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Abstract

This study investigates the impact of investor sentiments on the nominal Kwacha/US dollar exchange rate for the period January 2013 to December 2019 using a vector error correction model and variance decomposition techniques. Investor sentiment is measured as residuals from an ordinary least square estimate of Zambian euro bond yield rates and copper prices. The empirical results reveal the existence of a significant and positive long-run relationship between investor sentiments and the nominal exchange rate. In the short-run, investor sentiments contemporaneously affect the nominal exchange rate. Despite impacting the nominal exchange rate, investor sentiments contribute the least to exchange rate variations in both the short- and long- run.

Keywords: Nominal Kwacha/US dollar exchange rate, investor sentiments, error correction model
JEL Classification: C01, C32, F31

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The study benefitted from comments received from the Research Seminar discussions held with Bank of Zambia staff. The findings and opinions expressed in this paper are entirely those of the author and do not in any way represent the views or position of the Bank of Zambia. The author remains responsible for all the errors and omissions.

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1 Introduction

Studies indicate that economic fundamentals have been some of the main drivers of the exchange rate in Zambia that include copper prices, domestic productivity, short-term interest rate on government securities, money supply, price differentials and trade openness (Mungule, 2004; Chikumbi, 2017; Chipili, 2019). Evidence has shown the importance of copper price developments in the Kwacha/US nominal exchange rate dynamics (Chikumbi, 2017; Chipili, 2019). Chikumbi (2017) argues that, historically, the performance of the Kwacha against the US dollar and other major currencies has broadly followed the behavior of copper prices. This is mainly ascribed to the dependence on copper for foreign exchange earnings. Copper mining in Zambia is the major source of foreign exchange as copper exports generated about 70 percent of total export earnings (Chipili, 2019).

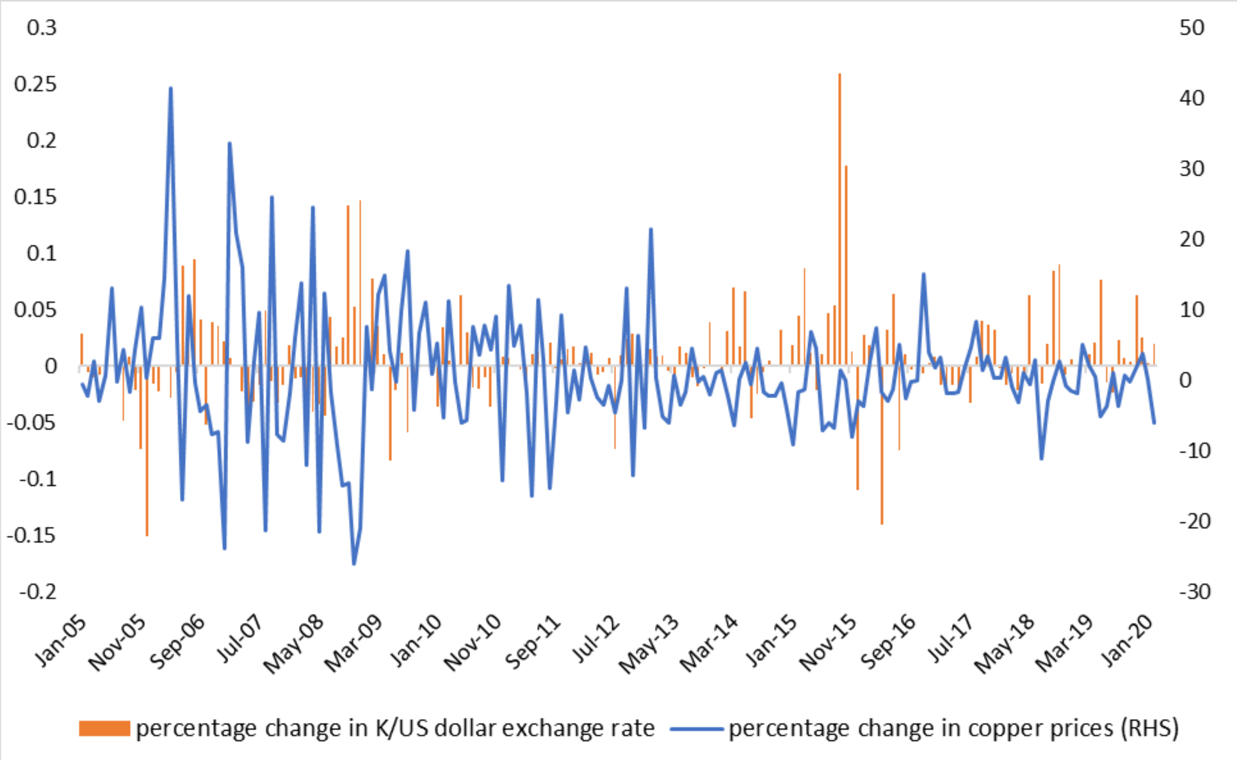
However, in the recent past, movements in the nominal Kwacha/US dollar exchange rate appear to be inconsistent with the traditional economic fundamentals. For example, there are instances when the Kwacha has depreciated despite increases in copper prices. Figure 1 shows that the inverse relationship[2] between the Kwacha/US dollar nominal exchange rate movements and copper prices seems to have weakened especially the period starting 2018. The correlation between the nominal exchange rate and copper price moved from strong to weak based on the Pearson correlation coefficient[3] for two samples: Jan 2005 to Dec 2015 and Jan 2016 to Dec 2019[4]. Chipili (2019) presented similar evidence of limited impact of the copper price on the Zambian economy over the period 1994-2012 in the short-run. This has conformed to the "exchange rate disconnect puzzle", a case where major macroeconomic fundamentals fall short in explaining exchange rate movements (Obstfeld and Rogoff, 2000; Chitre, 2018). Phiri et al. (2021) argues that the poor performance of macroeconomic fundamentals in such cases arises from the inability of macro-based models to adequately capture dynamic expectations, especially at short horizons.

[2] The relationship is inverse as upward movements in the Kwacha/US dollar exchange rate signify a depreciation of the Kwacha when copper prices fall and vice-versa.

[3] Pearson's correlation coefficient measures the strength and direction of the relationship between two variables.

[4] The former period had a coefficient of minus 0.89 while the latter period was minus 0.05. Negative correlation entails a rise/fall in copper prices correlates with a fall in ZMW/USD (appreciation)/rise (depreciation).

Figure 1: Changes in nominal Kwacha/US dollar exchange rate and copper price



Source: Bank of Zambia Statistics Fortnightly

The foregoing has led policy makers to take interest in other factors that possibly affect exchange rate dynamics. Some researchers have argued that sentiments or anomalies of investors play a major role in exchange rate dynamics besides fundamentals (Menkhoff and Rebitzky, 2008; Dogo and Ezema, 2016; Shahzad, 2020). Further, Heiden (2013) argues that investor sentiments—measurement of a given investor's mood or that of the overall investing public—play a role in the formation of exchange rate returns over a longer time horizon. This is in line with Menkhoff and Rebitzky (2008)'s argument that sentiments reflect a longer-term mean reversion in exchange rates towards the purchasing power parity (PPP) and that sentiments are aligned with exchange rate fundamentals[5].

Most studies on the drivers of the exchange rate in Zambia have focused on the role of macroeconomic fundamentals (Mungule, 2004; Chikumbi, 2017; Chipili, 2019). Empirical studies on the significance of the role of non-fundamental factors in exchange rate dynamics in Zambia is scanty. Notably, Phiri et al. (2021) established that order flows from different customer types seem to contain varying information. The interbank and household order flows are the most important influences in impacting the variation in the exchange rate while order flows from non-bank financial institutions, foreign financial institutions and non-financial corporates are less informative. Nevertheless, cross-market

[5] The fundamentals of exchange rate tend to be associated with changes in investor sentiments, for instance, productivity, interest rate differentials and commodity-based balance of trade.

order flows are insignificant in explaining the Kwacha/US dollar exchange rate. The study on order flows to explain daily exchange rate dynamics was premised on the poor performance by macro-based models to capture expectations at short horizons. The inability by macro-based models to capture dynamic expectations that also manifest through investor sentiments in response to macroeconomic developments partly contribute to the general poor performance of macro-based models in explaining exchange rate movements in some instances (Phiri et al., 2021). The scanty empirical evidence surrounding the role of sentiments in the foreign exchange market, in both short- and long-run, as well as observed movements in the exchange rate against fundamentals in some instances motives this study to contribute to the body of knowledge on exchange rate fluctuations beyond fundamentals.

This study investigates the role of investor sentiments on movements in the nominal Kwacha exchange rate. Instead of relying on economic fundamentals or order flows, which only explain exchange rate movements at short horizons, the study focuses on the role of investor sentiments in exchange rate dynamics both in short- and long-run in Zambia. The impact of market sentiments on the exchange rate is mostly short-term (Rao 2014; Plakandaras et al., 2015; Phiri et al., 2021). However, Menkhoff and Rebitzky (2008) highlight that sentiments play a key role in predicting exchange rate movements at longer horizons. This is mainly on the back of investor sentiments alignment with fundamentals of the exchange rate. Therefore, to fill the gap in literature on whether sentiments may have impact on exchange rate dynamics beyond the short-run, the paper employs a vector auto regression model (VECM)[6] to analyze long-run and short-run causality between sentiment and the nominal exchange rate. Understanding the link between the aforementioned variables is critical for policy makers as fluctuations in the nominal exchange rate has a significant impact on price stability in Zambia. Roger, Smith and Morrissey (2017) present evidence of significant pass-through from the exchange rate to consumer prices in Zambia similar to Chipili (2021) and Zgambo (2015).

Using monthly data, a vector error correction model approach provides evidence that there is a long-run relationship between investor sentiments and exchange rate movements in Zambia. Investor sentiments contemporaneously affect the nominal exchange rate in the short-run.

The rest of the paper is structured as follows. Section 2 presents a literature review on factors that influence exchange rate fluctuations with emphasis on the role of investor sentiments. Section 3 outlines the empirical model specification and the estimation method. Section 4 describes the data and sources. Section 5 presents the empirical findings. Section 6 concludes.

[6] The VECM makes it possible to analyze the short-term and long-run dynamics with flexibility in dynamic specification with long-term desirable properties (Pinshi, 2020).

2 Literature Review

Zambia adopted a floating exchange rate regime in 1994 as efforts towards liberal economic reformation heightened (Roger, Smith and Morrissey, 2017). Prior to this, Zambia experimented with several exchange rate regimes split broadly as fixed exchange rate and flexible exchange rate regime episodes (Mungule, 2014). The move towards flexible exchange rates was motivated by the need to promote more efficient and competitive foreign markets as occasional adjustments of the exchange rate and administrative controls such as issuance of import licenses were scaled down in preference for official interventions in the foreign exchange market (Chipili, 2012).

Under floating exchange rate regimes, exchange rate values are market determined; thus, movements in macroeconomic fundamentals play a critical role. This evidence is well documented. However, Dogo and Ezema (2016) add that, while there exists significant evidence which shows that exchange rates are linked to fundamentals in the long-run, findings in the empirical literature that exchange rate models fail to outperform naïve random walk forecasts over the shorter-term points to factors beyond economic fundamentals that may influence movements in exchange rates.

Thus, Menkhoff and Rebitzky (2008) argue that an alternative view to exchange rate determination is partly market sentiment. The behaviour of participants in the foreign exchange market is based largely on expectations. Dogo and Ezema (2016) further argue that rational participants in the foreign exchange market expect a particular price of the currency in the future that can maximize their profit and tend to behave in a way that realises their expectations. Expectations feed into the pricing of financial assets as investors use more information than just past data on a variable of interest. Thus, expectations of the future value of a variable will almost surely be reflected in the setting of current prices. Accordingly, this lays ground for the impact of investor sentiments in asset price volatility. Asset price volatility is widely described as a combination of investor reaction to the current market situation and unjustified expectation of the future cash flows. In light of new information, pricing of asset prices may fluctuate as expectations change (Mishkin, 2004). Specific to exchange rates, Chikumbi (2017) argues that the current value of the exchange rate also factors in expectations about the future value of the exchange rate as demand for domestic assets depends on the future resale price. Based on the information on the future value of the exchange rate, the currency may fluctuate.

According to Algaba et al. (2020), the term "sentiment" is used in many different contexts and research areas, but there is no established definition. Nonetheless, various scholars have proposed working definitions that encapsulate the most important characteristics of sentiment from the perspective of a researcher wishing to transform textual, audio, and visual data into sentiment variables and to apply them in an economic analysis. For instance, Yang (2015) broadly defined market sentiment as an aggregate level of individual beliefs about future economic performance. In consequence, exchange rate sentiment is an aggregate level of investors' beliefs about the future risk and return on the exchange rate

(Yang, 2015). Zhang (2018) also defines investor sentiment as beliefs that investors have about an aggregate economic variable, such as, a stock or currency price.

Two approaches are mainly presented on investor sentiments. The first approach is based on the traditional asset-pricing theories of classical finance, which argue that asset prices are rational assessments of expected future payoffs. Traditionally, this view makes no room for investor sentiment since price changes only reflect the arrival of external news about future cash flows and interest rates. An alternative approach, behavioral finance, suggests that investor sentiment may significantly distort market outcomes thereby affecting asset prices in equilibrium. Specifically, the noise trader model posits that if there are limits to arbitrage and investor beliefs are correlated, then noise unrelated to fundamentals, such as sentiment may lead asset prices to deviate from what is expected from the benchmark of market efficiency (Zhang, 2018).

As presented by Zhang (2018), in classical finance, there is typically no room for the presence of investor sentiment. Such theories have mostly ignored or assumed away investor sentiment arguing that in a highly competitive financial market, suboptimal trading behaviors, such as paying attention to signals unrelated to fundamental value will be quickly eliminated. In short, classical finance evolves around two basic premises, that when taken together imply the lack of prolonged arbitrage opportunities: (a) financial markets are informationally efficient; and (b) market participants are rational. First, the cornerstone of modern financial economics, efficient market hypothesis, maintains that asset prices should reflect all available information about the fundamental value of the underlying security. Assuming no frictions, the price of a security should equal its fundamental value, defined as the discounted sum of future cash flows. Hence, the efficient market hypothesis postulates that the asset price is equivalent to its optimal forecast (Fama, 1965). This implies that any surprising movements in the stock market must originate from new information about the fundamental value. Consistent with the market efficiency paradigm is the presumption that individuals behave rationally and fully take into account all available information in the decision-making process. Therefore, when there is new information about a security, rational investors will quickly respond, leaving no room for excess risk-adjusted returns based on the information signal.

The behavioral finance approach advances that there are limits to arbitrage, implying that even in a highly incentivized financial market with a large number of investors interacting, investors with suboptimal biases are not completely eliminated from the market. Behavioral finance formalizes and postulates ways this may occur (Zhang, 2018). One-way behavioral finance formalizes the possibility of limited arbitrage is through the noise trader model, which is arguably one of the most cited alternatives to the efficient market paradigm. The model suggests that because investors are risk-averse and have short horizons, real-life arbitrage must take account of the fact that arbitrageurs may not want to expose themselves to too much undiversifiable risk (DeLong et al., 1990). In particular, an important consideration for rational arbitrageurs is the behavior of other investors who may be prone to exogenous sentiment. The so-called noise traders are not fully rational in the sense that they may trade on the basis of noisy sentiment rather than information. As a result, noise traders' expectations about asset returns are sensitive to fluctuations in sentiment, that is, they overestimate expected returns in some periods and underestimate them in other periods such that their trades are not randomly distributed across assets. Because sentiment is correlated across these noise traders, this risk cannot be diversified away. This implies that limits to arbitrage may persist due to noise-trader risk, defined as the risk incurred by rational arbitrageurs from the unpredictability of noise traders. Specifically, noise traders pose the risk that their beliefs may not revert to the mean and become even more extreme over time. This risk is borne by market participants and is thus a potential explanation for the existence of unexploited arbitrage opportunities. This means that prices of financial assets are determined by the interaction of sophisticated arbitrageurs and unpredictable noise traders in addition to standard risk factors and macroeconomic variables. In this way, the noise trader theory makes room for the presence of investor sentiment (Zhang, 2018).

Plakandaras et al., (2015) attempted to examine the role of investor sentiments as a predictor of exchange rate evolution. As a proxy of investor sentiments, StockTwits posts (public message boards on investors' market expectations) were used. The study employed econometric and machine learning methodologies using daily data on the nominal exchange rates of currencies against the U.S. dollar and the market sentiment measure for the year 2013. The empirical findings reject the efficient market hypothesis even in its weak form for all exchange rates. Overall findings showed that investor sentiments as expressed in public message boards can be an additional source of information regarding the future directional movement of exchange rates to the ones proposed by economic theory.

Shahzad (2020) investigates the cross-quantile dependence between investor sentiment and exchange rate returns using an extreme quantile approach utilising daily data covering the period January 4, 1905 to January 3, 2006. In this study, the bull (positive) minus bear (negative) spread is used as a proxy of investor sentiment. The results show that the lower quantiles of investor sentiment have a positive and significant effect on the quantiles of dollar-pound exchange rate returns. However, the sign of dependence is reversed for the median to higher quantiles of the distribution of the sentiment. In addition, the findings remain unchanged even after controlling for the performance of the equity market. This provides additional evidence that investor sentiment can augment conventional predictors with respect to the future evolution of exchange rate returns.

Heiden et al., (2013) analyse the relation between investor sentiments and exchange rate movement. The study used weekly data bull-bear spread as a measure of investor sentiments spanning February 2001 to July 2010. Sentiments were assessed in relation to two currency pairs: EUR/USD and USD/JPY. Long horizon regressions were employed to assess the predictive power of exchange rate sentiments over various horizons. It was found that institutional investor sentiments were significant in the medium-term while the predictive power on private investor sentiments fluctuates with respect to the sample. These results point to local investors having an informational advantage in exchange rate forecasting.

Rehman (2013) evaluated the role of investor sentiments on exchange rate volatility in emerging market economies in a vector autoregressive framework. For empirical testing, the study used a sentiment equation mainly composing six sentimental proxies, namely, dividend premium, number of initial public issues in a single year, closed-end mutual fund discount, first day return on initial public offering, share turnover on the Karachi Stock Exchange and equity share in total equity and long-term debt issuance. The results confirmed that investor sentiments did explain volatility in the exchange rate although the impact was low, suggesting that there may be other factors that explain the variation in the exchange rates.

Using a hybrid-model incorporating non-fundamental factors in the standard exchange rate determination model, Dogo and Ezema (2016) examined the role of market sentiments in the determination of the Naira-dollar exchange rate. The study covered the period January 2005 to September 2013 and the bid-ask-spread was used as a proxy for market sentiment. The results indicate that the market sentiment variable was significant in determining the Naira-dollar exchange rate. In addition, the inclusion of the market sentiment variable improved the overall robustness of the model in terms of the goodness-of-fit. The conclusion from the findings is that the Naira-dollar exchange rate is determined not only by economic fundamentals, as contained in the standard literature, but also by non-economic fundamentals such as market sentiments/expectations.

Menkhoff and Rebitzky (2008) investigated the exchange rate puzzle from the perspective of analyzing investor sentiment in the US-dollar market. The study measured investor sentiments using indices from financial market survey data on economic and financial expectations. To distinguish between investor sentiment's short- and long-run determinants, the study used a vector error correction model for the period December 1991 to August 2005. The results showed that investor sentiment is connected with exchange rate returns at longer horizons and sentiment was cointegrated with fundamentals. Further, the relationship becomes stronger the larger the exchange rate's misalignment from PPP.

To establish factors that possibly explain nominal exchange rates at short horizons beyond traditional macroeconomic fundamentals, Phiri et al., (2021) used an order flow-based microstructure model within a vector autoregressive (VAR) framework. They attempted to establish whether order flows[7] in the foreign exchange market in Zambia contain useful information in explaining daily exchange rate movements. The study employed data for the period 2016-2020. The study shows that order flows from different customer types have different information content. The interbank and household order flows are the most important in explaining variation in the exchange rate while order flows from non-bank financial institutions, foreign financial institutions and non-financial corporates are less informative. Cross-market order flows are, however, insignificant in explaining the Kwacha-US dollar exchange rate.

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[7] Order flows are a signed transaction volumes that measure net buying pressure—essentially the transmission mechanism of information contained in the transaction volume to the price (Phiri et al., 2021)

Notable from the highlighted studies is that there is extensive literature in the developed countries wherein the role of investor sentiments is documented to explain the exchange rate dynamics. It is, therefore, rational to extend the work in the context of frontier and emerging markets like Zambia. Studies show that different proxies are used to measure investor sentiments when assessing their impact on exchange rates. The proxies are derived depending on the economic environment of the region or country of interest. Most studies have used the indirect approach to measuring sentiments (Heiden et al., 2013; Rehman, 2013; Plakandaras et al., 2015). A limitation is also observed on the number of studies that have attempted to study the impact of non-fundamental factors on nominal exchange rate dynamics in Zambia. To the best of the author's knowledge, only Phiri et al., (2021) assessed movements in the nominal Kwacha/US dollar exchange rate beyond fundamentals and used an order flow-based microstructure model. To address this limitation, this study endeavors to explain the role of investor sentiments in nominal Kwacha/US dollar exchange rates dynamics both in the short- and long-run in Zambia. The study uses an indirect approach to deriving an investor sentiment proxy. In this context, the study aims to add to this strand of literature on the exchange rate movements beyond macroeconomic variables.

3 Model Specification and Estimation Strategy

The conventional approach mostly adopted in modelling exchange rate dynamics assumes that macroeconomic fundamentals are the key drivers in both short- and long-run. However, in recent times, some pundits have challenged this view (Rebitzky, 2006; Menkhoff and Rebitzky, 2008; Dogo and Ezema, 2016). Lyons (2001) argued that in addition to macroeconomic fundamentals, non-fundamental factors may also be crucial.

Selected studies have employed the Johansen cointegration approach in modelling nominal exchange rate and sentiments. These include Menkhoff and Rebitzky (2008) and Dogo and Ezema (2016). Similar to Menkhoff and Rebitzky (2008), this study estimates long-run and short-run equations 1 and 2, respectively to capture the impact of investor sentiments on the nominal exchange rate.

Long-run relationship:

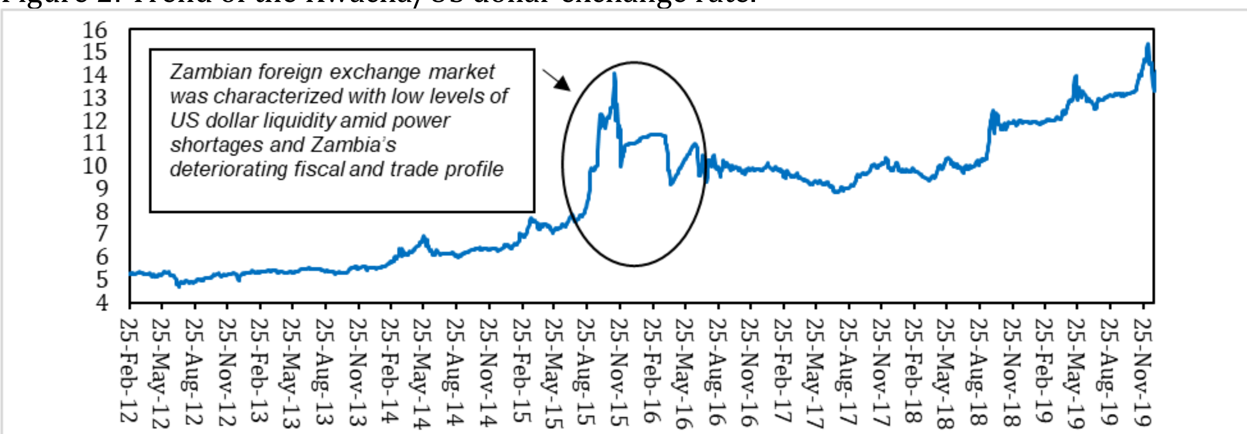
$$exr_t = \beta_0 + \beta_1 sent_t + \beta_2 ms_t + \beta_3 tt_t + u_t \tag{1}$$

Short-run relationship:

$$\Delta exr_t = \lambda_0 ecm_{t-1} + \sum_{K=1}^{k} \lambda_1 \Delta exr_{t-K} + \sum_{K=0}^{k} \lambda_2 \Delta sent_{t-K} + \sum_{K=0}^{k} \lambda_3 \Delta ms_{t-K} + \sum_{K=0}^{k} \lambda_4 \Delta tt_{t-K} + \lambda_5 DV + \varepsilon_t \tag{2}$$

where exr_t is the nominal Kwacha/US dollar exchange rate; $sent_t$ is a measure of investor sentiments; ms_t is a measure of money supply; tt_t is the terms of trade; Δ is the first difference operator; u_t and ε_t are error terms; β_i and λ_i are long- and short-run coefficients, respectively, estimating the impact of *sent*, *ms* and *tt* on *exr*; a positive β_1 implies unfavorable investor sentiments while a negative sign entails favorable investor sentiments[8]. ecm_{t-1} is an error correction term defined as $exr_{t-1} - \hat{\beta}_0 - \hat{\beta}_1 sent_{t-1} - \hat{\beta}_2 ms_{t-1} - \hat{\beta}_4 tt_{t-1}$ which measures the rate at which variables move towards the long-run equilibrium after a disturbance and DV is a binary dummy variable taking the value of 1, for the period September 2015 to about April 2016, otherwise 0. During the foresaid period, there was a relatively high jump in the Kwacha/US dollar nominal exchange rate (Figure 2). To account for this period, a dummy variable (impulse dummy) was included in the model specification.

Figure 2: Trend of the Kwacha/US dollar exchange rate.



Source: Bank of Zambia

Investor sentiments affect nominal exchange rates contemporaneously and with a lag (Rehman, 2013). This approach was used on the basis that all variables were stationary at first difference (Augmented Dickey Fuller test was used). The cointegration technique was pioneered by Engle and Granger (1987) and extended by Johansen (1988) and Johansen and Juselius (1990). After establishing long-run a relationship, the study used the vector error correction model (VECM) technique to estimate long-run dynamics (in equation 1) and short run relationship (in equation 2).

Investor sentiments can be measured by direct or indirect approaches. Direct measures rely on information gained through surveys, seeking information from individuals regarding their feelings about the variable of interest and economic conditions. Conversely, indirect measures are based on financial and economic variables that depict investor mindset (Khan and Ahmad, 2018). Likewise, market sentiments in the foreign exchange market are measured using survey-based or market-based indicators (Yang, 2015). Survey proxies are mostly indices derived from perceptions on key macroeconomic variables. On

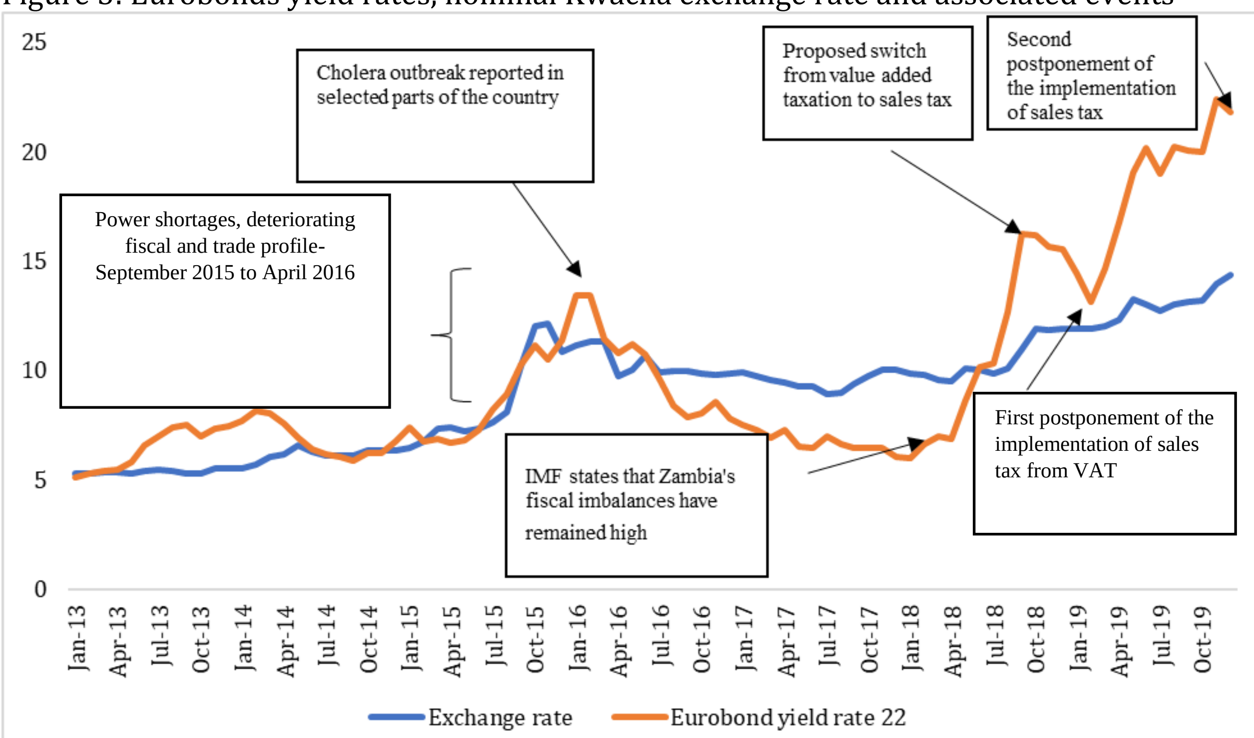
[8] When investor sentiments are favorable, the price of the Eurobond increases while the yield rate falls and vice-versa.

the other hand, market-based indicators are mainly derived from developments in the futures market, forward markets, market reports and news on relevant macroeconomic developments. This study employs an indirect sentiment proxy derived from the Eurobond yield rate. This measure is broadly associated with investor reaction to macroeconomic news reflected in movements in the Eurobond yield rates.

Zambia completed its first Eurobond issue in the international capital market in September 2012. Movements in Eurobond yield rates mostly reflect investor perceptions on the issuer's (country in this case) ability to repay or meet its redemption or coupon obligations as they fall due. For instance, during crisis periods, some countries are usually faced with a surge in sovereign bond yields and thus lose access to international financial markets (Badarau, Huart and Sang, 2020). Therefore, movements in yield rates tend to be driven by macroeconomic developments that may affect the country's ability to meet its repayment obligations in international capital markets.

Movements in Eurobond yield rates tend to be closely linked to news that may directly or indirectly impact on Zambia's macroeconomic performance. News on tax reforms, energy sector developments and disease outbreaks, among others, are reflected in Eurobond yield rates (Figure 3). With a change in sentiment, the investor's desire to hold Kwacha balances against the US dollar also fluctuates, thereby influencing movements in the nominal exchange rate. To this effect, movements in Eurobond yield rates tend to be associated with nominal Kwacha exchange rate movements (Figure 3).

Figure 3: Eurobonds yield rates, nominal Kwacha exchange rate and associated events



Source: Authors compilation using data from Bank of Zambia and Reuters

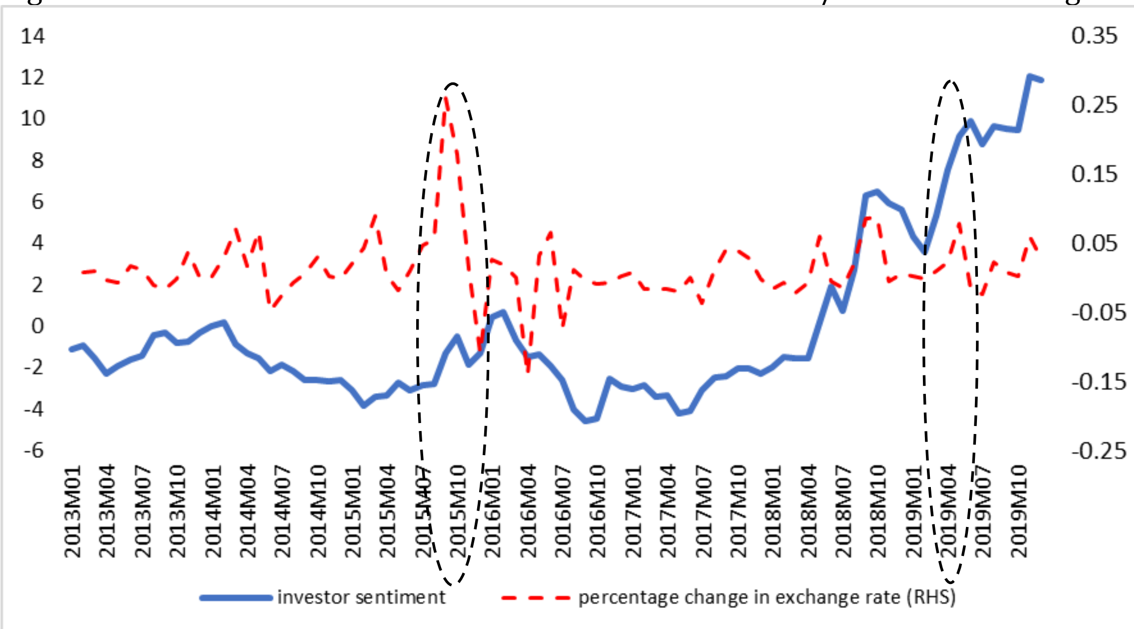
Besides the highlighted events, Zambia's ability to meet Eurobond obligations is also reflected in development in copper prices. Zambia earns most of its foreign exchange from copper exports. To this effect, there is correlation between copper price and Eurobond yield rates[9]. Given the established correlation with one of the major macroeconomic fundamentals (copper prices) in exchange rate determination, the study attempts to remove the influence of copper price movements from the Eurobond yields rate. Therefore, similar to Yadav, Chakraborty, and Vijaya (2022), this study derives investor sentiment proxy that is orthogonalized by regressing the Eurobond yield rate on copper prices and the residuals, from equation 3[10], are used as a measure of investor sentiment:

$$euro_t = \beta_0 + \beta_1 cu_t + \varepsilon_t \quad (3)$$

where $euro_t$ is yield rate on the 2022 Zambian Eurobond[11]; cu_t is copper prices (US dollar/ton); and ε_t is the error term. The residuals from the regression in equation 3 reflect the component of the Eurobond yield rate movement explained by non-copper prices that include investor sentiments. Thus, the residuals are used as a proxy to measure investor sentiments in the study to depict the possible influence of non-fundamental variables on the nominal exchange rate. When sentiments are favorable, demand for Zambian Eurobonds increases which leads to a rise in the price and a fall in yield rates and vice-versa. Negative residuals indicate favorable sentiments while positives show adverse sentiments. As shown in Figure 4, negative residuals are associated with nominal exchange rate appreciation and vice-versa. For instance, between August and October 2015, the foreign exchange market in Zambia was under strain from the turmoil that hit most emerging and developing economies. This resulted in the Kwacha depreciating by 48.5 percent largely due to negative sentiments stemming from power rationing and concerns about widening fiscal deficits (Figure 4). Another notable period was January to March 2019 when the sharp rise in the sentiment measure coincided with a depreciation in the nominal Kwacha/US dollar exchange rate by a percent. This period was characterized by adverse market sentiments as fiscal challenges mounted, coupled with credit rating downgrades[12].

[9] The Pearson correlation coefficient for the period January 2013 to December 2019 was negative 0.36. This entails that movements in copper prices have some influence on the Eurobond yield rate.
[10] The copper price coefficient was significant, p-value=0.0007
[11] The Eurobond issued in 2012 and matured in 2022.
[12] In March 2019, Moody's Rating Agency downgraded Zambia's credit rating to Caa2 with a negative outlook.

Figure 4: Investor sentiments measure and nominal Kwacha/US dollar exchange rate.



Source: Authors compilation using data from Bank of Zambia

In addition, the variance decomposition technique is used to understand the extent of dynamic interrelationships among variables. It helps to determine the proportion of variation of the dependent variable explained by each of the independent variables. Ruan et al., (2017), Zhou et al. (2018) and Liu (2019) argue that when the dependent variable is disturbed by other variables, variance decomposition can attribute and decompose the fluctuations into different parts related to different variables so as to show the impact of each variable on the dependent variable and better present the contribution rates.

4 Data Description and Sources

Monthly data covering the period January 2013 to December 2019 are utilized. In line with extant literature, the following macroeconomic or fundamental variables are included in the model: broad money (M2) and terms of trade. In preceding studies on the drivers of the exchange rate in Zambia, Mungule (2004) and Chipili (2012), broad money and exports were found to have a significant impact on the exchange rate. The terms of trade tend to lead to significant changes in foreign earnings, thereby translating into currency fluctuations. When the terms of trade ratio exceeds 1 (exports exceed imports), the currency tends to appreciate, holding other things constant, and vice versa. When money supply increases in the domestic economy at a faster rate than its trading partners, it is expected that the domestic currency will depreciate through purchasing power parity (PPP). Table 2 summarizes the variables used in the study.

Table 2: Summary of the Data

	Variable	Description	Unit of Measurement	Source
1	$sent_t$	Investor sentiment	Regression residuals	Author computation
2	$lnms_t$	Logarithm of broad money	Millions of Kwacha	Bank of Zambia
3	$lnexr_t$	Logarithm of nominal Kwacha/US dollar exchange rate	Kwacha/US dollar	Bank of Zambia
4	$lntt_t$	Logarithm of terms of trade	Ratio	Bank of Zambia

Source: Author's compilation

There is generally little variability in the data except the investor sentiment proxy measured by the standard deviation (Table 3). This shows that data is generally concentrated around the mean. The range, difference between the maximum and the minimum data, also shows that data are fairly distributed.

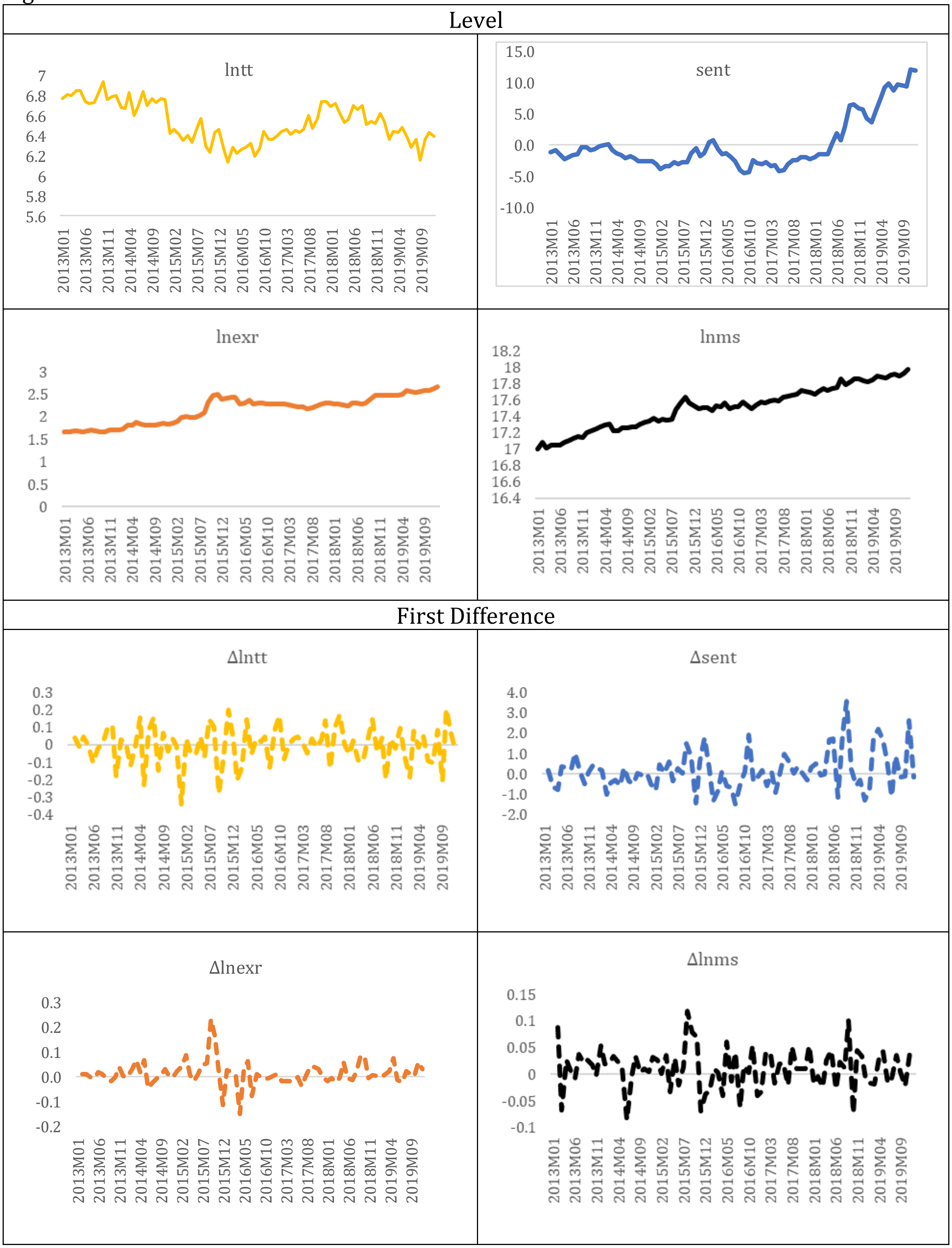
Table 3: Summary statistics

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
lner	2.16	2.28	2.67	1.67	0.30	-0.33	1.77
sent	0.00	-1.54	12.04	-4.58	4.19	1.48	4.06
lnms	17.51	17.53	17.98	17.00	0.26	-0.16	2.02
lntt	6.54	6.50	6.94	6.14	0.20	0.03	1.92

Source: Author's compilation

A visual inspection of the time plots (at level) in Figure 5 reveals a general upward trend in the nominal Kwacha/US dollar exchange rate, investor sentiments proxy and money supply while the terms of trade has been declining over the sample period. At first difference, all the series are mean reverting (Figure 5). This is prima facie evidence that the series could be first difference stationary type of processes. This is confirmed by the unit root tests results in Table 4. Figure 5 suggests some level of directional relationship among the series over the sample period reflected in the similarity of swings and turning points, especially in period 2015M7 to 2016M6 and 2018M8 to 2018M11.

Figure 5: Data trends at level and first difference.



Source: Authors compilation using data from Bank of Zambia

5 Empirical Results and Discussion

Stationarity tests are performed on the data series to avoid spurious relationships using the Augmented Dickey Fuller (ADF) unit root test before estimating equations 1 and 2. The results in Table 4 indicate that all the variables are level non-stationary, but stationary at first difference. Thus, the variables are integrated of order one, I (1).

Table 4: Augmented Dickey-Fuller (ADF) stationarity results

	t-ADF Level	lags	t-ADF First Difference	lags	Deterministic Terms	Order of Integration	Variable Description
$lnexr_t$	-2.44	1	-7.04***	1	C and T	I(1)	Logarithm of nominal exchange rate
$sent_t$	-0.40	0	-7.65***	1	C and T	I(1)	Residuals from a regression of Eurobond yields on copper prices
$lnms_t$	-0.002	0	-10.51***	0	C	I(1)	Logarithm of broad money
$lntt_t$	-1.13	2	-10.94***	1	C and T	I(1)	Logarithm of terms of trade
$lncu_t$	-2.19	1	-7.08*	0	C and T	I(1)	Logarithm of copper price

****, **, and * denote 1%, 5% and 10% levels of significance. In the ADF test, C represents constant is included while T signifies linear trends included*

Source: Author's compilation

Given that the variables are integrated of order 1, there is a likelihood that they are cointegrated. In this study, the main interest is the possible long-run relationship between the exchange rate and the measure of investor sentiments. The Johansen methodology is employed to test for cointegration among the variables in the model. The aforementioned test entails running an unrestricted VAR. In the estimation of the VAR, the lag length selection criteria is used to determine the optimal number of lags. The VAR is estimated by specifying the appropriate lag length for the test using several information criteria and choosing the appropriate test assumption. Table 5 shows the optimal lag lengths suggested by the various information criteria.

Table 5: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-2726.572	NA	3.13e+23	68.28929	68.43817	68.34898
1	-2032.423	1284.175	1.70e+16	51.56058	52.45384*	51.91872
2	**-1990.999**	**71.45702**	**1.14e+16***	**51.14997***	**52.78762**	**51.80655***
3	-1978.177	20.51487	1.57e+16	51.45443	53.83646	52.40945
4	-1946.579	46.60760*	1.38e+16	51.28947	54.41588	52.54294

Source: Authors compilation

From Table 5, the optimal lag length for the autoregressive model selected using the likelihood ratio (LR), Final Prediction Error (FPE), Akaike Information Criteria (AIC), and the Hannan-Quinn Information Criteria (HQ) is 2 while the Schwartz Information Criteria (SC) suggest 1 lag. Thus, the Johansen cointegration test is estimating a VAR with 2 lags.

The trace test results in Table 6 indicate that there is a cointegration relationship between nominal Kwacha/US dollar exchange rate, money supply, terms of trade and investor sentiments. The results show that there is one (1) cointegrating equation at the 5 percent level of significance.

Table 6: Results of multiple cointegration test for nominal exchange rate and investor sentiments (Johansen-Juselius maximum likelihood method)

Null hypothesis	Alternative hypothesis	Eigenvalue	Trace Statistic	95% critical value
$r = 0$	$r > 1$	0.3691	52.41	47.86
$r < 1$	$r > 2$	0.1173	15.09	29.80
$r < 2$	$r > 3$	0.0590	4.98	15.94

Source: Author's compilation

With the establishment of a cointegration relationship, Engle and Granger (1987) argues for the need to estimation of an error correction model. Thus, cointegration results are displayed in Table 7 while Table 8 shows the results of the estimated vector error correction model.

Table 7: Results of the cointegration (normalized) equation.

Variable	Coefficient	t-value
$lnexr_t$	1.00	
$sent_t$	0.0024	(3.62) ***
$lnms_t$	0.0013	(4.82) ***
$lntt_t$	-0.18	(-7.75) ***

*Note: ***, **, and * denote 1%, 5% and 10% levels of significance; ( ) represent t-statistics*

Source: Author's compilation

The model passed the serial correlation and heteroscedastic tests but failed the test for normality[13]. Nonetheless, the results are amenable for policy as the Johansen cointegration method is robust to non-normal errors (Diouf, 2007).

All the variables are correctly signed and statistically significant. Investor sentiments[14] had a positive impact on the nominal Kwacha/US dollar exchange rate over the sample period. A unit change in the measure of investor sentiment leads to a 0.24 percent change in the Kwacha/US dollar nominal exchange rate in the long-run (Table 7). This entails that market sentiments are correlated with nominal exchange rate movements in the long-run in Zambia. This result can be attributed to the fact that the country suffered credit rating downgrades from all credit rating agencies over the sample period. The downgrades were largely attributed to the deterioration in the fiscal position and low international reserves amid elevated external debt obligations. Most of this was mainly on account of an expansionary fiscal stance financed by non-concessional borrowings and domestic

[13] The LM serial correlation test: F(1-3)= 0.7754[0.7705]; Normality test: χ^2 (2)= 86.19266[0.0000]; and Heterosekedasticity test: χ^2 (2) = 81.24184[0.3485]

[14] Investor sentiments are extracted from Eurobonds yield rates, thus a rise indicates negative sentiments while higher value of the Kwacha/US dollar nominal exchange rate signifies a depreciation.

expenditure arrears that led to a rapid increase in debt (International Monetary Fund, 2019). The result is similar to Menkhoff and Rebitzky (2008) who also established a short- and long-run link between investor sentiments and Euro/US-dollar exchange rate dynamics.

Regarding money supply, the coefficient was significant and had a positive association with nominal exchange rate. This is consistent with the predictions of the monetary model. The negative relationship between the terms of trade and nominal exchange rate shows that a percentage increase in terms of trade translates into 0.18 percent appreciation in the Kwacha/US dollar nominal exchange rate. This is an indication that increasing terms of trade translates into higher export earnings, which in turn increases the value of the local currency.

Table 8 shows a parsimonious model[15] depicting the main influences of Kwacha/US dollar exchange rate for the sample period. Investor sentiments positively impact the Kwacha/US dollar nominal exchange rate contemporaneously in the short-run. Similarly, broad money had a significant and positive relationship contemporaneously and at first lag, though with very small coefficients over the sample period. It is also established that a percentage change in the previous month's nominal exchange rate results in a 0.22 percentage change in the present exchange rate. The terms of trade has a significant and negative relationship in line with economic theory: rising exports earnings tends to support the Kwacha/US dollar exchange rate, *ceteris paribus*.

Table 8: Parsimonious vector error correction model results

Variable	Coefficient	Std.Error	t-value	t-prob
$\Delta lnexr_{t-1}$	0.223665	0.04627	2.59	0.0115***
$\Delta sent_t$	0.0018354	0.00046	3.99	0.0002***
$\Delta lnms_t$	1.19e-007	2.74e-008	4.37	0.0000***
$\Delta lnms_{t-1}$	1.53e-007	2.53e-008	6.08	0.0000***
$\Delta lntt_{t-1}$	-0.14651	0.05667	-2.59	0.0002***
ecm_{t-1}	-0.120734	0.0827	- 4.73	0.0000***
dummy	0.29652	0.03996	3.02	0.0035***

Sigma=0.336535 RSS=8.04117995 log-likelihood= -21.8437 no. of observations=79 no. of parameters=8
mean (DEXR)= 0.114626 se(DEXR)=0.487617

Model diagnostic test:

AR 1-5 test: F (5,69) = 1.7175 [0.1422] ARCH 1-5 test: F(5,71) = 0.71282 [0.6158]
Normality test: Chi^2(2) = 3.9794 [0.1367] Hetero test: F(12,68) = 1.0823 [0.3887]
Hetero-X test: F(44,34) = 1.4095 [0.1510] RESET23 test: F(2,69) = 0.25973 [0.7720]

*Note: ***, **, and * denote 1%, 5% and 10% levels of significance*
Source: Author's compilation

The error correction term (coefficient of the cointegrating equation) or speed of adjustment towards long-run equilibrium is 0.12 (correctly signed) and statistically significant (Table 8). This entails that when the exchange rate deviates from equilibrium, it

[15] The reduction of the general model to obtain a parsimonious model was executed using Autometrics, a computer-automated general-to-specific modeling approach in the Oxmetric software under PCgive modelling.

adjusts by 12 percent per month towards the re-establishment of equilibrium. This means that it takes 8 months for equilibrium to be restored.

The results also show that the dummy variable was significant implying that the associated events represented by the dummy contributed to the weakness of the Kwacha against the US dollar (Table 8).

The variance decomposition results for ten periods are depicted in Table 9. Broadly, in the short-run (period 3), the biggest proportion of variation in the nominal exchange rate is explained by its own shock, followed by a shock to money supply (ms), then investor sentiments (sent) and lastly terms of trade (tt). In the long-run (period 10), investor sentiments is the least contributor to the variations in nominal exchange rates. Exchange rate variability by its own shock decays over time while that of investor sentiment remains broadly the same over the 10-period horizon. On the flipside, the influence of money supply and terms of trade increases with time. This entails that for the period under review, exchange rate own shocks dissipate while investor sentiments shock persists despite having low influence on exchange rate variability. Persistence of the investor sentiments shocks may partially be explained by expectations in behavioral finance literature for persistent investor beliefs (Han, Sakkas, Danbolt, and Eshraghi, 2022). This occurs due to sustained overconfidence and financial asset prices may remain persistently mispriced if noise traders dominate and limits to arbitrage prevent rational investors from correcting prices (DeLong et al., 1990).

Table 9: Variance Decomposition

Period	S.E	exr	sent	ms	tt
1	0.411095	100.0000	0.000000	0.000000	0.000000
2	0.705254	92.24669	3.037048	3.650857	1.065406
3	0.870704	87.77181	4.218991	4.513318	3.495886
4	0.985646	83.04394	4.048420	4.670561	8.237077
5	1.115794	77.84288	3.711098	5.188587	13.25744
6	1.253451	75.02914	3.612650	5.611341	15.74687
7	1.371519	74.03049	3.636964	5.753510	16.57903
8	1.469667	73.30049	3.625278	5.820084	17.25415
9	1.560737	72.46227	3.578012	5.905976	18.05374
10	1.650774	71.73102	3.541576	5.993787	18.73362

Source: Authors' own computation

Robustness test

Being a highly commodity dependent country, copper prices do not only directly affect exchange rate movements but may also drive market sentiments as investors use the copper price developments as a barometer for the economic performance of the economy. Therefore, to check the reliability of the results presented, the study undertakes robustness checks by re-estimating the above equations 1 and 2. In the robustness check, the investor sentiments measure (residuals) is replaced by the 2022 Zambian Eurobond yield rate (euro). This incorporates the influence of copper prices as a driver of investor sentiments.

Table 10: Long-run cointegrating relationship

Variable	Coefficient	t-value
exr_t	1.00	
$euro_t$	0.0018	(3.66)***
ms_t	0.000014	(6.80)***
tt_t	- 0.14	(-7.81)***

*Note: ***, **, and * denote 1%, 5% and 10% levels of significance () represent t statistics*
Source: Authors' own computation

Long-run results in Table 10 reconfirm that investor sentiments have a long-run impact on the Kwacha/US dollar nominal exchange rate. Table 11, displaying short-run dynamics, shows that the error correction term remains correctly signed and significant as well as coefficients on all variables remain virtually changed.

Table 11: Vector error correction model: Short-run parsimonious model

Variable	Coefficient	Std.Error	t-value	t-prob
$\Delta lnexr_{t-1}$	0.341374	0.1074	3.18	0.0022***
$\Delta euro_t$	0.001197	0.00046	2.60	0.0111***
$\Delta lnms_t$	9.51E-08	2.78E-09	3.41	0.0010***
$\Delta lnms_{t-1}$	1.31e-007	2.52e-008	5.22	0.0000 ***
$\Delta lntt_{t-1}$	-0.111645	0.5827	-1.92	0.0592**
ecm_{t-1}	-0.179370	0.05465	-3.28	0.0000***
dummy	0.275055	0.101	2.27	0.0080***

*Note: ***, **, and * denote 1%, 5% and 10% levels of significance*
Source: Authors' own computation

6 Conclusion

The paper attempted to establish the impact of investor sentiments on the Kwacha/US dollar nominal exchange rate using a Johansen cointegration approach to provide statistical evidence of the long-run relationship. The study also used the variance decomposition technique. Monthly data spanning from January 2013 to December 2019 was used. In this analysis, broad money and exports were used as control variables. After establishing cointegration between investor sentiments and nominal exchange rate, a VECM was employed to investigate long-run and short-run dynamics.

The paper found that negative investor sentiments may cause the Kwacha/US dollar nominal exchange rate to depreciate in the long-run. The study also found a correctly signed negative and statistically significant error correction term with coefficient of 0.12. This means that when the nominal exchange rate deviates from its long-run equilibrium due to changes in investor sentiments, the exchange rate moves towards restoration of equilibrium 12 percent each period (a month in this case). The study employed a dummy to control for events (power shortages, deterioration in fiscal and trade profiles amid low foreign exchange liquidity) between September 2015 and April 2016. The dummy was found to be significant with a coefficient of 0.30. This means that the aforementioned events might have contributed to the Kwacha/US dollar nominal exchange rate depreciation within the sample period. In the short-run, it was found that investor sentiments and broad money had a positive relationship with nominal exchange rate contemporaneously. At first lag, past nominal exchange rate values were the main influences of exchange rate dynamics in the short-run. Despite impacting on the nominal exchange rate, investor sentiments were found to contribute the least to exchange rate variations both in the short- and long- run. The biggest proportion of variation in the nominal exchange rate was explained by its own past values. Evidence revealed in this study showing that investor sentiments matter in the Kwacha/US dollar nominal exchange rate dynamics is likely to have implications on the conduct of monetary policy.

Given the evidence presented, the study recommends the need to mainstream communication management on economic developments to the public as part of policy strategy. Communication has increasingly become a key part of economic management, especially in monetary policy as it has a major impact on financial markets (Picault, Pinter and Renault, 2020). There are global developments that a country might not have full control of, for instance general global growth worries, but can communicate on measure to address such developments. Nonetheless, within the control of countries are idiosyncrasies to an economy, which if combined with global development may sour investor sentiments more. Thus, to help brighten sentiments in the case of Zambia amid continued worries of fiscal consolidation in the face of high debt levels and low levels of foreign reserves, there is need for continuous sound and joint economic management between the monetary and fiscal authorities. This may help improve credit ratings and ultimately reflected better via positively inclined investor sentiments.

The study has some limitation in its approach. The study used a proxy for investor sentiments, which is an indirect measure. This was due to unavailable sentiment survey measures for the desired period of study. Rupande, Muguto, and Muzindutsi (2019) also highlighted similar limitation.

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