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Martingale difference hypothesis and financial crisis: Empirical evidence from European emerging foreign exchange markets

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ABSTRACT

This study investigates the effects of the recent global crisis on the relative efficiency of six CEE currency markets, using the generalized spectral test of Escanciano and Velasco (2006) in a rolling window approach. The empirical results show that the global crisis adversely affected the efficiency of most CEE currency markets, with the Turkish lira being hit the hardest, followed by the Russian ruble, Czech koruna, Romanian leu, Polish zloty and Hungarian forint. In the first stage of the crisis, covering the second half of 2008 and the first months of 2009, all foreign exchange markets experienced periods of inefficiency. In the second stage of the crisis, the Hungarian, Polish and Romanian foreign markets recovered market efficiency quickly, while Russia, Turkey and the Czech Republic continue to register a low degree of efficiency.

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1. Introduction and motivation

In an efficient foreign exchange market, the exchange rates reflect, by the actions of rational investors, all information relevant to their fundamental value. Focusing on the weak form of informational efficiency, the martingale stochastic model provides an appropriate framework for testing whether exchange returns are predictable. The weak form efficiency implies that the past

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exchange rates cannot help to improve forecasts about future spot exchange rates; therefore there are no opportunities for profit based upon past data.

The efficient market hypothesis asserts that markets are efficient concerning information. Depending on the information set in setting prices, Fama (1970) classifies market efficiency into three categories; namely, weak-form, semi-strong and strong-form efficiency. A market is weak-form efficient if current prices fully and quickly incorporate the information contained in historical prices. In addition to the history of past prices, the semi-strong and strong forms of efficiency consider the publicly respectively privately available information. This paper focuses on the weak-form efficiency of foreign exchange markets. This is related to the ability to predict foreign exchange rate changes based on historical exchange rates.

As Escanciano and Lobato (2009) point out, the lack of predictability of financial series has been commonly referred to as the random walk hypothesis, with some confusing meanings. Within the terminology of Campbell et al. (1997), the dynamic of prices can be described by three different processes: a random walk with independently and identically distributed increments (random walk 1), a random walk with independent but not identically distributed increments (random walk 2), and by the weakest form of random walk hypothesis, which includes processes with uncorrelated changes (random walk 3).

The present paper investigates if the successive exchange rate returns follow a martingale difference sequence; this would imply that the log of exchange rate follows a martingale process. As Escanciano and Lobato (2009) observed, a martingale process for prices corresponds to the random walk 2 hypothesis within the previous terminology. Under this hypothesis the increments, given by the exchange rate returns, are mean-independent. The past and current data are of no use for forecasting future values of exchange rate returns; no linear or nonlinear dependence can be detected in the conditional mean.

The dynamics of exchange rates, in terms of efficiency/inefficiency behavior, is of interest for investors and traders, policy makers, monetary and fiscal authorities, and economic agents. The exchange rate movements affect the international trade flows, balance of payments and allocation of resources in national and international economy. On the other hand, foreign direct investment has a positive impact on the host country's economic growth (Masca and Vaidean, 2009). The regulators, through policy instruments, aim at improving the informational inefficiency of the markets, at reducing the associated risks, and at ensuring economic stabilization. Evaluation of the degree of financial efficiency for Central and Eastern European (CEE) countries is important to assess to what extent these countries are prepared for the transition towards full monetary integration. Financial markets could provide stabilization in economies affected by specific shocks as long as they are efficient and integrated, substituting the traditional policy instruments (Vieira and Vieira, 2007).

A number of studies investigate the efficiency of financial markets, most of them using various versions of the variance ratio test. Charles and Darne (2009a,b) provide a good survey of the recent developments related to the variance-ratio tests. Also, Hoque et al. (2007) make a brief comparative description of these tests. The papers of Liu and He (1991), Ajayi and Karemera (1996), Wright (2000), Azad (2009) and Lin et al. (2010), among others, have studied the foreign exchange market efficiency. Belaire-Franch and Opong (2005) examine the behavior of ten major trading currencies quoted against the euro. With small exceptions, the empirical results reveal that the markets are weak-form efficient. Belaire-Franch and Opong (2010) test for random walk behavior of euro exchange rates using the variance ratio tests based on the subsampling approach; the results are mixed.

Escanciano and Velasco (2006) developed and applied a generalized spectral (GS) test for the martingale difference hypothesis (MDH) for five exchange rates and the results suggest the presence of some nonlinear dependencies in the conditional mean. Charles et al. (2010) applied the GS test to look for predictability of the five major foreign exchange markets. The simulation experiments conducted by Charles et al. (2011) show that the wild bootstrap automatic variance ratio test of Kim (2009) has highest power against linear dependence, while the GS test has high power against nonlinear dependence; the authors suggest to use both tests in practice.

Other groups of studies use the Hurst exponent to assess informational efficiency (Da Silva et al., 2007; Qian and Rasheed, 2010). Giannellis and Papadopoulos (2009) investigate the efficiency of CEE foreign exchange markets using a test procedure based on equilibrium exchange rates. As a general

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