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# Nonlinearities in exchange rate determination in a small open economy: Some evidence for Canada

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### ABSTRACT

We analyze bilateral Canadian-US dollar exchange rate movements within a Markov switching framework with two states, one in which the exchange rate is determined by the monetary model, and the other in which its behavior follows the predictions of a Taylor rule exchange rate model. There are a number of regime switches throughout the estimation period 1991:2–2008:12 which we can each relate to particular changes in Canadian monetary policy. These results imply that an active monetary policy stance may account for nonlinearities in the exchange rate–fundamentals nexus. The strong evidence of nonlinearities also confirms the notion that exchange rate movements cannot be explained exclusively in terms of any one particular exchange rate model.

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## 1. Introduction

Standard monetary models of exchange rate determination possess rather weak explanatory power, as forcefully documented by Meese and Rogoff (1983) and Flood and Rose (1995). It has long been suspected that nonlinearities between exchange rates and their underlying fundamental determinants may account for the disappointing performance of these models (see e.g., Cheung, Chinn, & Pascual, 2005; Hsieh, 1989; McMillan, 2005).

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A growing body of literature employs the Markov-switching framework pioneered by Hamilton (1989) to model such nonlinearities. That literature usually finds significant time variation in the exchange rate-fundamentals nexus (Sarno, Valente, & Wohar, 2004), which may itself be due to time-varying transitional dynamics (Yuan, 2011), or to different sets of macroeconomic fundamentals acting as driving forces of the exchange rate during different time periods (Altavilla & De Grauwe, 2010). Focusing specifically on the empirical performance of the monetary exchange rate model, Frömmel, MacDonald, and Menkhoff (2005) confirm the presence of nonlinearities for a number of bilateral US dollar exchange rates. They also identify sub-periods in which the monetary model appears to be a suitable framework for explaining exchange rate movements.

A recent strand of literature identifies as one of the major shortcomings of the monetary model its lack of attention to the market's expectations of future values of the macroeconomic fundamentals (Engel & West, 2004, 2005). Such expectations may be captured by taking account of the endogeneity of monetary policy. For example, central banks following a Taylor rule base their monetary policy decisions on the expected future realizations of inflation and the output gap. A new class of monetary exchange rate models therefore incorporates a Taylor rule interest rate reaction function into an otherwise standard exchange rate model (Engel, Mark, & West, 2008; Engel & West, 2006). These models display exchange rate behavior quite different from the baseline monetary model. In particular, whereas in the monetary model an increase in the current inflation rate causes the exchange rate to depreciate, in Taylor rule models the exchange rate appreciates because higher inflation induces expectations of tighter future monetary policy (Clarida & Waldman, 2008).<sup>1</sup>

The aim of the present paper is twofold. First, we demonstrate that the monetary and Taylor rule exchange rate models yield a common estimating equation which differs only in terms of the signs of the expected coefficients. For this purpose we consider a variant of the two-country Taylor rule model introduced by Engel and West (2006). Beside expected inflation and the output gap, their model stipulates that the Taylor rule of one of the two countries also contains the exchange rate as an argument.<sup>2</sup>

Second, we analyze monthly bilateral Canadian-US dollar exchange rate movements for the estimation period 1991:2–2008:12. To this end we incorporate the common estimating equation into a Markov switching framework that takes account of nonlinearities in the relationship between exchange rates and their fundamentals. In the model we allow for two states, one in which the exchange rate is determined by the monetary model, and the other in which its behavior follows the predictions of the Taylor rule exchange rate model. We focus on the Canadian-US dollar exchange rate because it meets the assumptions of the Taylor rule model by Engel and West (2006). The Bank of Canada (BoC) adheres to an inflation target since the early 1990s, and has also traditionally engaged in exchange market management, with the bilateral Canadian-US dollar rate as the primary target of these intervention activities (Weymark, 1995, 1997).<sup>3</sup> Moreover, in comparison to other bilateral exchange rates, the Canadian-US dollar rate fares particularly poorly in terms of explanations using standard monetary fundamentals (Cushman, 2000; Faust, Rogers, & Wright, 2003; Mark, 1995; Rapach & Wohar, 2002).

Our results can briefly be summarized as follows. We find that the Canadian-US bilateral exchange rate is characterized by strong nonlinearities with respect to its fundamental determinants. In particular, the Markov switching model reveals a number of regime switches which can historically be linked to particular changes in Canadian monetary policy. This result implies both that an active monetary policy stance may account for the observed exchange rate nonlinearities, and that exchange rate movements cannot be explained exclusively in terms of any one particular exchange rate model.

The remainder of the paper is structured as follows: Section 2 provides a characterization of the monetary and Taylor rule exchange rate models, and derives a common estimating equation for the

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<sup>1</sup> The growing literature on the empirical performance of Taylor rule exchange rate models is quite encouraging. Representative studies are Mark (2009) or Molodtsova and Papell (2009).

<sup>2</sup> This feature is frequently, although not exclusively, associated with inflation targeting strategies in small open economies (Ball, 1999; Taylor, 2001).

<sup>3</sup> This evidence has recently been confirmed by Lubik and Schorfheide (2007), who find that the BoC adjusts its policy interest rate in response to exchange rate movements.

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