ESTIMATING TAYLOR-TYPE RULES IN CENTRAL AND EASTERN EUROPE

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Abstract

This paper set out to estimate Taylor-type rules for four emerging European economies with inflation targets. Using the different specifications, methods and forecast horizons I suggest a number of interesting results. In the case of the Czech Republic the estimates from different specifications are surprisingly robust, yet in the case of Hungary one gets the opposite results, based on the assumption of the target horizon of the central bank. Additionally the paper provides some evidence of explicit exchange rate consideration in the policy reaction function by Hungary and the Czech Republic, in line with the theory offered by Obsfeld and Rogoff (1995) as well as Taylor (2001), and illustrates the policy shift in Romania. Finally, the paper provides the specific functional forms of the Taylor rules of the analyzed countries that track the historic record of the short-term interest rates remarkably well.

I. Introduction

If we were to name something that macroeconomists agree on nowadays, it would be that from all other alternatives the consistent and credible monetary policy gives the best payoff. The fixed exchange rates in many cases proved to be unattainable and the monetary growth targeting rules are plagued by the large scale disturbances of money demand. In this sense the Taylor-type rules became the most attractive candidates for becoming policy instruments. They meet the main criteria: they are simple and transparent, easy to communicate and check. Unlike discretion, the rules avoid the problem of time inconsistency by being able to commit and eliminate the potential instability. Hence, not surprisingly, when Taylor (1993) discovered that a simple rule summarizes the interest rate-setting behavior of the Federal Reserve remarkably well, the new line of research for finding a systematic component in monetary policy opened. Yet, the simple rules turned out not to be that simple to identify, with various shortcomings and problems of estimation, causing many authors to report conflicting results on the same sample. The rules turned out sensitive on estimation methods, data and samples. Some authors (Carare and Tchaidze (2005)) ironically compared this activity to Confucius' classic saying: searching a black cat in a dark room and with not even knowing if the cat is there at all.

This paper is my attempt to identify such systematic patterns in the behavior of the central banks of the four Central and Eastern European Countries: the Czech Republic, Hungary, Poland and Romania, i.e. the emerging EU countries, who already adopted inflation targeting and are not bound to any formal exchange rate mechanism that would limit their monetary policy. The commonly used check of robustness in estimation of Taylor-type rules is employing the different type of data; However, I choose a different approach, to apply different methods of estimation to the same data. Namely, I consider: simple Taylor rule and its open-economy counterpart, contemporaneous Taylor rule with interest smoothing and its open-economy counterpart and forward-looking Taylor rule and its open-economy counterpart. For the robustness check I apply all the mentioned specifications on the quarterly and monthly data. This exercise in estimation, I believe, has many advantages: it gives possibility of hedging from the bias of certain single methods; illustrates the sensitivity on the estimation methods applied; and lastly, it gives the possibility of choosing the best model from the set of estimated ones.

The structure of the paper is as follows: the first section is a comprehensive overview of previously existing literature on the Taylor rule; the second section summarized the monetary policies of the analyzed countries; in the third section I present my data and methodology; in the fourth section I report the estimates and findings and the fifth section concludes.

II. The Taylor Rule Literature Review

During the last two decades, Taylor type rules have become the most popular method to summarize the reaction function of central banks. Taylor (1993) argued that the monetary policy of the US during the period 1987-1993 was well-described by a simple rule: the short-term nominal interest rates react positively on the deviation of actual inflation from its desired level and deviation of actual output from the potential one. Namely he advocated the following relation:

$$i_t = r^* + \pi_t + \alpha(\pi_t - \pi_t^*) - \beta(y_t) \qquad (1)$$

Where i is the nominal federal funds rate, π is the inflation rate, y is the output gap (defined as a deviation of real GDP from its target: $y = 100(Y - Y^*)/Y^*$, where Y^* is trend real GDP), r^* is equilibrium federal funds rate and π_t^* is equilibrium inflation rate.

Taylor set both r^* and π_t^* equal to 2, and Y^* as a 2.2 percent linear trend of Real GDP. He also considered other representations of policy rules, namely those that focus additionally on exchange rate and on the money supply; however, he rejected them since they appeared not to deliver such good performance as policies that focus directly on the price level and real output.

Equation (1) can be rewritten as

$$i_t = r^* - \alpha\pi_t^* + (1+\alpha)\pi_t + \beta y_t \qquad (2)$$

In the original Taylor rule α and β are both given weights 0.5. Stability condition α >0 implies that the increase in nominal rate can mirror increase in real rate, hence central bank gives convincing signal to the market that is willing to fight inflation.

Many researchers followed Taylor in estimating central bank response function. Although the rule seems to approximate really well the monetary policy of the Fed, various issues have come up since its introduction. Empirics show that interest rate hikes have a significant real effect on the output after several quarters as well as on inflation and hence make it less justifiable to allow central banks to react on contemporaneous movements to inflation and output, in sense that they will be relatively unresponsive to such changes. Further, the original rule does not consider interest rate smoothing, behavior exhibited by many central banks, when they change interest rates slowly and in one direction, with very rare reversals. A common rational behind smoothing is that a central bank fears to distort money and capital markets and lose credibility by sudden and large policy reversals and wants to exploit the dependency of demand on expected future interest rate.

Popular approach was suggested by Clarida, Gali and Gertler (1997 and 2000) by introducing a forward looking element in the Taylor rule and considering interest smoothing. They incorporate into Taylor specification expected values of future inflation and output gap:

$$i_t^* = i^* + \varphi(E\left\{\pi_{t+k} \middle| \Omega_t\right\} - \pi^*) + \beta E\left[y_{t+m} \middle| \Omega_t\right] \qquad (3)$$

where i_t^* is the nominal interest rate, i^* is the desired (equilibrium) nominal interest rate and Ω_t is the information set, available at the time t when interest rate is set. It is easy to show that the sign of response of the real rate target depends on weather inflation coefficient φ is greater or smaller than 1 and the output gap coefficient β is greater or smaller than 0. This is the so called Taylor Principle.[1] Moreover, Clarida, Gali and Gertler allow the interest rate to depend on its lagged values through partial adjustment process:

$$i_t = \rho(L)i_{t-1} + (1-\rho)i_t^* \qquad (4)$$

where $\rho(L) = \rho_1 + \rho_2 L + ... + \rho_n L^{n-1}$, $\rho \equiv \rho(1)$ and i_t is *actual* funds rate. The authors interpret $\rho \in [0,1]$ as an indicator of the degree of interest rate smoothing. The value of ρ near unity indicates that central bank adjusts interest rates very slowly towards their target rate.

By combining (3) and (4) we get:

$$i_t = (1-\rho)\left\{i^* - (\varphi - 1)\pi^*\right\} + (1-\rho)\varphi\pi_{t,k} + (1-\rho)\beta y_{t,k} + \rho(L)i_{t-1} + \varepsilon_t \qquad (5)$$

where $\varepsilon_t \equiv -(1-\rho)\left\{\varphi(\pi_{t,k} - E\left\{\pi_{tk} \left|\Omega_t\right.\right\}) + \beta(y_{t,k} - E\left\{y_{t,k} \left|\Omega_t\right.\right\})\right\}_t$. The composite error term ε_t hence is a linear combination of forecast errors and orthogonal to the variables in the information set Ω_t. Clarida, Gali and Gertler estimate the equation using Generalized Method of Moments (Hansen 1982) by imposing orthogonality moment conditions implied by equation (5) and utilizing instruments from the set of information of central bank: Ω_t.

Many authors raised methodological and practical concerns over Taylor-type rules. One of the main concerns is whether to use current versus real time data.

[1] Real ex ante interest rate can be written as $r_t^* = i_t^* - E\left\{\pi_{t+k} \left|\Omega_t\right.\right\}$ and real equilibrium interest rate as $r^* = i^* - \pi^*$. By substituting these conditions into equation (3) we get $r_t^* = r^* + (\varphi - 1)(E\left\{\pi_{t+k} \left|\Omega_t\right.\right\} - \pi^*) + \beta E\left[y_{t+m} \left|\Omega_t\right.\right]$, from where it is straightforward that real rate moves upwards only if φ >1 and/or β >0 and downwards otherwise.

Orphanides (2001) demonstrates on US data that the use of real time data instead of current (ex-post) one significantly changes the estimates. Another important question is how to proxy variables in Taylor rule, since, as demonstrated by some authors, the estimation differs significantly depending on which proxy for inflation or output is used (Kozicki (1999)). Moreover, it is argued that the estimates on coefficients of inflation and output gap are regime sensitive, and the estimation for different sample periods yields different results (Siklos and Wohar (2004)).

One important aspect of Taylor-type of rules, widely missed in the previous literature, is the possibility of a unit root. Siklos and Wohar (2004) address the problem and conclude that most of the existing estimates are based on *unbalanced regression*. Researchers simply used to ignore unit root in inflation and interest rate. They offer the solution by integrating an error correction term in the Taylor equation.

Taylor rules are assumed relations in sense that they rose in empirical studies and generally are assumed as additional equilibrium condition of economy. Gillman et al. (2008) show that this need not be the case by deriving the Taylor rule using general equilibrium model, with endogenous growth economy and micro founded banking sector. By analyzing the consumer, the goods producer, the banking firm and the government money supply problems, they demonstrate that from first-order conditions the Taylor-type rule can be derived where coefficient of inflation φ corresponds to 1 (the marginal case of "Taylor principle") and coefficient on output gap corresponds to constant relative risk aversion in isoelastic utility function.

The majority of researches into Taylor-type rules were conducted on the developed economies: on the economies with developed asset markets and with a high degree of capital mobility. However, Taylor (2000) argues that Taylor-type rules can also be applied to the emerging market economies, especially where inflation targeting is practiced, with the same advantages as in developed economies. Nevertheless, he highlights the possible differences in monetary policy: (1) the use of monetary aggregates instead of interest rate as a policy instrument can be more appropriate for emerging markets, due to the difficulties of measuring equilibrium real interest rate in those economies; (2) emerging markets should respond more quickly and by larger amounts to economic events, since without highly liquid long term securities markets they cannot count on expectation effect; (3) there should be some room for the exchange rate in the rule, taking into account that exchange rate pass-through is the fastest way to influence the economy in open markets. Ball (2002) argues that inflation targeting without exchange rate consideration might be dangerous for the small, open, emerging economies and proposes to use Monetary Condition Index (the combination of interest rate and exchange rate) rather than interest rate as policy instrument.

However, it is clear that when trying to estimate reaction function of central banks in emerging market economies, one should consider other variables than just inflation and output gap. From their sample of 13 relatively advanced emerging markets Mohanty and Klau (2004) find that many central banks react to interest rate changes and in some cases to the extent that can be even classified as exchange rate targeting. Frommel and Schobert (2006) show that after introduction of floating exchange regime the importance of exchange rate in setting monetary policy declined for the sample of Eastern and Central European countries, although some countries still exhibit exchange rate targeting. Some authors report other important variables in deciding stance of monetary policy for some countries in Latin America, for example deficit of current account to GDP matters for Chile (Corbo(2002)).

II. Country description

I estimate Taylor-type rules for four Central and Eastern European emerging market economies: the Czech Republic, Hungary, Poland and Romania. The similarities between these economies are that they all are members of European Union, but they are not yet bound to ERM II (European Exchange Rate Mechanism), a condition for entering Euro zone.[2] Hence these countries have relative freedom to run a monetary policy of their own and not to limit it by adjusting it to the policy of ECB. Moreover, all these countries already have moved to direct inflation targeting. In this section I will briefly review basic characteristics of monetary policy of the analyzed countries as well as their exchange rate regimes.

The Czech Republic was first to adopt inflation targeting in the beginning of 1998; however this did not include the change in the objective of the Czech National Bank (CNB) to maintain price stability but only the change in the way of achieving this objective. Since 2005 the CNB has pursued an inflation target of 1-3%; the main instruments to achieve the target are key interest rates, most importantly two weeks repo rate. The central bank has escape clause from inflation targeting in the case of occurrence of large shock changes in exogenous factors, which are not in control of monetary policy.

[2] I do not analyze Bulgaria another EU country who is not yet in ERM II, since because of currency board is unable to pursue independent monetary policy.

The Czech Coruna maintained fixed exchange rate regime from 1994 to May of 1997 and after that started managed float.

Poland, the second to adopt direct inflation targeting, introduced it in 1999. In order to the achieve target the National Bank of Poland (NBP) adjusts the NBP basic interest rate, with the use of following instruments: open market operations, required reserves and credit-deposit operations. Since the beginning of 2004 the NBP has pursued continuous target of 2.5 % with fluctuation band of +/- 1 percentage point. The crawling peg against the basket of currencies was abandoned and Zloty exchange rate started an unrestricted float in April 2000 and no predetermined band of Zloty exchange rate is pursued officially against other currencies. However, central bank has the right to intervene "if it deems this necessary in order to achieve inflation target" as the official website of NBC states (The National Bank of Poland).

Hungary started inflation targeting in summer 2001, thus changing the previous policy of exchange rate targeting. The Magyar Nemzeti Bank (MNB) adjusts short term money market rate (the most important instrument to influence three month money market rate is two weeks MNB-bill) to achieve price stability. MNB pursues the continuous inflation target of 3% with +/- 1 percentage point permissible deviation. From 2001 until February 2008 Hungarian Forint had a wide crawling peg with +/- 15 percentage point band against Euro, with a free float of Forint starting afterwards.

Romania adopted direct inflation targeting in summer 2005. Since 2008 the target level of inflation has been 2.5% with a +/-1 percentage point deviation band. The exchange rate regime, unlike the other analyzed countries, was never fixed during the analyzed period, as now it followed managed float. The Romanian National Bank (RNB) never announced official monetary policy before it started explicit inflation targeting. Moreover, Romania is the country with the average highest inflation rates and in 1997 the inflation hit even a 3 digit number (160%).

III. Data Description and Methodology

For my analysis I use the monthly and quarterly frequency data obtained from the IMF website spanning the period January 1996 to January 2009. In most cases the time series were already seasonally adjusted at the source and others I adjust seasonally using Census XII.

I estimate inflation rate by annual change in log of Consumer Price Index (CPI) multiplied by 100. For defining output gap I use Gross domestic Product (GDP) for quarterly frequency and Industrial Production (IP) for monthly frequency. I estimate output gap as a difference between log of GDP with its Hodrick-Prescott (H-P) filtered value for quarterly frequency and between log of IP with its H-P filtered value for monthly frequency.[3] To proxy potential output by applying H-P filter on real output has a long tradition in Taylor rule literature. Although the filter is a useful tool to separate structural and cyclical components of time series it suffers from a well-known endpoint problem, when at the end of the series the last points have exaggerated impact. Other common methods of deriving potential output are fitting linear or quadratic time trends to real GDP or using band-pass filter.

[3] For monthly frequency I use the value of multiplier λ =14,400 and for quarterly frequency – λ =1,600 as suggested by the authors (Hodrick, Prescott (1997)).

The interest rate and inflation for almost all countries in my sample are found non-stationary.[4] The output gap is by construction stationary, and this is confirmed by Augmented Dickey Fuller test. The problems of estimating unit root are well-known: if variables are integrated of order 1 levels regression may yield spurious results and then estimated parameter vector will be inconsistent and t and F statistics will not be valid. Moreover there are problems with economic explanation of unit root in interest rate, since it is implausible to have infinite variance (see Siklos and Wohar (2004)). Nevertheless, the issue of nonstationarity has been largely ignored in literature. Because of the short sample and low power of unit root tests most authors assume stationarity (see for example Clarida, Gali and Gertler (2000)). The data description is summarized in table 1 in Appendix. Graph 1 and 2 plots the main variables against time.

I estimate contemporaneous and forward looking Taylor rules. For contemporaneous rule I use Ordinary Least Squares (OLS) with Newey-West heteroskedasticity and autocorrelation consistent (HAC) standard errors. For contemporaneous Taylor rule with smoothing, which corresponds equation (5) with k=0 and m=0 I use OLS as well with Newey/West standard errors, in line with common practice (see Siklos and Wohar (2002)). As for forward-looking Taylor rule, I use Clarida, Gali and Gertler formulation – equation (5). In line with Clarida Gali and Gertler (1997) I set forecast horizon for inflation one year (for monthly frequency k=12 and m=0). This seems reasonable, since policy makers generally are not concerned with month to month changes in prices, but care about medium and long term targets. However, since the target of one-quarter-ahead inflation seems plausible as well (and

[4] Except for Hungary monthly frequency, where ADF test cannot reject the null of non-stationarity in inflation.

used by Clarida, Gali and Gertler (2000), Sauer and Sturm (2003) and others), I estimate the results from one quarter inflation targeting horizon as well (for monthly frequency k=3 and m=0 in equation (5)) and report them if they offer different insight. I assume that the policy makers react to current GDP gap, which seems again reasonable.[5] I estimate equation (5) using GMM in line with authors. Because of overlapping nature of forecast errors the composite disturbance term ε will follow MA(k) process, then GMM estimator with Newey-West weighted covariance matrix can produce consistent estimates.[6] I use instruments from the information set of central bank, namely 12 lags of inflation, output gap and interest rate. Each variable is in the information set of the central bank at time t, is potentially useful for forecasting inflation and is exogenous to the error term.

I also expand the parameter vector by including exchange rate. Additionally I used monetary aggregates – m3, but since it did not enter significantly in the baseline equations, I do not report the results. I expand instrument list with the same number of lagged values of the additional variables as main variables. For real exchange rate I use the real effective exchange rate (REER)[7] of the analyzed countries.

Taylor (2001) emphasized the usefulness for analysis when including the lag of exchange rate in the equation (2):

[5] When I introduced a 3 month forward looking component in GDP gap, the results were not significantly affected, hence I do nott report them bellow.

[6] The procedure as mentioned in Clarida, Gali and Gertler (1997) will be a two step non-linear two stage least squares, when the model is overidentified. I rely on Eviews 6 with this and all other estimations. I set Bartlett kernel, Newey West bandwidth and no prewhitening, since it gives heteroskedasticity and autocorrelation consistent GMM estimator and ensures fast convergence. The results are largely robust when using QS kernel and fixed bandwidth.

[7] The weighted average of a country's currency relative to an index or basket of other major currencies adjusted for the effects of inflation. I use levels as suggested by Taylor. The estimations stays robust when I consider changes in REER (as in Mohanty and Klay (2004)).

$$i_t = \mu + \varphi\pi_t + \beta y_t + \delta_1 s_t + \delta_2 s_{t-1} \tag{6}$$

where s_t is REER at time t and s_{t-1} the same a period earlier. The increase in REER means appreciation. Note that $\mu \equiv r^* - \alpha\pi_t^*$ and $\varphi \equiv 1 + \alpha$.

Taylor (2001, p. 4) in line with Obsfeld and Rogoff (1995) argues that "The lagged exchange rate allows for slightly more complicated dynamics than simply reacting to the current exchange rate." "The rule of thumb" he proposes can be summarized as follows:

1. γ_1<0 and γ_2=0, then higher nominal real exchange rate would call on central bank to lower short term interest rate, which Taylor calls "relaxing monetary policy";
2. γ_1<0 and γ_2>0, but $\gamma_1 + \gamma_2$<0, then initial interest rate reaction will be partially offset next period;
3. γ_1<0 and γ_1=-γ_2, then interest rate reacts to the change in exchange rate;
4. γ_1<0 and γ_2<0, then central bank gives high weight to exchange rate stability and the shocks to exchange rate are large and persistent. This condition can be summarized as exchange rate targeting.

I utilize the formulation above in forward looking Taylor Rule (3) as well:

$$i_t^* = i^* + \varphi(E\{\pi_{t+k} | \Omega_t\} - \pi^*) + \beta E[y_{t+m} | \Omega_t] + \gamma_1 s_t + \gamma_2 s_{t-1} \tag{7}$$

This implies the orthogonality moment condition (5) will have following form:

$$i_t = (1-\rho)\{i^* - (\varphi - 1)\pi^*\} + (1-\rho)\varphi\pi_{t,k} + (1-\rho)\beta y_{t,k} + (1-\rho)\gamma_1 s_t +$$

$$+(1-\rho)\gamma_2 s_{t-1} + \rho(L) i_{t-1} + \varepsilon_t \tag{8}$$

I will refer, from now on, to the Taylor-type rules that consider explicitly exchange rate as *open economy Taylor rules,* for the sake of convenience, although such terminology can be misleading, because the optimal policy rules in open economies in reality can give zero weights to current and lagged exchange rate.

IV. The Estimation Results

In this section I report estimates of the following policy reaction functions for both the monthly and quarterly frequency for analyzed countries:

- the simple Taylor rule and its open economy version (equation (2) and equation (5) respectively);
- contemporaneous Taylor rule with smoothing and its open economy version (equation (5) and equation (8) respectively, where both *k* and *m* is set to 0);
- forward looking Taylor rule and its open economy version (equations (5) and equation (8) respectively, where *k* is set to 12 for monthly and 4 for quarterly frequency and *m* is set to 0).

Before presenting the results, it must be noted that the estimates of the simple rule (equation (2)) are severed by serial correlation. Serial correlation is the most common problem that has plagued the Taylor-type rules estimation (See an interesting review of estimation difficulties of Taylor rules by Carare and Tchaidze (2005)). Although I use Newey-West standard errors accounting for serial correlation and heteroskedasicity, the significant serial correlation is still an issue with the simple models. In GMM estimation, which accounts for serial correlation of unknown form, this is no longer a problem. However, standard errors should be valid even in simple model. The Unit root is another problematic issue: despite the fact that standard tests cannot reject the presence of unit root in interest rate, I assume the stationarity of the series, along with other authors,[8] since it seems reasonable assumption for the short sample I am considering.[9]

A. The Czech Republic

I estimate the monetary policy reaction function for the Czech Republic in the sample spanning the period January 1996 - January 2009. The estimates of the parameters: μ, φ, β, γ_1, γ_2 and ρ for the whole sample are reported in *table A*. The coefficient for inflation, in all specifications, has expected sign and always enters in the equation significantly. In the most cases the coefficient for output gap has expected sign as well, but is rarely significant.

The findings about monetary policy of the Czech Republic are somewhat remarkable, stating that the CNB followed the Taylor principle marginally during the analyzed period, raising the nominal interest rates in the response of expected rise of inflation just enough not to let the real short term interest rate fall. By this behavior the CNB avoids "accommodative" monetary policy, which is argued to leave the economy open to the possibility of burst of inflation and output that result in the self fulfilling changes in expectations (Clarida, Gali and Gertler 2000). It is remarkable that the value of φ is near unity in almost all the specifications: the average φ is 1.06, varying very little. Moreover, Wald coefficient restriction test cannot reject that φ is not different from 1 in all the specifications with conventional significance levels.

[8] Clarida, Gali and Gertler (1997, 2000) consider stationarity of inflation and interest rate reasonable in postwar US, although "the null of unit root in either of the variables is often hard to reject." Clarida, Gali and Gertler (2000, p. 154). Many authors avoid the problem by not mentioning it at all.

[9] Especially for the inflation targeting period it is hard to explain the presence of unit root, where one cannot account for the structural break.

Table A. Taylor-type rules estimation for the Czech Republic

	Freq.	μ	φ	β	γ_1	γ_2	ρ	Adj. R^2
Simple TR	M.	0.51 (.30)	1.24*** (.00)	-0.11 (.22)	-	-	-	0.72
	Q.	0.68 (.29)	1.19*** (.00)	0.15 (.66)	-	-	-	0.64
Open Economy Simple TR	M.	12*** (.00)	1.01*** (.00)	-0.56 (.19)	-0.19** (.02)	0,09 (.22)	-	0.89
	Q.	12.45*** (.00)	1.04*** (.00)	0.22 (.27)	-0.30** (.02)	0.20*** (.01)	-	0.89
TR with Interest Smoothing	M.	0.03 (.98)	0.98** (.03)	0.59 (.29)	-	-	0.96*** (.00)	0.97
	Q.	0.55 (.65)	0.82** (.02)	2.09 (.20)	-	-	0.89*** (.00)	0.94
Open Economy TR with Interest Smoothing	M.	13.03*** (.00)	0.89*** (.00)	0.20 (.21)	-0.38 (.13)	0.28 (.27)	0.90*** (.00)	0.97
	Q.	11.4*** (.00)	0.97*** (.00)	1.09** (.02)	-0.40 (.20)	0.32 (.31)	(0.70)*** (.00)	0.95
	M.**	48.7* (.07)	0.65* (0.06)	0.35 (.29)	1.07* (0.08)	0.61 (.26)	0.85*** (.00)	0.94
Forward Looking TR	M.	0.15 (.74)	1.06*** (.00)	0.11* (.07)	-	-	0.96***	0.97
	Q.	0.99 (.34)	0.70** (.02)	0.16 (.76)	-	-	0.72*** (.00)	0.90
Open Economy Forward Looking TR	M.	3.77 (.12)	0.85** (.00)	0.31*** (.00)	0.26 (.13)	-0.29 (.11)	0.91*** (.00)	0.97
	Q.	2.41 (.30)	1.13*** (.00)	-0.65** (.00)	0.28** (.00)	-0.29 (.00)	0.73*** (.00)	0.96
	Q.*	13.7*** (.00)	1.01*** (.00)	0.66*** (.00)	-0.21*** (.00)	0.11** (.02)	0.62 (.00)	0.93

Note: M-monthly: Sample spanning 1996:1-2009:1. Q-quarterly: sample spanning 1996:1-1998:4. Forward looking models are GMM, OLS. For GMM 1996 year sample is lost. For simple models in parenthesis are given p values (t statistic). For models with interest rate smoothing in parenthesis are given p-values for Wald test (F-statistic) that $(\mu \equiv) c/(1-\rho) = 0$, $(\varphi \equiv) c_\pi /(1-\rho) = 0$, $(\beta \equiv) c_y /(1-\rho) = 0$, $(\gamma_1 \equiv) c_{s_t} /(1-\rho) = 0$, $(\gamma_2 \equiv) c_{s_{t-1}} /(1-\rho) = 0$; where $c_\pi, c_y, c_{s_t}, c_{s_{t-1}}$ are coefficients for linear regression of π_t, y_t, s_t, s_{t-1} respectively and c is a constant. The simple models are characterized with high degree of positive serial correlation; however, in the models with interest rate smoothing the null of no serial correlation cannot be rejected conventional significance levels by Breusch-Godfrey LM test within 5 lags. Hence smoothing parameter improves the model. In GMM the set instrument variables include constant, for monthly frequency: twelve lags of inflation, output gap and, in the case of open economy, REER; for quarterly frequency four lags respectively. Hansen J test can't reject that overidentifying restrictions are satisfied at any conventional significance level for all GMM. ***, **, ***** corresponds respectively to 10%, 5% and 1% significance level.

* Forward looking model target is one-quarter-ahead inflation. Here the instruments are four lags of the covariates.

* * Sample 1996-2001.

The model specifications give result for parameter β with less synchronicity, with a possible consensus of a little positive weight on the output gap. In the most contemporaneous cases β is insignificant. However, β enters significantly in forward looking GMM model in monthly frequency. The estimates are significant, with little positive weight, much in line with the theory. Does not compound to the pattern the value of β in the open economy forward looking Taylor rule in quarterly frequency, which is negative and significant. This would suggest that the CNB follows a pro-cyclical monetary policy. However, taking into account the small sample, it could be just a statistical illusion. The same regression has non-intuitive signs for the real exchange rate coefficients. It is known that the estimates of GMM are sometimes sensitive to the order of lags of the instruments used.[10] The estimates from quarterly sample with one-year-ahead inflation targets are very unstable in this sense. Yet, the Hansen J test cannot detect that overidentifying restrictions are not valid in any of the GMM specification.[11] When I change the target horizon of inflation with one-quarter-ahead inflation target, I get statistically very significant coefficients with the expected signs. Moreover, the model is now robust to slight changes in instruments.

Another interesting finding concerns the dynamics of exchange rate targeting. The majority of the model specifications suggest that the CNB does react to the rise of REER by loosening monetary policy, but initial reaction is almost fully offset in the following period. For example, the forward-looking model with one-quarter–ahead inflation targets

[10] This problem is mentioned by Siklos and Wohar (2004) and Carare and Tchaidze (2005), although largely unexplored in the literature and no formal cure offered.

[11] The P value of the test is far from rejecting threshold (1-10%) in all specifications, generally being beyond 90% in monthly specifications and above 50% in quarterly specifications generally.

implies that appreciation in REER for 10 percentage points would call on the cut of interest rate by 2.1 percentage points, which will be partially offset in following period by 1.1 percentage points, implying a percentage point long run cut in the interest rate. The reason for negative response is that the cut of interest rates mitigates the contractionary effect of appreciation; the later is due to the increase of attractiveness of foreign goods since they become relatively cheaper than domestic ones. As for rational of (partial) offsetting, one can trace the effect of inflation concerns: Since the appreciation of the real exchange rate drives down the inflation rate, the loosening of the monetary policy will be justified by the Taylor rule; however, the impact of currency appreciation on inflation will only be temporary and a further decrease of interest rate will be regarded as deviation of the central bank from its anti-inflationary commitments.

The Analysis of the subsamples gave some more interesting dynamics regarding exchange rates: both contemporaneous and forward-looking models with interest rate smoothing confirmed that the policy reaction on exchange rate was high and significant during the sample of 1996-2000 and was insignificant in the period after 2000, suggesting that the reaction on the exchange rate changes was matter of the past rather than of the present.

Note that parameter μ equals $i^{*}-(\varphi-1)\pi_{t}^{*}$ and hence is approximately real equilibrium exchange rate when φ is not significantly different from 1. In the case the table A suggests that in the Czech Republic equilibrium real exchange rate estimates are very high.

Finally, the estimates of smoothing parameter ρ are very high and statistically very significant, suggesting significant smoothing behavior: that only between 20 to 30 percent change in interest rate target is reflected in the short term interest rate within the quarter of the change. Hence it is the strong support of the hypothesis that the central banks smooth interest rates. This pattern is maintained in other countries as well.

B. Hungary

I estimate the Taylor-type rules in Hungary for the period starting from the beginning of 1996 ending at the end of 2008. The estimates of the parameters for the full sample are reported in the *table B.*

The value of φ displays much more variation than in the case of the Czech Republic, but has the expected sign and is always significant. Interestingly enough φ is bellow the unity when the contemporaneous specification is used and is above the unity when the forward-looking specification is used. This result implies one more interesting finding of the paper, one might conclude that the MNB follows the "accommodative" monetary policy if she assumes that the MNB is reacting on contemporaneous inflation and output gap; and can conclude that the MNB follows the "active" monetary policy if she assumes that the MNB reacts on the expected inflation and output gap.

In the case of β the negative signs are prevalent, often significant. This can suggest that the MNB follows pro-cyclical monetary policy. However, the simple Taylor rule model, which counts on four from reported eight negative signs, is flawed by serial correlation. Interesting confrontation arises between the more sophisticated quarterly and monthly models: The quarterly models report negative sign while the monthly – positive. Yet, the monthly estimates with GMM are unstable and give a very large smoothing parameter, and the output gap coefficient is never significantly different from zero.

Table B. Taylor-type rules estimation for Hungary

	Freq.	μ	φ	β	γ_1	γ_2	ρ	Adj. R^2
Simple TR	M.	3.14*** (.00)	1.05*** (.00)	-0.27** (.01)	-	-	-	0.92
	Q.	3.94*** (.00)	0.90*** (.00)	-0.58* (.02)	-	-	-	0.91
Open Economy Simple TR	M.	1.36** (.04)	0.74*** (.00)	-0.36** (.00)	-0.19* (.06)	-0.21 (.13)	-	0.95
	Q.	13.77** (.00)	0.73*** (.00)	-0.58* (.02)	-0.09* (0.08)	0.02 (.76)	-	0.94
TR with Interest Smoothing	M.	0.94 (.51)	0.62*** (.00)	0.27 (.31)	-	-	0.94*** (.00)	0.98
	Q.	4.96*** (.00)	0.64*** (.00)	-0.99 (0.12)	-	-	0.79 (.00)	0.96
Open Economy TR with Interest Smoothing	M.	5.18 (.51)	0.72*** (.00)	0.37 (.23)	-1.19* (.08)	1.19* (.09)	0.94*** (.00)	0.98
	Q.	10.04 (.11)	0.62** (.01)	-0.82 (0.15)	-0.15 (.29)	0.11 (.31)	0.79 (.00)	0.97
Forward Looking TR	M.	0.01 (.99)	1.12*** (.00)	0.91* (.08)	-	-	0.97*** (.00)	0.97
	Q.	0.88*** (.00)	1.04*** (.00)	0.61 (.73)	-	-	0.88*** (.00)	0.94
Open Economy Forward Looking TR	M.	4.54 (.80)	1.25*** (.00)	0.67** (.02)	2.06** (.00)	-2.11*** (.00)	0.96*** (.00)	0.97
	Q.	6.39 (.57)	1.40*** (.00)	-0.36 (.81)	0.83** (.05)	-0.91** (.03)	0.85*** (.00)	0.95
	Q.*	-3.48 (.35)	1.02*** (.00)	-0.68 (.81)	-0.35* (.06)	0.41** (.03)	0.81*** (.00)	0.96

Note: M-monthly: Sample spanning 1996:1-2009:1. Q-quarterly: sample spanning 1996:1-1998:4. Forward looking models are GMM, others OLS. For GMM 1996 year sample is lost. For simple models in parenthesis are given p-values (t statistic). For models with interest rate smoothing in parenthesis are given p-values for Wald test (F-statistic) that $(\mu \equiv) c/(1-\rho)=0$, $(\varphi \equiv) c_\pi/(1-\rho)=0$, $(\beta \equiv) c_y/(1-\rho)=0$, $(\gamma_1 \equiv) c_{s_t}/(1-\rho)=0$, $(\gamma_2 \equiv) c_{s_{t-1}}/(1-\rho)=0$; where $c_\pi, c_y, c_{s_t}, c_{s_{t-1}}$ are coefficients for linear regression of π_t, y_t, s_t, s_{t-1} respectively and c is a constant. The simple models are characterized with high degree of positive serial correlation; in the models which incorporate interest rate smoothing are free from problems of serial correlation. Hence smoothing parameter improves the model. In GMM the set instrument variables include constant, for monthly frequency: twelve lags of inflation, output gap and, in the case of open economy, REER; for quarterly frequency four lags respectively. Hansen J test is very far from rejecting that overidnetifying restrictions are satisfied again at any GMM model.

, **, ** corresponds to 10%, 5% and 1% significance levels respectively.

* Forward looking model target is one-quarter-ahead inflation and contemporaneous output gap. The instruments are four lags of the covariates.

The estimates of γ_1 and γ_2 imply that the MNB still reacts directly on the movements in exchange rate. The results are not surprising since the wide peg of Forint (+/-15) against Euro was maintained until the end of 2008. The result is in line with the findings of other authors (Mohanty and Claw (2004) and Frommel and Schobert (2006)) and much similar to the case of the Czech Republic. Yet when considering the period after 2002, the exchange rate coefficient looses significance. The monetary policy of Hungary can be summarized as inflation targeting with significant exchange rate considerations.

C. Poland

Due to the data limitation, the estimation sample of Poland starts in 1998 and hence contains only the period of inflation targeting. The estimates for parameters are reported in table 1.

The estimates of φ are much in line with each other across the model specifications, and all of them come with expected sign and all are significant. Moreover, the Wald coefficient restriction test rejects that the estimates are not different from one in all cases but one, implying that the NBP is the only central bank from the analyzed group of inflation targeting countries that runs active monetary policy for controlling inflation: it adjusts the nominal rates enough to rise the real rates and thus contains the rising inflation.

The coefficient for β has significant negative values in simple models plagued by serial correlation. However, in more reliable specifications β enters significantly only if positive. The overall impression is that the NBP gives a slight positive weight to the output gap.

Table B. The Taylor-type Rules Estimation for Poland

	Freq.	μ	φ	β	γ_1	γ_2	ρ	*Adj.* R^2
Simple TR	M.	2.86*** (.00)	1.48*** (.00)	-0.11* (.06)	-	-	-	0.83
	Q.	1.36** (.04)	1.82*** (.00)	-0.62** (.02)	-	-	-	0.86
Open Economy Simple TR	M.	8.41*** (.00)	1.43*** (.00)	-0.11* (.06)	-0.05 (.53)	0.00 (.93)	-	0.84
	Q.	4.55 (.32)	1.71*** (.00)	-0.46 (.17))	-0.05 (.33)	0.03 (.44)	-	0.87
TR with Interest Smoothing	M.	0.90 (.00)	1.40*** (.00)	0.36** (.02)	-	-	0.90*** (.00)	0.98
	Q.	1.45* (.08)	1.61*** (.00)	0.30 (.55)	-	-	0.76 (.00)	0.98
Open Economy TR with Interest Smoothing	M.	9.26** (.03)	1.35*** (.00)	0.34** (.02)	-0.10 (.45)	0.03 (.77)	0.90*** (.00)	0.98
	Q.	15.72** (.04)	0.88* (.05)	0.72 (.22)	-0.01 (.99)	0.12 (.36)	0.76*** (.00)	0.96
	M.	-3.02 (.28)	0.28* (0.8)	0.35 (.26)	-0.81* (.09)	0.55 (0.10)	0.90*** (.00)	
Forward Looking TR	M.	0.15 (.70)	1.06** (.00)	0.12* (0.7)	-	-	0.96*** (.00)	0.96
	Q.*	0.66 (.63)	1.52** (.00)	0.10 (0.79)	-	-	0.77*** (.00)	0.92
Open Economy Forward Looking TR	M.	2.38 (.16)	1.91*** (.00)	-0.31 (.36)	-0.19 (.34)	0.15 (.44)	0.92*** (.00)	0.97
	Q.*	10.21** (.03)	2.30*** (.00)	-0.09 (.80)	0.43 (.14)	-0.53* (.06)	0.88*** (.00)	0.96

Note: M-monthly: Sample spanning 1998:1-2009:1. Q-quarterly: sample spanning 1998:1-1998:4. Forward looking models are GMM, others OLS. For GMM 1998 year sample is lost. For simple models in parenthesis are given p-values (t statistic). For models with interest rate smoothing in parenthesis are given p-values for Wald test (F-statistic) that $(\mu \equiv) c/(1-\rho)=0$, $(\varphi \equiv) c_\pi /(1-\rho)=0$, $(\beta \equiv) c_y /(1-\rho)=0$, $(\gamma_1 \equiv) c_{s_t} /(1-\rho)=0$, $(\gamma_2 \equiv) c_{s_{t-1}} /(1-\rho)=0$; where $c_\pi, c_y, c_{s_t}, c_{s_{t-1}}$ are coefficients for linear regression of π_t, y_t, s_t, s_{t-1} respectively and c is a constant. The simple models are characterized with high degree of positive serial correlation; in the models which incorporate interest rate smoothing suffer from of serial correlation at quarterly frequency, at monthly frequency the null of no serial correlation can not be rejected at 5%. In GMM the set instrument variables include constant, for monthly frequency: twelve lags of inflation, output gap and, in the case of open economy, REER; for quarterly frequency four lags respectively. the Hansen J test cant reject that overidentifying restrictions are satisfied at any significance level. ***, **, ***** corresponds to 10%, 5% and 1% significance levels respectively.
* Forward looking model when target is one-quarter-ahead inflation and contemporaneous output gap. Here the instruments are four lags of the covariates.

The *table C* is unambiguous with regards to exchange rate: the NBP does not consider exchange rate explicitly in its reaction function. Hence, the reaction function of Poland is closer to those of closed economies, considering domestic inflation expectations and to some extent the deviation real output from the potential one. The monetary policy of Poland can be most closely summarized by label “the pure inflation targeting”.

D. Romania

For the monthly frequency of Romania I estimate the period starting from 1999, thus avoiding the high inflation volatility period of 1996-98, which might bias the results. As for quarterly frequency, I estimate from 2001 due to of data limitations. Estimates of the Coefficients are given in *table D.*

The estimates of parameter φ, although as in all cases with expected sign and significant, vary considerably through specifications, make it difficult to reach consensus whether the RNB pursued “accommodative” policy or not. The parameter β has expected sign in all specifications, which frees the RNB from the allegations of pursuing procyclical monetary policy. However, only the one-quarter-ahead inflation target model yields statistically significant estimates of β apart from the simple Taylor rule models. Exchange rate enters in the regressions insignificantly (except for the open economy simple Taylor rule model), although almost always correctly signed. The indicator of degree of interest rate smoothing is lower than the average of the analyzed countries in quarterly frequency, indicating around 40-50% of the interest rate target is reflected in short term interest rate within a quarter from change.

Table D. Taylor-type rules estimation for Romania

	Freq.	μ	φ	β	γ_1	γ_2	ρ	Adj. R^2
Simple TR	M.	**5.51*** (.00)**	**0.86*** (.00)**	**0.25* (.06)**	-	-	-	0.87
	Q.	0.52 (.55)	**1.37** (.00)**	0.46 (.53)	-	-	-	0.94
Open Economy Simple TR	M.	**34.62*** (.00)**	**0.65*** (.00)**	**0.33*** (.00)**	**-0.35** (.01)**	0.13 (.35)	-	0.92
	Q.	8.61 (.18)	**1.28*** (.00)**	0.58 (.23)	-0.04 (.82)	0.03 (.86)	-	0.94
TR with Interest Smoothing	M.	1.28 (.55)	**0.92*** (.00)**	0.17 (.52)	-	-	**0.94*** (.00)**	0.98
	Q.	1.13 (.22)	**1.22*** (.00)**	0.97 (.35)	-	-	**0.56 (.00)**	0.96
Open Economy TR with Interest Smoothing	M.	**-3.09 (.90)**	**0.97*** (.00)**	0.20 (.46)	-0.48 (.38)	0.51 (.34)	**0.94*** (.00)**	0.98
	Q.	3.44 (.53)	**1.17*** (.00)**	1.11 (.27)	-0.23 (.54)	0.22 (.57)	**0.59*** (.00)**	0.96
Forward Looking TR	M.	3.86 (.23)	**0.94*** (.00)**	1.05 (.21)	-	-	**0.96*** (.00)**	0.98
	Q.*	**0.46*** (.00)**	**1.45*** (.00)**	0.69 (.17)	-	-	**0.47*** (.00)**	0.91
Open Economy Forward Looking TR	M.	**29.25* (.07)**	**0.61*** (.01)**	1.65*** (.00)	-41 (.76)	0.22 (77)	**0.99*** (.00)**	0.97
	Q.*	**20.27** (.00)**	**0.50** (.00)**	**1.53*** (.00)**	0.15 (0.16)	**-0.27** (.02)**	0.64** (.12)	0.81

Note: M-monthly: Sample spanning 1999:1-2009:1. Q-quarterly: sample spanning 2001:1-2008:4. Forward looking models are estimated are GMM, others are OLS. For GMM the first year sample is lost. For simple models in parenthesis are given p-values (t statistic). For models with interest rate smoothing in parenthesis are given p-values for Wald test (F-statistic) that $(\mu \equiv) c/(1-\rho) = 0$, $(\varphi \equiv) c_\pi/(1-\rho) = 0$, $(\beta \equiv) c_y/(1-\rho) = 0$, $(\gamma_1 \equiv) c_{s_t}/(1-\rho) = 0$, $(\gamma_2 \equiv) c_{s_{t-1}}/(1-\rho) = 0$; where $c_\pi, c_y, c_{s_t}, c_{s_{t-1}}$ are coefficients for linear regression of π_t, y_t, s_t, s_{t-1} respectively and c is a constant. The simple models are characterized with high degree of positive serial correlation; in the models which incorporate interest rate smoothing suffer from of serial correlation at quarterly frequency, at monthly frequency the null of no serial correlation can not be rejected at 5%. In GMM the set instrument variables include constant, for monthly frequency: twelve lags of inflation, output gap and, in the case of open economy, REER for quarterly frequency four lags respectively. The Hansen J test can't reject that overidentifying restrictions are satisfied. ***, **, ***** corresponds to 10%, 5% and 1% significance levels respectively.

* Quarterly frequency when the target is a quarter-ahead inflation. Here the instruments are four lags of the covariates

The analysis of subsamples gives useful insight in the monetary policy of Romania. I divide the sample into pre inflation targeting 1995-2005 and post inflation targeting 2006-2009 subsamples and estimate them with contemporaneous open economy Taylor rule that accounts for interest rate smoothing. The results are given in *table E.*

Table E. Comparing pre inflation targeting and post inflation targeting Taylor rules.

Period	μ	φ	β	γ_1	γ_2	ρ	***Adj.*** R^2	D W
Pre-IT	***59.1****** ***(.00)***	*0.29 (0.18)*	*1.05 (0.14*	***-3.20***** ***(.02)***	*0.27 (.40)*	***0.94****** ***(.00)***	*0.98*	*1.95*
Post-IT	*7.04 (.40)*	***1.28***** ***(.01)***	*0.01 (.76)*	*-0.02 (.84)*	*-0.08 (.32)*	***0.90****** ***(.00)***	*0.97*	*1.98*

Note: Pre-IT 1996:1-2005:1, Post-IT; 2005:1-2009:1. Equations estimated are OLS. in parenthesis are given p-values for Wald test (F-statistic) that $(\mu \equiv)c/(1-\rho)=0$, $(\varphi \equiv)c_\pi/(1-\rho)=0$, $(\beta \equiv)c_y/(1-\rho)=0$, $(\gamma_1 \equiv)c_{s_t}/(1-\rho)=0$, $(\gamma_2 \equiv)c_{s_{t-1}}/(1-\rho)=0$; where $c_\pi, c_y, c_{s_t}, c_{s_{t-1}}$ are coefficients for linear regression of π_t, y_t, s_t, s_{t-1} respectively and c is a constant. The estimations are free from problems of serial correlation according to Breusch-Godfrey LM test.

The differences are striking. The NBR before inflation targeting was following the "relaxing monetary policy", but changed the policy drastically after adopting inflation targeting: started following the Taylor principle and stopped reacting directly on exchange rate.

E. Summing Up

The variety of Taylor-type rules, I estimated for the four Central and Eastern European countries, is useful to illustrate the problem of estimation and gives a good food for some generalizations, although makes hard to interpret the occasionally popped up conflicting results and limits the emergence of more specific conclusions on the monetary policy. The logical continuation of analysis, and a way to overcome the mentioned limitation, is to address the question: what type of rules, from the ones estimated, characterizes the monetary policy better? For this I investigate the forecasting power of the derived models for each country. I use the dynamic forecasting. The essence of dynamic forecasting is that it binds the lagged endogenous variable to the values solved in different period and hence only needs starting point of endogenous variable and the real values of independent variables to generate forecast. It is more powerful tool than static forecast which takes the real values of lagged endogenous variable. *Table F.* shows the models which have the best forecasting power in describing the monetary policy of the analyzed countries.

Table F. The models with best forecasting power

Country	***Specification, Method, horizon***	μ	φ	β	γ_1	γ_2	ρ	***RMSE***
The Czech Republic	*OEFLTR, GMM, Q,: k*=1, *m*=0	***13.7 (.00)***	***1.01 (.00)***	***0.66 (.00)***	***-0.21 (.00)***	***0.11 (.02)***	***0.62 (.00)***	1.31
Hungary	*OETR, OLS, M.*	*5.18 (.51)*	***0.72 (.00)***	*0.37 (.23)*	***-1.19 (.08)***	***1.19 (.09)***	***0.94 (.00)***	1.53
Poland	*TR, OLS, M.*	***0.90 (.00)***	***1.40 (.00)***	***0.36 (.02)***	-	-	***0.90 (.00)***	1.60
Romania	*OETR,OLS, Q.*	*3.44 (.53)*	***1.17 (.00)***	*1.11 (.27)*	*-0.23 (.54)*	*0.22 (.57)*	***0.59 (.00)***	2.05

Note: RMSE – Root-Mean-Square-Error; OEFLTR – Open Economy Taylor Rule; OETR – Open Economy Taylor Rule (with interest smoothing); TR – Taylor Rule (with interest smoothing); M – monthly; Q :k=1, m=0 – Quarterly, with targets: one-quarter-ahead inflation, contemporaneous output gap.

The results lead to some interesting conclusions:

(1) Poland follows a Taylor rule with well defined positive weights for inflations and output. The coefficient φ is significantly above unity,

thus the National Bank of Poland translates the raise of nominal interest rates in real rates and contains inflation while simultaneously responding positively to variation of output from its trend. If we consider their inflation target rate equal to 2, as a real equilibrium inflation rate, then the real equilibrium interest rate will be very near to 2 -the values Taylor (1993) assumed in the original Taylor rule;

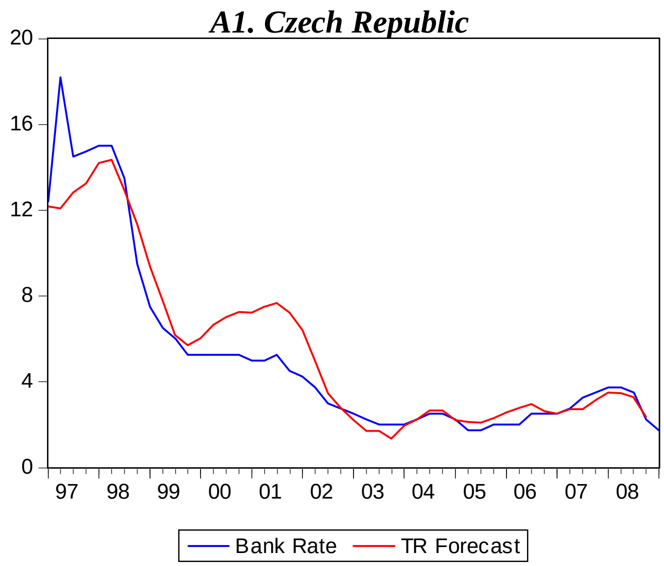
(2) The Czech Republic follows the Taylor principle marginally, leaving the real interest constant, thus avoiding accommodative monetary policy. It is strongly concerned with the variation of output and reacts to the movements in the real exchange rate most close to dynamics which Taylor labeled "the partial offsetting."

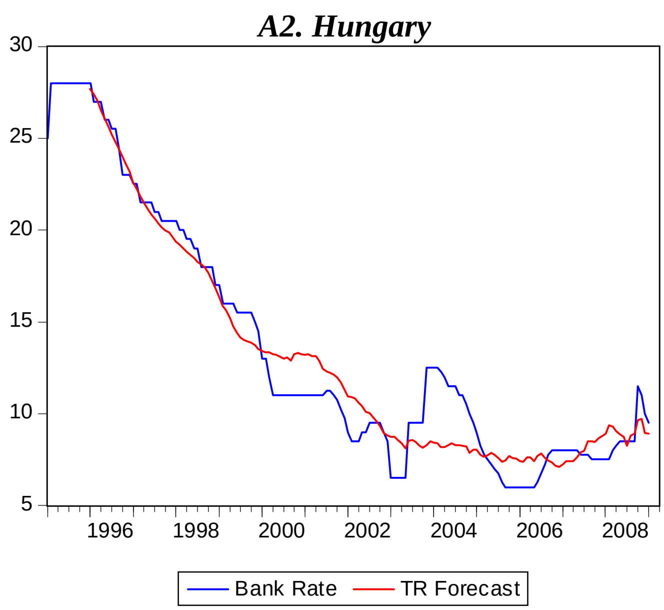
(3) To some extend Hungary has somewhat similar policy as the Czech Republic, although is less concerned with output. The country is the most close to the "accommodative" monetary policy from the sample. It strongly reacts to interest rate and fully offsets next period.

(4) Romania follows Taylor principle, making general emphasis on interest rate.

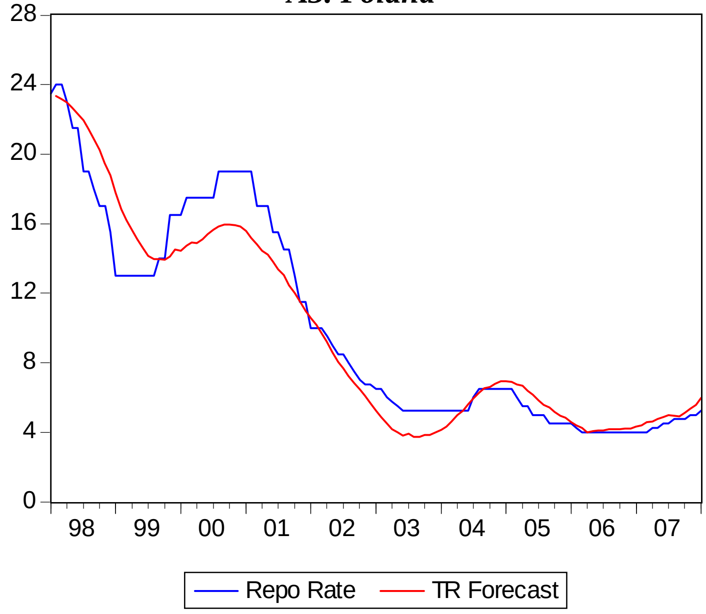
The figures from *A1* to *A4* bellow plot the Taylor-type rules forecasts against the actual interest rate. The figures indicate that that the simple rules proposed in the *table F* describe the historic path of the monetary policy rate of respective countries remarkably well, except possibly of Romania. The case of Hungary and Poland are remarkable, since the dynamic forecast of estimated Taylor rules capture all the turning points of the short term interest rate. The Taylor rule suggested for Poland is worth a separate mentioning: it tracks almost one to one the official repo rate since 2006.

Figure A. The dynamic forecast of the estimated Taylor rules against the actual interest rates

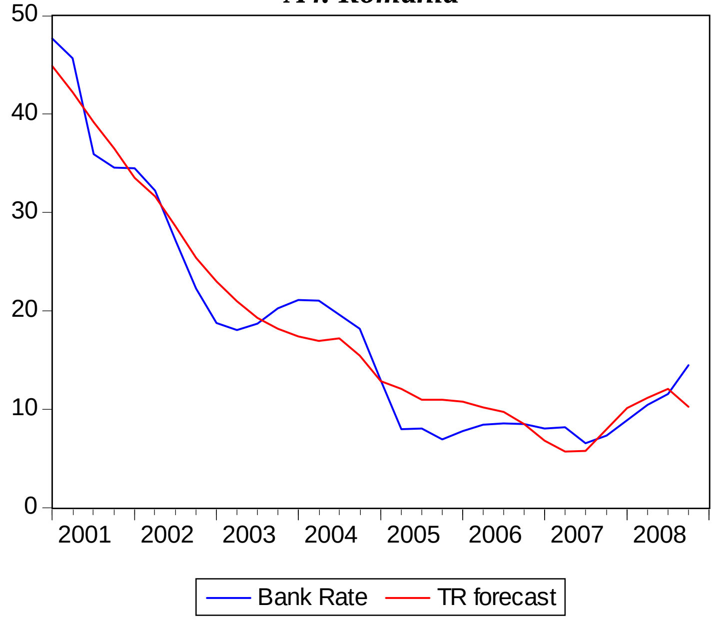




A3. Poland



A4. Romania



V. Conclusion

This paper set out to estimate Taylor-type rules for four emerging European economies with inflation targets. By using the different specifications, methods and assuming different sample horizons for central bank I suggest a number of interesting results that leads to the conclusion that the Taylor-type rules can offer a good insight into the monetary policy of inflation targeting emerging markets. The paper provides some evidence of direct policy reaction on exchange rate by the central banks of Hungary and the Czech Republic, in line with the theory offered by Obsfeld and Rogoff (1995) as well as Taylor (2001), and illustrates the policy shift in Romania from the exchange rates oriented to the inflation oriented monetary policy. All this gives some support to the "fear of floating" hypothesis, proposed by Calvo and Reinhart (2002). Yet, the case of Poland gives strong evidence that small, open, emerging markets can have the monetary policy very closed to that of the large "closed" economies.

Besides the paper suggest the specific functional forms of the Taylor rules of the analyzed countries, with specific weights of parameters that track the historic record of the short-term interest rates remarkably well.

Lastly, it illustrates some estimation shortcomings of Taylor-type rules. For example in the case of Hungary, one gets the opposite results, based on the assumption of the target horizon of the central bank. The method proposed in the paper, using comprehensive estimation approach, rather than relying on single assumptions, can be useful to hedge from the possible misspecifications.

The limitation of the paper is that it traces the historical policy responses of central banks on the movements of economy and does not provide any evidence about the optimal monetary policy in small, open, emerging markets of Central and Eastern Europe. This is a fruitful field for future researches.

Finally, returning to the saying of Confucius, mentioned in introduction, I can say: “I might not have found the cat, but at least I know that it *is* there for sure.”

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APPENDIX

Table 1. Descriptive Statistics of Main Variables

The Czech Republic

	Inflation	Bank Rate	GDP gap	REER
Mean	4.46	9.71	-0.04	104.9
Median	3.75	6.5	0.33	105.54
Maximum	13.18	24	9.16	135.93
Minimum	0.07	4	-11.94	88.7
Std. Dev.	3.47	5.88	3.55	10.84

Hungary

	Iinflation	Bank Rate	GDPgap	REER
Mean	8.88	12.52	-0.12	116.6
Median	7.39	11	-0.01	117.8
Maximum	25.29	28	7.68	162.3
Minimum	2.26	6	-20.62	91.25
Std. Dev.	5.25	5.818	3.56	18.30

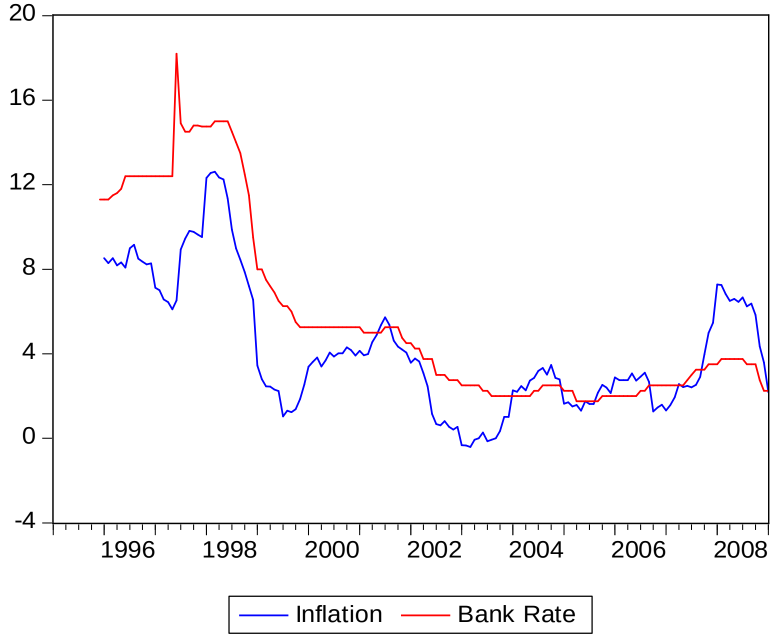
Poland

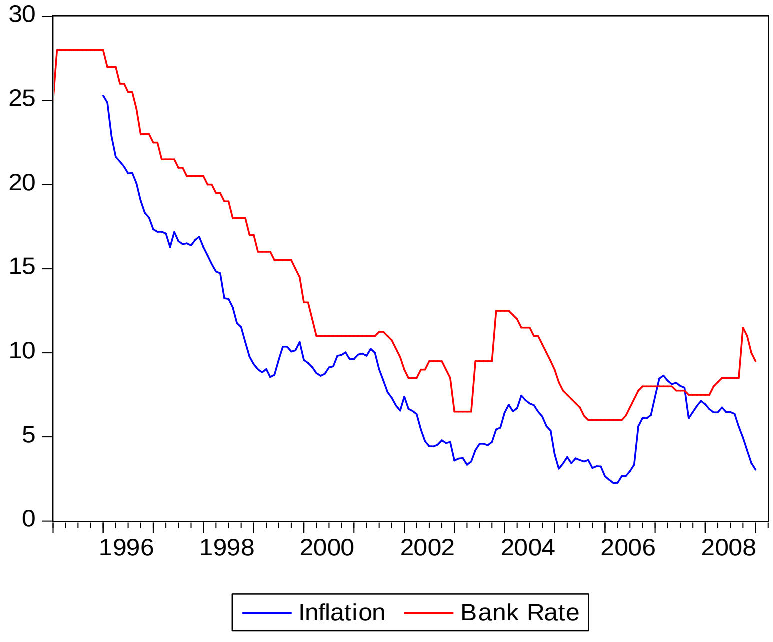
	Inflation	Repo Rate	GDP gap	REER
Mean	4.46	9.71	-0.04	104.9
Median	3.75	6.5	0.33	105.54
Maximum	13.18	24	9.16	135.93
Minimum	0.07	4	-11.94	88.7
Std. Dev.	3.47	5.88	3.55	10.88

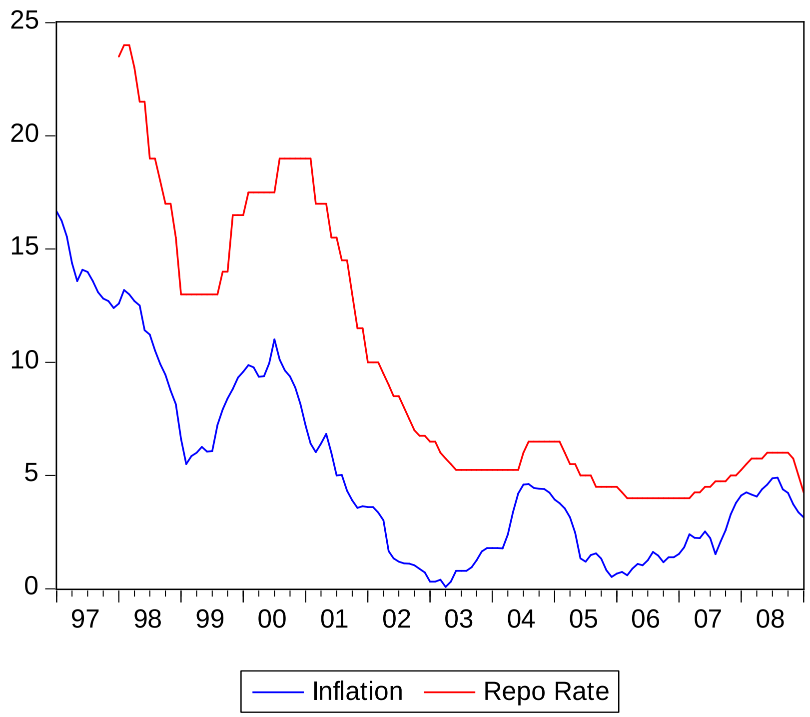
Romania

	Inflation	Bank Rate	GDP gap	REER
Mean	26.8	26.17	0	103.2
Median	20.73	34.1	-0.17	100.4
Maximum	102.0	58	17.5	148.6
Minimum	3.58	7	-16	58.26
Std. Dev.	24.1	13.34	4.86	21.3

Graph 1. ***The co-movement of inflation and interest Rate***






25
20
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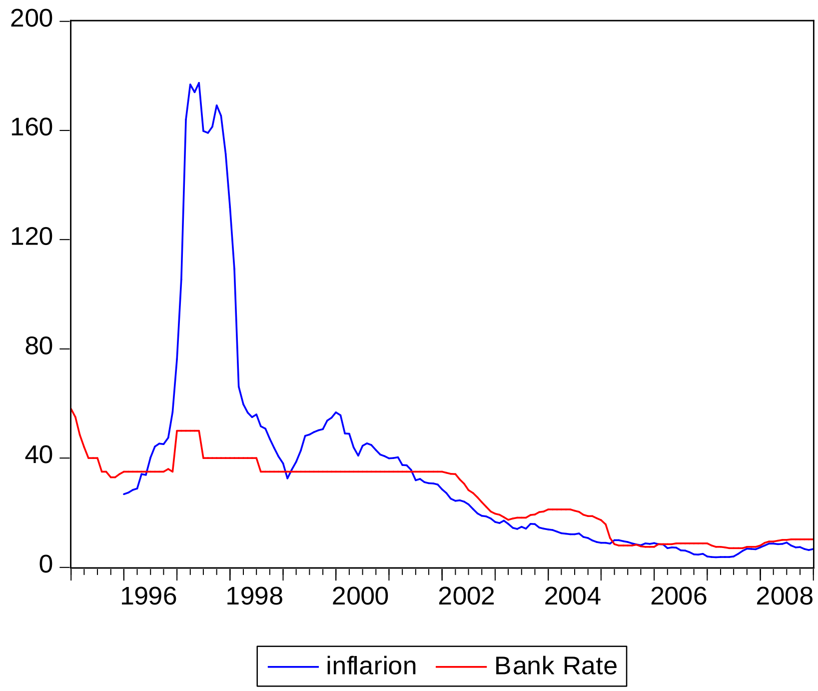
Inflation
Repo Rate


200
160
120
80
40
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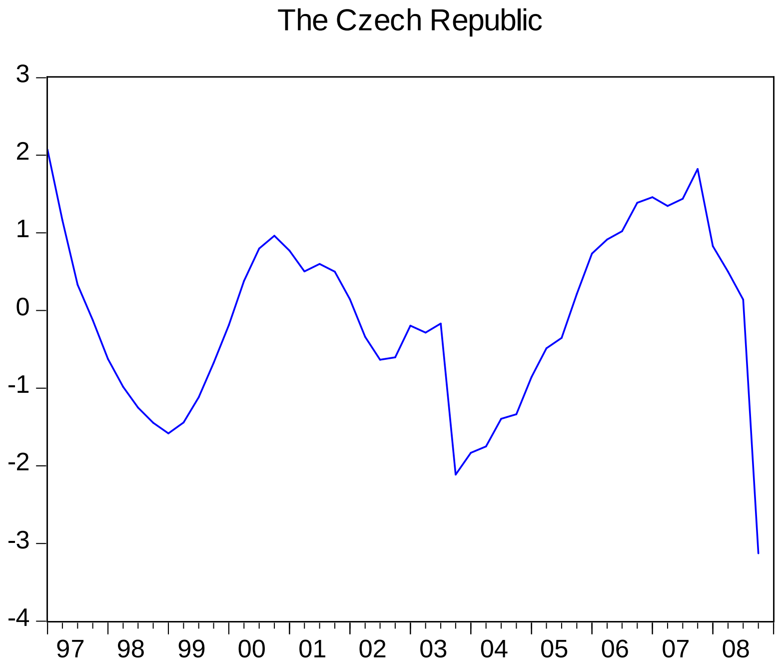
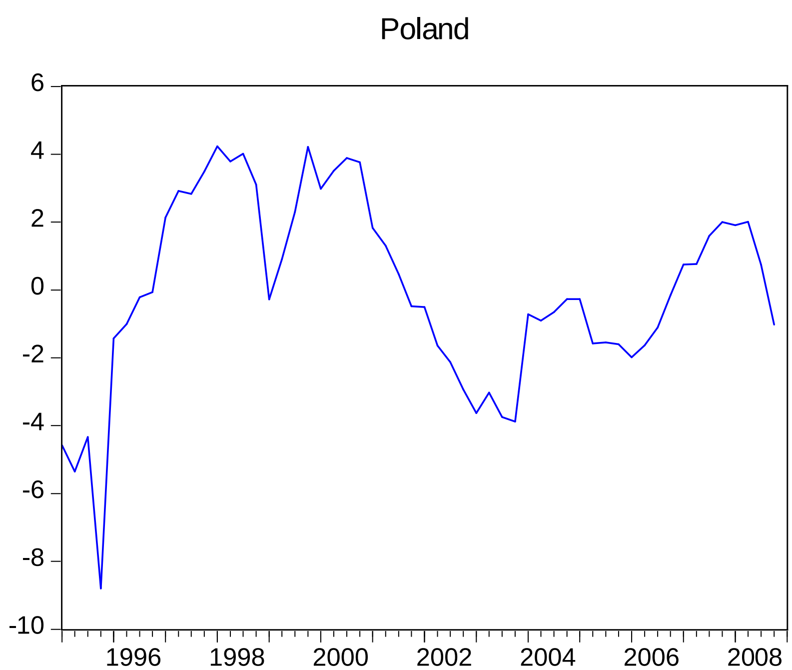
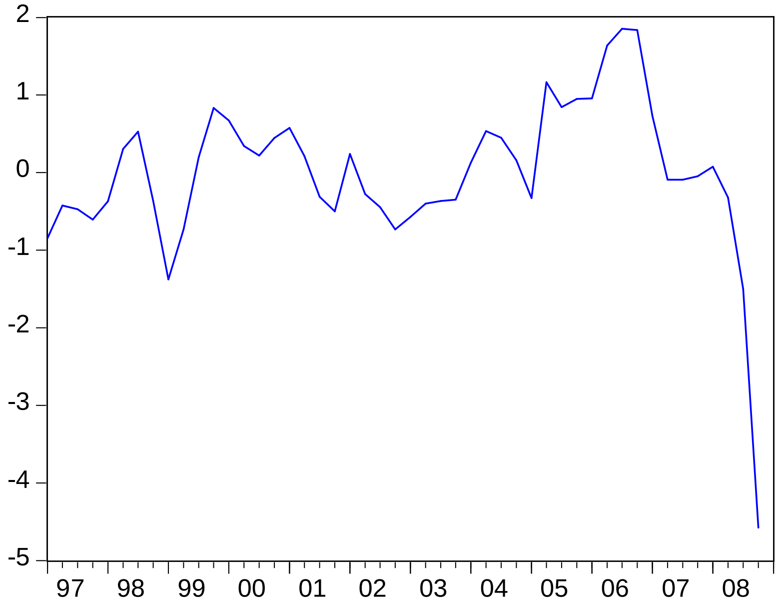
1996
1998
2000
2002
2004
2006
2008
inflarion
Bank Rate

Graph 2. GDP Gap.





Hungary



Romania