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Decomposing intraday dependence in currency markets: evidence from the AUD/USD spot market

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Abstract

The local Hurst exponent, a measure employed to detect the presence of dependence in a time series, may also be used to investigate the source of intraday variation observed in the returns in foreign exchange markets. Given that changes in the local Hurst exponent may be due to either a time-varying range, or standard deviation, or both of these simultaneously, values for the range, standard deviation and local Hurst exponent are recorded and analyzed separately. To illustrate this approach, a high-frequency data set of the spot Australian dollar/US dollar provides evidence of the returns distribution across the 24-hour trading 'day', with time-varying dependence and volatility clearly aligning with the opening and closing of markets. This variation is attributed to the effects of liquidity and the price-discovery actions of dealers.

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1. Introduction

Recently, the scope of empirical investigation possible in foreign exchange markets has been expanded by the availability of high-frequency, or tick, data of spot foreign exchange (FX) prices. For example in the financial economics literature, Muller et al. [1], Goodhart and Demos [2], Goodhart and Figliuoli [3], and later Bollerslev and Domowitz [4] and Bollerslev and Melvin [5] focus on quote arrivals (frequency) and the size of the bid-ask spread, which they find varies across the trading day, with higher spreads and volatility at the beginning and end of trading. From a time-series modelling perspective, differences in liquidity and price availability of markets organised around groups of dealers—who possess differing degrees of private information—ensures that prices cannot immediately incorporate all private information in individual trades [6]. Price discovery by these traders may therefore lead to time-series that display statistical properties consistent with dependent processes.

Studies investigating the statistical properties of financial series [7–11] identify the presence of non-linear dependence, which is a departure from the fair game, or martingale property of asset returns under Fama's [12] Efficient Market Hypothesis. In the econophysics literature, recent studies focusing on the long-range-dependent properties of stock indices by Grau-Carles [13], Costa and Vasconcelos [14], Matos et al [15] and Cajueiro and Tabak [16–18] also describe varying levels of long-range dependence. The implications of dependent processes, evident from low- and high-order autocorrelation structures in the data are of particular concern for the volatility-based pricing models (such as option pricing models) typically used in financial markets. Low-order correlations, which tend to exhibit hyperbolic decay, may be associated with short-range memory effects, while long-range memory effects have been linked to the presence of fractal structures.

Despite some studies investigating these issues in the major traded currencies such as the euro, Japanese yen, or English pound quoted against the US dollar, there is little information available on the microstructure and statistical properties of trading on the spot Australian dollar against the US dollar (AUD/USD). Extending the work of Batten and Ellis [19] who found weak evidence of positive dependence in the daily spot AUD/USD, this study provides evidence on the intraday behaviour of volatility and links this to the time-varying nature of dependence evident in the series. Measured using the statistical techniques of Hurst [20] and Mandelbrot and Wallis [21], the unique feature of this study is that we decompose the measure of dependence into its underlying components to provide an insight into the cause of the observed variation in volatility and dependence over the 24-hour trading day. The approach differs from recent studies that seek to identify dependence by various methods (see Refs. [13,15]) and from those which adopt a rolling sample approach (see Refs. [14,16,17,22]), the latter of which generally fail to account for the asymptotic behaviour of the Hurst statistic [23,24]. First we track the patterns and distributions of price quotes, spreads and returns across the trading day and week. Second we describe the nature and the form of price dependence in the markets. The approach adopted is to investigate