POLICY BRIEF

Order Flow-Based Microstructure Analysis of the Spot Exchange Rate in Zambia

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November 2023 / No.812

Abstract

Traditional macroeconomic fundamentals have challenges in explaining nominal exchange rate movements at short horizons partly due to their inability to capture expectations. Using data from the Bank of Zambia, and an order flow-based microstructure model within a vector autoregressive (VAR) framework, this study establishes that order flows in the foreign exchange market in Zambia contain useful information in explaining daily exchange rate movements for the period 2016–2020. Daily order flows of four out of 18 different customer types are found to contain information content with the interbank, manufacturing, households, as well as wholesale and retail being the most important. Cross-market order

flows contain less information to explain daily movements in the kwacha/US dollar exchange rate. The policy lesson from the empirical results point to the central bank paying attention to the demand requirements by the four identified segments of the foreign exchange market that can potentially drive up the exchange rate and generate inflationary pressures.

Introduction

Understanding the drivers of the nominal exchange rate dynamics at short to medium horizons is important for the monetary authorities due to the influence of the exchange rate on inflation dynamics. For example, in Zambia, the pass-through to domestic prices from the depreciation of the kwacha is empirically established as a key driver of inflation (Chipili, 2021; Roger *et al*., 2017). Therefore, a better understanding of such proximate drivers improves the information set of the monetary authorities in generating near-term exchange rate forecasts that feed into medium-term inflation forecasts (Zgambo, 2015; Roger *et al*., 2017; Chisha, 2018).

In the post 1973 era of floating exchange rates, the drivers of the nominal exchange rate at short to medium horizons have, however, puzzled economists ever since Meese and Rogoff (1983) concluded that traditional macro-based fundamental models could not beat a naïve random walk model at explaining nor predicting future exchange rates up to 12 months (Lyons, 2001). Subsequent attempts by researchers to convincingly overturn the Meese and Rogoff (1983) conclusions failed using both in-sample and out-of-sample fit criteria (Mcdonald & Taylor, 1994; Cheung *et al*., 2005; de Bruyn *et al*., 2012; Rossi, 2013; Chiliba *et al*., 2016; Ighagui, 2019). Consequently, Obstfeld & Rogoff (2000) birthed the term "exchange rate disconnect puzzle" to describe the general poor performance of macro-based models in explaining exchange rate movements at short horizons. The disappointing performance of macro-based models stems from their inability to adequately capture dynamic expectations at short horizons (Evans & Lyons, 2002a; Evans & Rime, 2016). In part, this is due to three strong assumptions upheld in macro-based exchange rate models: symmetric information amongst players, homogeneity of players, and the irrelevance of the bolts and nuts of foreign exchange (FX) trading rules (Lyons, 2001).

Alternative exchange rate models with a market microstructure perspective relax the three restrictive assumptions underlying macro-models. The alternative models have demonstrated explanatory and forecasting power that far exceeds that observed in macro-based exchange rate models for developed economies (Evans & Lyons, 2002a, b; Bachetta & Wincoop, 2003; Rime *et al*., 2010; Evans & Rime, 2016; Ranaldo & Somogyi, 2018) and developing economies (de Medeiros, 2004; Wu, 2012; Duffuor *et al*., 2011; Zhang *et al*., 2013; Katusiime *et al*., 2014; Anifowose *et al*., 2017; Hoosain *et al*., 2017). Initially, microstructure models were thought to be relevant in explaining intra-day

changes in exchange rates. However, the literature has shown that microstructure models can explain exchange rate movements beyond a day up to a year (Evans & Lyons, 2002a, b; Evans & Rime, 2016; Ranaldo & Somogyi, 2018). By virtue of relaxing the assumption of symmetric information and homogeneity of market players, microstructure foreign exchange models essentially model the economics of financial information that is described in a two-stage process (Lyons, 2001). In the first stage, market players with private information about underlying fundamentals back up their beliefs with actual money by initiating trades (buy or sell) in the foreign exchange market with FX dealers. In the second stage, the foreign exchange dealers learn about the underlying fundamentals from aggregated trades, update their expectations and reflect them in their pricing of foreign exchange. The net of buyer and seller-initiated FX trades gives rise to a variable called order flow. Order flow is a signed transaction volume that measures net buying pressure—essentially the transmission mechanism of information contained in the transaction volume to the price (Lyons, 2001). Thus, order flow is the key variable in microstructure models responsible for the high explanatory and forecasting power at short to medium horizons (Lyons, 1995, 2001; Evans & Lyons, 2002a).

From the preceding, dealers infer fundamentals from the aggregate order flows they receive. However, given market player heterogeneity, some order flows are informative while others are not. In microstructure theory, non-informative order flows have transitory effects on the price (Lyons, 2001). On the other hand, order flows with permanent effects on the price are understood to contain information that reflects underlying fundamentals. Transitory effects may arise due to market imperfections such as inventory control when there is reduced liquidity while permanent effects are due to information on underlying fundamentals (Hasbrouck, 1991). Empirically, distinguishing between transitory and permanent effects of order flows is usually done by estimating a Vector Autoregressive model (VAR) and testing if the innovations in order flows have long-term effects on the prices—whether the impulse response functions are statistically significant or not.

Literature on advanced markets has established that information contained in order flows is generally persistent; order flows from various customer types (differentiated order flows) have diverse impacts on the exchange rate, and that order flows in one currency market are transmitted to other currency markets (cross-market effects). In contrast, literature on developing markets has mostly focused on establishing the relevance of order flows in general. In addition, all the studies on developing and emerging markets use end-user customer order flows as opposed to interdealer order flows despite the latter being at the center of wholesale price discovery (Bachetta & Wincoop, 2003). The existence of this gap may, in part, be explained by the challenge in accessing raw, unfiltered, and highly confidential transaction level data demanded by the microstructure approach (Lyons, 2001; Sager & Taylor, 2008).

Establishing the type of information contained in order flows (transitory versus persistent) requires an empirical investigation which this study seeks to undertake on the foreign exchange market in Zambia. Only two known attempts by Kyamulanda (2015) and Geda *et al*. (2016) have applied a microstructure model to the spot kwacha-US dollar exchange rate in Zambia. However, these studies used distal proxy variables for order flows that are at variance with the typical measure of buying/selling pressure for order flow. Therefore, this study can be deemed as a benchmark in establishing the existence of information content in order flows (microstructure evidence) in explaining short- to medium-term movements in the spot kwacha/US dollar exchange rate that could also be relevant in near-term exchange rate forecast modelling. In particular, the study seeks to establish whether order flows in the FX market have transitory or persistent effects on the kwacha/US dollar exchange rate, whether order flows from various customer types convey different information on short-run movements in the kwacha/US dollar exchange rate, and whether cross-market order flows matter for the kwacha/US dollar exchange rate movements.

Using a VAR model for the period February 2016 to June 2020, the results indicate that order flows in Zambia contain information that explains daily exchange rate movements. Order flows from various customer types have different information content with the interdealer, manufacturing, wholesale, and retail, as well as household order flows being the most important in that order. Cross-market order flows are, however, found to be less important in explaining changes in the kwacha/US dollar exchange rate. This study establishes a role, albeit limited, for microstructure models in explaining nominal exchange rate dynamics in Zambia, while Chiliba *et al*. (2016) and Ibhagui (2019) conclude that macro-based fundamental models dismally fail to do so.

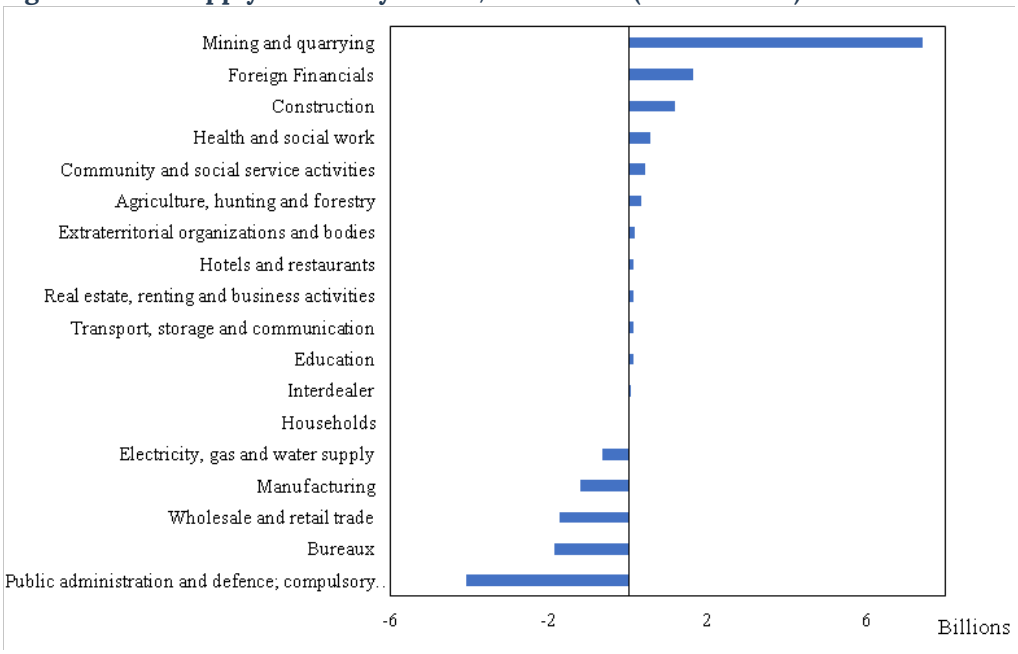
Structure of the foreign exchange market in Zambia

Both the current and capital accounts were fully liberalized in the early 1990s and a floating exchange regime adopted in 1994. This regime allows the central bank to intervene in the market to smooth out volatility in the exchange rate without influencing the underlying trend. However, Chipili (2014) established that the impact of central bank intervention on exchange rate volatility in Zambia is weak partly due to the small average size of intervention relative to the market turnover. In view of this, other domestic policy actions are required to reinforce intervention.

The FX market in Zambia is nascent with a limited role for brokers as most trades are directly conducted among dealers (interdealer) and/or between dealers and their clients (non-dealers). FX market players are classified by the economic

activity they engage in. Net suppliers of foreign exchange include exporters of goods and services: mining and quarrying; construction; agriculture, hunting, and forestry; hotels and restaurants; transport storage and communication; and education, as depicted in Figure 1. There are also portfolio investors (foreign financial institutions), non-bank financial intermediation, health and social work, community and social services, and extraterritorial organisation and bodies that promote FX liquidity in the market. The demand-side mostly comprises public administration spending on the importation of petroleum products; bureaux; wholesale and retail trade; manufacturing; and electricity, gas, and water supply. The household sector is unique: were net buyers of FX in the first three years from 2016 but turned net suppliers in the last two years of the sample. The interdealer sector of commercial banks is not included as demand and supply of FX net to zero by design.

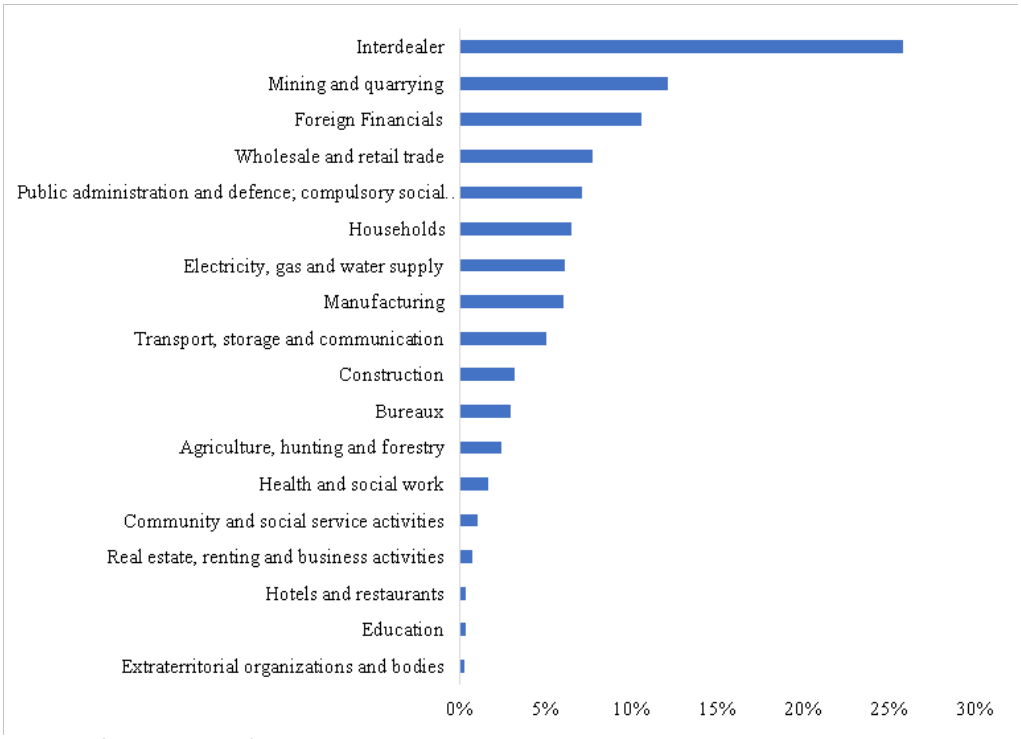
Figure 1: Net supply of USD by sector, 2016–2020 (USD million)



Source: Authors' own compilation.

Figure 2 shows that there is high concentration of liquidity as the top five sectors (interdealer, mining and quarrying, foreign financial institutions, non-bank financial services, as well as wholesale and retail trade) account for over 50% of market turnover. Nonetheless, the microstructure approach warrants the inclusion of all the sectors in the analysis since the information content of order flows is not linearly related to the transaction volume. The importance of foreign aid as a source of FX liquidity has reduced over time and only accounted for about 18% of total inflows received by the Bank of Zambia during the period 2016–2020.

Figure 2: Sectoral share of total turnover (2016-2020)



Source: Authors' own compilation.

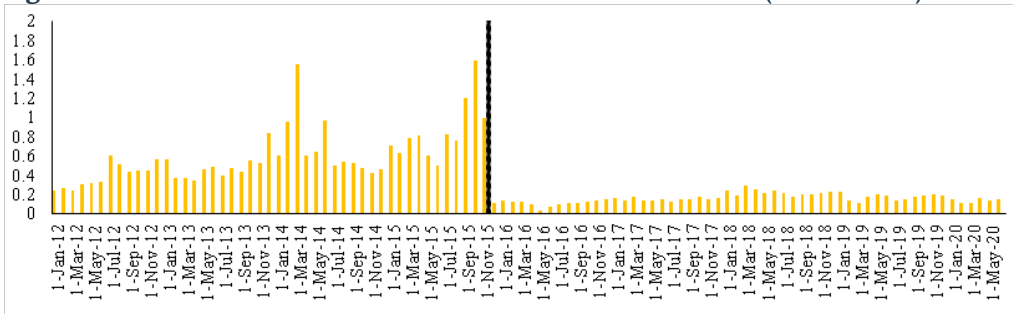
Commercial banks are the authorized dealers who set the wholesale price in the interdealer market and their trading practices are governed by the Interbank Foreign Exchange Market Framework (IFEM) Rules established in July 2003. All authorized dealers are required to maintain constant presence in the market during trading hours to provide firm two-way prices or quotes for prescribed marketable thresholds when requested by other dealers. The market opens at 08:30 hours and closes at 16:00 hours. There is no change in the price of foreign exchange during non-working hours such as nights, holidays, and weekends. Holidays and weekends are, therefore, not included in the analysis in this study.

There is a cap on the maximum bid-offer spread that commercial banks are required to observe in order to avoid a market trading freeze due to adverse pricing from dominant players in a small market. Trading among dealers first occurs on the phone using a dedicated recordable line. Thereafter, trades are posted on an electronic platform authorized by the Bank of Zambia.

Prior to September 2015, trading was primarily conducted directly on electronic platforms. However, an adverse exchange rate shock in September 2015 caused panic in the market and halted FX trading exacerbated by *hot-potato* trading. Hot-potato trading is responsible for the amplification of trading volumes in FX markets and

describes a phenomenon where dealers, in response to an incoming customer order, keep passing unwanted FX positions in the interdealer market until a counterparty willing to accept it is found (Lyons, 2001). To re-kindle the interdealer trading, market participants resorted to phone trading which has persisted since 2016. Thus, Figure 3 shows the presence of *hot-potato* trading evidenced by higher trading FX volumes before October 2015 and how the dominance of phone trading since then has resulted in reduced trading volumes by over 66%. According to Lyons (1997, 2001) hot-potato trading tends to reduce information content in order flows in interdealer trades.

Figure 3: Interbank turnover before and after October 2015 (USD billion)

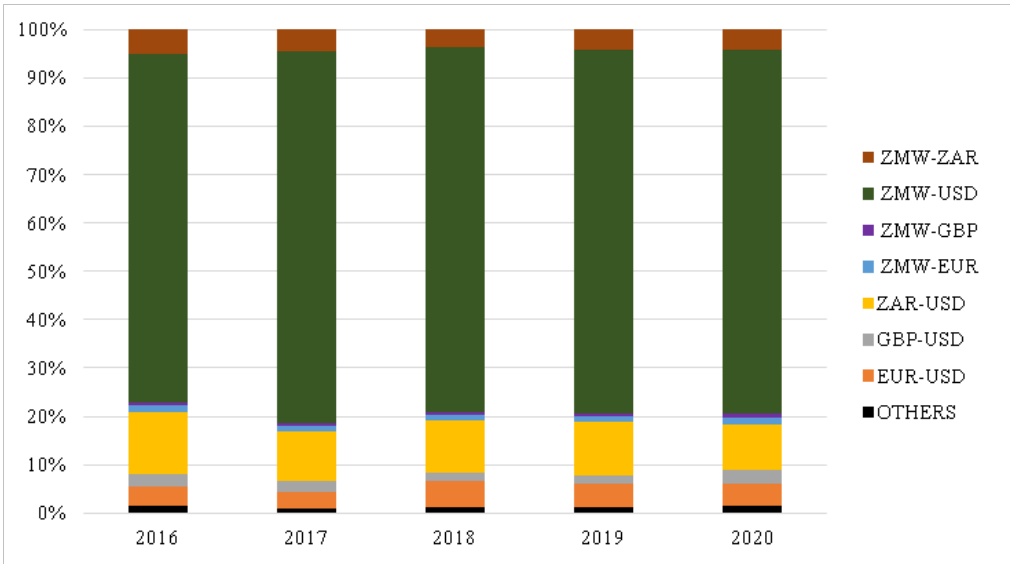


Source: Authors' own compilation.

Due to limited use of brokers, limit/stop orders are rarely conducted through a third party or done through a centralized electronic system as is practiced in developed FX markets. It is for this reason that the IFEM does not contain any formal rules governing limit and stop orders. Limit orders allow a client to set a minimum or maximum price a dealer is willing to buy or sell FX while stop orders allow clients to specify the price at which they would like to buy or sell FX. Although commercial banks allow their own customers to place limit/stop orders with them, there is no anonymity as these counterparties are already visible to the bank and are mostly price takers. Thus, limit/stop orders do not provide nuance to the price discovery process in the FX market in Zambia in the way they do in a typical market. This means that access to direct order flows from electronic trading platforms provides all the information needed to derive order flows in the FX market in Zambia. From June 2020, however, a policy was introduced requiring mining companies—largest supplier of foreign exchange—to pay all tax obligations directly in US dollars to the government through the central bank.

Annual foreign exchange turnover (all segments of the market) averaged 94% of gross domestic product between 2016 and 2020. The most traded currency pairs—kwacha/pound sterling (ZMW-GBP); kwacha/euro (ZMW-EUR), kwacha/South African rand (ZMW-ZAR); pound sterling/US dollar (GBP-USD); euro/US dollar (EUR-USD); South African rand/US dollar (ZAR-USD) and kwacha/US dollar (ZMW-USD)—accounted for over 97% of total turnover with the ZMW-USD being the most traded currency pair (Figure 4).

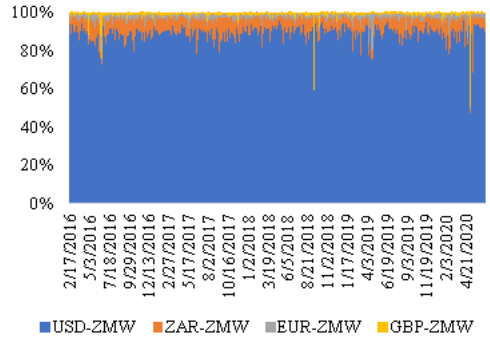
Figure 4: Share of major currency pairs in FX turnover in Zambia (2016-2020)



Source: Authors' own compilation.

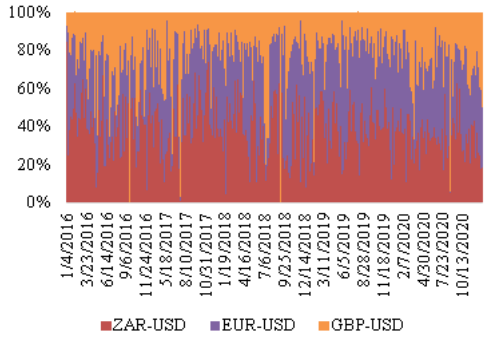
Across time, there is consistent daily trading in notably the USD-ZMW, ZAR-ZMW, EUR-ZMW and GBP-ZMW pairs and trading data is continuous (Figure 5). In addition, the USD-ZAR market accounts for the bulk of transactions in the cross-currency market (Figure 6).

Figure 5: Share of turnover by currency pair in the kwacha FX market (%)



Source: Authors' own compilation.

Figure 6: Share of currency pairs in cross-market (USD leg) turnover (%)



Source: Authors' own compilation.

It is not possible to disentangle commercial banks' proprietary order flows from non-dealer transactions. Ascertaining whether a bank is placing an order on behalf of a client or on its own behalf may not be straightforward. For practical purposes, all interdealer flows are ascribed to originate from the bank and not from respective clients.

Conclusion

This study analysed dynamics in the spot exchange rate in Zambia using an order flow-based microstructure model. Specifically, the study considered whether there is permanent information content in order flows that can explain changes in the daily exchange rate, whether order flows from different customers convey different information, and whether cross-market order flows are important for exchange rate determination. These questions have not been fully exploited in the literature for developing countries due to the challenge of accessing raw confidential data needed in these studies. In addition, an interesting aspect of the FX market in Zambia is that hot-potato trading is absent during the sample period due to reliance on phone trading. This implies that the information content in order flows in Zambia is expected to be rich as it is not dampened by hot-potato trading. Therefore, this study is to the authors' best knowledge, the first known attempt to investigate the role of differentiated order flows and cross-market order flows with the special inclusion of the interdealer market in a developing country setting where hot-potato trading is absent.

Using a vector autoregressive model across 18 customer types over the period February 2016 to June 2020, the study established that four order flows, namely, interdealer, manufacturing, wholesale and retail trade, and households contain persistent information that explains the kwacha/US dollar exchange rate. Variance decomposition shows that, besides the exchange rate itself, the interdealer order flow explains more of the variation in the exchange rate than manufacturing, wholesale, and retail, as well as household order flows during the first four days. However, manufacturing explains most of the variation from the fifth day. Wholesale and retail order flow has the least influence on the exchange rate.

Despite evidence of persistent information, the information content in these order flows is not as strong as that observed in developed markets and some developing markets even when the dominance of phone trading is expected to be associated with richer information content. This puzzle may require further investigation. Anecdotally, the shallowness of the FX market in Zambia may be associated with inefficiencies in the information aggregation processes (Smyth, 2009; Zhang *et al*., 2013).

Further, cross-market order flows do not appear to contain persistent information relevant for the kwacha/US dollar exchange rate movements regardless of whether interdealer or non-interdealer order flows are considered. This is not surprising given the low integration of the Zambian FX market and the Zambian kwacha in regional and global FX markets.

The policy implications from this study are that the central bank should pay attention to the demand requirements by the four sectors that can potentially drive up the exchange rate and generate inflationary pressures. Thus, understanding the foreign exchange needs by authorized dealers, manufacturers, wholesale, and retail trades, as well as households, and the impact of their behaviour in the foreign exchange market would help improve the monetary authority's appreciation of the source of information on the fundamental drivers of the exchange rates. Assessing the quality of the information content in these order flows is, however, a separate empirical issue left for future research. For example, it would be useful to empirically investigate whether the information content in order flows can be exploited for economic gains by market players or indeed whether it can be useful for near-term exchange rate forecasting.

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