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Time-varying equilibrium rates in small open economies: Evidence for Canada

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ABSTRACT

This paper estimates equilibrium rates of macroeconomic aggregates for small open economies. We simultaneously identify the transitory and permanent components of output, inflation, the interest rate and the exchange rate by means of a multivariate trend-cycle decomposition. Realizations of the observed macroeconomic aggregates are explained in terms of unobserved equilibrium rates and unobserved transitory components. The transitory components of the variables are linked to each other through an aggregate demand equation, a Phillips curve, and an equation specifying the interest rate-exchange rate nexus. The model is then applied to Canadian data.

1. Introduction

The identification and measurement of unobservable equilibrium rates of macroeconomic aggregates is an essential input in the formulation of policy recommendations. In terms of monetary policy, the neutral (equilibrium or natural) real interest rate is a key variable for assessing whether the monetary policy stance is contractionary or expansionary (Laubach and Williams, 2003). Moreover, the level of natural (or potential) output and the associated real-activity gap is an integral element of monetary policy rules, such as the Taylor-rule interest-rate reaction function (Taylor, 1993; Orphanides, 2008). In terms of fiscal policy, the output gap is an important measure of the economic cycle, and functions as an indicator of the sustainability of fiscal policy and the current fiscal stance (Koske and Pain, 2008).

One way to obtain empirical estimates of the unobservable gaps and equilibrium levels of macroeconomic aggregates is by means of unobserved components (UC) models. Such models utilize information from economic theory in a time-series approach in order to decompose realizations of observed macroeconomic aggregates into their unobserved equilibrium rates

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and unobserved transitory components.[1] In UC models, pioneered by Harvey (1985); Watson (1986) and Clark (1987), trend and cycle are both treated as latent state variables, and modeled as non-stationary and mean-reverting processes, respectively. Applications of this framework include estimates of the natural rate of interest by relating the transitory interest rate to the output gap in an aggregate-demand equation (Laubach and Williams, 2003; Mésonnier and Renne, 2007), or estimates of the output gap from a bivariate system combining inflation and output on the basis of a New-Keynesian Phillips curve (Basistha and Nelson, 2007).

Whereas previous UC models are explicitly or implicitly designed for the U.S. economy or other large economic regions such as the euro area, we are not aware of any studies which specifically focus on small open economies. This paper tries to fill this gap. The characteristic feature of any such model is the prominent role it imparts on the exchange rate in the empirical identification strategy. The exchange rate is the most important relative price of a small open economy, and should constitute an integral element in the identification of the transitory and permanent components of output, inflation and the interest rate.

In our model, the real exchange rate is related to the output gap through the current account, influences inflation via its effect on import prices, and impacts the interest rate by inducing expectations of mean reversion of the real exchange rate towards its equilibrium level. In a small open economy, both aggregate demand and the Phillips curve contain the real exchange rate as an argument. As the interest gap may also be associated with an exchange rate misalignment through a potential interest rate-exchange rate nexus, the model is extended by an equation linking the real interest rate to the real exchange rate.

Besides adding to the UC literature in general, our model provides potentially useful information for economic policymakers. Taking explicit account of the exchange rate not only affects the decomposition of macroeconomic variables into their permanent and transitory components, but also allows for the identification of the permanent and transitory components of the exchange rate itself. In an open-economy context, deviations of the real exchange rate from its equilibrium level function as a signal of a country's competitiveness. The determination of equilibrium exchange rates is also important for a variety of issues in exchange rate economics, including assessments of currency misalignments, the decision of opting for fixed or flexible exchange rates, and questions regarding the reform of the international monetary system (MacDonald and Stein, 1999).

In the following we lay out a rather general structure of a UC model that should be applicable to any small open economy. However, in view of our subsequent application using Canadian data, we choose to incorporate some Canada-specific features into the model. This allows us to confront our results with previous studies on Canada. The plan of the paper is as follows: Section 2 introduces the model, Section 3 presents the estimation results, and Section 4 concludes.

2. The model

Our model follows the earlier UC literature by specifying the equilibrium rates as random walk processes, while relating the transitory components of the variables to each other through an aggregate demand equation and a Phillips curve. However, in contrast to previous literature, we propose a multivariate UC model specifically geared towards a small open economy. The model consists of inflation, π, output, y , the real interest rate, r, and the real effective exchange rate, q, the latter defined as the price of the home currency in terms of foreign exchange. The period-t observed levels of y_t, r_t and q_t can each be expressed as the sum of two components, their respective equilibrium levels, denoted by an asterisk, and their gaps in terms of deviations of the actual realizations from their equilibrium levels, denoted by a tilde:

$$y_t = y_t^* + \tilde{y}_t, \tag{1}$$

$$r_t = r_t^* + \tilde{r}_t, \tag{2}$$

$$q_t = q_t^* + \tilde{q}_t. \tag{3}$$

The inflation rate is modeled as a function of expected inflation, the output gap, and the exchange rate gap. As we later apply the model to Canadian data, we follow Basistha (2007) and Kichian (1999) who report a better fit for Canada when inflation is modeled in level data instead of first differences. We therefore specify the Phillips curve in levels, such that the mean of inflation is a constant. As there is strong evidence of mean shifts in Canadian inflation, we allow for breaks in this constant. The number and the timing of the breaks is determined by the Bai and Perron (1998) structural break test.[2] We also use lagged inflation as a proxy for expected inflation.

$$\pi_t = \overline{\pi}_j + b_\pi \pi_{t-1} + b_y \tilde{y}_t + b_q \Delta q_{t-1} + \eta_t^\pi, \tag{4}$$

[1] UC models can be viewed as a compromise between the class of agnostic time series approaches on the one hand and full-fledged macroeconomic DSGE models on the other. Purely statistical de-trending procedures such as the HP filter do not incorporate any information from economic theory, and can neither capture non-zero correlation of trend and cycle nor any potential transitory fluctuations in equilibrium rates. Alternatively, DSGE models are explicitly designed to identify transitory deviations of macroeconomic variables from their respective natural rates, and are not suited to trace the dynamic evolution of the natural rates themselves.

[2] Bai and Perron suggest to first examine two tests (the so called *UDmax* and *WDmax* tests) to check if there are any structural breaks. If these tests reject the null of no breaks, a sequential procedure to determine the number of breaks is used. This means computing a sequence of $SupFT(l+1)$ statistics to test the null of l breaks against the alternative of $l+1$ breaks. A detailed description of this test can be found in Bai and Perron (1998) and Rapach and Wohar (2005).