



# Foreign exchange market efficiency and profitability of trading rules: Evidence from a developing country



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## ABSTRACT

This paper empirically investigates market efficiency and trading rule profitability of the Ugandan foreign exchange market for the period January 1994 to June 2012. We test for market efficiency using a battery of variance ratio tests with superior size and power properties. We find that the Ugandan foreign exchange market is characterised by pricing inefficiency, except for a few brief episodes of efficiency. We also find that the Buy signals outperform the Sell signals in correctly predicting exchange rate movements, and yield higher returns. Investors can earn excess returns over a buy-and-hold strategy using trading rules but these returns diminish substantially after accounting for transaction costs. We conclude that the Ugandan foreign exchange market is generally characterised by weak-form inefficiency. However, market participants are unable to consistently exploit pricing inefficiencies due to transaction costs and time variation in the inefficiencies under changing market conditions. Our finding of time variation in market efficiency is consistent with the adaptive market hypothesis of Lo (2004).

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## 1. Introduction

One of the earliest and most enduring questions in finance is whether financial markets are efficient. As the effects of the recent global financial crisis linger on, concerns over financial market instability have prompted renewed interest in policy circles about the efficiency and self-correcting capacity of financial markets. Since the seminal work of Fama (1965, 1970) who proposed the efficient market hypothesis (EMH), there has been a plethora of studies investigating the efficiency of financial markets. Despite extensive empirical investigation, conclusive evidence of the efficiency of foreign exchange markets remains elusive (see for instance, Al-Khazali, Pyun, and Kim (2012), Belaire-Franch and Opong (2005, 2009), and Chang (2004)). Lo (2004) developed the adaptive market hypothesis (AMH) to interpret time variation in market efficiency as a manifestation of changes in market ecology. Indeed recent evidence from major currency markets indicates that predictability and profitability of foreign exchange returns change with changing market conditions, supporting the tenets of the AMH (Charles, Darné, & Kim, 2012; Neely, Weller, & Ulrich, 2009).

Rejection of the EMH has important implications for investors and policy makers. An efficient market precludes trends and patterns in exchange rate changes that can be profitably exploited by traders using technical analyses, as well as providing central bank intervention in the foreign exchange market to correct mispricing. Thus, efficient markets are of interest to researchers seeking to understand the behaviour of asset prices, investors interested in exploiting market inefficiencies to make profit, and policy makers who seek to correct inefficiencies to ensure the efficient functioning of the foreign exchange market.

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The quest for achieving foreign exchange market efficiency is particularly pertinent for developing and transition economies given their nascent and often fragile financial systems with high vulnerability to economic shocks (Aghion, Bacchetta, Ranciere, & Rogoff, 2009; Tumusiime-Mutebile, 2012). Recently, Osler and Savaser (2011) show that the propensity for extreme exchange rate volatility and market crashes may be explained by price contingent trading, a feature of technical trading – a popular passion of foreign exchange traders. For Uganda, the excessive volatility of the foreign exchange rate during and after the global financial crisis (GFC) has raised concerns about possible market inefficiency in policy arenas as currency mispricing provides wrong signals for resource allocation and may lead to macroeconomic instability (Tumusiime-Mutebile, 2011). Notwithstanding the importance of efficient markets, there is limited and dated empirical evidence on the extent of efficiency in the Ugandan foreign exchange market. Although an early empirical study did indicate weak-form inefficiency in the Ugandan foreign exchange market (Atingi-Ego & Sebudde, 2003), no recent study has been undertaken to investigate efficiency in the foreign exchange market under the current global economic conditions.

The motivation of this study is three-fold. First, the Atingi-Ego and Sebudde (2003) study, which employed unit root and cointegration methods to evaluate efficiency in the Ugandan foreign exchange market, used pre-2002 data, so is out-dated. Further, it was limited in scope as it failed to investigate whether market inefficiency can be economically exploited. Consequently, as no other study has been undertaken to examine the efficiency of the foreign exchange market in Uganda since then, this present study aims to empirically investigate weak-form efficiency in the Ugandan foreign exchange market and to determine whether market inefficiency, if it exists, can be economically exploited using technical trading rules.

Second, this study sought a novel way to track time variation in weak form efficiency and profitability and thus, to provide evidence on the applicability of AMH to a developing country context, that is, the Ugandan foreign exchange market. Third, the paper sought to identify the sources of time variation in market efficiency particularly the forces that promote or impede market efficiency. Thus, this study aims to provide a better understanding of factors that enhance market functioning and also to provide a reference point for understanding issues affecting many emerging and developing countries in their quest for an efficient foreign exchange market. An understanding of efficiency in the foreign exchange market of a developing country in transition has become pertinent given increased volatility in the foreign exchange market in recent years.

Our approach differs from that of Atingi-Ego and Sebudde (2003) in several respects. First, we measure market efficiency using test statistics with superior statistical properties, namely, the automatic variance ratio test of Choi (1999), the non-parametric signs and rank test of Wright (2000), the joint variance ratio test of Belaïre-Franch and Contreras (2004) and the wild bootstrapping variance ratio tests of Kim (2006, 2009). We also employ traditional variance ratio tests developed by Lo and MacKinlay (1988, 1989), Chow and Denning (1993) and Richardson and Smith (1991). Second, we examine profitability of a wide range of technical trading rules, including filter rules, trading range break and simple moving average rules to check the robustness of our findings of market inefficiency. Third, we examine the evolution of market efficiency in the Ugandan foreign exchange market and explain it in terms of domestic and external market conditions including economic activity, inflation, interest rates, central bank intervention and financial crises.

The rest of this paper is organised as follows. Section 2 provides an overview of recent developments in the Ugandan foreign exchange market. Section 3 reviews the literature on foreign exchange market efficiency. Section 4 discusses the methodology employed for empirical analysis. Section 5 reports and discusses the empirical results of tests for market efficiency and profitability of trading rules in the Ugandan foreign exchange market. Section 6 concludes with some policy recommendations.

## 2. The Ugandan foreign exchange market: an overview

Since independence, the Ugandan economy has been characterised by recurring ups and downs. While the early 1960s were characterised by economic growth and a buoyant external sector, poor macroeconomic management in the 1970s and 1980s saw a reversal of these economic gains (Kasekende, Atingi-Ego, & Sebudde, 2004; Whitworth & Williamson, 2010). Macroeconomic reform efforts to reverse this trend in the 1980s and early 1990s resulted in an overhaul of the overall structure of the Ugandan economy. In the financial sector, reforms involved an overhaul of the legal and regulatory framework and the implementation of internationally accepted codes of conduct and standards of good practice, the elimination of market controls through the introduction of a floating of the exchange rate system, and the liberalisation of interest rates, current and capital accounts, and privatization of state owned enterprises (Whitworth & Williamson, 2010). These reforms were aimed at ensuring macroeconomic stability, promoting competitiveness and efficiency, increasing financial market intermediation and private sector participation.

Since the inception of the foreign exchange market, Ugandan authorities have adopted various exchange rate regimes in an attempt to restore macroeconomic stability and competitiveness (Atingi-Ego & Sebudde, 2004). In the period 1966 to 1980, the Uganda shilling was pegged to various currencies including the pound, US dollar and SDR. This was followed by various controlled foreign exchange regimes including an independent float in 1981 and a dual exchange rate regime, auction system, adjustable independent peg and discretionary crawl over the period 1982 to 1992. The adoption of a flexible exchange regime was expected to ensure a uniform market determined exchange rate for efficient resource allocation (Kasekende & Ssemogerere, 1994).

The Ugandan foreign exchange market has grown in size and depth since its humble beginnings in the early 1990s as evidenced by the significant increase in the number of participants, products and volume of trading. Total transaction volume in the interbank foreign exchange market increased by over 1000% from US\$ 1.7 billion in 1995 to US\$ 19.2 billion in 2011 (Bank of Uganda, 1999, 2012a). The majority of the transactions are spot transactions although the market for derivative instruments is developing. The foreign exchange market is comprised of both the interbank foreign exchange market (IFEM) and the retail market. The main participants in Uganda's foreign exchange market are shown in Fig. 1 while Fig. 2 provides a monthly plot of the foreign exchange rate, spread, trade volume and intervention.

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