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The effectiveness of the monetary policy in China: New evidence from long-range cross-correlation analysis and the components of multifractality

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HIGHLIGHTS

- We examine the long-range cross-correlations between RMB exchange rate and the Shibor markets.
- A nonlinear time-varying correlation between the FX rate and SHIBOR is found.
- Monetary policy can significantly reduce the multifractality of cross-correlations between FX and Shibor markets.
- The source of multifractality is mostly due to the nonlinear correlation and fat-tailed probability distribution.

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ABSTRACT

This study examines the long-range cross-correlations between the Chinese Renminbi (RMB) exchange rate and the Shanghai Interbank Offered Rate (Shibor) markets both on qualitative and quantitative basis, using a comprehensive dataset covering the period from October 8, 2006 to September 30, 2016. Our empirical results suggest that a nonlinear time-varying correlation exists between the markets. We also verify that the third stage of China's monetary policy reform from 2011 to 2016 had a greater influence on both small and large foreign exchange (FX) market fluctuations. Using the multifractality analysis, we conclude that China's monetary policy can significantly reduce the multifractality of cross-correlations between the RMB exchange rate and Shibor rate markets, and that market efficiency in the third stage of policy reform is improved. Furthermore, the source of multifractality of cross-correlations is found mostly in the nonlinear correlation and fat-tailed probability distribution (PDF) components.

1. Introduction

In recent years, the relationship between exchange rate and interest rate has drawn much attention from both market investors and policymakers. Quite a number of studies have investigated the relationship between FX rate and benchmark interest rate from central bank's angle and the results from those probes are either conflicting or insignificant. Drazen and Hubrich [1] for example, state that the European Central Bank (ECB) did not target the exchange rates. Similar results are obtained from İshak [2], who suggests that though the ECB systematically responds to exchange rate movements, the quantitative effects from the ECB intervention are quite small. Granville and Mallick [3], however, document some

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different results in special circumstances, they find that the exchange rate channel played an important role in the conduct of monetary policy in Russia, and that the interest rates tend to respond more to exchange rate shocks. Mallick and Sousa [4] provide evidence on monetary policy transmission for five key emerging economies: Brazil, Russia, India, China, and South Africa (the Brics). They find that a contractionary monetary policy shock leads to persistent appreciation in the real exchange rates in all countries except South Africa.

A number of studies show [4–11] that there does not exist any long-term co-movement relationship between the Chinese interest rate and exchange rate because China's monetary policy aims to keep the value of the RMB stable and the short-term interest rate plays an important role in the largest emerging economy [11]. Mallick et al. [4] also find the strong influence of Chinese monetary policy on economic activity, and that the main focus of the Chinese monetary policy has been more toward stabilizing output than toward controlling inflation. Therefore, an exogenous increase in the short-term interest rate tends to be followed by an appreciation in the RMB exchange rate. Consequently, an understanding of the real relationship between exchange rate and interest rate in the Chinese context is crucial.

The correlations between the exchange rate and interest rate have been investigated in various theoretical models of international economics, including the portfolio balance model [12–14], pricing-to-market (PTM) model [15], and the uncovered interest rate parity theory. These models demonstrate a negative relationship between the interest rate differential and exchange rate [16]. One of the implications of the Purchasing Power Parity (PPP) hypothesis is that any shock to the real exchange rate is temporary, and that in the long run, this rate reverts to its mean value. This model predicts a positive relationship between the interest rate and the exchange rate in the long run [17]. Theoretically, the relationship between the spot exchange rate and the interest rate differential is often considered to be negative in the short run when product prices are sticky, and positive in the long run when they are not. Furthermore, quite a lot of studies have confirmed that in the short run, the interest rate differential between the domestic and foreign markets is one of the most important economic factors that determine the FX rate movements.

More studies have further investigate the dynamic and time-varying correlations between the exchange rate and interest rate. Bautista [18] uses the dynamic conditional correlation (DCC) analysis to investigate the relationship between the interest rate and exchange rate, and finds that the correlation between these variables is far from constant. Sensoy and Sobaci [19] use a VAR model to investigate the dynamic relationship between the exchange rate (against US dollar) and interest rate in Turkey for a 10-year period from January 2003 to September 2013. They find that volatility shocks create abrupt changes in the dynamic correlations in the short run. Although a growing number of studies have demonstrated that the two markets are often nonlinear and cross-correlated, very few of them have employed the long-range cross-correlation analysis to discuss the effectiveness of the monetary policy and the components of multifractality in the Chinese markets.

A complex system usually contains several observable variables that exhibit multifractal cross-correlations. The extended forms of detrended cross-correlation analysis (DCCA or DXA) [20], height cross-correlation analysis (HXA) [21] and detrending moving-average cross-correlation analysis (DMCA) [22,23]—the MF-DCCA (MF-DXA), MF-HXA [21] and MF-X-DMA [24,25] methods, respectively—have been widely applied to investigate the multifractal nature in the long-range cross-correlations between two time series. In addition, several tests of power-law cross-correlations have been introduced based on the idea of bivariate estimators [26–33]. However, understanding the source and components of multifractality in long-range cross-correlations is still an important novel topic [34–38]. Zhou [34] finds that the effective multifractality is the apparent multifractality after eliminating the finite-size effect, and that effective multifractality can be further decomposed into two components: the fat-tailed component and the nonlinearity component. Sela et al. [35] and Kristoufek [36–38] argue that long-range correlated processes along with cross-correlated error terms can be identified as possible sources of long-range cross-correlations, and discuss six estimators of the bivariate Hurst exponent. In a recent study, Kristoufek [37] analytically shows that the long-range cross-correlation emerges from the correlation structure of separate processes. These theoretical results are extremely important to empirically analyze long-range cross-correlations and multifractal behaviors across various disciplines.

This study aims to identify the long-rang cross-correlations and multifractality between the interest rate and exchange rate in China during the period 2006–2016. To the best of the authors' knowledge, this study is the first attempt in the literature to empirically examine the effectiveness of China's monetary policy in different periods from this particular angle, by using the long-range cross-correlations analysis. In order to test the effectiveness of monetary policy operations in different stages of policy reform, we specially designed a qualitative analysis for long-range cross-correlations and the time-varying degree of multifractality and the bivariate Hurst exponents. And, to obtain a more accurate estimate of the possible sources of multifractality in the long-range cross-correlations, we study the components of multifractal spectrum using the detrending moving average cross-correlation analysis (MF-X-DMA) method.

The remainder of this paper is organized as follows. Section 2 presents the methodology of the study. Section 3 provides the statistical description of the data. Section 4 details the statistical tests and reports empirical results. Finally, In Section 5 we concludes the study.

2. Methodology

2.1. MF-DCCA

The MF-DCCA method [25] is a generalization of DCCA, which can investigate further the multifractal nature in two cross-correlated time series. Consider two time series $\{x(i)\}$ and $\{y(i)\}$, $i = 1, 2, \ldots, N$, N is the length of the series.