The time-varying policy neutral rate in real time

Horváth, Roman
2007

WORKING PAPER SERIES 4

2007

Roman Horváth:
The Time-Varying Policy Neutral Rate in Real Time: A Predictor for Future Inflation?

CZECH NATIONAL BANK

WORKING PAPER SERIES

The Time-Varying Policy Neutral Rate in Real Time: A Predictor for Future Inflation?

Roman Horváth

4/2007

CNB WORKING PAPER SERIES

The Working Paper Series of the Czech National Bank (CNB) is intended to disseminate the results of the CNB's research projects as well as the other research activities of both the staff of the CNB and collaborating outside contributor, including invited speakers. The Series aims to present original research contributions relevant to central banks. It is refereed internationally. The referee process is managed by the CNB Research Department. The working papers are circulated to stimulate discussion. The views expressed are those of the authors and do not necessarily reflect the official views of the CNB.

Printed and distributed by the Czech National Bank. Available at http://www.cnb.cz.

Reviewed by: Ian Babetskii (Czech National Bank)
Péter Benczúr (Hungarian National Bank)
Woon Gyu Choi (International Monetary Fund)

Project Coordinator: Juraj Antal

The Time-Varying Policy Neutral Rate in Real Time: A Predictor for Future Inflation?

Roman Horváth*

Abstract

This paper examines the time-varying policy neutral interest rate in real time for the Czech Republic in 2001:1-2006:09, estimating various specifications of simple Taylor-type monetary policy rules. For this reason, we apply a structural time-varying parameter model with endogenous regressors. The results indicate that the policy neutral rate gradually decreased over the sample period to levels comparable to those in the euro area. Next, we propose a measure of the monetary policy stance based on the deviation of the actual interest rate from the estimated policy neutral rate and find it a useful predictor of the level as well as the change of the future inflation rate.

JEL Codes: E43, E52, E58.
Keywords: Policy neutral rate, Taylor rule, time-varying parameter model with endogenous regressors.

---

* Roman Horváth, Czech National Bank; Institute of Economic Studies, Charles University (e-mail: roman.horvath@cnb.cz).
This work was supported by Czech National Bank Research.
I thank Juraj Antal, Ian Babetskii, Péter Benczúr, Martin Cincibuch, Woon Gyu Choi, Dana Hájková, Tomáš Holub, Anca Podpiera, Michal Ježek, Pavol Prievozník, Michal Skořepa, Guntram Wolff and the seminar participants at the Econometric Society - European Meeting, 11th International Conference on Macroeconomic Theory and Policy (Greece), DIW (Berlin), Czech National Bank, Czech Economic Society and Charles University (Prague) for helpful comments. All remaining errors are entirely my own. I am grateful to the Czech Economic Society for supporting this research. The views expressed in this paper are not necessarily those of the Czech National Bank.

Nontechnical Summary

This paper examines the fluctuations of the time-varying policy neutral interest rate for the Czech Republic in 2001:1-2006:09 within a simple Taylor-type monetary policy rules framework. Generally, these rules postulate that the central bank targets to set the nominal interest rate in line with the state of the economy (typically captured by inflation and output relative to their targeted values). To address the sensitivity of our results, the policy rule specifications differ according to whether we include real-time or ex-post revised data, employ backward or forward-looking monetary policy rules or vary the measure of the output gap.

The novelty of our approach lies in estimation of the policy neutral rate by a time-varying parameter model with endogenous regressors (Kim, 2006). Unlike the 'conventional' time-varying parameter model, this approach is robust to endogeneity of the explanatory variables, which is indeed relevant when estimating the monetary policy rules. While endogeneity is almost always accounted for in the literature on time-invariant monetary policy rules, as it is estimated by the generalized method of moments (GMM), it is almost never addressed in studies on time-varying policy rules.

The results indicate that the policy neutral rate decreases gradually over the course of the sample period from around 5% in 2001 to about 2.5% in 2006, showing substantial interest rate convergence to levels comparable to the euro area. Over the longer term, this trend may be supported by a number of economic factors such as capital accumulation, decrease in the risk premium, real equilibrium exchange rate appreciation as well as successful disinflation of the Czech economy and well-anchored inflation expectations.

One of our primary policy applications, besides measuring the policy neutral rate by a novel technique, is also to propose a measure of the monetary policy stance based on the deviation of the actual interest rate from the policy neutral rate. Our results suggest that this measure is quite useful in predicting future inflation developments, i.e. the monetary policy stance indicator affects the level as well as the change of the future inflation rate.

1. Introduction

Inflation targeting regimes are increasingly popular around the world. For example, regarding Central and Eastern Europe, while the first two countries adopted explicit inflation targeting regime back in 1998, there were already seven countries conducting inflation targeting in 2006 and others were contemplating doing so (International Monetary Fund, 2006).[1] A characteristic feature of inflation targeting is that central banks set the short-term nominal interest rate (path) so as to get inflation and output to their targeted levels. The level of interest rates that is associated with this objective is often labeled as the policy neutral rate.

In this regard, Woodford (2003) notes that central banks should on average track the policy neutral rate to stabilize the economy. In a similar fashion, Taylor (1999) emphasizes that the measurement of the policy neutral rate is one of the key issues for countries targeting inflation. In this respect, it is of great importance for central banks to identify as precisely as possible the policy neutral rate. This is quite an intricate exercise, as the policy neutral rate is unobservable; however its mis-measurement is high-priced, as it may result in over- or undershooting the inflation target.

In this light, it is quite striking that remarkably little evidence is available for Central and Eastern European Countries (CEECs) on the estimation of the policy neutral rate. While there are dozens of studies on *equilibrium exchange rates* in the new EU members, there is surprisingly very little evidence on *equilibrium interest rates* (Brzoza-Brzezina, 2006, seems to be the only exception, with evidence on Poland). This imbalance is rather paradoxical, as half the new EU members target inflation (Czech Republic, Hungary, Poland, Romania and Slovakia), for which the concept of the policy neutral rate is of primary importance for the conduct of monetary policy.[2] Consequently, this paper tries to bridge this gap.

This paper addresses the issue of policy neutral rate estimation in one of the new EU member states, the Czech Republic, based on various specifications of simple Taylor-type monetary policy rules. This former transition country provides an interesting case to evaluate the policy neutral interest rate, as one can expect a certain pattern in the path of nominal and real equilibrium interest rates over the longer term (note that the policy neutral rate is in fact the short-term nominal equilibrium interest rate; more on definitions below).

Lipschitz *et al.* (2006) point out that at the outset of the transition the capital/labor ratios were much lower than those in Western Europe and therefore the marginal product of capital and for that reason the real equilibrium interest rate were rather high. Given the capital accumulation over the course of the transition, there should be a tendency for the real equilibrium interest rate to decrease. From an open economy perspective, the new EU members exhibited falling exchange rate risk premium during their transition process to a market economy (Beneš and N'Diaye, 2004), which also puts downward pressure on real equilibrium interest rates (Archibald and Hunter, 2001). Analogously, it is a well-documented empirical regularity that these countries exhibit real equilibrium exchange rate appreciation (see Égert *et al.*, 2006 for a comprehensive

[1] The Czech Republic and Poland adopted inflation targeting in 1998, followed by Hungary in 2001, Romania and Slovakia in 2005 and Armenia and the Serbia in 2006 (note this is an updated list of Table 1 in IMF, 2006). Ukraine is likely to adopt inflation targeting in near future (IMF, 2006).

[2] See Coats *et al.* (2003) and Kotlan and Navratil (2003) on Czech monetary policy.

survey of the sources of appreciation). A decrease in the foreign equilibrium interest rate, which is reported by several authors for the euro area (e.g. Wintr *et al.*, 2005), may, especially in a small open economy, reduce the level of the domestic equilibrium interest rate as well. Additionally, the path of nominal equilibrium interest rates should reflect not only the decrease of real equilibrium rates, but also successful disinflation in transition countries (see Korhonen and Wachtel, 2006). All in all, the aforementioned arguments provide a rationale for modeling the policy neutral rate as time-varying.

In this paper we provide first an estimation of monetary policy rules with a time-varying intercept to assess the fluctuations of the policy neutral interest rate over time. The novelty of our approach lies in estimation of the policy neutral rate by the time-varying parameter model with endogenous regressors (Kim, 2006).[3] Unlike the 'conventional' time-varying parameter model[4], this approach is robust to endogeneity of the explanatory variables, which is indeed relevant when estimating the monetary policy rules. While endogeneity is almost always accounted for in the literature on time-invariant monetary policy rules, as it is estimated by the generalized method of moments (GMM), it is almost never addressed in studies on time-varying policy rules. An additional feature of this paper is that we utilize ex-post as well as real-time based data (see e.g. Orphanides, 2001, on real-time data analysis within a monetary policy rules framework), specifically the real-time output gap and real-time inflation forecast of the Czech National Bank (CNB), to estimate the monetary policy rules.

One of our primary policy applications, except for measuring the policy neutral rate by a novel technique, is also to propose a measure of the monetary policy stance based on the deviation of the actual interest rate from the estimated policy neutral rate. Anticipating our results, we find this measure of the monetary policy stance quite useful in predicting both the level and change of the future inflation rate.

The paper is organized as follows. Section 2 discusses related literature. Section 3 describes our data and empirical methodology. Section 4 gives the results of the estimation of time-varying estimates of the policy neutral rate as well as an analysis of the ability of the monetary policy stance to predict future inflation developments. Section 5 concludes. An appendix with additional results follows.

2. Related Literature

2.1 Methodological Background

It has been acknowledged in monetary economics for a long time that there exists some unobservable real interest rate that equilibrates aggregate demand and aggregate supply (Woodford, 2003). When the actual real interest rate is equal to the unobservable one, price stability is achieved. This unobservable rate is often labeled as the natural rate of interest or equilibrium interest rate. Equivalently, it has been noted that the equilibrium interest rate is the

[3] Note that in the working paper version of Kim (2006), this procedure is also labeled as the augmented Kalman filter.

[4] We label the time-varying parameter as conventional, when it does not account for endogeneity in the regressors hereinafter.

real interest rate that prevails when prices are fully flexible in all markets (Neiss and Nelson, 2003; Woodford, 2003).

Consequently, the equilibrium interest rate or natural rate of interest is a fairly general concept and in principle it may be well associated with short-term, medium-term or long-term interest rates. In this context, it is worth pointing out that the determinants of the equilibrium interest rate are likely to differ according to time horizon (different frequency movements). In the long-term, the level of the equilibrium interest rate is influenced by supply-side structural characteristics of economy such as long-run growth potential, which in turn depends on technological progress, population growth and inter-temporal substitution of consumption (Crespo-Cuaresma *et al.*, 2005). In the medium-term, the equilibrium interest rate is associated with business cycle fluctuations. In the short-term, the equilibrium interest rate is linked mainly to demand factors related to monetary policy and its targeting horizon (Archibald and Hunter, 2001). Here monetary policy may systematically influence inflation expectations and in turn the level of the short-term nominal equilibrium rate.

For the purposes of monetary policy conduct, it is vital to know which interest rate level the monetary authority should set in order to achieve price stability (i.e. neutral policy stance). As the primary monetary policy instrument is the level of the short-term interest rate, the equilibrium interest rate in this context is a rather short-term concept and is often labeled as the policy neutral rate (Coats *et al.*, 2003; Lam and Tkacz, 2004; Beneš *et al.*, 2005). The policy neutral rate thus represents the nominal equilibrium interest rate and is defined as the real equilibrium interest rate plus expected inflation (Coats *et al.*, 2003). In other words, the policy neutral rate is linked to the short-term nominal interest rate, over which the central bank has substantial control, and thus the policy neutral rate may be understood as a rather narrower concept in comparison to equilibrium interest rate and natural rate of interest.[5]

Should interest rate policy of the monetary authority strictly follow the neutral rate when targeting inflation? Not necessarily. The first point is that obviously there is uncertainty in policy neutral rate measurement. Second, and more importantly, there are shocks to which it is sub-optimal for the authority to react. More specifically, central banks may wish deliberately not to react to the first-round effects of cost-push shocks, as this can be destabilizing to the economy in the short run. This may, however, alter the inflation expectations of economic agents, if some fraction of them are myopic, and as a result, induce a change in the policy neutral rate. In such case, the central bank's interest rate policy may temporarily deviate from the policy neutral rate.

2.2 Methods for Natural Rate of Interest Estimation

Generally, there are several main methods for estimating the natural rate of interest (see e.g. Giammarioli and Valla, 2004, for a survey).[6] The simplest is to assume that the equilibrium is

[5] For convenience, we use policy neutral rate, natural rate of interest and equilibrium interest rate in the following text interchangeably to a certain extent. However, when we want to emphasize the short-run concept of it, we always use the term policy neutral rate.

[6] Note that we do not present the exhaustive list of methods for equilibrium interest rate estimation, for example Brzoza-Brzezina (2006) proposes a structural vector autoregression model in this regard. In general, the role of the equilibrium interest rate for monetary policy conduct is discussed extensively by Taylor (1993), Woodford (2003) and Amato (2005).

captured reasonably well by some univariate trend such as an HP filter. Nevertheless, a number of papers document that the estimates based on these filters are often misleading (Clark and Kozicki, 2005). In general, the limitations of the univariate methods have been pointed out by many authors (e.g. Canova, 1998).

Another method for deriving equilibrium interest rates is based on the estimation of a simple monetary policy rule of the central bank (Taylor, 1993). The reaction function typically associates short-term interest rate with its lagged value, the difference between inflation (forecast) and its target, and the output gap. The intercept of the estimated reaction function can be interpreted as the nominal equilibrium interest rate (that is, the interest rate that would prevail when inflation and output are at their targeted values). This method has been applied to estimate the equilibrium interest rates by e.g. Clarida *et al.* (1998, 2000) and Orphanides (2001) for the United States and Germany, Adam *et al.* (2005) for the United Kingdom, and Gerdesmeier and Roffia (2004, 2005) for the euro area. Nevertheless, the assumption of constant equilibrium interest rates is often found too restrictive over the longer term. Consequently, a number of studies model the equilibrium interest rate, or more generally the monetary policy rule as time-varying (see Plantier and Scrimgeour, 2002, Elkhoury, 2006, and Kim and Nelson, 2006). Typically, these studies find a rationale for modeling the rule as time-varying, given that the equilibrium interest rate sometimes fluctuates considerably over longer time horizons (as do other parameters in the policy rule). Generally, the monetary policy rules approach measures the behavior of the central bank and assumes that the central bank estimates equilibrium interest rates correctly. In case of systematic mis-measurement of equilibrium rates by the central bank, it is likely that the equilibrium rates retrieved from the estimation of the reaction function are mis-measured as well.

Structural time series models represent another common method for measuring equilibrium interest rates. The primary contribution in this area is Laubach and Williams (2003), who formulate a simple empirical model containing an IS curve, a Phillips curve and an equation linking the equilibrium interest rate to trend growth, and model equilibrium interest rates and potential output as unobserved components. Their method has gained popularity recently and has been applied by Manrique and Marques (2004) for the U.S. and Germany, Mesonnier and Renne (2007) for the euro area, and Wintr, Guarda and Rouabah (2005) for the euro area[7] and Luxembourg as well. In principle, the joint estimation of equilibrium interest rates and the output gap is an advantage of this approach; however it also reduces the degrees of freedom, which may be an issue for transition countries with rather short time series.

Equilibrium interest rates can also be estimated within stochastic dynamic general equilibrium models. The advantage of this type of literature is that it specifies the structure of the economy and thus in principle allows identification of a variety of shocks hitting the economy. On the other hand, Levin *et al.* (1999) find that more complex models seem to be less robust to model uncertainty (see also Giammarioli and Valla, 2004). Consequently, these model outcomes may be quite sensitive to model assumptions. The recent examples of this approach to estimating equilibrium interest rates include Giammarioli and Valla (2003), Neiss and Nelson (2003) and Smets and Wouters (2003).

[7] See Crespo-Cuaresma *et al.* (2004) on related estimates for the euro area using a somewhat different methodology.

The last major stream of literature estimates equilibrium interest rates from the yield curve and asset pricing models. Bomfim (2001) uses inflation linked bonds in order to eliminate the distortions from inflation expectations and retrieves equilibrium interest rates from the realized yields on U.S. Treasury inflation-indexed securities. In this regard, Giammarioli and Valla (2004) discuss equilibrium interest rate estimates in relation to consumption capital asset pricing models. Generally, this stream of literature hinges on the notion of liquid financial markets and thus this approach is viable mainly for countries with developed financial markets.

3. Data and Empirical Methodology

In this part, we discuss the methodology and dataset we employ to evaluate the policy neutral rate fluctuations in the Czech Republic. Specifically, we estimate a variety of backward or forward looking monetary policy rules with a time-varying policy neutral rate.

3.1 Monetary Policy Rules

A starting point for a formal derivation of the monetary policy rule is the reasonable assumption that the central bank targets to set the nominal interest rate in line with the state of the economy (see Clarida *et al*., 1998, 2000), as postulated in Eq. (1):

$$r_t^* = \bar{r} + \alpha\left(E\left\{\pi_{t+i}\middle|\Omega_t\right\} - \pi_{t+i}^*\right) + \beta E\left\{x_t\middle|\Omega_t\right\} \qquad (1)$$

where r_t^* denotes the targeted interest rate, $\bar{r}$ is the policy neutral rate, π_{t+i} stands for the central bank forecast of the yearly inflation rate *i* periods ahead, and π_{t+i}^* is the central bank's inflation target. x_t represents a measure of the output gap. $E(.)$ is the expectation operator and Ω_t is the information set available at the time when interest rates are set. Hereinafter, we set *i* either equal to 12 months to reflect the CNB's actual targeting horizon[8] or alternatively equal to 0, i.e. using the current inflation for the sensitivity analysis. Therefore, Eq. (1) links targeted nominal interest rates to a constant (i.e. the interest rate – policy neutral rate – that would prevail when expected inflation and output are at their targeted levels), the deviation of expected inflation from the target and the output gap.

Nevertheless, Eq. (1) is often argued to be too restrictive, as it does not account for interest rate smoothing of central banks. Clarida *et al.* (1998) assume that the central bank adjusts the interest rate sluggishly to the targeted value. This is so for a number of reasons. For example, Goodfriend (1991) puts forward concerns over the stability of financial markets. Sack (1997) highlights uncertainty about the effects of interest rate changes on the economy.[9] Instead of an explicit

[8] This is in line with the CNB main forecasting model – the Quarterly Prediction Model; see Coats *et al.*, 2003. The actual targeting horizon is 12-18 months, but due to data limitations we prefer to work with 12 months. In general, see Batini and Nelson, 1999, for contributions on the optimal targeting horizon. Note also that the policy neutral rate is defined as the real rate plus the expected inflation in period *t+k*, where *k* is given by the maturity of the interbank rate (in our case *k*=3). *k* is thus different from the forecasting horizon *i*. As argued by Clarida *et al.* (2000), this is not very relevant in practice, as the short-term interbank interest rates at various maturities are strongly linked together. Indeed, the correlation of 3M PRIBOR and 12M PRIBOR – to reflect that *i*=12 – stands at 0.99 in our sample.

[9] Nevertheless, Rudebusch (2006) recently questioned the extent of monetary policy inertia and argued that the inertia is rather low.

listing of various factors behind the interest rate smoothing, Clarida *et al.* (1998) assume for simplicity that the actual policy interest rate is a combination of its lagged value and the targeted policy rate as in Eq. (2).

$$r_t = \rho r_{t-1} + (1-\rho) r_t^* + \nu_t \qquad (2),^{10}$$

where $\rho \in [0,1]$. In line with Clarida *et al.* (1998), substituting Eq. (2) into Eq. (1) and eliminating unobserved forecast variables results in Eq. (3):

$$r_t = (1-\rho)\left[\bar{r} + \alpha\left(\pi_{t+i} - \pi^*_{t+i}\right) + \beta x_t\right] + \rho r_{t-1} + \varepsilon_t \qquad (3)$$

The disturbance term ε_t is a combination of forecast errors (i.e., $\varepsilon_t = -(1-\rho)[\alpha(\pi_{t+i} - E\{\pi_{t+i}|\Omega_t\}) + \beta(x_t - E\{x_t|\Omega_t\})]$) and is thus orthogonal to all information available at time t (Ω_t).

Next, in order to estimate the time-varying neutral policy rate we apply a structural time-varying coefficient model with endogenous regressors. Kim (2006) shows that the conventional time-varying parameter model delivers inconsistent estimates when explanatory variables are correlated with the disturbance term, which is indeed relevant when estimating policy rules. It is interesting to note that the correlation of π_{t+i} and x_t with ε_t in Eq. (3) is almost always taken into account in empirical work on time-invariant rules (as typically estimated by the GMM), while it is almost never considered in the literature on time-varying monetary policy rules (Kim and Nelson, 2006, seem to be the exception). Subsequently, Kim (2006) derives a consistent estimator of the time-varying parameter model when regressors are endogenous. In line with Kim (2006), we estimate the following empirical model:

$$r_t = (1-\rho)\left[\bar{r}_t + \alpha\left(\pi_{t+i} - \pi^*_{t+i}\right) + \beta x_t\right] + \rho r_{t-1} + \varepsilon_t \qquad (4)$$

$$\bar{r}_t = \bar{r}_{t-1} + \vartheta_t,\ \vartheta_t \sim i.i.d.N\left(0, \sigma^2_\vartheta\right) \qquad (5)$$

$$\pi_{t+i} = Z'_{t-j}\xi + \sigma_\varphi \varphi_t,\quad \varphi_t \sim i.i.d.N(0,1) \qquad (6)$$

$$x_t = Z'_{t-j}\psi + \sigma_\nu \nu_t,\ \nu_t \sim i.i.d.N(0,1) \qquad (7)$$

The measurement equation (4) is a Taylor rule with the policy neutral rate, $\bar{r}_t$, as outlined above. However, we relax here the assumption of a constant policy neutral rate and let it vary over time, $\bar{r}_t$, as specified in the transition equation (5), assuming a random walk process without drift.[11] Given the data limitations and the fact that our sample is characterized by a relatively stable

[10] We estimated the monetary policy rules including higher lags of interest rates, but failed to find them significant.

[11] We also experimented with an AR(1) structure in Eq. (5), but it just marginally reduced the likelihood and the estimated AR parameter was very close to one, anyway.

institutional structure as well as actual conduct of monetary policy, we do not allow α, β and ρ to be time-varying. The 'first-stage' Eqs. (6) and (7) lay out the relationship between the endogenous regressors (π_{t+i} and x_t) and their instruments, Z_t. The list of instruments, Z_{t-j}, is as follows: π_{t-1}, π_{t-2}, x_{t-1}, x_{t-2}, r_{t-1} and r_t^+ (foreign interest rate – 1YEURIBOR). We assume that the parameters in Eqs. (6) and (7) are time-invariant. Next, the correlation between the standardized residuals φ_t and ν_t and ε_t is $\kappa_{\varphi,\varepsilon}$ and $\kappa_{\nu,\varepsilon}$, respectively (note that σ_φ and σ_ν are standard errors of φ_t and ν_t, respectively). The consistent estimates of the coefficients in Eq. (4) are then obtained in two steps. In the first step, we estimate the equations (6) and (7) and save the standardized residuals φ_t and ν_t. In the second step, we estimate Eq. (8) along with Eq. (5) using maximum likelihood via the Kalman filter. Note that (8) now includes bias correction terms, (standardized) residuals from Eqs. (6) and (7), to address the aforementioned endogeneity of the regressors. Consequently, the estimated parameters in Eq. (8) are consistent, as ι_t is uncorrelated with the regressors.

$$r_t = (1-\rho)\left[\bar{r}_t + \alpha\left(\pi_{t+i} - \pi^*_{t+i}\right) + \beta x_t\right] + \rho r_{t-1} + \kappa_{\nu,\varepsilon}\sigma_{\varepsilon,t}\nu_t + \kappa_{\varphi,\varepsilon}\sigma_{\varepsilon,t}\varphi_t + \iota_t\,,$$

$$\iota_t \sim N\left(0,(1-\kappa^2_{\nu,\varepsilon} - \kappa^2_{\varphi,\varepsilon})\sigma^2_{\varepsilon,t}\right) \qquad (8)$$

Several authors (see for example Gerdesmeier and Roffia, 2004) raised the issue of including additional economic variables such as the (real) exchange rate or money growth in Eq. (3) to try to capture the state of the economy in a fuller manner. Nevertheless, this is typically done in an *ad hoc* manner. On the contrary, when the literature assumes that interest rates depend only on inflation and output, obviously it does not mean that other variables are neglected. For example, as Taylor (2001, p. 266) puts it for the exchange rate: *"Although the policy rule ... may not appear to involve interest rate reaction to exchange rate, it implies such a reaction. What might appear to be a closed economy policy rule is actually just as much an open economy rule as if the exchange rate appeared directly."* In other words, additional variables that do not enter Taylor rule directly may influence inflation and output and therefore the interest rate setting *indirectly*. It is also important to emphasize that CPI inflation targeting, as opposed to domestic inflation targeting, has an implicit concern for foreign shocks given the composition of the consumer basket (Svensson, 2000). Therefore, in our paper we do not introduce foreign disturbances explicitly in the monetary policy rule, but we will employ them as the instruments in our empirical specification.

Additionally, in a book describing the current forecasting and policy analysis process in the CNB, Coats *et al.* (2003) report that no other variables than inflation and the output gap enter into the monetary policy rule in the CNB Quarterly Projection Model (QPM hereinafter). In particular, as regards exchange rate fluctuations the CNB has stated several times that it does not directly react to them. It has acknowledged that the exchange rate plays an important role for inflation developments in small open economies and that it might react indirectly to exchange rate fluctuations if they jeopardize inflation developments (Kotlán and Navrátil, 2003). Regarding money aggregates, one can expect that an inflation targeting central bank in general views them as only supplementary information about the degree of economic activity and/or inflationary pressures, and also does not directly react to them.

Originally, the design of the Taylor rule lacked a forward-looking element characteristic of the modern monetary policy conduct. An additional way of assessing the sensitivity of our results is to estimate of both backward- and forward-looking Taylor-type rules. Therefore, we formulate the monetary policy rule in Eq. (3) in the case of backward-looking policy rule such that we set $i = 0$, i.e. we use current inflation rate instead of its forecasted value (which is utilized for the forward-looking policy rule). Another important point has been raised about the timeliness of information in monetary policy conduct (Orphanides, 2001). Output data are typically revised at a later stage, but monetary policy is conducted based on the information available at the time. Therefore, we collect real-time based CNB output gap estimates (note that inflation is not revised at a later stage by the Czech Statistical Office) and re-estimate the monetary policy rule with the real-time output gap. Analogously, we use one year ahead CNB's real-time inflation forecast in estimating the monetary policy rule.

There are further modeling issues stemming from the fact that the policy interest rate is not changed in a continuous fashion. For instance, the CNB Bank Board meets on a monthly basis to discuss the policy interest rate settings. Besides, the policy rate change itself is not continuous. Typically, if the rates are changed, the respective magnitude is 0.25 percentage points (or some multiple of 0.25), even if the change maximizing economic stability according to the model-based forecast might be of a (slightly) different magnitude. In consequence, the policy rate is not only discrete, but also censored. Given the inherent censoring of policy interest rates, the majority of authors, such as Clarida *et al.* (1998, 2000) and Adam *et al.* (2005), rely on using the 3-month interbank rate as an approximation of the censored policy rate.

On the other hand, Choi (1999) and Carstensen (2006) put forward modeling censoring in the policy rate directly by employing for example a modified Tobit model and an ordered probit model, respectively. The advantage of this approach is that it models the interest rate setting more realistically and does not have to make a simplifying assumption by utilizing the short-term interbank rate. On the other hand, this stream of literature so far models only censoring in the policy rate, but it has been stressed that there is also censoring in the policy rate change (Podpiera, 2006). In addition, censored models are known to be less efficient and the results based on them do not seem to stand up in sharp contrast to those using short-term interbank rates (for example, consider the extent of interest rate smoothing). An additional drawback of this approach in our case is that our main estimation technique is a time-varying parameter model with endogenous regressors (Kim, 2006) and to our knowledge this technique is simply not available with a censored dependent variable. Besides, the CNB's QPM also uses the 3-month interbank rate instead of the 2-week policy rate as well. Having all the pros and cons of these two approaches – short-term interbank rate vs. policy interest rate – in mind, we opt to use the short-term interbank rate in the estimation of the monetary policy rules.

3.2 Data

Our sample contains monthly data over the period 2001:1-2006:09 on yearly CPI inflation ($\pi_t = p_t - p_{t-12}$, where p_t is the log of the price level at time *t*), yearly net inflation (price indexes of regulated goods excluded from the price index; thus $\pi_t^{net} = p_t^{net} - p_{t-12}^{net}$, where p_t^{net} is the log of the net price level at time *t*), the output gap (x_t ,the difference between actual and potential GDP growth, defined as below), r_t, the short-term interbank rate (3M PRIBOR), the real effective exchange rate, $(reer_t)$, and r_t^+, the foreign interest rate (1YEURIBOR). We also use the real-time CNB internal forecasts of CPI $\left(\pi_{t+12}^{f}\right)$ and net inflation $\left(\pi_{t+12}^{net,f}\right)$, and the output gap. Three different estimates of the output gap are employed: a) the estimate using HP filter[12], b) the ex-post revised output gap from the CNB's QPM as of their October 2006 forecast round and c) the real-time based output gap collected from the CNB's QPM. The source of our data is the CNB public database system ARAD (except for inflation forecasts and the two aforementioned output gap measures – b) and c), which are not available publicly).

All our variables are available on a monthly basis, except the output gap. Following Adam *et al.* (2005), we linearly interpolate quarterly estimates of the output gap to monthly values.[13] We use the mid-points of the CNB inflation target. The choice of the 2001-2006 period is motivated to have as long a sample period as possible, while not rejecting stationarity of all variables at the 5% significance level (using the KPSS test). More importantly, the real-time output gap and inflation forecast are not available before 2001. As a further robustness check, we also estimate the monetary policy rules with net inflation (based on price indexes excluding regulated goods from the consumer basket) instead of CPI inflation.[14]

4. Results

4.1 Time-varying Equilibrium Interest Rates

Generally, we find that the policy neutral rate decreases over time, as depicted in Chart 1. This is in line with our conjecture laid out in the introduction. We report all specifications, from the backward-looking policy rule with the output gap estimated by the HP filter to the forward-looking rule with the real-time output gap.

The results in Chart 1 unambiguously indicate that the policy neutral rate gradually decreased from around 5% to values around 2% at the end of 2005 and subsequently slightly increased to around 2.5% over the course of 2006.[15] This confirms substantial interest rate convergence to levels comparable to the euro area countries. For example, Messonier and Renne (2007) estimate the euro area real equilibrium interest rate around 1% at the end of their sample (i.e. 2002) and Wintr *et al.* (2005) find it to have been just below 1% in 2004. If we add to these estimates 2% for

[12] The standard smoothing parameter of 14440 has been used. Different smoothing parameters, such as the one suggested by Ravn and Uhlig (2002), had very little impact on the resulting estimates of the policy neutral rate. The output gap derived from HP filter estimates of potential output differs considerably from those used by the CNB – see Chart B.2 in the Appendix. Note that the output gap from the CNB's QPM is constructed using a multivariate Kalman filter. Generally, output gap estimates based on the HP filter can be viewed as less reliable, but we keep them in our empirical work, as this gap is replicable based on publicly available data, which is not the case with the two other output gap measures derived from the CNB's QPM. Note also that the HP filter is known to suffer from end-point bias, making it cumbersome for real-time analysis.

[13] We also used a quadratic match procedure for interpolation. This yields only little differences for the resulting output gap estimates. We are aware that interpolation introduces information not available at the time in the case of the output gap.

[14] These results are available upon request. As net inflation is largely correlated with headline CPI inflation (a value of 0.93 in our sample), it is not surprising that the results are quite similar.

[15] The increase at the end of sample period is likely to reflect higher inflation expectations of economic agents. The CNB conducts regularly a survey on inflation expectations of financial markets, households and non-financial firms (actual numbers are easily available from CNB website within their public database ARAD). Inflation expectations of financial markets for the 1 year horizon have risen from some 2.5% in mid 2005 to 3% over the course of 2006. Similar pattern is visible also for household's and firm's expectations.

expected inflation – to reflect the European Central Bank definition of price stability, we receive an estimate of the policy neutral rate of about 3% for the euro area. The results actually suggest that the Czech policy neutral rate seems to be slightly below the euro area level. This should not come as a surprise, as actual short-term interest rates were also often below those in the euro area (except for several months in 2004, Czech rates appear to be below euro area rates from around mid-2002 onwards).

Detailed parameter estimates of the monetary policy rules are presented in the Appendix – Table A.2. The degree of interest rate smoothing falls considerably when allowing for time-varying parameter specification. Compared to the case of the constant policy neutral assumption, which is estimated by the GMM[16], the value of the interest rate smoothing parameter falls from around 0.9 to 0.4. Time-invariant rules thus appear to overestimate substantially the degree of interest rate smoothing. This complies with the results of Rudebusch (2006), who stresses that once one accounts for expectations about future monetary policy, the actual policy rate inertia is in fact quite low. The standard errors of the estimates are in some cases large, probably reflecting the smaller sample size. The coefficient on inflation is around 0.3 in the case of the backward-looking specifications (interestingly, it is significant only when we introduce bias correction terms, φ_t and ν_t), and insignificant for the forward-looking specifications. The coefficient on the output gap is around 0.6 when it is significant; otherwise it is smaller for other specifications.

Additionally, the results support the usefulness of applying the time-varying parameter model with endogenous regressors. The bias correction terms, φ_t and ν_t, in Eq. (8), are typically significant and the log likelihood improves after their inclusion. Comparing the estimated policy neutral rate with those implied by the conventional time-varying parameter model, we find that the resulting difference between these two varies according to the specification of the policy rule as well as over time. While the median difference is only 0.05 p.p. in absolute terms, the maximum difference that the inclusion of bias correction terms amounts to is 1.8 p.p.

Chart 3 in the Appendix presents a comparison of the policy neutral rate based on an identical specification of the policy rule, but estimated either by the time-varying parameter model with endogenous regressors or by the conventional time-varying parameter model. Denoting the policy neutral rate estimated by the former method, $\bar{r}_{t,er}$, and the latter method, $\bar{r}_{t,c}$, Chart A.3 reports the difference between these two. Obviously, if $\bar{r}_{t,er} - \bar{r}_{t,c} = 0$, the bias correction terms do not matter at all.[17] However, we can see from the results that although the two methods yield in general rather similar estimates of the policy neutral rate path, there are periods when the bias correction terms matter considerably, i.e. when the policy neutral rate estimates by the conventional time-varying parameter model do not even lie inside the confidence interval of the policy neutral rate estimated by the time-varying parameter model with endogenous regressors, as shown in Chart A.3.

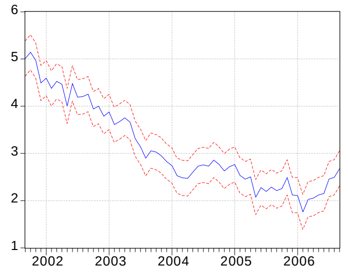
[16] The GMM results are available upon request.

[17] Obviously, it might be the case that both bias correction terms are statistically significant, but they just "cancel out" their impact on the estimated policy neutral rate. The probability of "canceling out" for each month is virtually zero.

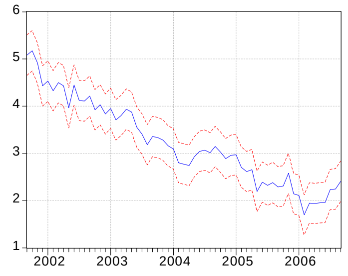
Figure 1: Policy Neutral Rate Estimates

Time-varying parameter model with endogenous regressors

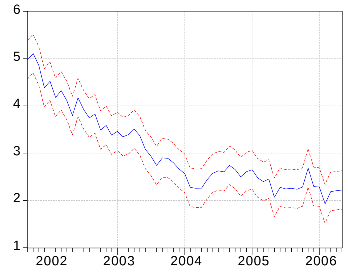
Backward-looking policy rule



Current inflation, output gap – HP filter

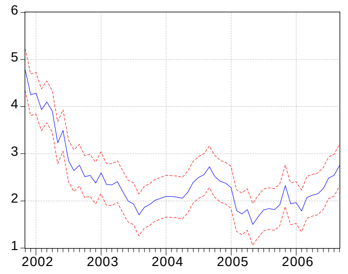


Current inflation, output gap – ex-post

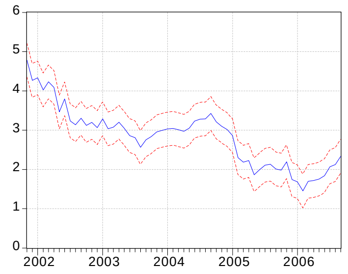


Current inflation, output gap – real-time

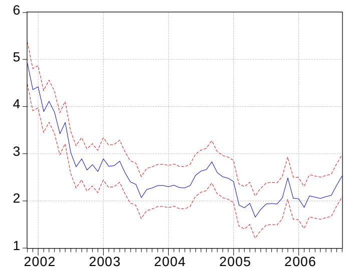
Forward-looking policy rule



Inflation forecast – real-time, output gap – HP filter



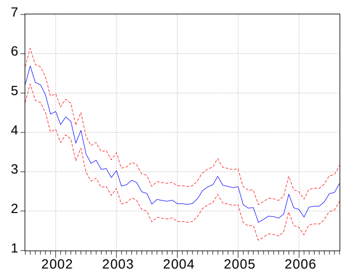
Inflation forecast – real-time, output gap – ex-post



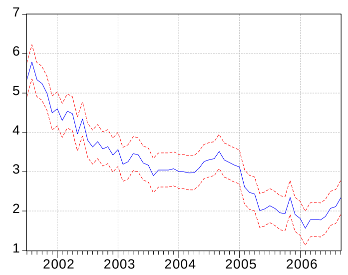
Inflation forecast – real-time, output gap – real-time

'Conventional' time-varying parameter model

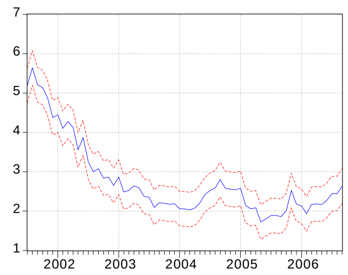
Backward-looking policy rule



Current inflation, output gap – HP filter

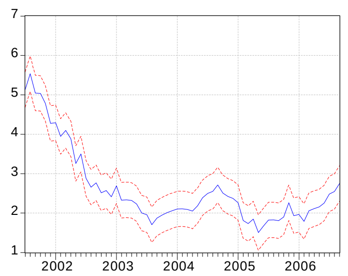


Current inflation, output gap – ex-post

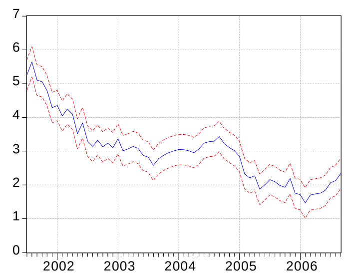


Current inflation, output gap – real-time

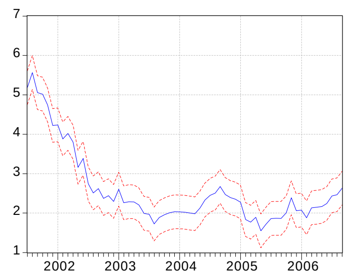
Forward-looking policy rule



Inflation forecast – real-time, output gap – HP filter



Inflation forecast – real-time, output gap – ex-post



Inflation forecast – real-time, output gap – real-time

Note: The policy neutral rate ±2 standard errors is reported. The measure of the output gap and inflation used for estimation of the policy neutral rate is reported below each chart. The time-varying parameter model is labeled as conventional when it does not account for endogeneity of regressors.

4.2 Monetary Policy Stance and Inflation Developments

There is a discussion in the literature about to what extent monetary policy rules provide a useful framework to evaluate the monetary policy stance and its impact on subsequent inflation. This is typically done by comparing the actual interest rate setting with the one implied by the rule and inflation outcomes. For example, Taylor (1999, p. 340) labels the difference as the policy mistakes (i.e. the residual from the policy rule) and shows that they are well associated with high inflation or low capacity utilization with the U.S. data. On the other hand, Reynard (2007), analyzing the U.S. and Swiss data, questions the reliability of the so-called policy mistakes, as he observes rather weak link between so-called policy mistakes and inflation relative to the inflation target.

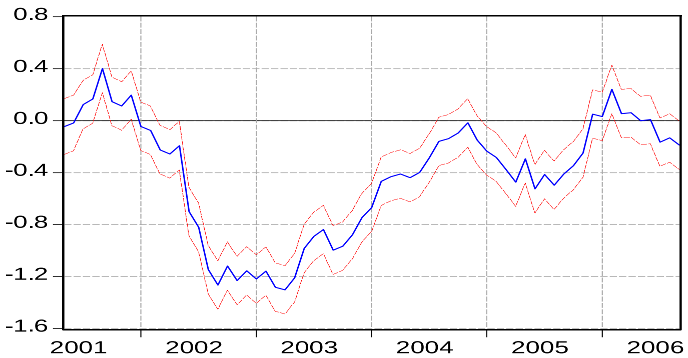
Here we propose a rather different framework to evaluate the usefulness of policy rules. Instead of focusing on the residual from the policy rule, we analyze the deviation of actual interest rates from the policy neutral rate ("equilibrium rate") and its impact on subsequent inflation. We leave examination of the link between policy mistakes and inflation outcomes for further research, as we do not concentrate in this paper on whether the estimated monetary policy rule provides an accurate description of CNB policy, but rather on the estimation and evolution of the policy neutral rate. Implicitly, by carrying out this estimation we also address the issue of the uncertainty surrounding with equilibrium interest rate measurement (see Laubach and Williams, 2003, or Herrmann, Orphanides and Siklos, 2005, on this uncertainty). In this regard, Amato (2005) emphasizes that the uncertainty in neutral rate estimates makes it difficult to use them as a reliable indicator of excess demand pressures, but the theories of neutral interest rates still remain a useful concept for the formulation of monetary policy.

So, our simple test here is to examine whether our estimated policy neutral rate is helpful in predicting future inflation developments. If the policy neutral rate is too uncertain a measure, then it is more likely that it does not provide information for subsequent inflation. Our supposition is thus that when the actual interest rate is above the policy neutral rate, the future inflation rate is then likely to fall, as monetary policy can be considered restrictive, and *vice versa*. We label the difference between the actual interest rate and the policy neutral rate as the monetary policy stance hereinafter.

The generic monetary policy stance is plotted in Chart 2.[18] As we also have confidence intervals for the policy neutral rate, it is possible to evaluate whether the stance was statistically different from zero. The results indicate that monetary policy during the sample period can be regarded as relatively easy, especially around the years 2002-2003. This should not come as a surprise, since inflation was well below the target and even got into negative numbers for several months in 2003 and the output gap was negative, reaching its minimum in mid-2003 according to the CNB output gap estimates (see Chart A.1).

[18] The monetary policy stance presented in Chart 2 is based on a monetary policy rule specification with an inflation forecast and an ex-post GDP gap. Different specifications play a rather minor role in the overall assessment of the monetary policy stance. In addition, it is interesting to note that the significance of monetary policy stance is not affected by whether we employed the backward or the forward looking policy rule.

Figure 2: Monetary Policy Stance



Note: Positive values refer to monetary policy tightening, while negative values point to policy easing.

As there are transmission lags between a monetary policy action and its impact on the bank's targeted variables, we assume that the current monetary policy stance affects inflation after 12 to 24 months. This coincides well with the CNB monetary policy horizon, as the bank acknowledges that *"…interest rate changes have their greatest impact on inflation some 12 to 18 months …"* (CNB). It is also supported by the empirical findings of Borys-Morgese and Horvath (2007). Within their factor augmented VAR framework, they find that the peak response of inflation to interest rate shocks is around a year or so (note the maximum reaction of non-tradable inflation is found to be close to two years). Based on this evidence, it seems to be fruitful to analyze the horizon between about one and two years. Here we broadly follow the empirical specification by Moser *et al.* (2007), which is a variant of Stock and Watson (1999). While these two studies examine the role of factor models for inflation forecasting, we analyze the impact of the monetary policy stance instead. More specifically, we test the significance of monetary policy stance indicator, including it in an autoregressive-type model for the inflation process.

Our estimation framework begins with the following regression:

$$\pi_{t+i} = \phi_0 + \phi_1 \left(\left(r_t - \bar{r}_t \right) \Big/ \bar{r}_t \right) + \upsilon_{t+i} \qquad (9)$$

where π_{t+i} is yearly inflation i months ahead, where i=12,….,24. Next, we control for the lagged inflation terms:

$$\pi_{t+i} = \phi_0 + \phi_1 \left(\left(r_t - \bar{r}_t \right) \Big/ \bar{r}_t \right) + \sum_{h=1}^{n} \phi_{h+1} \pi_{t-h} + \upsilon_{t+i} \qquad (10)$$

where for simplicity we set n=4.[19]

Using Eqs. (9) and (10), we investigate the information content of the monetary policy stance on the future level of inflation. We also re-specify the above equations to address the future change in the inflation rate as follows:

[19] We also included higher lags, but with little impact on the results.

$$\pi_{t+i} - \pi_t = \phi_0 + \phi_1\left(\left(r_t - \bar{r}_t\right)\Big/\bar{r}_t\right) + \upsilon_{t+i} \quad (11)$$

$$\pi_{t+i} - \pi_t = \phi_0 + \phi_1\left(\left(r_t - \bar{r}_t\right)\Big/\bar{r}_t\right) + \sum_{h=1}^{n}\phi_{h+1}\pi_{t-h} + \upsilon_{t+i} \quad (12)$$

Table 1: Monetary Stance and Future Level of Inflation

$$\pi_{t+i} = \phi_0 + \phi_1\left(\left(r_t - \bar{r}_t\right)\Big/\bar{r}_t\right) + \upsilon_{t+i}$$

i	ϕ_0	ϕ_1	**Adj. R^2**
12	1.43***	-6.89	0.07
13	1.31***	-9.91*	0.15
14	1.26***	-11.30**	0.19
15	1.26***	-11.58**	0.20
16	1.22***	-13.23**	0.27
17	1.20***	-14.31***	0.32
18	1.23***	-13.93***	0.31
19	1.14***	-16.02***	0.39
20	1.18***	-15.81***	0.39
21	1.25***	-14.81***	0.36
22	1.31***	-13.82**	0.32
23	1.42***	-12.54**	0.30
24	1.57***	-10.16*	0.21

Note: Robust standard errors. ***, ** and * indicate significance at 1, 5 and 10%, respectively.

Table 2: Monetary Stance and Future Level of Inflation, Controlling for Lagged Inflation

$$\pi_{t+i} = \phi_0 + \phi_1\left(\left(r_t - \bar{r}_t\right)\Big/\bar{r}_t\right) + \sum_{h=1}^{n}\phi_{h+1}\pi_{t-h} + \upsilon_{t+i}$$

i	ϕ_0	ϕ_1	ϕ_2	ϕ_3	ϕ_4	ϕ_5	**Adj. R^2**
12	2.33***	-0.94	0.03	0.04	0.07	-0.48	0.33
13	1.95**	-2.49	-0.11	0.19	-0.06	-0.33	0.41
14	1.67*	-3.59	-0.14	0.04	0.19	-0.36	0.46
15	1.49	-4.26	-0.25	0.24	-0.07	-0.15	0.48
16	0.66	-6.86**	-0.09	-0.07	-0.22	0.30	0.52
17	0.02	-8.89***	-0.25	-0.16	0.14	0.31	0.57
18	-0.33	-9.98***	-0.55***	0.19	0.14	0.33	0.60
19	-1.05	-12.12***	-0.57***	0.20	0.27	0.36	0.63
20	-1.12	-12.27***	-0.62**	0.36	0.17	0.38	0.60
21	-0.78	-11.09**	-0.46	0.18	0.21	0.34	0.51
22	-0.57	-10.31**	-0.42**	0.25	-0.09	0.52	0.45
23	-0.48	-9.86**	-0.26	-0.06	0.01	0.61*	0.41
24	-0.53	-9.89**	-0.40	0.12	-0.12	0.73*	0.39

Note: Robust standard errors. ***, ** and * indicate significance at 1, 5 and 10%, respectively.

Table 3: Monetary Stance and Future Change of Inflation

$$\pi_{t+i} - \pi_t = \phi_0 + \phi_1 \left(\left(r_t - \bar{r}_t \right) \Big/ \bar{r}_t \right) + \upsilon_{t+i}$$

i	ϕ_0	ϕ_1	Adj. R^2
12	-3.04***	-15.39***	0.53
13	-3.29***	-16.55***	0.57
14	-3.48***	-17.47***	0.59
15	-3.54***	-17.77***	0.59
16	-3.58***	-18.01***	0.60
17	-3.60***	-18.09***	0.60
18	-3.56***	-17.93***	0.59
19	-3.60***	-18.05***	0.60
20	-3.54***	-17.81***	0.60
21	-3.42***	-17.24***	0.60
22	-3.28***	-16.62***	0.58
23	-3.10***	-15.88***	0.56
24	-2.89***	-15.11***	0.53

Note: Robust standard errors. ***, ** and *indicate significance at 1, 5 and 10%, respectively.

Table 4: Monetary Stance and Future Change of Inflation, Controlling for Lagged Inflation

$$\pi_{t+i} - \pi_t = \phi_0 + \phi_1 \left(\left(r_t - \bar{r}_t \right) \Big/ \bar{r}_t \right) + \sum_{h=1}^{n} \phi_{h+1} \pi_{t-h} + \upsilon_{t+i}$$

i	ϕ_0	ϕ_1	ϕ_2	ϕ_3	ϕ_4	ϕ_5	Adj. R^2
12	2.12***	-1.26	-1.11***	-0.08	0.53*	-0.59	0.82
13	1.62*	-3.18	-1.26***	0.05	0.43	-0.42	0.84
14	1.41	-4.06	-1.28***	-0.11	0.67*	-0.46	0.85
15	1.44	-4.10	-1.41***	0.08	0.46	-0.33	0.86
16	0.56	-6.82*	-1.24***	-0.23	0.33	0.13	0.86
17	-0.08	-8.89**	-1.41***	-0.31	0.69**	0.14	0.89
18	-0.33	-9.70***	-1.72***	0.05	0.68*	0.14	0.89
19	-1.13	-12.05***	-1.74***	0.07	0.80**	0.19	0.88
20	-1.19	-12.20***	-1.79***	0.23	0.70*	0.20	0.87
21	-0.86	-11.03***	-1.63***	0.02	0.77*	0.16	0.86
22	-0.67	-10.31***	-1.61***	0.12	0.45	0.36	0.85
23	-0.49	-9.55***	-1.45***	-0.13	0.42	0.48*	0.85
24	-0.51	-9.49***	-1.57***	0.02	0.32	0.59**	0.86

Note: Robust standard errors. ***, ** and *indicate significance at 1, 5 and 10%, respectively.

The results from Eq. (9) are given in Table 1. Our definition of the monetary policy stance seems to be informative for future inflation, explaining typically about 1/3 of its variance. These results are largely confirmed when controlling for the lagged inflation terms, as suggested by the estimation of Eq. (10) presented in Table 2. The results suggest that when the actual interest rate is 10% above the policy neutral rate, inflation is likely to fall by about 1 p.p. at the monetary policy horizon. Similarly, the policy neutral rate seems to be a relatively good predictor of the future change of the inflation rate, as presented in Table 3. This result is largely robust to the inclusion of lagged inflation as well (see Table 4). All in all, the results support the usefulness of the policy neutral rate in understanding the future behavior of inflation.[20]

5. Conclusions

This paper analyzes the policy neutral rate in the Czech Republic. In order to do so, we estimate various specifications of simple Taylor-type monetary policy rules at monthly frequency from 2001:1 to 2006:9. To address the sensitivity of results, the specifications differ based on whether we include real-time or ex-post revised data, employ backward or forward-looking monetary policy rules or vary the measure of the output gap.

As we focus on the fluctuations of the policy neutral rate over time, we use a time-varying parameter model with endogenous regressors (Kim, 2006). This approach is especially appealing for estimating monetary policy rules, as it addresses the endogeneity of inflation (forecast) and output gap. Indeed, the results support the usefulness of applying the time-varying parameter model with endogenous regressors. The bias correction terms, accounting for the endogeneity of the regressors, are typically significant. The log likelihood improves after their inclusion and the estimated path of the policy neutral rate is for certain periods considerably different from the estimates ignoring the endogeneity.

The results indicate that the policy neutral rate decreases gradually over the course of the sample period from around 5% in 2001 to about 2.5% in 2006, showing substantial interest rate convergence to levels comparable to the euro area. Over the longer term, the decrease may be supported by a number of factors such as capital accumulation, decrease in the risk premium, real equilibrium exchange rate appreciation as well as successful disinflation of the Czech economy and well-anchored inflation expectations.

One of our primary policy applications, besides measuring the policy neutral rate by a novel technique, is also to propose a measure of the monetary policy stance based on the deviation of the actual interest rate from the policy neutral rate. Our results indicate that this measure is quite useful in predicting future inflation developments, i.e. the monetary policy stance indicator affects the level as well as the change of the future inflation rate. In terms of future research, it would be interesting to see more evidence on other inflation targeting countries to uncover whether our proposed monetary policy stance measure remains a useful predictor of future inflation developments, as we find in the case of the Czech Republic.

[20] We also tested the robustness of our results by including other macroeconomic variables in Eqs. (10) and (12) such as the real effective exchange rate, credit and monetary aggregates. The results remain largely unchanged and are available upon request.

References

ADAM, CH., D. COBHAM, AND E. GIRARDIN (2005): "Monetary Frameworks and Institutional Constraints: UK Monetary Policy Reaction Functions, 1985-2003." Oxford Bulletin of Economics and Statistics 67, 497-516.

AMATO, J. (2005): "The Role of Natural Rate of Interest in Monetary Policy." CESifo Economic Studies 51, 729-755.

ARCHIBALD, J. AND L. HUNTER (2001): "What is the Neutral Interest Rate, and How Can We Use It?" Reserve Bank of New Zealand Bulletin 64, 15-28.

BATINI, N. AND E. NELSON (1999): "Optimal Horizons for Inflation Targeting." *Journal of Economic Dynamics and Control* 25, 891-910.

BENEŠ, J. AND P. N'DIAYE (2004): "A Multivariate Filter for Measuring Potential Output and the NAIRU: Application to the Czech Republic." IMF Working Paper, No. 04/45.

BENEŠ, J., T. HLÉDIK, M. KUMHOF, AND D. VÁVRA (2005): "An Economy in Transition and DSGE: What the Czech National Bank's New Projection Model Needs." Czech National Bank Working Paper Series, No. 12/2005.

BOMFIM, A.N. (2001): "Measuring Equilibrium Real Interest Rates: What Can We Learn from Yields on Indexed Bonds?" Board of Governors of the Federal Reserve System, mimeo.

BORYS M.M. AND R. HORVATH (2007): "The Effects of Monetary Policy in the Czech Republic: An Empirical Study." IES Working Paper, Charles University, No. 26/2007.

BRZOZA-BRZEZINA, M. (2006): "The Information Content of Neutral Rate of Interest". *Economics of Transition* 14, 391-412.

CANOVA, F. (1998): "Detrending and Business Cycle Facts." *Journal of Monetary Economics* 41, 475-512.

CARSTENSEN, K. (2006): "Estimating the ECB Policy Reaction Function." *German Economic Review* 7, 1-34.

CHOI, W.G. (1999): "Estimating the Discount Rate Policy Reaction Function of the Monetary Authority." *Journal of Applied Econometrics* 14, 379-401.

CLARIDA, R., J. GALI, AND M. GERTLER (1998): "Monetary Policy Rules in Practice: Some International Evidence." *European Economic Review* 42, 1033-1067.

CLARIDA, R., J. GALI, AND M. GERTLER (2000): "Monetary Policy Rules and Macroeconomic Stability: Evidence and Some Theory." *The Quarterly Journal of Economics* 115, 147-180.

CLARK, T.E. AND S. KOZICKI (2005): "Estimating Equilibrium Real Interest Rates in Real Time." *North American Journal of Economics and Finance* 16, 395-413.

COATS, W., D. LAXTON, AND D. ROSE (Eds.) (2003): "The Czech National Bank's Forecasting and Policy Analysis System." Czech National Bank (available at www.cnb.cz).

CRESPO-CUARESMA, J., E. GNAN, AND D. RITZBERGER-GRUENWALD (2004): "Searching for the Natural Rate of Interest: A Euro Area Perspective." *Empirica* 31, 185-204.

CRESPO-CUARESMA, J., E. GNAN, AND D. RITZBERGER-GRUENWALD (2005): "The Natural Rate of Interest - Concepts and Appraisal for the Euro Area." *Monetary Policy and the Economy* 4/2005, Oesterreichische Nationalbank.

CZECH NATIONAL BANK, Inflation Reports, various issues.

ÉGERT, B., L. HALPERN AND R. MACDONALD (2006): "Equilibrium Exchange Rates in Transition Economies: Taking Stock of the Issues." *Journal of Economic Surveys* 20, 257-324.

ELKHOURY, M. (2006): "Time-Varying Parameter Model of a Monetary Policy Rule in the Switzerland." HEI Working Paper, No.01, Geneva.

GERDESMEIER, D. AND B. ROFFIA (2004): "Empirical Estimates of Reaction Functions for the Euro Area." *Swiss Journal of Economics and Statistics* 140, 37-66.

GERDESMEIER, D. AND B. ROFFIA (2005): "The Relevance of Real-Time Data in Estimating Reaction Functions for the Euro Area." *North American Journal of Economics and Finance* 16, 293-307.

GIAMMARIOLI, N. AND N. VALLA (2003): "The Natural Real Rate of Interest in the Euro Area." European Central Bank Working Paper, No. 233.

GIAMMARIOLI, N. AND N. VALLA (2004): "The Natural Real Interest Rate and Monetary Policy: A Review." *Journal of Policy Modeling* 26, 641-660.

GOODFRIEND, M. (1991): "Interest Rates and the Conduct of Monetary Policy." Carnegie-Rochester Conference Series on Public Policy 34, 7-30.

HERRMANN, H., A. ORPHANIDES, AND P. SIKLOS (2005): "Real-Time Data and Monetary Policy." *North American Journal of Economics and Finance* 16, 271-276.

INTERNATIONAL MONETARY FUND (2006): *Inflation Targeting and the IMF*. IMF: Washington D.C.

KIM, C.-J. (2006): "Time-Varying Parameter Models with Endogenous Regressors." *Economics Letters* 91, 21-26.

KIM, C.-J. AND C.R. NELSON (2006): "Estimation of a Forward-Looking Monetary Policy Rule: A Time-Varying Parameter Model Using Ex-post Data." *Journal of Monetary Economics* 53, 1949-1966.

KORHONEN, I. AND P. WACHTEL (2006): "Observations on Disinflation in Transition Economies." In: Altig, David, Nosal, Ed, (Eds.) *Monetary Policy in Low Inflation Economies*. Cambridge University Press: Cambridge.

KOTLÁN, V. AND D. NAVRÁTIL (2003): "Inflation Targeting as a Stabilization Tool: Its Design and Performance in the Czech Republic." *Finance a úvěr – Czech Journal of Economics and Finance* 53, 220-242.

KWIATKOWSKI, D., P.C.B. PHILLIPS, P. SCHMIDT, AND Y. SHIN (1992): "Testing the Null Hypothesis of Stationarity against the Alternative of a Unit Root: How Sure Are We that Economic Time Series Have a Unit Root?" *Journal of Econometrics* 54, 159-178.

LAM, J.-P. AND G. TKACZ (2004): "Estimating Policy Neutral Rate for Canada Using a Dynamic Stochastic General Equilibrium Framework." *Swiss Journal of Economics and Statistics* 140, 89-126.

LAUBACH, T. AND J.C. WILLIAMS (2003): "Measuring the Natural Rate of Interest." *The Review of Economics and Statistics* 85, 1063–1070.

LEVIN, A., V. WIELAND, AND J.C. WILLIAMS (1999): "Robustness of Simple Monetary Policy Rules under Model Uncertainty." In: J. B. Taylor (Ed), *Monetary Policy Rules*. Chicago: University of Chicago.

LIPSHITZ, L., T. LANE, AND A. MOUMOURAS (2006): "Capital Flows to Transition Countries: Master or Servant." *Finance a úvěr – Czech Journal of Economics and Finance* 56, 202-222.

MANRIQUE, M. AND J.M. MARQUES (2007): "An Empirical Approximation of the Natural Rate of Interest and Potential Growth." Banco de Espana Working Paper, No. 0416.

MESONNIER, J.-S., J.-P. RENNE (2007): "Time Varying "Natural" Rate of Interest in the Euro Area." *European Economic Review*, forthcoming.

MOSER, G., F. RUMLER, AND J.SCHARLER (2007): "Forecasting Austrian Inflation." *Economic Modelling* 24, 470-480.

NEISS, K.S. AND E. NELSON (2003): "The Real Interest Rate Gap as an Inflation Indicator." *Macroeconomic Dynamics* 7, 239-262.

ORPHANIDES, A. (2001): "Monetary Policy Rules Based on Real-Time Data." *American Economic Review* 91, 964-985.

PLANTIER, L.CH. AND D. SCRIMGEOUR (2002): "Estimating a Taylor Rule for New Zealand with a Time-Varying Neutral Real Rate." Reserve Bank of New Zealand Discussion Paper Series, 06/2002.

PODPIERA, J. (2006): "The Role of Policy Rule Misspecification in Monetary Policy Inertia Debate". CERGE-EI Working Paper, No. 315, Charles University.

RAVN, M.O. AND H. UHLIG (2002): "On Adjusting the Hodrick-Prescott Filter for the Frequency of Observations." *Review of Economics and Statistics* 84, 371-375.

REYNARD, S. (2007): "Maintaining Low Inflation: Money, Interest Rates and Inflation." *Journal of Monetary Economics* 54, 1441-1471.

RUDEBUSCH, G. (2006): "Monetary Policy Inertia: Fact or Fiction?" *International Journal of Central Banking* 2(4), 85-136.

SACK, B. (1997): "Uncertainty, Learning and Gradual Monetary Policy, Board of Governors of the Federal Reserve System." Finance and Economics Discussion Series, 1997-34.

SMETS, F. AND R. WOUTERS (2003): "An Estimated Dynamic Stochastic General Equilibrium Model of the Euro Area." *Journal of the European Economics Association* 1, 1123-1175.

STOCK, J.H. AND M.W. WATSON (1999): "Forecasting Inflation." *Journal of Monetary Economics* 44, 293-335.

SVENSSON, L.E.O. (2000): "Open Economy Inflation Targeting." *Journal of International Economics* 50, 155-183.

TAYLOR, J.B. (1993): "Discretion versus Policy Rules in Practice." Carnegie-Rochester Conference Series on Public Policy 39, 195-214.

TAYLOR, J.B. (2001): "The Role of Exchange Rate in Monetary-Policy Rules." *American Economic Review* 91, 263-267.

TAYLOR, J.B. (Ed.) (1999): "Monetary Policy Rules." The University of Chicago Press: Chicago.

WINTR, L., P. GUARDA, AND A. ROUABAH (2005): "Estimating the Natural Interest Rate for the Euro Area and Luxembourg." Central Bank of Luxembourg Working Paper, No. 15.

WOODFORD, M. (2003): "Interest and Prices: Foundations of a Theory of Monetary Policy." Princeton University Press, Princeton: New Jersey.

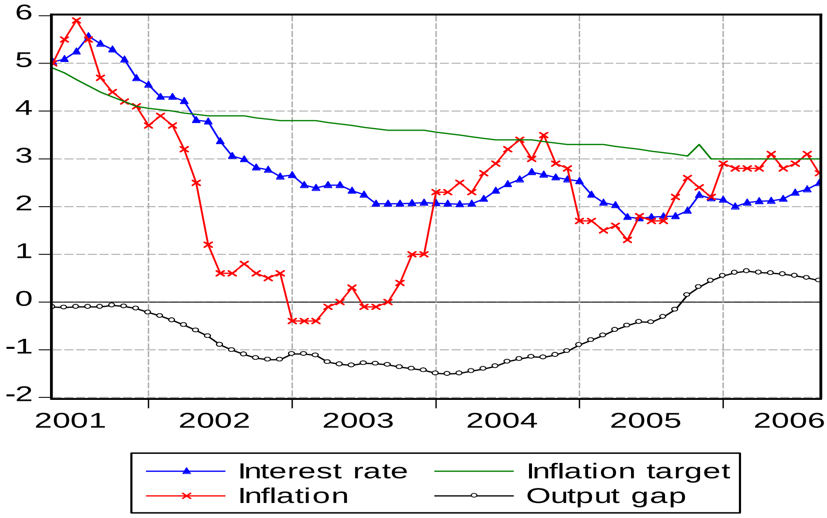
Internet resources:

CNB – THE MONETARY POLICY OF THE CZECH NATIONAL BANK, downloaded: June 10, 2007

http://www.cnb.cz/www.cnb.cz/en/about_cnb/missions_and_functions/mp_faktsheet_en.html

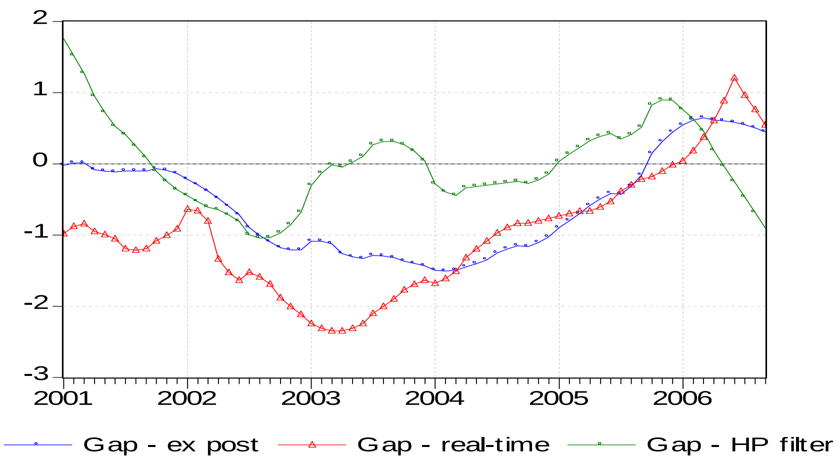
APPENDIX

Figure A.1: Interest Rate, Output Gap, Inflation and Inflation Target



Note: This chart presents current inflation, the short-term interbank interest rate (3M PRIBOR) and the CNB output gap as of the October 2006 forecast round.

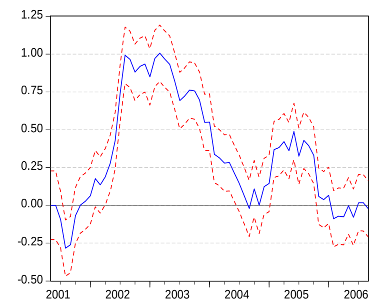
Figure A.2: Comparison of Output Gap Estimates



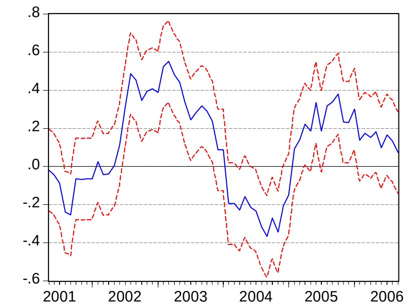
Note: This chart presents the three measures of the output gap used in the paper: the output gap estimated by the CNB as of their October 2006 forecast round (Gap - ex post), the real-time based output gap estimated by the CNB (Gap - real-time) and the output gap calculated using the HP filter (Gap – HP filter) as the estimate of potential output.

Figure A.3: Importance of Bias Correction Terms in Estimating Policy Rules

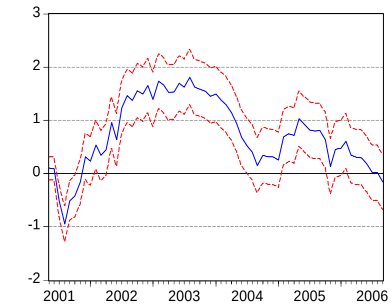
Backward-looking policy rule



Current inflation, output gap – HP filter

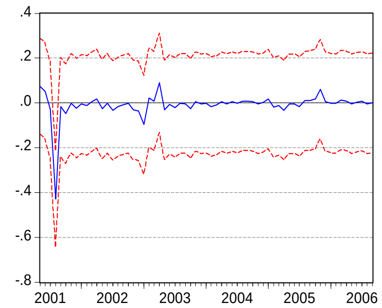


Current inflation, output gap – ex-post

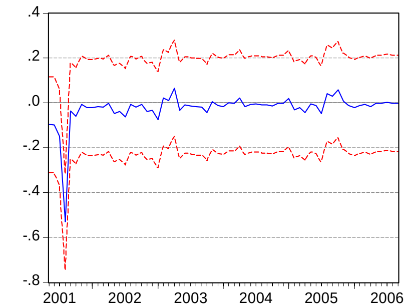


Current inflation, output gap – real-time

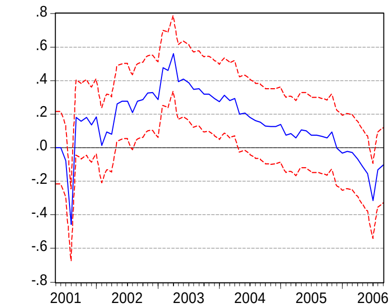
Forward-looking policy rule



Inflation forecast – real-time, output gap – HP filter



Inflation forecast – real-time, output gap – ex-post



Inflation forecast – real-time, output gap – real-time

Note: The difference between the policy neutral rates estimated from the time-varying parameter model with endogenous regressors, $\bar{r}_{t,er}$, with its confidence intervals, and from the conventional time-varying parameter model, $\bar{r}_{t,c}$. The measure of the output gap and inflation used for the estimation of the policy neutral rate is reported below each chart. Consequently, if the confidence intervals are different from zero, it means that $\bar{r}_{t,c}$ does not lie within the confidence intervals of $\bar{r}_{t,er}$.

Table A.1: KPSS Test

Series	Test statistic
PRIBOR 3M	0.355*
CPI Inflation	0.165
CPI Inflation forecast (t+12)	0.163
Net Inflation	0.147
Output gap – HP filtered	0.106
Output gap – Real-time	0.293
Output gap – Ex-post	0.214
M2 growth	0.168
Real effective exchange rate	0.447*

Note: The null hypothesis is that the series is level stationary. Critical values for the null hypothesis: 10% - 0.347, 5% - 0.463, 1% - 0.739. Sample period: 2001:1-2006:09. *, **, *** denote significance at the 10, 5 and 1 percent level, respectively.

Table A.2: Monetary Policy Rules Estimation

$$r_t = (1-\rho)\left[\bar{r}_t + \alpha\left(\pi_{t+i} - \pi^*_{t+i}\right) + \beta x_t\right] + \rho r_{t-1} + \varepsilon_t$$

$$\bar{r}_t = \bar{r}_{t-1} + \vartheta_t\,,\ \vartheta_t \sim i.i.d.N\left(0, \sigma^2_\vartheta\right)$$

$$\varepsilon_t = \kappa_{v,\varepsilon}\sigma_{\varepsilon,t}v_t + \kappa_{\varphi,\varepsilon}\sigma_{\varepsilon,t}\varphi_t + \iota_t\,,\ \ \iota_t \sim N\left(0, (1-\kappa^2_{v,\varepsilon} - \kappa^2_{\varphi,\varepsilon})\sigma^2_{\varepsilon,t}\right)$$

	Model											
Parameters	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***11***	***12***
ρ	0.40***	0.40***	0.40***	0.41***	0.40***	0.40***	0.42***	0.40***	0.42***	0.42***	0.45***	0.40***
	(0.02)	(0.09)	(0.06)	(0.06)	(0.07)	(0.09)	(0.11)	(0.10)	(0.10)	(0.09)	(0.10)	(0.15)
α	0.27***	0.07	0.28***	0.06	0.28***	0.07	-0.15	-0.15	-0.18	-0.16	-0.17	-0.14
	(0.07)	(0.07)	(0.08)	(0.06)	(0.07)	(0.06)	(0.12)	(0.11)	(0.11)	(0.11)	(0.10)	(0.09)
β	0.21	0.11	-0.06	0.57**	-0.06	-0.06	0.12	0.14	0.66**	0.66**	0.18	-0.02
	(0.24)	(0.24)	(0.28)	(0.29)	(0.22)	(0.23)	(0.27)	(0.25)	(0.28)	(0.31)	(0.23)	(0.19)
$\kappa_{v,\varepsilon}$	-0.06***		-0.07***		-0.06***		0.01		0.02		0.02	
	(0.01)		(0.02)		(0.02)		(0.01)		(0.01)		(0.01)	
$\kappa_{\varphi,\varepsilon}$	-0.02*		-0.02*		-0.02*		0.01		-0.01		-0.02***	
	(0.01)		(0.01)		(0.01)		(0.01)		(0.02)		(0.01)	
AIC	-1.10	-1.00	-1.07	-1.00	-0.95	-0.94	-0.91	-0.94	-0.94	-0.96	-0.91	-0.88

Note: Robust standard errors in brackets. ***, ** and *indicate significance at 1, 5 and 10%, respectively. The models differ according to whether bias correction terms are included and the specification of π_{t+i} and x_t. π_{t+i} is either the CNB inflation forecast one year ahead (abbreviated as IF below) or the current inflation rate (IC). x_t is a measure of the output gap: 1. as estimated by HP filtering (HP), 2. CNB ex-post output gap measure based on multivariate Kalman filter procedure (EX), 3. CNB real-time output gap measure based on multivariate Kalman filter procedure (REAL). Models 1 and 2 = IC, HP; Models 3 and 4 = IC, EX; Models 5 and 6 = IC, REAL; Models 7 and 8 = IF, HP; Models 9 and 10 = IF, EX and Models 11 and 12 = IF, REAL;

CNB WORKING PAPER SERIES

4/2007	Roman Horváth:	*The time-varying policy neutral rate in real time: A predictor for future inflation?*
3/2007	Jan Brůha: Jiří Podpiera Stanislav Polák	*The convergence of a transition economy: The case of the Czech Republic*
2/2007	Ian Babetskii: Nauro F. Campos	*Does reform work? An econometric examination of the reform-growth puzzle*
1/2007	Ian Babetskii: Fabrizio Coricelli Roman Horváth	*Measuring and explaining inflation persistence: Disaggregate evidence on the Czech Republic*
13/2006	Frederic S. Mishkin: Klaus Schmidt-Hebbel	*Does inflation targeting make a difference?*
12/2006	Richard Disney: Sarah Bridges John Gathergood	*Housing wealth and household indebtedness: Is there a household 'financial accelerator'?*
11/2006	Michel Juillard: Ondřej Kameník Michael Kumhof Douglas Laxton	*Measures of potential output from an estimated DSGE model of the United States*
10/2006	Jiří Podpiera: Marie Raková	*Degree of competition and export-production relative prices when the exchange rate changes: Evidence from a panel of Czech exporting companies*
9/2006	Alexis Derviz: Jiří Podpiera	*Cross-border lending contagion in multinational banks*
8/2006	Aleš Bulíř: Jaromír Hurník	*The Maastricht inflation criterion: "Saints" and "Sinners"*
7/2006	Alena Bičáková: Jiří Slačálek Michal Slavík	*Fiscal implications of personal tax adjustments in the Czech Republic*
6/2006	Martin Fukač: Adrian Pagan	*Issues in adopting DSGE models for use in the policy process*
5/2006	Martin Fukač:	*New Keynesian model dynamics under heterogeneous expectations and adaptive learning*
4/2006	Kamil Dybczak: Vladislav Flek Dana Hájková Jaromír Hurník	*Supply-side performance and structure in the Czech Republic (1995–2005)*
3/2006	Aleš Krejdl:	*Fiscal sustainability – definition, indicators and assessment of Czech public finance sustainability*
2/2006	Kamil Dybczak:	*Generational accounts in the Czech Republic*
1/2006	Ian Babetskii:	*Aggregate wage flexibility in selected new EU member states*

14/2005	Stephen G. Cecchetti:	*The brave new world of central banking: The policy challenges posed by asset price booms and busts*
13/2005	Robert F. Engle: Jose Gonzalo Rangel	*The spline GARCH model for unconditional volatility and its global macroeconomic causes*
12/2005	Jaromír Beneš: Tibor Hlédik Michael Kumhof David Vávra	*An economy in transition and DSGE: What the Czech national bank's new projection model needs*
11/2005	Marek Hlaváček: Michael Koňák Josef Čada	*The application of structured feedforward neural networks to the modelling of daily series of currency in circulation*
10/2005	Ondřej Kameník:	*Solving SDGE models: A new algorithm for the sylvester equation*
9/2005	Roman Šustek:	*Plant-level nonconvexities and the monetary transmission mechanism*
8/2005	Roman Horváth:	*Exchange rate variability, pressures and optimum currency area criteria: Implications for the central and eastern european countries*
7/2005	Balázs Égert: Luboš Komárek	*Foreign exchange interventions and interest rate policy in the Czech Republic: Hand in glove?*
6/2005	Anca Podpiera: Jiří Podpiera	*Deteriorating cost efficiency in commercial banks signals an increasing risk of failure*
5/2005	Luboš Komárek: Martin Melecký	*The behavioural equilibrium exchange rate of the Czech koruna*
4/2005	Kateřina Arnoštová: Jaromír Hurník	*The monetary transmission mechanism in the Czech Republic (evidence from VAR analysis)*
3/2005	Vladimír Benáček: Jiří Podpiera Ladislav Prokop	*Determining factors of Czech foreign trade: A cross-section time series perspective*
2/2005	Kamil Galuščák: Daniel Münich	*Structural and cyclical unemployment: What can we derive from the matching function?*
1/2005	Ivan Babouček: Martin Jančar	*Effects of macroeconomic shocks to the quality of the aggregate loan portfolio*
10/2004	Aleš Bulíř: Kateřina Šmídková	*Exchange rates in the new EU accession countries: What have we learned from the forerunners*
9/2004	Martin Cincibuch: Jiří Podpiera	*Beyond Balassa-Samuelson: Real appreciation in tradables in transition countries*
8/2004	Jaromír Beneš: David Vávra	*Eigenvalue decomposition of time series with application to the Czech business cycle*
7/2004	Vladislav Flek, ed.:	*Anatomy of the Czech labour market: From over-employment to under-employment in ten years?*
6/2004	Narcisa Kadlčáková: Joerg Keplinger	*Credit risk and bank lending in the Czech Republic*
5/2004	Petr Král:	*Identification and measurement of relationships concerning inflow of FDI: The case of the Czech Republic*
4/2004	Jiří Podpiera:	*Consumers, consumer prices and the Czech business cycle identification*

3/2004	Anca Pruteanu:	*The role of banks in the Czech monetary policy transmission mechanism*
2/2004	Ian Babetskii:	*EU enlargement and endogeneity of some OCA criteria: Evidence from the CEECs*
1/2004	Alexis Derviz: Jiří Podpiera	*Predicting bank CAMELS and S&P ratings: The case of the Czech Republic*
12/2003	Tibor Hlédik:	*Modelling the second-round effects of supply-side shocks on inflation*
11/2003	Luboš Komárek: Zdeněk Čech Roman Horváth	*ERM II membership – the view of the accession countries*
10/2003	Luboš Komárek: Zdeněk Čech Roman Horváth	*Optimum currency area indices – how close is the Czech Republic to the eurozone?*
9/2003	Alexis Derviz: Narcisa Kadlčáková Lucie Kobzová	*Credit risk, systemic uncertainties and economic capital requirements for an artificial bank loan portfolio*
8/2003	Tomáš Holub: Martin Čihák	*Price convergence: What can the Balassa–Samuelson model tell us?*
7/2003	Vladimír Bezděk: Kamil Dybczak Aleš Krejdl	*Czech fiscal policy: Introductory analysis*
6/2003	Alexis Derviz:	*FOREX microstructure, invisible price determinants, and the central bank's understanding of exchange rate formation*
5/2003	Aleš Bulíř:	*Some exchange rates are more stable than others: Short-run evidence from transition countries*
4/2003	Alexis Derviz:	*Components of the Czech koruna risk premium in a multiple-dealer FX market*
3/2003	Vladimír Benáček: Ladislav Prokop Jan Á. Víšek	*Determining factors of the Czech foreign trade balance: Structural issues in trade creation*
2/2003	Martin Čihák: Tomáš Holub	*Price convergence to the EU: What do the 1999 ICP data tell us?*
1/2003	Kamil Galuščák: Daniel Münich	*Microfoundations of the wage inflation in the Czech Republic*
4/2002	Vladislav Flek: Lenka Marková Jiří Podpiera	*Sectoral productivity and real exchange rate appreciation: Much ado about nothing?*
3/2002	Kateřina Šmídková: Ray Barrell Dawn Holland	*Estimates of fundamental real exchange rates for the five EU pre-accession countries*
2/2002	Martin Hlušek:	*Estimating market probabilities of future interest rate changes*
1/2002	Viktor Kotlán:	*Monetary policy and the term spread in a macro model of a small open economy*

CNB RESEARCH AND POLICY NOTES		
2/2006	Garry J. Schinasi:	*Private finance and public policy*
1/2006	Ondřej Schneider:	*The EU budget dispute – A blessing in disguise?*
5/2005	Jan Stráský:	*Optimal forward-looking policy rules in the quarterly projection model of the Czech National Bank*
4/2005	Vít Bárta:	*Fulfilment of the Maastricht inflation criterion by the Czech Republic: Potential costs and policy options*
3/2005	Helena Sůvová: Eva Kozelková David Zeman Jaroslava Bauerová	*Eligibility of external credit assessment institutions*
2/2005	Martin Čihák: Jaroslav Heřmánek	*Stress testing the Czech banking system: Where are we? Where are we going?*
1/2005	David Navrátil: Viktor Kotlán	*The CNB's policy decisions – Are they priced in by the markets?*
4/2004	Aleš Bulíř:	*External and fiscal sustainability of the Czech economy: A quick look through the IMF's night-vision goggles*
3/2004	Martin Čihák:	*Designing stress tests for the Czech banking system*
2/2004	Martin Čihák:	*Stress testing: A review of key concepts*
1/2004	Tomáš Holub:	*Foreign exchange interventions under inflation targeting: The Czech experience*
2/2003	Kateřina Šmídková:	*Targeting inflation under uncertainty: Policy makers' perspective*
1/2003	Michal Skořepa: Viktor Kotlán	*Inflation targeting: To forecast or to simulate?*

CNB ECONOMIC RESEARCH BULLETIN	
December 2007	*Fiscal policy and its sustainability*
August 2007	*Financial stability in a transforming economy*
November 2006	*ERM II and euro adoption*
August 2006	*Research priorities and central banks*
November 2005	*Financial stability*
May 2005	*Potential output*
October 2004	*Fiscal issues*
May 2004	*Inflation targeting*
December 2003	*Equilibrium exchange rate*

Czech National Bank
Economic Research Department
Na Příkopě 28, 115 03 Praha 1
Czech Republic
phone: +420 2 244 12 321
fax: +420 2 244 14 278
http://www.cnb.cz
e-mail: research@cnb.cz