EPIC Project Proposal: Monetary Policy in a Small Open Economy

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1. Theory / Model

Research Question:

My research question can be simply put as: *Is there a role for an exchange rate to play in construction of monetary policy rule?*

By a role, I do not necessary mean direct exchange rate targeting, but only a feedback on exchange rate (either level or change) in the rule. Possible stabilization gain from feedback on exchange rate is to be measured in terms of output and inflation variability associated with respective policy rule specification. The role of exchange rate in monetary policy rules is still being debated and a consensus is far from being established. Although Taylor (2000a) suggests that rules which feedback on exchange rate produce only negligible improvements in an open-economy setting, the issue 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 Argument and a Place in the Debate:

The main distinguishing feature of my strategy is a macroeconomic model that strives to incorporate more realistic view about impacts of exchange rate changes on domestic inflation. Within such a framework I expect to find results different from these established in the literature. As a point of departure I briefly review two empirical puzzles that are related to present models.

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 an apparently 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.
Secondly, McCallum, Nelson (2000) 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).
In the model of Batini and Haldane, both immediate effect of exchange-rate change on inflation in traded goods sector, and medium run demand effect are present. Thus, an exchange rate depreciation causes immediate price level jump proportional to the size of traded goods sector, and subsequently triggers an aggregate demand mechanism that slowly adds to the initial inflation.
On the other hand, McCallum, Nelson (2000) proposes different way of modelling. Their model assumes that *all imports* in the economy are used as inputs to domestic production. Consequently, an immediate effect of the exchange rate change on domestic inflation is ruled out by assumption. They argue that an increase in relative prices induced by depreciation is not immediately and proportionately reflected in the *aggregate* price level. This argument 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, and increased output gap is then reflected in higher price level. They then proceed to show that their model fits the empirical data on exchange rate and inflation changes correlation much better than usual specifications.

Aims of the Research:

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 following the demand shock that better match the empirical data.

The Model:

Proposed model 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 effects of exchange rate on domestic inflation.

2. Research Design

First, the model will be estimated using empirical data for the Czech Republic and at least one another European country, most likely the U.K., or Germany. 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.
Techniques of policy evaluation are based on Taylor (1993). The model solution incorporating model consistent expectations rests on McCallum (1998) and Uhlig (1995).

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, relative Britain or German institutions, and the International Monetary Fund publications. Monthly data, although obtainable in principle, are arguably less appropriate since they contain a lot of noise compared with 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 (error term being omitted):

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

where y_t is the real domestic output, y_t^* is the real output abroad constructed as a weighted average of main international trade partners, R_t is domestic one period nominal interest rate. In addition, Δp_t is a measure of inflation, p_t is log of home price of imports, and q_t is the price of imports in terms of consumption goods; this implies that $Q_t = \ln q_t$ is the real exchange rate.

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

where $\bar{y}_t$ is the potential output (output corresponding to instantaneous and complete price adjustment), defined as:

$$\bar{y}_t = a_t - [\sigma\alpha/(1-\alpha)].q_t + const. \quad (2a)$$

In this definition, the negative relationship between potential output and real exchange rate is clearly assumed. Presumably the most distinguishing part of the setting is a $\gamma_3(y_t - \bar{y}_t)$ term in equation (2): instead of real exchange rate change entering directly into the pricing equation, the inflationary effect is only mitigated through the output gap term.

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

where R_t^* is the appropriate foreign nominal interest rate constructed as a weighted average of main international trade partners` one period interest 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.

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

where s_t is log of the nominal exchange rate. This is just an identity defining the real exchange rate.

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

which is a monetary policy rule equation. Policy rule is in all cases defined in terms of the nominal interest rate. Note, that $g_3 = 0$ restriction implies that there is no feedback on exchange rate at all, and thus there is no role for the exchange rate to play in designing the monetary policy rule.

It is clear that 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 an interest-rate policy rule.

Estimation:

Potential output is not to be 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 and the U.K. or Germany respectively on the basis of the International Financial Statistics. The world level of 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. For the U.K. or Germany case, the world interest rate is defined as an average of the U.S. and either Germany or the U.K. three months money market rate.

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