework and flexible exchange rate regime. Furthermore, monetary authorities can focus on objectives beyond price stability such as output gap or exchange rate volatility during turbulent periods (Siregar and Goo, 2010).

The paper proceeds as follows. Section 2 provides styled facts about the implementation of inflation targeting in EMEs. Section 3 discusses the original idea of the Taylor rule as a guidance for monetary policy analysis and its application in small open economies. Section 4 discusses the empirical methodology and measures of unobservable variables in the Taylor rule such as output gap, inflation gap, and expected inflation. Section 5 presents important empirical findings and discusses its implications. Section 6 are conclusions.

Inflation targeting in EMEs

Since 1990s, many EMEs have adopted the inflation targeting framework, which is a result of economic crises (Asian countries and other Latin America) or recommendations of stabilization and disinflation program supported by the IMF (Turkey). The crises reveal the ineffectiveness of previous monetary framework such as monetary base targeting in Indonesia. The reasons are the thin and segmented markets, the pro-cyclicality of monetary base, the unstable linkage between monetary aggregates and output growth (Siregar and Goo,

2010). The adoption of the inflation targeting framework is rather different for the Eastern and Central European countries because they have no experience of turbulent periods. The primary motive is the process of economic transition or the meeting of the European Union membership.

The introduction of inflation targeting improves the accountability and transparency of monetary policy conduct. Compared with other framework such as monetary aggregate targeting or exchange rate peg, the inflation targeting framework is characterized by the ease of communication with the public (Jonas and Mishkin 2003), which contributes to anchor the long run expected inflation in the economy (Ferreira de Mendonça and Simão Filho, 2007). Since the objective of inflation targeting is to maintain low and stable level of prices or inflation, economic agents can evaluate ex post performance (credibility) by examining the fulfillment of a specified quantitative target (deviation between inflation expectations and inflation target) (Svensson, 1997). Other benefit is the isolation of domestic shocks from external shocks (Krušec, 2011). In summary, the inflation targeting framework mitigates the problem of time inconsistence in the implementation of monetary policy.

However, the inflation targeting framework of EMEs is different from that of advanced counterparts in several aspects. First, in EMEs, both governments and central banks have significant role in setting the inflation target. This is contrary to the high level of the central bank independence in advanced economies. Therefore, EME central banks cannot prevent political pressures from the policy design. The fulfilment of other objectives beyond price stability leads to the consideration of the departure of the inflation target from the inflation forecast (Svensson, 1997). As a result, a tolerance band is popular, which is believed to reduce the variation of policy rate when coping with temporary economic shocks (Siregar and Goo, 2010).

Second, the setting of inflation target is different across countries. Some countries (i.e. Thailand or South Africa) aim for a target band whereas other countries aim for a point target. These targets are adjusted annually. A fixed target for multiple years is only visible in later years: from 2003 for Mexico, from 2005 for Brazil, or even from 2016 for Korea. Chile is an exception because it aims at the target of 3% from the beginning of the inflation targeting framework.

Literature review

Baseline Taylor (1993) rule

Taylor (1993) developed a simple rule (equation 1) that prescribes how central banks set the interest rate instrument i_t^* based on deviation of inflation from the target ($\pi_t - \bar{\pi}_t$) and deviation of output from its potential (y_t). Remarkably, the rule closely approximates the actual movement of the interest rate in the United States during the period 1987 – 1992.

$$i_t^* = \alpha + 1.5\left(\pi_t - \bar{\pi}_t\right) + 0.5 y_t \tag{1}$$

A more generalized version is constructed by putting weights on output gap and inflation gap:

$$i_t^* = \alpha + \beta^\pi \left(\pi_t - \pi_t^* \right) + \beta^y y_t + \varepsilon_t \tag{2}$$

Although the rule is sub-optimal, its application is popular due to its simplicity and the ease of verification (Wimanda et al., 2012). Other reason is that it provides a good approximation of the monetary policy setting in many countries (Taylor, 1999), especially advanced economies (Clarida et al., 1998). Taylor (2000) also emphasized that the evaluation of simple policy rule is not influenced by monetary transmission mechanisms.

Taylor (1998) recommended that the interest rate should have positive and larger responses to inflation gap and positive response to output gap. The recommendation is known as the Taylor principle, an important condition for the attainment of stability in theoretical models (Woodford, 2001; Davig and Leeper, 2007). The violation of the Taylor principle increases inflationary pressure and lowers real interest rate, thereby leading to an unstable economy.

Clarida et al. (1998; 2000) extended the Taylor (1993) rule to account for the management of inflationary expectation.

$$i_t^* = \alpha + \beta^\pi \left(E_t \pi_{t+n} - \pi_{t+n}^* \right) + \beta^y E_t y_{t+k} + \varepsilon_t \tag{3}$$

Different with the Taylor (1993) rule, this rule explicit considers the expected value of inflation $E_t \pi_{t+n}$ and output $E_t y_{t+k}$ in setting interest rates. For this reason, inflation forecast is more important than observed inflation rate. According to Clarida et al. (1999), the derivation of the rule bases on a simple model that minimizes a quadratic loss function (equation 4), a forward-looking IS (equation 5) and a Phillips curve (equation 6).

$$\min \frac{1}{2} E_t \left\{ \sum_{i=0}^{\infty} \beta^i \left[\lambda y_{t+i}^2 + \left(\pi_{t+i} - \bar{\pi}_{t+i} \right)^2 \right] \right\} \tag{4}$$

$$y_t = -\alpha_1 \left[i_t - E_t \pi_{t+1} \right] + \alpha_2 E_t y_{t+1} + \varepsilon_t^d \tag{5}$$

$$\pi_t = -\beta_1 y_t + \beta_2 E_t \pi_{t+1} + \varepsilon_t^s \tag{6}$$

Where $\varepsilon_t^d = \rho^d \varepsilon_{t-1}^d + \eta_t^d$ is the demand shock ; $\varepsilon_t^s = \rho^s \varepsilon_{t-1}^s + \eta_t^s$ is the supply shocks; η_t^d and η_t^s are i.i.d. random disturbances. E_t is the expectation operator.

Equation (4) indicates that the objective function of monetary authorities is to minimize the discounted value of the weighted sum of the square of output gap and inflation gap. A higher λ indicates higher degree of output stability consideration. It also implies the longer adjustment of inflation forecast toward inflation target (Svensson, 1997). However, on the positive side, the presence of additional objectives allows less frequent policy adjustments, thereby possibly resulting in less volatility of macroeconomic variables (Svensson, 2000).

Clarida et al. (1999) examined how to design the policy rule as given in equation (3) with and without commitments to inflation targeting. In the latter case, the principle is that the interest rate should be changed with greater amount than changes in expected inflation. Therefore, the coefficient on expected inflation (or inflation gap) should be greater than one so that changes in short-term interest rate alters the level of real interest rate, leading to changes in aggregate demand and prices.

However, monetary authorities sometime show systematic violations of the Taylor principle because of concerns about financial instability or economic recovery. In these cases, interest rate policy amplifies the effect of fundamental shocks, resulting in the high level of macroeconomic volatility (Davig and Leeper, 2007). Furthermore, monetary authorities are sluggish in achieving the inflation target when they put high weigh on the volatility of output gap (Svensson, 1997; Ball, 1999a).

Specifications of Taylor rule for EMEs

Studies of Taylor rules for EMEs require modifications in some directions. Firstly, many studies add variables Z_t into equation (3) to account for factors specific to the conduct of monetary policy in small-open economies. Although there is no consensus on specific variables that should be included in Z_t, the popular practice is to use exchange rates to account for the vulnerability to external shocks coped by EMEs (Ball, 1999b; Vašíček, 2010; Erdem and Kayhan, 2011).

$$i_t^* = \alpha + \beta^\pi \left(E_t \pi_{t+n} - \pi_{t+n}^* \right) + \beta^y E_t y_{t+k} + \beta^z E_t z_{t+l} + \varepsilon_t \tag{7}$$

Second, monetary authorities concern about disruptive effect of monetary policy on macroeconomic activities; therefore, they tend to smooth the path of interest rate. To characterize this behavior, a smoothing coefficient can be integrated into the rule (2), (3), and (7) as follows:

$$i_t = \varphi i_{t-1} + (1-\varphi) i_t^* + \varepsilon_t \tag{8}$$

Where φ indicates the degree of inertia. i_t is the short-term interest rate.

Empirical investigation of the Taylor rules in EMEs

Some studies for EMEs mainly examine whether the setting of interest rate is according to the Taylor principle and answer whether monetary policy contributes to the stability of inflation in the region. The relevance of the Taylor rule was found in many studies: Teles and Zaidan (2010) for twelve EMEs, Moura and de Carvalho (2010) for Latin America, Wang et al. (2015) for Central Eastern Europe, Minella et al. (2003) for Brazil, Erdem and Kayhan (2011) for Turkey, to name a few.

Khakimov et al. (2010) found that modified McCallum is more effective than different versions of Taylor rule and the Taylor rule provides closer approximation of the decision of Turkish central bank only in the regime of explicit inflation targeting. Aklan and Nargelecekenler (2008) showed that the inflation response is different in backward-looking and forward-looking Taylor rule in Turkey. Accordingly, the interest rate instrument is more responsive to expected inflation than observed inflation. Moreover, the reaction to expected inflation is larger than unity, implying monetary policy can stabilize inflation pressure.

For EMEs, the interest rate rule has strong emphasis on (expected) inflation during disinflation period, for instance, from 1999 to 2002 for Brazil (Minella et al., 2003) or from 2002 to 2006 for Turkey (Erdem and Kayhan, 2011). On the contrary, during stable period, the rule accepts additional variables such as output gap or exchange rate (Erdem and Kayhan, 2011). Similarly, Siregar and Goo (2010) found that Indonesia and Thailand respond to other objective beyond price stability during stable period but focus more on inflation during volatile periods. Moura and de Carvalho (2010) and Rossi and Pagano (2013), however, showed that interest rate cut is larger when inflation is below the target than interest rate increase when it is above the target, which reflects the preference to avoid recession in EMEs. In Asia, the severe effect of extreme events such as East Asian crisis 1997 motivates some Asian EMEs to officially adopt inflation targeting. However, studies examining the performance of the Taylor rule is scant for these countries.

Regarding the Taylor principle, Vašíček (2010) found mixed results for twelve new members of European Union during the period 1999–2007. The inflation response is consistent with the Taylor principle in Poland, Romania, Slovenia; insignificant in Bulgaria, Cyprus, Estonia; and even negative in Slovakia, Lithuania. Ghatak and Moore (2011) examined seven new European Union members from 1994 to 2006 and found that the interest rate rule and monetary base rule have different determinants in different countries. While interest rates respond to exchange rate deviations, monetary base responds to inflation in Czech Republic, Poland, Slovakia, and Slovenia, both instruments respond to inflation in Hungary and Romania.

Some studies detect signs of the violation of the Taylor principle in the aftermath of the global financial crisis. This happens for Brazil after the mid-2010 (Aragón and de Medeiros, 2015). However, most studies emphasize the time horizon before crisis. In Eastern Europe, the occurrence of the zero-lower bound during post-crisis periods reduces the room for monetary authorities to conduct easing policy by cutting interest rate. Therefore, to promote economic recovery, they opt to use unconventional instrument to construct expansionary effect on economic activities. For instance, Czech National Bank decides on exchange rate commitment policy (last until April 2017), whereby interventions are ready to prevent the weakening of the koruna. Therefore, it raises doubts about the effectiveness of the interest rate instrument in this region.

Methodology

Econometric estimators

We apply the GMM method to estimate specifications of the Taylor rule because of the endogeneity problem. The reason is that use of the realization of inflation as a proxy for expected inflation introduces the forecast error into the disturbance term, which, in turn, increases the correlation between expected inflation and disturbance term. Moreover, we apply Bartlett procedure to account for the presence of heteroskedasticity and serial correlation. We use five lagged instruments for most specifications of Taylor rule. The choice of instruments ensures the robustness of the GMM estimation, implying that the instruments are not correlated with the error disturbances and not weakly correlated with endogenous regressors.

Data

This paper uses quarterly data of eleven EMEs. All data is derived from the IMF International Financial Statistics. The start of the series is different between countries due to the reason of data availability. The series begins earliest in 2000:Q1 for Poland, Indonesia, and South Africa. The series begins in 2000:Q2 in Korea and Brazil; 2001:Q1 for Mexico and Czech Republic; 2000:Q3 for Hungary; 2002:Q1 for Philippines; 2002:Q3 for Colombia; and 2003:Q1 for Chile. All series ends in 2017:Q1 for all countries.

Output gap measures deviation of output from its potential level that is unobservable. For empirical purpose, the vast literature uses Hodrick and Prescott (1997) filter to decompose actual output into transitory and permanent/ trend component. Output gap is obtained by subtracting the permanent/ trend component from the actual value of output.

There are several possible measures of expected inflation, which is also unobservable. One, we can use the information of expectation surveys reported by central banks. However, this method is less likely because of poor statistics in some EMEs. The other method is to replace expected inflation by the forward value of the actual inflation. From empirical perspective, this method is simpler and more applicable because we can always represent expected inflation as sum of a forward value and a random forecast error. However, the procedure leads to the correlation between disturbance terms and forward inflation rates. Therefore, the problem of endogeneity emerges.

In EMEs, inflation targets are determined by the cooperation between monetary authorities and the government. Those targets are usually year-end point. This paper assumes that yearly inflation targets and monthly inflation targets are equal.

Empirical analysis

The Taylor principle in EMEs

The results shown in
Table *10* show that smoothing behavior is crucial in the process of setting interest rate in EMEs. As observed, Brazil has the smallest smoothing coefficient, 0.75, whereas Philippines has the largest smoothing coefficient, 1.03. Most of other economies have relatively high smoothing coefficient, being larger than 0.9.

According to the Taylor principle, monetary policy can stabilize inflation only if the inflation coefficient should be larger than unity. This implies that changes in the short-term interest rate alters the level of real interest rate, leading to changes in aggregate demand and inflation. As shown in
Table *10*, the Taylor principle only holds in Brazil, Mexico, Hungary, Poland, and South Africa. Such a finding is consistent with previous studies such as Minella et al. (2003), Aragón and de Medeiros (2015), and Sánchez-Fung (2011). However, the finding of the compliance of the Taylor principle in Hungary is contrary with the finding of Vašíček (2010). On the other hand, the Taylor principle does not hold in other economies as the inflation coefficient is less than unity in Chile, Czech Republic, and Indonesia or is even negative in Colombia and Philippines.

Turning to output coefficient, it is positive, statistically significant, and large in Chile, Colombia, Indonesia, and South Africa. The coefficient is negative and statistically significant

in Hungary, suggesting the violation of the Taylor rule, whereby the response to output should be positive. In other countries, the coefficient is positive, large, but statistically insignificant. Regarding the coefficient on both output and inflation, the Taylor principle does not hold for EMEs under investigation. The coefficient on growth rate of exchange rate is statistically significant in most of economies, except for Chile and South Africa. This implies the relevance of the fear of floating in EMEs.

In the aftermath of the global financial crisis, monetary policy experiences shift in the reaction to inflation, output, and exchange rate. However, the changes have different directions. Firstly, improvements in the inflation reaction is found in Chile and Colombia, suggesting the strengthening of the Taylor principle in these countries. On the contrary, many countries show a reduction in the response to inflation. The exception is Philippines, Czech Republic, and Indonesia. While the inflation response is statistically significant in Philippines, it is statistically insignificant in Czech Republic and Indonesia. Furthermore, the coefficient on the interaction between exchange rate and crisis dummy has the sign opposite with the coefficient on exchange rate, suggesting the reduction in the role of the exchange rate in the monetary policy rule in EMEs.

In summary, the empirical evidence suggests some crucial characteristics of the conduct of monetary policy in EMEs. First, monetary policy rule responds to the expected inflation, implying that monetary authorities in EMEs emphasize managing inflationary expectation. Second, the response of the interest rate to inflation gap and output gap does not follow the Taylor principle. This indicates that interest rate setting cannot stabilize the movement of inflation. Third, exchange rate plays important role in the monetary policy rule in emerging economy; however, such a contribution is diminishing after crisis. Fourth, monetary policy on average is less responsive to inflation and more responsive to output after crisis.

Table 10: GMM estimation of Taylor rule in EMES

	φ	β^π_{t+1} / $\beta^{\pi\,a}_{t-1}$ / $\beta^{\pi b}_t$	β^y_{t+1} / $\beta^{y\,a}_{t-1}$ / $\beta^{y\,b}_{t-1}$	β^q_{t+1} / $\beta^{q\,a}_{t-1}$ / $\beta^{q\,b}_{t-1}$	$\beta^\pi_{t+1,crisis}$ / $\beta^{\pi\,a}_{t-1,crisis}$ / $\beta^{\pi\,b}_{t,crisis}$	$\beta^y_{t+1,crisis}$ / $\beta^{y\,a}_{t-1,crisis}$ / $\beta^{y\,b}_{t-1,crisis}$	$\beta^q_{t+1,crisis}$ / $\beta^{q\,a}_{t-1,crisis}$ / $\beta^{q\,b}_{t-1,crisis}$	α
Brazil	0.75 (0.03)***	1.93 (0.17)***	1.79 (18.07)	0.12 (0.04)***	-1.29 (0.15)***	-42.90 (25.52)*	-0.13 (0.05)***	10.84 (0.41)***
Chile	0.82 (0.02)***	0.50 (0.08)***	26.78 (7.89)***	0.07 (0.04)	1.07 (0.17)***	10.09 (8.27)	0.06 (0.06)	3.85 (0.17)***
Colombia	0.89 (0.02)***	-0.24 (0.55)	253.81 (47.39)***	0.24 (0.04)***	3.22 (0.83)***	-45.38 (37.65)	-0.04 (0.06)	4.47 (0.25)***
Mexico	0.81 (0.03)***	4.16 (0.53)***	33.48 (20.75)	0.32 (0.12)***	-3.87 (0.68)***	-33.81 (21.57)	-0.32 (0.12)***	4.17 (0.21)***
Hungary	0.97 (0.01)***	15.24[b] (6.79)**	-550.81[b] (258.86)**	-5.30[b] (2.48)**	-9.27[b] (5.01)*	1229.90[b] (524.65)**	3.40[b] (1.75)*	0.53 (2.94)
Poland	0.90 (0.01)***	1.98 (0.48)***	4.24 (6.21)	0.13 (0.06)**	-1.12 (0.49)**	3.49 (7.02)	0.15 (0.12)	4.27 (0.32)***
Czech Republic	0.90 (0.01)***	0.71 (0.19)***	-10.53 (7.64)	0.15 (0.05)***	0.20 (0.19)	12.81 (8.06)	-0.14 (0.06)**	1.40 (0.22)***
Korea	0.92 (0.02)***	-2.26[b] (0.98)**	-3.55[b] (6.69)	-0.10[b] (0.06)*	4.33[b] (1.21)***	39.19[b] (16.51)**	0.34[b] (0.12)***	4.93 (0.27)***
Indonesia	0.75 (0.01)***	0.89 (0.15)***	81.85 (12.91)***	0.19 (0.04)***	0.08 (0.12)	-107.30 (14.84)***	-0.17 (0.04)***	5.05 (0.10)***
Philippines	1.03 (0.01)***	-4.96[a] (2.64)*	29.55[a] (35.43)	1.04[a] (0.50)**	6.76[a] (2.94)**	-22.58[a] (32.96)	-0.54[a] (0.43)	6.02 (0.86)***
South Africa	0.96 (0.02)***	3.61 (1.45)**	289.66 (147.35)**	-0.09 (0.15)	-4.35 (2.13)**	740.66 (384.59)*	0.06 (0.18)	7.85 (1.30)***

Counterfactual analysis

In line with previous studies (McCallum, 2000; Orphanides, 2003; Vašíček, 2010; Cortes and Paiva, 2017; Madeira and Palma, 2018), the paper proceeds with the counterfactual analysis of the Taylor rule. Figure 10 shows that there is little difference between specifications in approximating the process of interest rate setting. The implied interest rate of the forward-looking specification closely approximates the actual value of the short-term interest rate. However, there are certain distance between the implied interest rate and the actual interest rate in the beginning of the inflation targeting regime in some economies such as Hungary, Indonesia, and Poland.
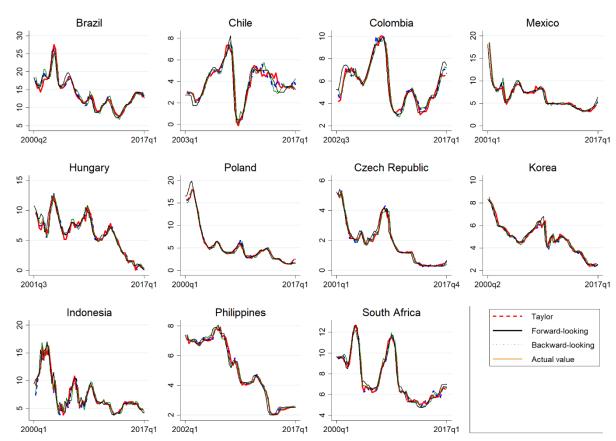
Figure 10: Counterfactual performance of Taylor in EMEs

Source: Author's construction

Robustness test

This section examines the performance of the Taylor rule by using other measure of inflation gap. We use HP filter to generate trend component of inflation and consider it as implicit inflation target. Then, we use the deviation of the inflation rate from the HP trend value as a new measure of inflation gap. The results are worse. The counterfactual analysis shows greater divergence between the implied interest rate of the new specifications and the actual value of the short-term interest rate. Moreover, the coefficients are different with the baseline estimations.

Conclusion

The objective of this paper examines important aspects of the interest rate setting in EMEs. Firstly, can a simple version of the Taylor rule approximate the historical path of the short-term interest rate? Secondly, is the response to inflation gap and output gap consistent with the Taylor principle? Thirdly, does the global financial crisis cause changes in the setting of the interest rate?

We applied GMM method to estimate three specifications of the small-open economy Taylor rule: contemporaneous, forward looking, and backward looking. We found that the forward-looking specification is better than other specifications based on the AIC criteria. Moreover, the monetary policy rule does not follow the Taylor principle. After crisis, the significance of the exchange rate reduces and the interest rate is less responsive to inflation and more responsive to output.

References

Aklan, N. A. & Nargelecekenler, M. (2008). Taylor rule in practice: Evidence from Turkey. *International Advances in Economic Research*, 14(2), 156-166. https://doi.org/10.1007/s11294-008-9148-9

Aragón, E. K. D. S. B. & De Medeiros, G. B. (2015). Monetary policy in Brazil: evidence of a reaction function with time-varying parameters and endogenous regressors. *Empirical Economics*, 48(2), 557-575. https://doi.org/10.1007/s00181-013-0791-5

Ball, L. (1999a). Efficient rules for monetary policy. *International finance*, 2(1), 63-83. https://doi.org/10.1111/1468-2362.00019

Ball, L. (1999b): Policy rules for open economies. In: *Monetary Policy Rules*, University of Chicago Press, Chicago, pp. 127-144.

Clarida, R.- Gali, J. & Gertler, M. (1999). The science of monetary policy: a new Keynesian perspective. *Journal of economic literature*, 37(4), 1661-1707. https://doi.org/10.1257/jel.37.4.1661

Clarida, R.- Gali, J. & Gertler, M. (2000). Monetary policy rules and macroeconomic stability: evidence and some theory. *The Quarterly Journal of Economics*, 115(1), 147-180. https://doi.org/10.1162/003355300554692

Clarida, R.- Galı, J. & Gertler, M. (1998). Monetary policy rules in practice: Some international evidence. *European Economic Review*, 42(6), 1033-1067. https://doi.org/10.1016/S0014-2921(98)00016-6

Cortes, G. S. & Paiva, C. A. (2017). Deconstructing credibility: The breaking of monetary policy rules in Brazil. *Journal of International Money and Finance*, 74(6), 31-52. https://doi.org/10.1016/j.jimonfin.2017.03.004

Davig, T. & Leeper, E. M. (2007). Generalizing the Taylor Principle. *The American Economic Review*, 97(3), 607-635. https://dx.doi.org/10.1257/aer.97.3.607

Erdem, E. & Kayhan, S. (2011). The Taylor rule in estimating the performance of inflation targeting programs: The case of Turkey. *Global Economy Journal*, 11(1), 1-15. https://doi.org/10.2202/1524-5861.1718

Ferreira De Mendonça, H. & Simão Filho, J. (2007). Economic transparency and effectiveness of monetary policy. *Journal of Economic Studies*, 34(6), 497-514. https://doi.org/10.1108/01443580710830961

Ghatak, S. & Moore, T. (2011). Monetary policy rules for transition economies: an empirical analysis. *Review of Development Economics*, 15(4), 714-728. https://doi.org/10.1111/j.1467-9361.2011.00638.x

Hodrick, R. J. & Prescott, E. C. (1997). Postwar US business cycles: an empirical investigation. *Journal of Money, credit, and Banking*, 9(1), 1-16. https://doi.org/10.2307/2953682

Keefe, H. G. & Rengifo, E. W. (2015). Options and central bank currency market intervention: The case of Colombia. *Emerging Markets Review*, 23, 1-25. https://doi.org/10.1016/j.ememar.2015.04.011

Khakimov, O. A.- Erdogan, L. & Uslu, N. Ç. (2010). Assessing Monetary Policy Rule in Turkey. *International Journal of Economic Perspectives*, 4(1), 319.

Krušec, D. (2011). Is Inflation Targeting Effective? Monetary Transmission in Poland, the Czech Republic, Slovakia, and Hungary. *Eastern European Economics*, 49(1), 52-71. https://doi.org/10.2753/EEE0012-8775490104

Laxton, D. & Pesenti, P. (2003). Monetary rules for small, open, emerging economies. *Journal of Monetary Economics*, 50(5), 1109-1146. https://doi.org/10.1016/S0304-3932(03)00057-6

Madeira, J. & Palma, N. (2018). Measuring monetary policy deviations from the Taylor rule. *Economics Letters*, 168, 25-27. https://doi.org/10.1016/j.econlet.2018.03.034

Mccallum, B. T. (2000): *Alternative monetary policy rules: A comparison with historical settings for the United States, the United Kingdom, and Japan*. National Bureau of Economic Research, New York. https://doi.org/10.3386/w7725

Minella, A.- De Freitas, P. S.- Goldfajn, I. & Muinhos, M. K. (2003). Inflation targeting in Brazil: constructing credibility under exchange rate volatility. *Journal of International Money and Finance*, 22(7), 1015-1040. https://doi.org/10.1016/j.jimonfin.2003.09.008

Moura, M. L. & De Carvalho, A. (2010). What can Taylor rules say about monetary policy in Latin America? *Journal of Macroeconomics*, 32(1), 392-404. https://doi.org/10.1016/j.jmacro.2009.03.002

Orphanides, A. (2003). Historical monetary policy analysis and the Taylor rule. *Journal of monetary economics*, 50(5), 983-1022. https://doi.org/10.1016/S0304-3932(03)00065-5

Rossi, J. L. & Pagano, T. (2013). An analysis of nonlinearity of the Brazilian Central Bank reaction function. *Applied Financial Economics*, 23(10), 837-845. https://doi.org/10.1080/09603107.2013.767978

Rusnok, J. (2018). Two Decades of Inflation Targeting in the Czech Republic. *Finance a Uver*, 68(6), 514-517.

Sánchez-Fung, J. R. (2011). Estimating monetary policy reaction functions for emerging market economies: The case of Brazil. *Economic Modelling*, 28(4), 1730-1738. https://doi.org/10.1016/j.econmod.2011.03.007

Siregar, R. Y. & Goo, S. (2010). Effectiveness and commitment to inflation targeting policy: Evidence from Indonesia and Thailand. *Journal of Asian Economics*, 21(2), 113-128. https://doi.org/10.1016/j.asieco.2009.12.002

Svensson, L. E. (1997). Inflation forecast targeting: Implementing and monitoring inflation targets. *European economic review*, 41(6), 1111-1146. https://doi.org/10.1016/S0014-2921(96)00055-4

Svensson, L. E. (2000). Open-economy inflation targeting. *Journal of international economics*, 50(1), 155-183. https://doi.org/10.1016/S0022-1996(98)00078-6

Taylor, J. B. (1993). Discretion versus policy rules in practice. *Carnegie-Rochester conference series on public policy*, 39(12), 195-214. https://doi.org/10.1016/0167-2231(93)90009-L

Taylor, J. B. (1998): A historical analysis of monetary policy rules. In: *Monetary policy rules*, University of Chicago Press, pp. 319-348.

Taylor, J. B. (1999). The robustness and efficiency of monetary policy rules as guidelines for interest rate setting by the European Central Bank. *Journal of Monetary Economics*, 43(3), 655-679. https://doi.org/10.1016/S0304-3932(99)00008-2

Taylor, J. B. (2000): *The monetary transmission mechanism and the evaluation of monetary policy rules*. Central Bank of Chile, Santiago.

Teles, V. K. & Zaidan, M. (2010). Taylor principle and inflation stability in emerging market countries. *Journal of Development Economics*, 91(1), 180-183. https://doi.org/10.1016/j.jdeveco.2009.07.007

Vašíček, B. (2010). Monetary Policy Rules and Inflation Processes in Open Emerging Economies: Evidence from Twelve New EU Members. *Eastern European Economics*, 48(4), 36-58. https://doi.org/10.2753/EEE0012-8775480402

Wang, Y.- Jiang, C.- Chang, H.-L. & Su, C.-W. (2015). Are Taylor Rules Valid in Central Eastern European Countries? *Ekonomicky Casopis*, 63(7), 665.

Wimanda, R. E.- Turner, P. M. & Hall, M. J. (2012). Monetary policy rules for Indonesia: which type is the most efficient? *Journal of Economic Studies*, 39(4), 469-484. https://doi.org/10.1108/01443581211255666

Woodford, M. (2001). The Taylor rule and optimal monetary policy. *American Economic Review*, 91(2), 232-237. https://dx.doi.org/10.1257/aer.91.2.232