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The exchange rate and macroeconomic determinants: Time-varying transitional dynamics

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ABSTRACT

In this paper, I consider modeling the effects of the macroeconomic determinants on the nominal exchange rate to be channeled through the transition probabilities in a Markovian process. The model posits that the deviation of the exchange rate from its fundamental value alters the market's belief in the probability of the process staying in certain regime next period. This paper further takes into account the ARCH effects of the volatility of the exchange rate. Empirical results generally confirm that fundamentals can affect the evolution of the dynamics of the exchange rate in a nonlinear way through the transition probabilities. In addition, I find that the volatility of the exchange rate is associated with significant ARCH effects which are subject to regime changes.

1. Introduction

The floating exchange rate in the post-Bretton Woods era appears to be disconnected from its underlying macroeconomic determinants most of the time. Empirical work has often failed to present evidence of stable relationship between nominal exchange rate movements and fundamental variables suggested by the exchange rate determination models. "Indeed, the explanatory power of these models is essentially zero," as Evans and Lyons (2002, p. 170) assert. In addition, a plethora of empirical studies

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find that the nominal exchange rate is excessively volatile relative to the underlying macroeconomic variables during the recent floating period. Flood and Rose (1999), for example, show that there are no macro-fundamentals capable of explaining the dramatic volatility of the exchange rate.

In this paper, I consider modeling the effects of the macroeconomic determinants on the nominal exchange rate to be channeled through the transition probabilities in a Markovian process. Many researchers have sought ways to model the possible nonlinearities in the relationship between the exchange rate and macro-fundamentals.[1] Little work, nevertheless, has ever studied the transitional effects of the macroeconomic determinants on the exchange rate. In effect, allowing fundamentals to affect the transition probabilities in the Markovian process is intuitively attractive: the market responds to the updated news in the macro variables—deviation of the exchange rate from its fundamental value—and in turn alters the belief in the chance of the process staying in certain regime next period.

My work further takes into account the autoregressive conditional heteroskedasticity (ARCH) effects of the volatility of the exchange rate. The ARCH and related effects have been repeatedly documented in exchange rates. Diebold (1988), for example, finds strong ARCH effects in all the seven nominal exchange rates examined. The ARCH (GARCH) models have been extensively applied to financial time series and have probably become one of the most popular tools to study financial market volatility since the pioneering works by Engle (1982) and Bollerslev (1986). The application of ARCH models, however, may be problematic according to Lamoreux and Lastrapes (1990) since ARCH estimates are seriously affected by structural changes or regime shifts. On the other hand, the Markov-switching model popularized by Hamilton (1988, 1989) has proved especially successful in modeling time series with changes of regime.[2] Nevertheless, the Hamilton's Markov-switching model takes little consideration of the movements in the variance. For example, Pagan and Schwert (1990) show that Markov-switching specification is not satisfactory in explaining the monthly U.S. stock-return volatility from 1834 to 1925. In this regard, an extension combining the traditional Markov-switching model with ARCH specification turns out to be a natural motivation.

The Markov-switching model has appealing economic interpretations and is able to accurately track economic movements. Economic activities, for instance, usually exhibit asymmetric business cycles, featured by alternations between long-lived expansions and more violent but short-lived recessions.[3] Theoretical models of multiple equilibria developed to account for this asymmetry have been found to be consistent with the central idea of the regime-switching model.[4] Patterns, like bull and bear markets, or bubbles and crashes, are often seen in the dynamics of stock prices and exchange rates. While these extraordinary price movements are intricately associated with speculative behavior like "manias and panics" as described by Kindleberger (1989), many researchers have shown that regime switching is linked to speculative behavior. Van Nordan and Schaller (1999), for example, develop a model of speculative behavior as an explanation of stock market crashes, which can empirically be translated into a regime-switching specification. Along with the same line, De Grauwe and Kaltwasser (2007) show that divergence of beliefs—optimism and pessimism—about the fundamental value of the dollar exchange rate creates regime switches in the foreign exchange market. Switches between regimes can also be the result of deliberate policy actions of the government. Ang and Bekaert (2002), for example, find strong evidence of regimes in the US short-term interest rate data when the Fed responds to alternate inflationary regimes.

Using four major dollar exchange rates, I investigate the potential transitional effects of macroeconomic determinants and ARCH effects in the volatility of the exchange rate. A variety of

[1] See, for example, Taylor and Peel (2000), Taylor, Peel, and Sarno (2001), and Killian and Taylor (2001) consider an exponential smooth transition autoregressive (ESTAR) model to capture the nature of nonlinear mean reversion in real exchange rates, and Wu and Chen (2001) propose a nonlinear error-correction model allowing for time-varying coefficients.

[2] Prominent applications include, but not limit to, Hamilton's (1989) model of trends in the business cycle, Cecchetti, Lam, and Mark's (1990) model of mean reversion in equilibrium asset prices, Engel and Hamilton's (1990) model of exchange rate dynamics, Raymond and Rich's (1997) model of the relationship between oil price shocks and macroeconomic fluctuations, and Psaradakis, Sola, and Spagnolo's (2004) model of stock prices and dividends.

[3] See a survey by Raj (2002) on evidence of business cycle asymmetry.

[4] See, for example, Cooper and John (1988), Howitt and McAfee (1992), and Jeanne and Masson (2000).