

**EPIC, Second Cohort, 1st Advanced Research Workshop, Corfu 24 – 29 May 2001
Project Proposal**

**Monetary Policy in a Small Open Economy: The Case of Czech Republic
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1. Theory / Model

Empirical question or puzzle:

Broadly, my research will focus on the role of the exchange rate in monetary policy. In particular, the impact of exchange rate on the design of policy rules is to be studied. This area is widely debated and a consensus is still far from being established.

The research focuses on the differences between simple and complex rules. For the sake of this exposition, a simple policy rule is a rule of the Taylor type (dependent only on inflation and output); more complex rules incorporate other variables: exchange rate, the degree of interest rate volatility, etc. The task is to investigate whether there is a potential gain from complex rules in open economy conditions.

Taylor (2000a) suggests that complex rules produce negligible improvements in an open-economy setting. There are two reasons that can help to explain this conclusion. First is the fact that models are estimated or calibrated to fit the empirical data. Thus, the underlying cross-auto-correlation structure between the changes in policy instruments and the endogenous variables that are being modelled, is present in the data and must be captured by the model, irrespective of its exact structural form. Consequently, models that may differ in structure may be rather similar in their reduced form.

Secondly, a theory-based explanation of the similarity of outcomes resulting from simple and complex rules builds upon the indirect reaction of the interest rate to exchange rate changes as discussed in Taylor (2000b). After appreciation, agents will expect a decline in output and inflation. They will therefore anticipate a subsequent fall in the short-term interest rate as the authorities respond according to a simple policy rule. The effect may even be amplified through the expectational fall in the long-term rate. Such an indirect effect makes the simple and complex rule in the end very similar in their effects. However, the puzzle needs to be researched further, as I argue below.

Economic / Political relevance:

There are important implications for the practical implementation of monetary policy. Several models described in literature are very similar to those used in the decision making process of some central banks (e. g., Bank of England). If there is a welfare gain from stabilising the exchange rate, this would be of the utmost importance for policy-makers. The analysis will also shed light on theoretical issues such as inflationary bias, credibility, and time-consistency that are among the main reasons for ongoing research in the area.

Theoretical Relevance:

Taylor (2000a,b) reports simulation results for different policy rules in several open economy models. A simple rule is used as a benchmark in all reported simulations and various complex rules are in turn compared to it. The variability of inflation and output is used as the performance measure in the comparisons. Ball (1999) reports a very small improvement in the inflation variability when the output variability is held constant and relatively high (perhaps unrealistic) coefficients are used for the exchange rate in his rule. Svensson (2000) uses a more plausible exchange-rate coefficient and arrives to decreased inflation but higher output variability. Thus, output performance in fact deteriorates in the model with a complex rule. Taylor (1999) using somewhat lower coefficients than Ball and his empirical multicountry

model reports improvements in some countries but poorer performance of the complex rule in others. Taylor himself, though, stresses the need of future research both in terms of empirical studies and the development of more appropriate theoretical models.

Other strands of research on the role of the exchange rate in policy rules include the question of forward-looking rules [Batini, Haldane (1999)] and the use of monetary condition indices in monetary policy design and operation [Batini, Turnbull (2000)]. The attempt to model the exchange rate pass-through to inflation in a way that fits the data better, as in McCallum, Nelson (2000), is of direct relevance to my research and is discussed in more detail below. There are two striking points to be made about recently developed open economy models that are prompting further investigation. Firstly, the Bank of England (1999) review of Batini, Haldane (1999) which also reports some simulations conducted on a calibrated version of the model, ends up with interesting conclusion. An open-economy version of the model, calibrated to fit the U.K. data, gives a counterintuitive impulse response to a positive aggregate demand shock. In particular, inflation initially drops in response to such a positive demand shock. This reaction can be fully attributed to “the way that the openness in the economy is modelled” [the Bank, op. cit., p. 103]. The positive demand shock affects the output gap in future and causes higher expected inflation. From the policy rule, agents know that rise in expected inflation will prompt the authorities to react by future increases in the real interest rate. Through the uncovered interest parity condition, the immediate appreciation follows higher expected interest rates. Since the model posits an immediate effect of the exchange rate on inflation, appreciation reduces current inflation and the counterintuitive result for inflation follows.

The claim that immediate pass-through is inappropriate on empirical grounds is further supported by the results reported in McCallum, Nelson (2000). They report empirical correlations between changes in the price level and lagged changes in the nominal exchange rates for several countries during 1970s, 1980s and 1990s. Obviously, smaller lags (starting at zero) should be significant under the immediate pass-through. However, only some countries in the sample show correlations significant at the 0.05 level and their value is always below 0.3 (Germany being the only exception).

McCallum, Nelson (2000) shows that more appropriate theoretic model of the exchange rate to inflation pass-through can be built assuming that all imports in the economy are treated as inputs to domestic production. They argue that an increase in relative prices induced by depreciation is not necessarily reflected in the *aggregate* price level. In order for inflation to take place, depreciation needs to be accompanied by monetary expansion. This theoretical conclusion translates to the model setting that limits the inflationary impact of depreciation to the twofold aggregate supply effect. Firstly, as depreciation increases the costs of producing domestic goods, it reduces the potential output. Secondly, by increasing the export demand, depreciation leads to higher actual output. They also show that their model fits the empirical pass-through data much better than usual specifications.

Alternative theoretical solution:

McCallum, Nelson (2000) do not discuss the issue of an optimal policy rule. My first aim is to present an optimal policy rule for their model and to quantify any stabilisation gain. The second aim is to test the Batini, Haldane (1999) hypothesis about the output response function. I hope to conclude that my alternative model specification yields a pattern of inflation accompanying the demand shock that better match the empirical data.

The model I am proposing is a simplified version of McCallum, Nelson (2000) and is summarised in the Appendix. It can be estimated on the empirical data and solved for model consistent expectations. An optimal policy rule analysis and the construction of the optimal policy frontier can be conducted. In comparison with the other models in the area, the

proposed one incorporates arguably a more realistic view of the exchange rate to inflation pass-through.

2. Research Design

My proposed research design is a combination of modelling and an empirical case study. I intend to use Czech Republic data as an illustration of a small open economy. I intend to test whether there is evidence in favour of what I have described above as complex rules.

Applying the model to empirical data should strengthen the theoretical results and show the direct relevance of theory to real-world policy-making. My approach, however, draws substantially on established theoretical approaches in order to simplify the complexity of the real-world events and to design a tractable formulation of the problem. Techniques of policy evaluation are based on Taylor (1993). The model solution incorporating model consistent expectations rests on McCallum (1998) and Uhlig (1995).

First, the model will be estimated using empirical data. Then, the model will be solved for different competing formulations of the policy rule. The optimal solutions obtained will be directly compared in terms of their relative inflation and output volatility. The next step of policy-evaluation can be conducted on the basis of the steady-state covariance matrix obtained from the model. Policy relevant outcomes of the model will be stochastically simulated on the basis of the estimated steady-state variance covariance matrix. This will yield more general results that are comparable in terms of the inflation and output volatility and characterise varying values of the policy rule coefficients. The results will be then summarised in the form of the optimal policy frontier for different policy rules.

In addition, performance of the rules can also be compared with respect to the historical shocks over the sample period. This can yield particular insights about the alternatives to the actual economic policy in the Czech Republic during the 1990s.

Time period and data sources:

The sample period for model estimation is from 1994:1 to 2000:4 and quarterly data are to be used. The data were obtained from the Czech Statistical Office, the Czech National Bank, and the International Monetary Fund publications and are in the public domain. Monthly data, although obtainable in principle, are arguably less appropriate since they contain a lot of noise compared to the quarterly series.

Since the number of observations in the data set may not be sufficient for a full estimation, some coefficients of the model may be in fact rather calibrated instead.

Appendix: The Model

Modifications in the model are in line with McCallum (2000) and Fuhrer, Moore (1995). The original model draws upon the preceding paper by the same authors, McCallum, Nelson (1999). The model assumes that all imports are used as material inputs in domestic production. The equations of the model can be summarised as follows:

$$y_t = \alpha_0 + \alpha_1 \cdot y_{t-1} + \alpha_2 \cdot E_t y_{t+1} + \alpha_3 \cdot [R_t - E_t \Delta p_{t+1}] + \alpha_4 \cdot (\eta \cdot q_t + y_t^*) \quad (1)$$

$$\Delta p_t = \beta \cdot [\gamma_1 \cdot \Delta p_{t-1} + \gamma_2 \cdot E_t \Delta p_{t+1}] + \gamma_3 (y_t - \bar{y}_t) \quad (2)$$

$$R_t - R_t^* = E_t \Delta s_{t+1} + \xi_t \quad (3)$$

$$\Delta s_t = \Delta q_t + \Delta p_t \quad (4)$$

$$R_t = g_0 + g_1 \cdot E_t \Delta p_{t+1} + g_2 \cdot (y_t - \bar{y}_t) + g_3 \cdot s_t \quad (5)$$

As for the notation, y_t is the real domestic output, y_t^* is the real output abroad (world level), Δp_t is a measure of inflation, q_t is the price of imports in terms of consumption goods, $Q_t = \ln q_t$ being the real exchange rate. R_t is domestic one period nominal interest rate, while R_t^* is the appropriate foreign nominal interest rate (world level). In addition, the potential output is denoted \bar{y}_t , the p_t, p_t^* are logs of home and foreign prices of imports respectively, and S_t is the nominal exchange rate. The error term ξ_t can be interpreted as a time-varying risk premium and can explain pertaining deviations of the real exchange rate from the level implied by the uncovered interest rate parity condition.

Equation (1) is an aggregate demand relationship (an IS curve), (2) is a pricing-relationship (aggregate supply), (3) is an uncovered interest parity condition, (4) is a real exchange rate identity, and (5) is a complex policy rule.

Potential output is not explicitly modelled - I will use simple deviation from the logarithmic trend over the sample period as a measure of the potential output. The real output abroad, y_t^* , is constructed as a weighted average of twelve main international trade partners of the Czech Republic on the basis of the International Financial Statistics. The world level of the nominal interest rates, R_t^* , is obtained as the weighted average of the German and the U.S. three months money market rate with weights of 0.65 and 0.35 respectively. These weights reflect the fixed exchange rate arrangement in the Czech Republic prior to 1996.

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