



# Comparing monetary policy rules in CEE economies: A Bayesian approach<sup>☆</sup>

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## ABSTRACT

Using the Bayesian approach, a small open economy DSGE model was estimated using a sample of quarterly data for three Central and Eastern Europe economies, Czech Republic, Hungary and Poland. The hypothesis that central banks react to exchange rate movements was tested using posterior odds ratio. For these economies, evidence was found that central banks reacted to exchange rate changes. Evidence of similar monetary policy characterized by moderate or low gradualism as well as an active and conservative monetary policy was also found, for the selected countries. When a richer DSGE model featuring habit formation and imperfect pass-through is estimated, the results are generally similar. The inclusion of exchange rate in Taylor rule can also drastically change the dynamics of inflation and output following certain shocks.

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## 1. Introduction

Whether central banks react or not to exchange rates debate may be traced back to the 2001 contribution of Taylor. He showed that a successful monetary policy should be based on a mix of flexible exchange rate, inflation target and monetary policy rule. The debate followed two main directions. The first direction focused on the benefits brought by a monetary policy responsive to exchange rate, while the second direction focused on how central banks actually behave. This paper follows the second approach, testing whether central banks in several Central and Eastern European (CEE, hereafter) economies responded to exchange rate movements.

Univariate approaches were initially used to address the question. Clarida et al. (1998) found, for some industrialized countries, that monetary policy responded to exchange rate fluctuations. Additional evidence was found by Calvo and Reinhart (2002) for the case of emerging economies. According to them, central banks reacted to exchange rate fluctuations through monetary policy in order to smooth the exchange rate variation.

More recently, the same topic was studied from a structural perspective within the dynamic stochastic general equilibrium approach. In one of the first studies, Lubik and Schorfheide (2007) estimated a small open economy New Keynesian (NK) model using a Bayesian approach for a selection of developed small open economies (Australia, Canada, New Zealand and UK). They tested based on posterior odds

ratios if central banks reacted to exchange rate movements. According to their results, evidence was found that central banks reacted to exchange rate fluctuations only for Canada and United Kingdom.

This approach was also applied by Eschenhof (2009b) for the Euro Area viewed as a small open economy. The paper employs Lubik and Schorfheide (2007) model with additional specifications for monetary policy rule. The results indicated that the best monetary policy was based on the expected inflation rate and on the output gap. Also, it was found that ECB reacted to exchange rate movements.

Dong (2008) offers further evidence for a more elaborate two sectors DSGE model. The most important features of the model were sticky prices and wages, partial indexation on lagged inflation, combined producer currency pricing and local currency pricing and distributions services. Based on this estimation, it was found that, in the past, central banks in Australia, Canada and England paid attention to real exchange rates, while New Zealand's central bank did not react to exchange rate changes.

This paper supplements the literature testing whether central banks in selected CEE economies reacted to exchange rate movements. There are theoretical arguments on why the central banks in CEE area may and should react to exchange rate movements. As Egert et al. (2003) observed in an analysis regarding what was at that moment the accession in the near future to the EU of the 10 new member states, a sample in which the three countries in our analysis are included, it might be necessary for central banks in these economies to react to exchange rate movements in order to adjust their possible current account deteriorations or other departures from economic fundamentals, although, at the same time, a too great flexibility is to be avoided (a thing which might again justify reactions to exchange rate movements). Based on

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these arguments, Egert et al. (2003) argued for a ‘double role for interest policy’, which would take into account both price stabilization and exchange rate management.

Most of the research for the case of monetary policy rules in CEE economies focused until now on using either instrumental variables, as in Maria-Dolores (2005), or cointegration as in Frommel et al. (2009). While Maria-Dolores’ studies have focused on the relevance of the Taylor rule for selected CEE economies, Frommel et al. (2009) were interested not only if Taylor rule is significant for CEE economies, but also if the Taylor rule should include the exchange rate. They found a different behavior for the Taylor rule: for rigid exchange rate regimes there is a predominant role for exchange rate, while for more flexible exchange rate regimes the focus is more on inflation. Also, Caraiani (2011a) offers an example of structural approach based on a New Keynesian model, showing that in the past Romanian national bank reacted to exchange rate fluctuations.

The rest of the paper estimates two different small open economy models for Czech Republic, Hungary and Poland featuring different specifications for monetary policy rules. Several specifications are compared using the Bayesian framework and they test whether, using posterior odds ratio, a better explanation of real data is given with or without the inclusion of exchange rate in the monetary policy rule. Changes in the impulse response functions are also analyzed when the exchange rate is or is not considered in the monetary policy rule.

2. The models

Our analysis is based on the small open economy NK model proposed by Lubik and Schorfheide (2007) (LS, hereafter) who asked a similar question for the case of Australia, Canada, New Zealand and United Kingdom. The LS model is presented in Section 2.1, while Section 2.2 introduces a more complex model due to Justiniano and Preston (2010).

2.1. A simple open economy New Keynesian model

The LS model is presented below and is already in a log-linear form:

$$y_t = E_t y_{t+1} - [\tau + \alpha(2-\alpha)(1-\tau)](r_t - E_t \pi_{t+1}) - \rho_z z_t - \alpha[\tau + \alpha(2-\alpha)(1-\tau)]E_t \Delta q_{t+1} - \alpha(2-\alpha) \frac{1-\tau}{\tau} E_t \Delta y_{t+1}^* \tag{1}$$

$$\pi_t = \beta E_t \pi_{t+1} + \alpha \beta E_t \Delta q_{t+1} - \alpha \Delta q_t + \frac{\kappa}{\tau + \alpha(2-\alpha)(1-\tau)} (y_t - \bar{y}_t) \tag{2}$$

$$\bar{y}_t = \left[ \frac{-\alpha(2-\alpha)(1-\tau)}{\tau} \right] y_t^* \tag{3}$$

$$\pi_t = \Delta e_t + (1-\alpha) \Delta q_t + \pi_t^* \tag{4}$$

$$\Delta q_t = \rho_q \Delta q_{t-1} + \varepsilon_t^q \tag{5}$$

$$z_t = \rho_z z_{t-1} + \varepsilon_t^z \tag{6}$$

$$y_t^* = \rho_y y_{t-1}^* + \varepsilon_t^y \tag{7}$$

$$\pi_t^* = \rho_\pi \varepsilon_{t-1}^{\pi^*} + \varepsilon_t^{\pi^*} \tag{8}$$

Eq. (1) describes the demand side of the economy using a New Keynesian open economy IS curve. Domestic economy output  $y_t$  is modeled depending on expected output, real interest rate, terms of trade,  $q_t$ , world productivity  $z_t$  as well as output in the foreign economy,  $y_t^*$ .

In Eq. (2), the supply side of the domestic economy is modeled using an open economy New Keynesian Phillips curve. Domestic inflation  $\pi_t$  is driven by expected inflation,  $\pi_{t+1}$ , expected changes in the terms of trade  $q_t$ , and output gap. Output gap is the difference between potential output  $\bar{y}_t$  and actual output  $y_t$ .

Potential output, in Eq. (3), is output without nominal rigidities and with non-stationary technology.

In Eq. (4), domestic inflation is modeled using the PPP relationship. Changes in nominal exchange rate,  $e_t$ , terms of trade  $q_t$  and world inflation  $\pi_t^*$  determine the dynamics of domestic inflation. Terms of trade, see Eq. (5), is modeled assuming exogenous terms of trade.

Exogenous variables world inflation,  $\pi_t^*$ , world output  $y_t^*$ , and world productivity  $z_t$  are assumed to be AR(1) processes, see Eqs. (6)–(8).

The baseline Taylor rule is given in Eq. (9) below. It models nominal interest rate  $r_t$  driven by domestic inflation, domestic output and changes in nominal exchange rate. As an alternative to the baseline monetary policy rule, starting from suggestions in Lubik and Schorfheide (2007) as well as in Eschenhof (2009a), this paper suggests a different specification. As presented in Eq. (10) below, output gap could be used instead of output.

$$r_t = \rho_r r_{t-1} + (1-\rho_r)(\psi_1 \pi_t + \psi_2 y_t + \psi_3 \Delta e_t) + \varepsilon_t^r \tag{9}$$

$$r_t = \rho_r r_{t-1} + (1-\rho_r)(\psi_1 \pi_t + \psi_2 (y_t - \bar{y}_t) + \psi_3 \Delta e_t) + \varepsilon_t^r \tag{10}$$

2.2. A New Keynesian model with habit formation and imperfect pass-through

We discuss here the model due to Justiniano and Preston (2010) (JP, hereafter). We slightly modify their model introducing interest smoothing in the Taylor rule (and thus having a similar monetary policy rule as in the previous model), as well as allowing for different price rigidities and habit formation in the domestic and foreign economies. We also model the foreign economy as a simpler representation of the domestic economy. However, price indexation is excluded for both economies concentrating on the essential features of the model.

The JP model has been proposed as a more general version of the baseline New Open Economy Models (NOEM, hereafter) due to Gali and Monacelli (2005) and Monacelli (2005). Besides the imperfect pass-through, already present in the latter paper, there is also habit formation.

We present below the model in a succinct manner, directing the readers to the original paper for further details. The following variables are included in the model: domestic consumption  $c_t$ , domestic output  $y_t$ , law of one price gap  $\psi_{F,t}$ , nominal exchange rate  $e_t$ , domestic marginal cost  $mc_t$ , inflation in domestic final goods sector  $\pi_{H,t}$ , inflation in domestic retailing sector  $\pi_{F,t}$ , terms of trade  $s_t$ , real exchange rate  $q_t$ , nominal interest rate  $i_t$ , foreign output  $y_t^*$ , foreign marginal cost  $mc_t^*$ , foreign inflation  $\pi_t^*$ , foreign nominal interest rate  $i_t^*$ , domestic total factor productivity  $v_{a,t}$ , foreign total factor productivity  $v_{a^*,t}$ . The following equations describe the model in its log-linear version.

$$(1-\alpha)c_t = y_t - \alpha\eta(2-\alpha)s_t - \alpha\eta\psi_{F,t} - \alpha y_t^* \tag{11}$$

$$\Delta\psi_{F,t} = (\Delta e_t + \pi_t^*) - \pi_{F,t} \tag{12}$$

$$\Delta s_t = \pi_{F,t} - \pi_{H,t} + \varepsilon_{s,t} \tag{13}$$

$$\Delta q_t = \Delta\psi_{F,t} + (1-\alpha)\Delta s_t \tag{14}$$

$$\pi_{H,t} = \theta_H^{-1}(1-\theta_H)(1-\beta\theta_H)mc_t + \beta E_t \pi_{H,t+1} \tag{15}$$

$$mc_t = \phi y_t - (1+\phi)v_{a,t} + \alpha s_t + \sigma(1-h)^{-1}(c_t - hc_{t-1}) \tag{16}$$

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