

Testing for long-range dependence in the Brazilian term structure of interest rates

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Abstract

This paper presents empirical evidence of fractional dynamics in interest rates for different maturities for Brazil. A variation of a newly developed test for long-range dependence, the V/S statistic, with a post-blackening bootstrap is employed. Results suggest that Brazilian interest rates possess strong long-range dependence in volatility, even when considering the structural break in 1999. These findings imply that the development of policy models that give rise to long-range dependence in interest rates' volatility could be very useful. The long-short-term interest rates spread has strong long-range dependence, which suggests that traditional tests of expectation hypothesis of the term structure of interest rates may be misspecified.

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1. Introduction

The analysis of persistence in interest rates is a fundamental question in macroeconomics and finance. In macroeconomics, since monetary policy is implemented through the setting of short-term interest, the term structure of interest rates is crucial to the conduction of monetary policy in most countries. Interest rates for different maturities (and duration) tend to move together. By changing short-term interest rates, monetary authorities provoke changes in longer term interest rates, which by the transmission mechanisms influences the entire economy. The expectation hypothesis (EH) is one of the main explanations found in the financial literature for interest rates for different maturities to be linked¹.

If short-term interest rates are persistent then eventual shocks take longer than one would expect to dissipate. These shocks are transmitted to the entire spectrum of interest rates for different maturities with different intensities, depending on expectations. Peel and Ionnidis [38] argue that most consistent predictors of future changes in real output are variables derived from the term structure of interest rates. Therefore, predicting and understanding interest rates dynamics is essential. It has been shown by Pfann et al. [39] that allowing for long-range dependence in the short-term

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¹ See [48].

process of interest rates for the US improves the fit of the term structure models. This suggests that testing for long-range dependence for interest rates is important as it has important implications for modeling and forecasting purposes.

This study investigates the presence of long-range dependence in a variety of Brazilian interest rates (1–6-month maturity interest rates). Unfortunately, a consistent data set for longer term interest rates does not exist for the Brazilian economy, which implies that we have to focus on the short end of the term structure.

This research is particularly interesting for the Brazilian economy. In Brazil, as in most countries, monetary policy is primarily implemented through the setting of short-term interest rates. These interest rates affect the entire spectrum of interest rates for different maturities and have an impact on spending and saving decisions, affecting economic activity. Actually, if interest rates possess long memory then macroeconomic models currently in use for the Brazilian economy should take into account this property. For example, the traditional linear vector autoregressive models approach is no longer adequate to study joint dynamics of interest rates and other macro variables of interest. On the other hand, the Brazilian economy has had high real interest rates in the recent years. These high interest rates are the main culprits of the dramatic increase in the debt-to-GDP ratio in this period. Due to the high debt-to-GDP ratio the economy has entered a bad equilibrium in 2002 and 2003, when increases in interest rates were unable to contain domestic currency depreciations (as it increases perception of risk), rendering monetary policy non-effective.² Furthermore, a local long-term credit market does not exist in Brazil. This fact has been recently attributed to jurisdictional uncertainty.³

The paper contributes to the financial literature in three ways. In the first place, this is the first paper that studies long-range dependence for interest rates for the Brazilian economy and presents empirical evidence for interest rates' volatility. Secondly, we propose a new methodology to test for long-range dependence and present a Monte Carlo simulation providing convincing evidence of the superiority of the proposed methodology. Finally, we also test for structural changes and propose a time-varying procedure in order to check for robustness of the results.

This paper proceed as follows. In Section 2, a brief review of literature is presented. In Section 3, the R/S and the V/S analysis, the statistical approaches used to evaluate the Hurst's exponent, are presented. Moreover, the two statistical approaches are compared to each other and the superiority of the V/S analysis is shown. In Section 4, the data used in this work are described. In Section 5, empirical results for stationarity/non-stationarity tests using newly developed unit root tests are presented. In Section 6, results for testing for long-range dependence in changes in interest rates and in interest rate's volatility are shown. In Section 7, an approach is presented to investigate the dynamics of the long-range dependence parameter over time. Using this approach, one may see that there may exist breaks in the long memory parameters, depending on the time period being analyzed. Finally, in Section 8, this paper is concluded.

2. Brief literature review

While the presence of long-range dependence in equity asset returns and returns volatility seems to be an stylized fact,⁴ only few papers have provided empirical evidence of long-range dependence in interest rates.⁵

The first to consider the existence of long memory in interest rates seems to be Backus and Zin [1] who find evidence of long-memory in the 3-month zero-coupon rate for the US, and that allowing for long memory in the short interest rate improves the fitted mean and volatility yield curves. The authors suggest that the origins of the long-memory property of the short-term interest rate may be derived from a fractionally integrated dynamic for inflation and/or the money growth rate.

Since then, others have supported Backus and Zin's results. For example, Tsay [49] has showed that the ex post real interest rate for the US possesses long memory. The author employed unit root [40] and KPSS [29] tests. For most of the samples the authors analyzes the rejection of both hypothesis suggesting that these process are neither an $I(1)$ nor $I(0)$ process. Therefore, an ARFIMA model was estimated and empirical evidence suggested that ex post real interest rates could be well described by an ARFIMA model with long memory. Other evidences are provided by Barkoulas and Baum [4] employing spectral regression and Gaussian semiparametric methods to the Euroyen deposit rates and Euroyen term premium and McCarthy et al. [36] applying wavelets to a large class of US debt instruments.⁶

² This perverse effects of interest rates on exchange rates and inflation are known in the literature as fiscal dominance. The main point is that increases of interest rates may provoke a rise in the default probability on the domestic debt, which weakens the domestic currency and may cause domestic inflation. For details, see [6].

³ Jurisdictional uncertainty is associated to the lack of confidence in the monetary standard, due to the risk of capital losses associated to acts of the Prince of judicial interpretations unfavorable to the saver. See [2].

⁴ For details, see [3,22,23,32,34,51].

⁵ See also [5,12–15,30,41,52].

⁶ See also [20].

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