GLOBAL FINANCIAL CRISIS AND EFFICIENCY IN FOREIGN EXCHANGE MARKETS

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Abstract

This article inspects the efficiency of the foreign exchange market after the global financial crisis of 2007-08. A BDS independence test was applied to the returns of weekly exchange rates of the Euro, the Australian Dollar, the Swiss Franc, the New Zealand Dollar, and the Singapore Dollar against the US Dollar, one time from 2002 to 2007, and the other time from 2007 to 2011. The results indicates that the exchange rates returns are independent and identically distributed (iid) before the crisis, but they are founded not to be iid after the crisis, that is, Efficient Markets Hypothesis cannot be rejected before the crisis, while it is rejected after the crisis. In other words, the efficiency of the foreign exchange market has fallen after the crisis. It will be discussed that it could have happened because of a substantial reduction in speculative activity caused by the interventions of the governments of the developed countries in the currency markets.

Keywords: Independence BDS Test; Efficient market hypothesis; exchange rate; global financial crisis; speculator.

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1. Introduction

The recent global financial crisis, whose initial effects emerged in 2007, has changed international economic relations, and has severely affected financial markets. Many articles have been written about the effects of the crisis on financial sectors. In this article, it will be shown that the return of some of the main exchange rates of the world are independent and identically distributed (*iid*) before the crisis, but they are not *iid* after the crisis. This conclusion was obtained from applying BDS test to the returns of weekly exchange rates of the Euro, the Australian dollar, the Swiss franc, the New Zealand dollar, and the Singapore dollar against the US dollar.

BDS test is generally applied to a time series to test for time based dependence in the series. The null hypothesis of this test is that a given time series is *iid* against a variety of possible deviations from independence including linear and nonlinear dependence. Assume that the time series under consideration is exchange rate return, if the null is not rejected, the return is *iid*, and it is stated that the foreign exchange rate market is efficient.

The origins of the *Efficient Market Hypothesis* (EMH) can be found in the works of Fama and Samuelson and Roberts who had been working independently on the issue in the 1960s. A market is said to be informationally efficient, if prices in the market completely reflect all the available and relevant information. From this perspective, in an efficient market, price changes only because of the arrival of new information. But, because future information cannot be predicted, it is also impossible to forecast future price changes according to the information set available, so it is not possible to make economic profit using the available information (see Malkiel, 1992). It is generally has accepted that there are three forms of efficiency depending on the information set Ω_t. *Weak form*: no investor can earn excess returns using historical prices (return is *iid*). *Semi-strong form*: no investor can earn excess returns using historical prices and all publicly available information. *Strong form*: no investor can earn excess returns using any information, including historical prices, publicly available information, and private or insider information. In this article, our focus is on the weak form of the EMH. the weak form can be tested by testing whether price changes (returns) are *iid* or not.

As already mentioned, it will be shown that the return of some of the main exchange rates of the world are independent and identically distributed (*iid*) before the crisis, so EMH cannot be rejected, but they are not *iid* after the crisis, that is, EMH is rejected after the crisis. We cannot claim certainly what has happen in the foreign exchange market, but the following scenario is probable: after the recent crisis, approximately, all of the developed economies either bankrupted or encountered severe economic losses. One of the main reactions of the central banks of the countries was that they began to depreciate their currencies against the most important currencies of the world in order to increase their exports to compensate for the losses. Their interventions in the currency markets, made forecasting of exchange rates for speculators and traders very difficult (It is necessary to consider that the governments often intervene when the direction of the market is not in their desired direction, so they change the direction in the opposite direction it should be.); consequently, the speculators lost money because of wrong predictions. These losses caused them to leave the foreign exchange market, and they preferred to convert their assets into some of the safe assets such as gold (they increased demand for gold; hence, gold price increased substantially. As it can be seen in Figure 1, although gold price has been rising continuously from 2001, it has increased with a very steeper slope after the crisis). Therefore, the interventions caused the number of the speculators to decrease. Speculators play an important role in financial markets. The less (more) the number of speculators, the less (more) efficient the market will be (see Bekaert, Garcia, and Harvey, 1995). In other words, the efficiency of the markets decreases as speculative activities decreases and this is why EMH is rejected after the crisis.

The remainder of this paper is organized as follows: section 2 describes the BDS test. Section 3 represents the empirical results. Section 4 summarizes the article.

2. ***BDS Test:***

Brock *et al* (1996) proposed a test for time based dependence in a series. The null hypothesis of this test is that a given time series is *iid* against a variety of possible deviations from independence including linear and nonlinear dependence. For explaining the concept of the test, let ε be a given distance and let ε_i and ε_j be two realizations of the $\{\varepsilon_t\}$ series. If all values of

$\{\varepsilon_t\}$ are independent, then the probability that the distant between any pair of $(\varepsilon_i, \varepsilon_j)$ is less than *d* must be the same for all *i* and *j*, the probability is denoted by $C_1(\varepsilon)$. This simple concept is the base of the test. Under the null hypothesis of *iid*, given a sample of n observations, the BDS statistic is

$$\sqrt{n-m-1}\frac{C_{m,n}(\varepsilon) - C_{1,\ n-m+1}(\varepsilon)^m}{\sigma_{m,n}(\varepsilon)} \quad \rightarrow \quad N(0,1)$$

Where m is the number of consecutive points $(\{\varepsilon_i, \varepsilon_j\}, \{\varepsilon_{i+1}, \varepsilon_{j+1}\}, \ldots, \{\varepsilon_{i+m}, \varepsilon_{j+m}\})$, and $C_{m,n}(\varepsilon) = \frac{2}{(n-m+1)(n-m)} \sum_{a=1}^{n-m+1} \sum_{b=a+1}^{n-m+1} \prod_{j=0}^{m-1} I(\varepsilon_{a+j}, \varepsilon_{b+j})$, and $I(A, B) = \begin{cases} 1 \text{ if } |A - B| \leq \varepsilon \\ 0 \text{ if } |A - B| > \varepsilon \end{cases}$.

See Brock *et al.* (1996) for the formulae of $\sigma_{m,n}(\varepsilon)$ and more details. If the sample size is large enough, the statistic has a standard normal distribution; otherwise, the distribution can be approximately obtained through simulation (see Kanzler, 1999).

3. ***Empirical Results***

To demonstrate the claim that the behavior of the returns of weekly exchange rates of the euro (EUR), the Australian dollar (AUD), the Swiss franc (CHF), the New Zealand dollar (NZD), and the Singapore dollar (SGD) against the US dollar have changed after the global financial crisis of 2007, two BDS tests were done on each return ($return \approx \Delta \log(spot\ exchange\ rate)$), one from July 12, 2002 to February 9, 2007, and the other one from February 16, 2007 to September 16, 2011.

The p-values of the BDS statistic have been shown in Table 1 for dimensions 2 through 5 with $\varepsilon = 0.7$ being specified as a fraction of pairs. As it can be seen, the null of *iid* cannot be rejected for all exchange rates at the 5% significance level before 2007, so EMH cannot be rejected before 2007. But the null is rejected for all exchange rates at the 5% level after 2007, in other words, EMH is rejected after 2007.

Table1. The p-values of the BDS test for dimensions 2 through 5

	Before the crisis				After the crisis			
	2	3	4	5	2	3	4	5
AUD/USD	0.1936	0.1431	0.2288	0.0929	0.0000	0.0000	0.0000	0.0000
USD/CHF	0.5329	0.3681	0.6358	0.9776	0.0333	0.0123	0.0041	0.0023
EUR/USD	0.8014	0.4500	0.4136	0.6995	0.0126	0.0353	0.0360	0.0112
NZD/USD	0.6263	0.3814	0.7476	0.9855	0.0075	0.0008	0.0000	0.0000
SGD/USD	0.6578	0.3722	0.4852	0.7029	0.0117	0.0187	0.0043	0.0004

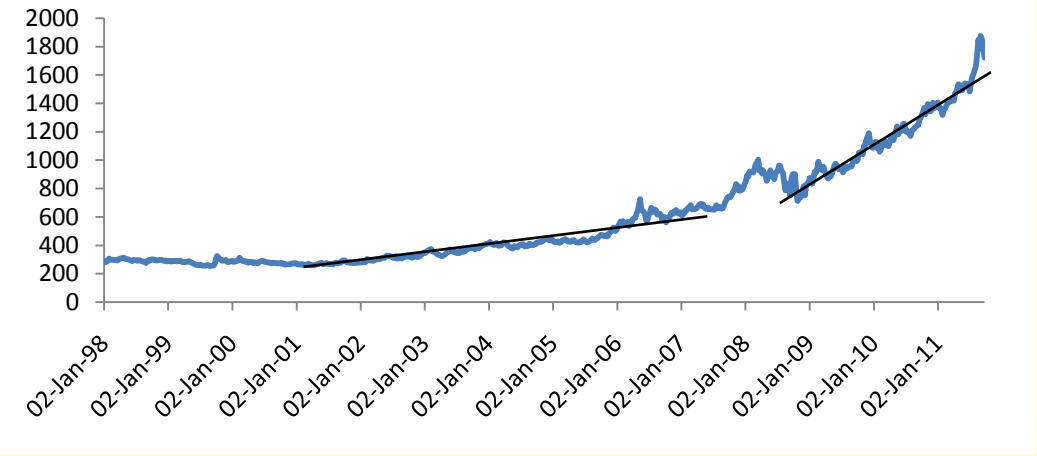

Figure1. Gold price

4. Conclusion

In this article, we applied BDS test to the returns of some of the most important exchange rates of the world to test whether the returns are *iid* or not. It was shown that the null of *iid* cannot be rejected at the 5% level before the global financial crisis of 2007, but the null was rejected at the

5% level after the crisis. Therefore, the efficiency of the foreign exchange market has fallen after the crisis. We argued that governments' interventions in the foreign exchange market caused speculators to encounter economic losses, and consequently, many of the speculators left the foreign exchange market, and this intensive reduction in speculative activity leaded to a substantial reduction in the efficiency of the market.

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