

Chapter 3

Real exchange rate dynamics: An alternative approach

By Yin-Wong CHEUNG¹ and Ulf G. ERLANDSSON²

Abstract

This exercise presents a systematic study on the presence of Markov switching dynamics in three dollar-based real exchange rates. A Monte Carlo approach is adopted to circumvent the statistical inference problem inherent to the test of regime-switching behavior. Annual, quarterly and monthly data are considered. While annual and quarterly data yield inconclusive or weak evidence on the presence of Markov switching behavior, monthly data strongly indicate the presence of multiple regimes in real exchange rate data. The results suggest that data frequency can be crucial for determining the number of regimes.

3.1 Introduction

Real exchange rate dynamics have significant implications for both academia and policymakers. For instance, real exchange rate behavior bears some direct implications for the relevancy of purchasing power parity hypothesis, which is a key assumption in international economics. On the other hand, policymakers are interested in the nature of shocks to real exchange rates that affect trade balances.

Over time, the study of real exchange rate dynamics evolves from simply computing the correlation to sophisticated modeling of nonlinear temporal be-

¹Corresponding Author: Yin-Wong Cheung, Department of Economics SS1, University of California, Santa Cruz, CA 95044, USA. Email: cheung@cats.ucsc.edu.

²Ulf G. Erlandsson, Economics Department, Lund University.

havior. The level of technical complexity in these empirical studies traces the development in (time-series) econometrics. Despite a plethora of empirical studies on real exchange rate behavior, there are still unsettled issues on, for example, the persistence of real exchange rates (Cheung and Lai (2000a, 2000b)), the sources of real exchange rate persistence (Cheung, Lai, and Bergman (2003), Engel and Morley (2001)), and the nonlinear real exchange rate dynamics (Obstfeld and Taylor (1997), Taylor, Peel, and Sarno (2001)). The recent empirical studies on real exchange rate dynamics are surveyed and evaluated in, for example, Rogoff (1996) and Sarno and Taylor (2002).

The purpose of the exercise is to investigate whether real exchange rates follow Markov switching dynamics. Engel and Hamilton (1990), for example, advocate the use of a Markov switching model to describe the behavior of nominal exchange rates. These authors found that a two-regime Markov switching model performs well in both in-sample and out-of-sample periods for three exchange rate series. It is well documented that real exchange rate variability is mainly driven by movements in nominal exchange rates. A Markov switching model for nominal exchange rates is, thus, suggestive of a Markov switching model for real exchange rates. The possibility that real exchange rates follow a Markov switching process is recently explored in Bergman and Hansson (2003).

The presence of regime-switching dynamics has important implications for theoretical models of real exchange rate dynamics. For instance, real exchange rate behavior can depend on how far the real exchange rate is from its equilibrium position (Dumas (1992)). Further, if a real exchange rate "inherits" the time-series property of the corresponding nominal exchange rate, then factors that generate regime-switching behavior in nominal data can also induce regime-switching behavior in real exchange rates. These factors include the "Peso problem", the changing importance of chartists and fundamentalists in the foreign exchange market, differences between domestic and foreign monetary and fiscal policies, and the presence of transaction costs and diversity of opinions (De Grauwe and Vansteenkiste (2001), Engel and Hamilton (1990), Vigfusson (1996)). The relevance of these factors depends critically on whether the observed real exchange rates are generated from multiple regimes. Thus, the research on Markov switching dynamics sheds some useful insight on modeling of real exchange rate behavior.

One main feature of the current exercise is the focus on the determination of the number of regimes in the empirical Markov switching model. Most existing empirical studies on Markov regime-switching dynamics either explicitly or implicitly assume that data are drawn from a specific multi-regime Markov switching process and estimate the model parameters accordingly. The absence of a formal test before estimation is probably due to the fact that the test for the number of regimes is a non-standard statistical inference problem. The commonly used test statistics, including the likelihood ratio statistic, do not have their usual asymptotic distributions. However, without formal evidence of the existence of multiple regimes, estimation of Markov switching models may lead to spurious results. For instance, data generated from a Markov switching model exhibit long swings. However, it is also known that realizations of

a random walk process resemble observations displaying long swings. Fitting a Markov switching model to a unit root process may generate spurious estimation results and mis-identify long swings due to unit root persistence as regime-switching behavior. Thus, a formal test for the number of regimes is essential for determining the presence of Markov switching dynamics.

Another interesting feature of the exercise is the attempt to find a level field to determine whether a random walk model or a Markov switching model provides a better description of real exchange rate dynamics. A typical procedure will test the null hypothesis of a random walk against a Markov switching alternative. Such a procedure demands strong evidence to overturn the null hypothesis and establish the alternative specification. It is known that the non-rejection of the null hypothesis does not necessarily mean that the null hypothesis is correct and the alternative is false. If a test procedure has low power, then it may not reject the null hypothesis even if it is false. To mitigate the problem, we consider the null hypothesis of a random walk process and, then, the null hypothesis of a Markov switching process. Thus, both a random walk and a Markov switching model have the same opportunity to be treated “favorably” under the null hypothesis. In addition, we tally the power of the test procedures and incorporate the information in making statistical inferences.

In this study, we adopt a Monte Carlo approach to test for the number of regimes in a Markov switching model (Rydén, Teräsvirta, and Asbrink (1998)). In particular, the data-specific empirical distribution of the likelihood ratio statistic is used to evaluate the probability of the presence of regime-switching behavior. While simulation may not offer general conclusions, it circumvents the issues of non-standard statistical inferences inflicting the standard approach to model regime switching and provides some useful sample-specific results. Further, the use of data-specific distributions helps mitigate finite sample biases.

The remainder of the paper is organized as follows. In Section 3.2 we state the random walk and Markov switching models examined in the exercise and conduct some preliminary analyses on the real exchange rate data. Section 3.3 describes the Monte Carlo based test for the number of regimes. Test results from the annual, quarterly, and monthly data set are also reported in this section. Some concluding remarks are offered in Section 3.4.

3.2 Preliminary analyses

The US dollar real exchange rates of Deutsche mark, British pound, and French franc are considered. The corresponding nominal exchange rates are examined by Engel and Hamilton (1990). The sample spans from 1973 to 1997 and contains data at the monthly, quarterly, and annual frequencies. All data are retrieved from the International Monetary Fund data CD.

It is conceived that the frequency of observations plays a role in revealing regime-switching behavior. Specifically, a higher sampling frequency can give better information on the dynamic property. Suppose a real exchange rate switches between two regimes. If the expected duration of the real exchange

