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The Impact of Exchange Rate Volatility on Foreign Direct Investment and Sovereign Bond Yield in South Africa

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Abstract: Exchange rates are one of the key factors that influence the macroeconomic performance of a country. The stability or volatility of the exchange rate of a country determines the type of impact it has on the economy of that country. The purpose of this study is not only to contribute to the existing literature by shedding light on the specific impact of exchange rate volatility on FDI and SBY in the South African context using GARCH models but also to empirically establish the relationship that exists between FDI and SBY using VECM to establish their short-run and long-run dynamics. To

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determine this, time series data of exchange rates, foreign direct investments, sovereign bond yields, inflation, and gross domestic product was collected for the period 1995 to 2022. This period accounts for occurrence of the Rand crisis in 1998, global financial crisis in 2008, and global Covid-19 pandemic in 2020. The GARCH model selected was chosen based on the SBIC information criteria under the student-t distribution. The results of this investigation suggested that exchange rate volatility has a negative impact on FDI but no significant impact on SBY. Engle-Granger tests illustrated that FDI impacts SBY have long-run relationship, meaning any short-run deviation will be corrected in the long-run. The findings further illustrate that FDI has no significant impact on SBY. Furthermore, the findings of this study suggest that there are no leverage effects, meaning that the impact of positive and negative shock are different. The recommendation of the study requires that monetary authorities set policies that would mitigate the exchange rate volatility in order to secure or to attract foreign investments and maintain a stable interest on sovereign bonds (SBY). Therefore, monetary policy maker must ensure to stabilize Rand to US dollar exchange rate by controlling inflation and other economic indicators whilst the government also has to stabilize SBY by selling and buying sovereign (government) bonds to control the yield on it.

Keywords: Exchange Rate; Foreign Direct Investment; Sovereign Bond Yield; South Africa; Volatility

JEL Codes: G11, G12, G14, G41

1. Introduction

The intersection of exchange rates, foreign direct investment (FDI), and sovereign bond yields (SBY) is fascinating because it facilitates international trade by influencing the cost of capital for companies that trade internationally (Akinlo & Onatunji, 2021). The exchange rate is the relative price of one currency represented in terms of another currency and has a significant effect on a country's economic stability and level of international competitiveness (Rossi & Galbraith, 2013). Exchange rate volatility, defined as a risk caused by uncertainty in the currency rate in international trade, is frequently influenced by inflation, the interest rate, and other macroeconomic variables. Decisions regarding foreign commerce and investments are more challenging when exchange rates are volatile because volatility raises exchange rate risk which is the risk of losing money due to fluctuations in currency rates (Thaw, 2023).

Exchange rate volatility in foreign direct investment (FDI) has the ability to limit global trade and economic progress by increasing risk and discouraging foreign investments. Such volatility can also increase the cost of borrowing for the government, adding to the burden of public debt and risking the stability of the financial markets (Latief & Lefen, 2018). FDI is an investment made by a corporation or entity with its primary residence in one country into another (Denisia, 2012). South Africa's promising growth has attracted international investors while its improved financial markets have allowed for FDI diversification (Ng'ambi, 2015). Severe capital shortages in developing countries like South Africa result in a critical demand for FDI as FDI also serves as a cornerstone of economic globalization, stimulating growth and development (Bjorvatn, 2001).

Over the past two decades, the African bond market especially, the government bond market has grown because of rising government spending and the demand for funding (Mu, Stotsky & Phelps, 2013). Variables such as the degree of risk associated with African governments and the availability of international financial markets, limit the expansion of bond markets (Mukoki, 2022). The ongoing exchange rate volatility of African countries is also significant, as it may have a negative impact on sovereign bond yields World Bank (2021). More generally, opinions about a nation's local government and economy in relation to the global economy are reflected in the stability or volatility of the currency rate. Being a developing market economy, South Africa's growth and development are largely dependent on foreign investment. Therefore, assessing the connection between FDI, sovereign bond yields, and exchange rate volatility is particularly essential in the context of South Africa. (Gries, Grundmann, Palnau & Redlin, 2018).

The South African economy is significantly reliant on foreign investment, and FDI is one of the most important capital transmission channels (Gries et al., 2018). Exchange rate volatility is problematic and a concern as in recent years it has caused a notable decline in FDI as rising SBY caused bond holders seek higher returns for higher levels of risk. Economic growth and inflation also affect bond yields in opposite directions conducted on exchange rate volatility. Exchange rate volatility is a factor that hinders foreign investment in the bond market, thereby limiting its potential (Udoh & Egwaikhide, 2008).

African countries' government bond yields have been on a steady growth phase but only a few of these countries have access to the world financial markets, this hinders the growth potential of these African countries. Exchange rate volatility poses a negative risk to these African countries and has a negative effect on bond yields (Ślusarczyk, Meyer & Neethling, 2020). Understanding the complex effects of exchange rates on FDI and sovereign bond yields is important for investors and policymakers, and it also has a big impact on the stability and growth prospects of the global economy (Shanmugam & Raghu, 2017). This investigation dives into the intricate interconnections that underpin these relationships, providing insight into how changes in exchange rates can affect FDI inflows and sovereign bond yields, eventually determining nations' economic futures.

The interactions between exchange rates, FDI, and bond yields have not been extensively studied in the context of South Africa (Kiat, 2010). The existing literature only examines the links between exchange rates and FDI only or exchange rates and bond markets, fewer studies have examined the links between bond markets and FDI. Therefore, this study unravels the impact of exchange rate volatility on FDI and SBY by employing the GARCH models. Furthermore, using VECM the study investigates the relationship between FDI and SBY to establish their short-run and long-run dynamic relationship. Thereby contributing to the existing literature on the

intrinsic relationship among exchange rate volatility, FDI and SBY in the South African context.

2. Literature Review

2.1. Theoretical Concepts

The dynamics of currency rates and foreign direct investment (FDI) can be described by the Efficient Market Hypothesis (EMH), a foundational theory in finance. According to this theory, it is practically impossible for investors to regularly earn returns above average (Woo, Mai, McAleer & Wong, 2020). The EMH assumes that exchange rates accurately represent all available information, including economic indicators, geopolitical developments, and market emotion (Lee & Sodoikhuu, 2012). In essence, it is thought that exchange prices respond quickly to any new information that becomes accessible.

The EMH advises investors to take a different tack when it comes to FDI. Making investment decisions entirely based on the expectation of future exchange rate adjustments may not be a sound approach if exchange rates are effective and already take into account all relevant information. Instead, when considering FDI, investors should place more weight on other aspects such as the host nation's economic fundamentals, political stability, legal and regulatory framework, and overall business potential (Ylander & Palmgren, 2015). Exchange rates are one of many variables to consider in a larger context, even though they influence investment decisions. It's crucial to note that the EMH has generated some controversy and criticism within the banking sector. Some contend that the assumptions of the theory might not always hold in real-world markets, particularly where there is market irrationality or information asymmetry. Even while the EMH shows that continuously outperforming the market through such predictions is difficult, many investors and analysts still try to estimate exchange rate changes and take these projections into account when making FDI decisions (Ndungi, 2018).

2.2. Empirical Review

A study conducted by Morrissey and Görg (2009), utilized annual panel data for the years 1990 to 2002 to examine how exchange rates affect US foreign direct investment (FDI) flows to a sample of 16 emerging market nations. The value of the local currency (a less expensive currency attracts FDI) predicted fluctuations in the exchange rate (expected depreciation suggests FDI is postponed), and exchange rate volatility (discourages FDI) are three distinct exchange rate effects that are considered. The findings show a negative correlation between FDI and higher local currency prices, local currency depreciation expectations, and erratic exchange rates.

In contrast, the findings of the study by Sharifi-Renani and Mirfatah (2012) indicate that foreign direct investment has a positive correlation with macroeconomic factors such as gross domestic product, openness of the economy, and the exchange rate.

Sharifi-Renani and Mirfatah (2012) used Johansen and Juselius's cointegration system approach covering the period 1980-2006 to evaluate the determinants of FDI inflows, particularly volatility of the exchange rate in Iran which is a developing economy according to the IMF. Similarly, (Meyer & Hassan, 2020) utilized a Johansen cointegration estimation technique as well to examine the effects of the exchange rate volatility on the bond market and the overall South African economy. The data utilized is from the rand/US dollar exchange rate series, exchange rate volatility was generated using GARCH, which was then combined with other variables in a VECM for the primary estimation. Real GDP, bond yields, currency rates, and CPI were among the variables examined in analyses of monthly datasets from January 2000 to December 2018. The results reveal causality, there is a bidirectional relationship between the volatility of exchange rates and the bond market. The findings from utilising the same technique reveal similar findings of an inverse relationship.

Moreover, the VECM estimation results show that volatility about the external variables, furthermore, it was observed that exchange rate fluctuation affects the economy. Additionally, exchange rate volatility has minimal impact on the economy in the short term. Considering the statistical insignificance of both the inflation and bond market factors, the short-run results also show no effect on economic growth, (Meyer & Hassan, 2020). However, foreign direct investment has an unfavourable connection with global crude oil prices and exchange rate volatility. Exchange rate volatility creates risk and uncertainty, lowers incentives for foreign investment, and especially lowers inward FDI flows.

Bilawal, Ibrahim, Abbas, Shuaib, Ahmed, Hussain and Fatima (2014) study of the impact of exchange rate on foreign direct investment in Pakistan, using correlation and regression analysis for the period from 1982 to 2013. The correlation results showed that FDI and the exchange rate had a substantial positive association. This is because Pakistan is a developing nation with abundant resources and low labour costs; therefore, when a foreign corporation wants to invest in Pakistani local currency, it first checks Pakistan's currency exchange rate. Simply said, a high currency exchange rate for Pakistan indicates that the corporation gets paid more to invest in Pakistan. Thus, this study has demonstrated that foreign direct investment is positively impacted by currency rates.

A study conducted by Suliman, Elmawazini and Shariff (2015), employed panel data methodologies and the Two-stage Least Squares (2SLS) approach to analyse the link between FDI and the exchange rate volatility of twenty sub-Saharan African countries between 1980 and 2003. The findings demonstrated that exchange rate

volatility had a negative impact on foreign direct investment (FDI), indicating that higher exchange rate uncertainty reduces a host country's desirability to international investors. In contrast, the rising deficits and government debt lead to increased long-term interest rates driving higher sovereign bond yields in developed economies. The findings above are pulled from the paper by Kumar and Baldacci (2010) where the bivariate correlation bivariate model was utilized using an annual frequency for 31 developed countries. The need for stable and predictable exchange rate policies as a tool to attracting FDCI to attract is highlighted in the research. The researchers concluded that the real exchange rate has a major impact on FDI inflows because employing the pegged exchange rate to attract FDI inflows increases pricing fluctuation in the face of escalating real exchange rate instability.

In addition to resources and cheap labour, variables such as GDP, trade openness, exchange rates, gross capital creation, and accessibility of infrastructure facilities in long-term relationships in influencing FDI. This is revealed by an empirical examination done by Maryam and Mittal (2020) of how macroeconomic factors affect foreign direct investment inflows with respect to the BRICS nations. The auto-regressive distributive lag technique test and pooled mean group were employed in the paper's analysis of annual data from 1994 to 2018. The results of the study demonstrate the importance of. The short-term country-specific research reveals that each of the BRICS has different factors influencing foreign direct investment. China is the best of the BRICS, having the most notable and favourable effects on the variables under study when it comes to FDI inflows. Given the challenges the BRICS economies face on a global scale, the need for more liberal policies is large in order to attract more foreign direct investment to promote growth.

Akinlo and Onatunji (2021), conducted thorough research of FDI inflows and currency rate variations in developing nations. The study concluded that by making local industries more competitive and lowering the cost of production, a depreciation of the domestic currency increases FDI inflows. However, as Maxwele (2018) point out, the effect of exchange rates on FDI differs among nations and industries. They noted that FDI may be discouraged by currency fluctuation in nations with poor institutions and significant political risk. In a similar study, Guan, Lian, Zhao and Chen (2020) investigated the non-linear connection between FDI and currency rates. The results showed that while a small degree of currency depreciation increases foreign direct investment, a large degree of depreciation may have negative consequences due to increased risk and uncertainty. This implies that decision-makers need to carefully evaluate the ideal rate of currency rate depreciation to draw FDI inflows.

In later stages, a similar study by Ehrmann, Osbat, Stráský and Uusküla (2014), employed a regression analysis to assess how variations in exchange rates impacted the spreads on sovereign bonds in Eurozone countries (developed countries). The

results demonstrated that higher exchange rate volatility led to wider bond spreads, indicating that investors perceived risk as being higher. The dynamic relationship between changes in the exchange rate and the yields on government bonds in Latin American countries was investigated using a VAR model. The analysis found a bidirectional association between changes in the exchange rate and bond yields.

Furthermore, the relationship between the volatility of the exchange rate and the yields on sovereign bonds in both developed and developing market economies was examined by Kim and Kwon (2014) using a time-series approach. Similar results show that exchange rate volatility has a positive and considerable impact on sovereign bond yields. As volatility increases because more individuals consider the currency to be risky and unstable, bond rates increase. The study also found that in developing market nations, exchange rate volatility had a greater impact on bond yields.

Cheikh and Rault (2015) studied the pass-through of exchange rates about the European sovereign debt crisis and examined if exchange rate pass-through (ERPT) for five highly indebted Euro area countries in the so-called GIIPS (Greece, Ireland, Italy, Portugal, and Spain) group is a nonlinear phenomenon. This study used logistic smooth transition models to investigate if nonlinearity in sovereign bond yield spreads (in relation to the German bund) could be a sign of macroeconomic instability or a crisis in confidence. The findings provided compelling evidence that ERPT is more severe when there is macroeconomic distress, that is when sovereign bond yield spreads are higher than a certain threshold. The results brought to light the important question of whether, during a financial crisis, the exchange rate could be a helpful instrument to maintain a positive trade balance and prevent deflationary dangers.

In addition to more empirical evidence of this investigation for developing economies, Meyer and Hassan (2020) examined empirically the effects of exchange rate volatility on the bond market and the overall economy of South Africa. The variables' cointegration condition and the impact of exchange rate volatility on the bond market and the economy were evaluated quantitatively using a Johansen cointegration estimation technique. From the rand/US dollar exchange rate series, exchange rate volatility was generated using GARCH, which was then combined with other variables in a VECM for the primary estimation. Real GDP, bond yields, currency rates, and CPI were among the variables examined in analyses of monthly datasets from January 2000 to December 2018.

Giving a more detailed analysis, the findings of the Johansen cointegration test showed a long-term relationship between the variables. In contrast to the previously discussed empirical evidence, the VECM estimation results show exchange rate volatility as a factor that discourages foreign investment in the bond market, hence reducing the market's potential. Furthermore, it was observed that exchange rate

fluctuation affects the economy. Additionally, exchange rate volatility has minimal impact on the economy in the short term. Considering the statistical insignificance of both the inflation and bond market factors, the short-run results also show no effect on economic growth. In terms of causality, there is a bidirectional relationship between the volatility of exchange rates and the bond market.

Existing literature hasn't given much attention to the interaction between sovereign bond yields and FDI. With the intent of shedding some insight on this link by looking at how government bond yields affect FDI inflows, the Busse and Hefeker (2007) study examined the relationships between foreign direct investment inflows, institutions, and political risk which is represented by sovereign bond yields. Using data from 83 developing countries between 1984 and 2003, significant indicators of multinational businesses' operations were identified. The study used panel data and the fixed effects model to obtain results. The findings demonstrate that several elements significantly affect foreign investment inflows, including government stability, internal and external conflict, racial tensions and corruption, law and order, democratic accountability of the government, and bureaucratic excellence.

Contributing to this investigation, the study by Conterius. Akimov, Su and Roca (2023) used a pooled mean group (PMG) approach to study the effect of foreign investors on the yield and volatility of the domestic government bond market. Thirty-eight (38) countries' panel data from 2004 to 2018 are included in the study. This sample enables the examination and contrast of these connections between developed and developing nations. To differentiate between the short-term and long-term relationships between foreign ownership and bond yield and yield volatility, this study employs the PMG methodology.

Furthermore, the authors used nonlinear autoregressive distributed lag (ARDL), which has not been done in previous studies, to test for possible relationship asymmetries.

The study's key findings proved that, both in the short and long periods, foreign ownership of the domestic bond market considerably lowers domestic government bond yield. Additionally, Conterius. Akimov, Su and Roca (2023) discovered some data that suggests short-term bond market volatility may be lessened by foreign investment. Only developed countries showed a significant and negative connection when the data were divided into developed and developing subsets. The study also discovered an asymmetric relationship between the increase and reduction in foreign ownership on the yield on the domestic bond market, with the increase in foreign ownership having a greater short-term impact on the total yield than the decline in foreign investments.

Empirical evidence suggests that exchange rates increase sovereign bond yields for both developed and developing countries even though the impact is greater in

developing countries, but in the long run, exchange rates discourage SBY. The literature further suggests that exchange rate volatility discourages FDI, and there is a negative relationship, but in contrast to this, a study conducted in Pakistan concluded that there was a positive relationship between exchange rate volatility and FDI. The contrast of these studies can be attributed to the different countries that were investigated and the various analysis methodologies that each author used. Not enough empirical evidence exists for the relationship between FDI and SBY in emerging markets such as South Africa, this study aims to fill this gap in the literature. Therefore, the purpose of this study is to establish the specific impact of exchange rate volatility on FDI and SBY in the South African context and empirically establish the relationship that exists between FDI and SBY using VECM to establish their short-run and long-run dynamics.

3. Data and Methods

3.1. Data Collection and Sampling

Monthly data spanning the period starting 2 January to 30 December 2022 of Exchange rate, South African Bond yield and the foreign direct Investments were collected. The rand to dollar exchange rate, the net inflow (BoP, current US$), interest rate on long-term bonds (IRLB) SBY were used to proxy exchange rate, FDI and SBY respectively. The Nominal Gross domestic product was used as proxy for GDP, inflation as measured by the consumer price index, and interest rate on long-term bonds (IRLB) used as a proxy for sovereign bonds. Data were sourced from The World Development Indicators, McGregor database, and the OECD's economic indicators database.

3.2. Empirical Model

The GARCH model assumes that shocks are modelled symmetrically and that the time-varying volatility response to both positive and negative shocks is the same (Moodley, Ferreira-Schenk & Matlhaku, 2024). The GARCH equation for a univariate GARCH (1, 1) model in this instance can be written as:

- $lfdi_t = \beta_0 + \sigma exc\_v_{\mathrm{t}} + lfdi_{\mathrm{t-1}} + \varepsilon_t$ (1)
- $lsby_t = \alpha_0 + \sigma exc\_v_{\mathrm{t}} + lsby_{\mathrm{t-1}} + \varepsilon_t$ (2)

Mean equation:

- $y_t = \mu + \phi y_{t-1} + \Phi \beta_{\mathrm{t-1}} + \varphi \theta_{t-1} + \pi \rho_{t-1} + u_t$ (3)
- $y_t = \mu + \phi y_{t-1} + \Phi \beta_{\mathrm{t-1}} + \varphi \theta_{t-1} + \pi \rho_{t-1} + \sigma exc\_v + u_t$ (4)

In the mean equation y_t represents the index return, μ represents the mean return, α represents the effect of past returns, β captures the effect of past shocks, φ is the risk premium, and σexc_v represents exchange rate volatility. The log of foreign direct investments, log of sovereign bond yields, logged of exchange rate was used to extract residuals to get exchange rate volatility series, log of gross domestic product and log of inflation are represented as (lfdi), (lsby), (lexr), (lgdp), (linf). By examining the significance, sign, and size of the coefficient, the effect of exchange rate volatility on γ was identified. To find out how exchange rate volatility affected the significance and signs of the other variables in the equations, coefficients from Equations 4 and 5 were also compared.

The conditional variance equations of the GARCH models, according to (Brooks, Parks & Stamoulis, 2021):

GARCH (1, 1)

- $\delta_t^2 = \omega + \alpha\, \varepsilon_{t-1}^2 + \beta \delta_{t-1}^2$ (5)
- $\delta_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta \delta_{t-1}^2 + \sigma exc\_v$ (6)

GJR-GARCH (1, 1)

- $\delta_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta \lambda_{t-1} + \theta \delta_{t-1}^2 \varphi_{t-1}$ (7)
- $\delta_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta \lambda_{t-1} + \theta \delta_{t-1}^2 \varphi_{t-1} + \sigma exc\_v$ (8)

E-GARCH (1, 1)

- $log\delta_t^2 = \omega + \beta\, \delta_{t-1}^2 + \lambda \left({\varepsilon_{t-1}}/{\sqrt{\delta_{t-1}^2}} \right) + \alpha \left[{\varepsilon_{t-1}}/{\sqrt{\delta_{t-1}^2}} - \sqrt{{2}/{n}} \right]$ (9)
- $log\delta_t^2 = \omega + \beta\, \delta_{t-1}^2 + \lambda \left({\varepsilon_{t-1}}/{\sqrt{\delta_{t-1}^2}} \right) + \alpha \left[{\varepsilon_{t-1}}/{\sqrt{\delta_{t-1}^2}} - \sqrt{{2}/{n}} \right] + \sigma exc\_v$ (10)

A variance equation estimate was used to determine how exchange rate volatility impacted FDI and SBY. Equations 6, 8, and 10 estimate the non-augmented conditional variance equations for the GARCH (1.1), GJR-GARCH (1.1), and E-GARCH (1.1), while Equations 7, 9, and 11 estimate the same equations with the addition of accounting for the impact of exchange rate volatility on FDI and SBY. The parameter δ_t^2 is the conditional variance, ω is the intercept, and α and β, respectively, represent the impact of shocks in volatility and historical volatility on current volatility. An insignificant coefficient on σ suggested that FDI and SBY was not impacted by the exchange rate volatility, whereas a statistically significant coefficient on σ showed a strong impact of the volatility on FDI and SBY. If the

coefficient was positive, it would indicate that the impact on FDI and SBY rises with volatility and falls with a negative coefficient.

Equations 6 and 7 of the GARCH (1.1) model assume that time-varying volatility responds to positive and negative shocks in the same way, and as a result model of shocks are symmetrical. In order to overcome this constraint, the GJR-GARCH (1.1) model, which is a GARCH (1.1) extension, takes into consideration asymmetry in the volatility's response to both positive and negative shocks (Moodley, Ferreira-Schenk & Matlhaku, 2024). Equation 6 adds a multiplicative dummy term from the conditional variance of the GJRGARCH (1.1) in Equations 8 (and 9), which captures the leverage effects. The leverage effect is indicated by a statistically significant and positive value (Brooks, Parks & Stamoulis 2021). Furthermore, the SBIC was used to select the most appropriate GARCH model. The GARCH (1, 1) was elected as the most appropriate model since it has the lowest possible error. Since this sample study is considered a big sample with a monthly data of 27 years (335 observations). According to Brooks, Parks and Stamoulis (2021) SBIC is consistent and efficient on large sample.

3.3. Vector Error Correction Model (VECM) Specification

The vector error correction model (VECM) is an extension of the VAR employed in examining the between cointegrated variable, whereby the variables in the system are assumed to be stationary and have no long-run equilibrium relationship (Ogun, Egwaikhide & Ogunleye, 2012). The VECM, allows for the existence of cointegration across variables, implying that there is a long-run equilibrium relationship that drives the system's dynamics. Rather than levels, the VECM is characterized in terms of the differences between the variables in the system. This is caused by the fact that cointegration means that the variables share a stochastic trend that cannot be captured by simple differencing (Meyer & Hassan, 2020). In this study VECM was used to study the relationship between SBY and FDI.

The VECM can be written in the following form, with up to k lags, according to Brooks et al, (2021):

- $Z_t = \Pi_1 Z_{t-1} + \Pi_2 Z_{t-2} + \ldots \Pi_k Z_{t-k} + \varepsilon_t$ (11)

Where Z_t is a (p x 1) vector of p endogenous variables, which for this study, comprises log of SBY, log of Exchange rate volatility, and log of FDI. Πi is a (p x p) matrix of parameters, and ε_t is the error term. Equation (13) presents the error correction model (ECM):

- $\Delta Z_t = \Pi_k Z_{t-k} + \sum_{i=1}^{k-1} \phi i \Delta Z_{t-i} + \varepsilon_t$ (12)

4. Empirical Findings

4.1. Descriptive Statistic and Correlation Results

Table 1 shows a descriptive statistic of the data used in this study. FDI shows highest average returns while SBY yields the lowest return. FDI also has the highest standard deviation, while exchange rate volatility has the lowest. Exchange rate volatility, FDI, SBY, and CPI are positively skewed except for GDP which suggests that it is not normally distributed. Kurtosis of greater than 3 depicts a type of distribution called leptokurtosis (Gawali, 2021). A lower likelihood further indicates that the variable might not follow a normal distribution in the Jarque-Bera test, which measures normality.

Table 1. Descriptive statistics

	LSBY	LFDI	LEXC	LGDP	LCPI
Mean	-0.001193	21.83056	0.004734	0.001885	1.634501
Median	0.000000	22.04541	0.002816	0.002105	1.715798
Maximum	0.158748	24.42848	0.190175	0.044750	2.639559
Minimum	-0.112267	20.12605	-0.151792	-0.065545	-0.681248
Std. Dev.	0.034136	1.028488	0.037228	0.007534	0.516478
Skewness	0.423189	0.154733	0.633065	-3.994006	-1.172943
Kurtosis	5.248741	2.603954	6.709698	54.28177	5.239950
Jarque-Bera	80.58409	3.536703	214.4690	37598.56	147.2878
Observations	335	336	335	335	336

Source: Authors' estimation (2025)

The F- statistic is significant at 10%, 5% and 1% this suggests that all variables were serially correlated evident in Table 2. This further suggests the use of ARMA process to model the mean equation (Brooks, Parks & Stamoulis, 2021). To address the issue caused by serial correlation, lagged dependent variables terms are used as additional explanatory variables (Gawali, 2021). Table 2 also shows significant F-statistic at 10%, 5% and 1%, revealing presence of ARCH effects, justifying the adoption of the GARCH model in the analysis of the impact of exchange rate on FDI and SBY.

Table 2. Correlation and ARCH Test

Breusch-Godfrey Serial Correlation LM Test	
F-statistic	13.76807 *
Obs*R-squared	25.79561 *
Heteroscedasticity Test: ARCH	
F-statistic	65.44285 *
Obs*R-squared	54.97001 *

**** for 10%, ** for 5%, and * for 1% level of significance.*

Source: Authors' estimation (2025)

Table 3. Stationarity and Unit Root Tests

	Exchange Rate	CPI	GDP	FDI	SBY
			ADF		
Levels	-13.753*	-3.097**	-6.634*	-9.909*	-13.274*
			KPSS		
Levels	0.076***	0.139***	0.444**	0.017***	0.448**

**** for 10%, ** for 5%, and * for 1% level of significance.*

Source: Authors' estimation (2025)

Table 3 shows the ADF test in levels. The statistics for the variables are more negative (are significant) than the critical values and therefore the null hypothesis that the series contains a unit root can be rejected. The KPSS test in levels confirms the findings of ADF as the statistics are less than any of the critical values; therefore, the null hypothesis that the series is stationary cannot be rejected, therefore it is stationary.

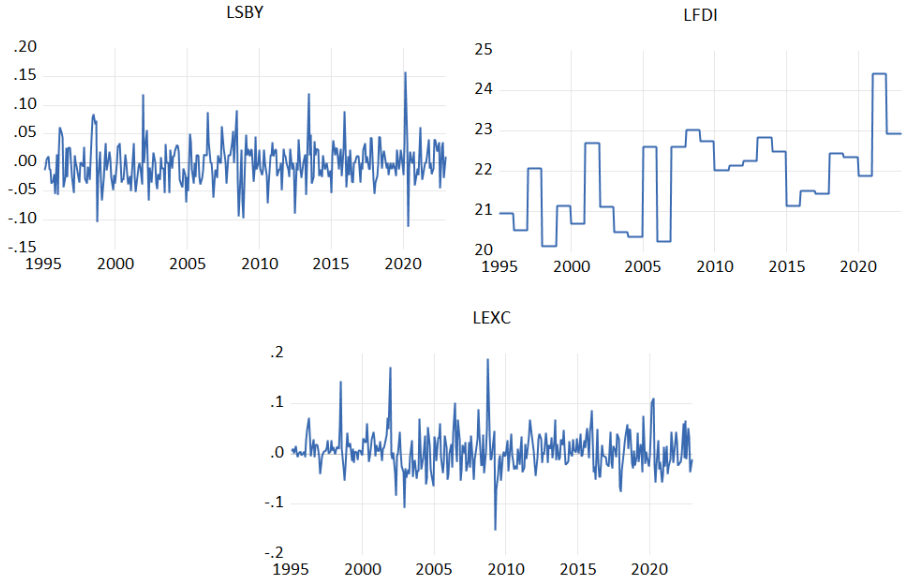

Figure 1. Trends in sovereign bond yields (SBY), foreign direct investment (FDI), and exchange rate (EXC) in South Africa (1995–2022)

Figure 1 plots the exchange rate volatility series that was derived from a GARCH model estimation. The series plot indicates substantial evidence of volatility clustering, periods of high and low volatility are clustered together suggesting that exchange rates experiences times of extreme oscillations followed by periods of

relative stability. This pattern implies that the volatility of the variable is not random but rather shows persistence over an extended period.

4.2. Mean Equations and Variance Equations

4.2.1. Mean Equations

Table 4 shows univariate and multivariate GARCH (1,1) where SBY is the dependent variable. The intercept (μ) is insignificant under student t distribution implying that SBY will be zero when other factors are zero, the lagged value of SBY is significant and positive in both univariate and multivariate models indicating a positive relationship between SBY and it lag, that is, an increase in the lag increase SBY by 0.234 and 0.214 respectively, and vice versa. CPI and GDP are both significant, but CPI is positive, and GDP is negative such that 1% increase in CPI will increase SBY by 0.027% and a 1% increase in GDP will decrease SBY by 0.687%. Moreso, exchange rate volatility does not have an impact on SBY.

Table 4. GARCH (SBY as dependent variable)

Model / Distribution	**Normal**		**Student T**		**GED**	
	Multivariate	**Univariate**	**Multivariate**	**Univariate**	**Multivariate**	**Univariate**
Mean equation						
μ		-0.001	-0.002	-0.002	-0.001	-0.002
σ			-0.354		-0.242	
Φ			0.027*		0.031*	
φ			-0.687*		-0.891*	
π	0.257*	0.257*	0.214*	0.234***	0.207*	0.240***
Variance equation						
ω	0.001*	0.001*	0.003	0.001	-2.043	0.002
α	0.260*	0.260*	0.131	0.150*	0.218	0.178*
λ					0.018	
β		0.329*	0.615*	0.556*	0.728*	0.469

α	0.	0	0.	0	0.	0
+β	652	.589	746	.706	946	.647

*Note: ***, **, and * for 10%, 5% and 1% significance respectively.*

 # for selected model.

Authors' estimation (2025)

Table 5. GARCH (FDI as dependent variable).

	Normal		**Student T**		**GED**	
Types of GARCH	**Multivariate**	**Univariate #**	**Multivariate**	**Univariate**	**Multivariate #**	**Univariate**
Mean equation						
μ	0.024	0.018	3.38E-06	6.78E-07	0.005*	0.003
σ_Exc_v	10.459		-0.003		4.489*	0.164**
ϕ FDI(-1)	0.007	0.020	0.000233	-1.12E-05**	-0.003*	
Φ CPI	0.117		1.20E-05		0.002*	
φ GDP	-1.039		-9.98E-05		0.068*	
π SBY			-0.001			
Variance equation						
ω	0.080*	0.079	0.024	0.010	0.120***	0.071
A	-0.029*	0.033	0.013	-0.001	0.028	-0.385
θ		0.066***			-0.078	
B	0.581***	0.569*	-0.238	0.952	0.564***	0.575*
α + β	0.552	0.602	-0.225	0.951	0.592	0.534

*Note: ***, **, and * for 10%, 5% and 1% significance respectively.*

 # for selected model.

Authors' estimation (2025)

Moreover, Table 5 shows multivariate GJR-GARCH (1,1) with FDI as the dependent variable in the GED distribution. The intercept (μ) is significant implying that FDI will increase 0.05%, ceteris paribus. The lagged value of FDI is significant and negative indicating that there is impact between FDI and it lag, with 1% increase in its lag decrease FDI by 0.03% and vice versa. CPI and GDP are both significant and positive suggesting a 1% increase in CPI will increase FDI by 0.02% and a 1% change in GDP will increase FDI by 0.68%. Due to the significant and negative exchange rate volatility, FDI will decrease by 4.489% for every 1% increase in the exchange rate, and vice versa. On the other hand, the univariate model chosen under normal distribution in table 4 shows GJR-GARCH (1,1) where both the intercept (μ)

and the lag of FDI are insignificant suggesting that it does not have any impact on FDI.

4.2.2. Variance Equations

The multivariate model GARCH (1,1) under the student t distribution in Table 4 has a significant intercept, indicating that there is a systematic and meaningful component of volatility that cannot be explained by independent variables which are Exchange rate volatility, CPI, and GDP. The ARCH term is insignificant, indicating that past squared errors have no long-term effect on current volatility. The sum of ARCH (α) and GARCH (β) terms is less than but approaches one implying the medium persistence of volatility and stationarity. The model does not violate the non-negativity conditions, the intercept, ARCH term and GARCH term (ω, α, β) on the variance equation are all greater than zero, making the model admissible (Maxwele, 2018).

The univariate model GARCH (1,1) in Table 4 shows a variance equation, where the intercept (μ) is insignificant. The ARCH term is significant, indicating that past squared errors have long-term effect on current volatility. The GARCH term is significant and less than one, it indicates that the past conditional variance has persistence effect on the current conditional variance. The model does not violate the non-negativity conditions, the intercept, ARCH term and GARCH term (ω, α, β) on the variance equation are all greater than zero. The sum of ARCH and GARCH terms is less than but closer to one implying more persistence of volatility and stationarity, therefore admissible. The GJR-GARCH model under the GED distribution in Table 5 shows a significant intercept, the ARCH term is insignificant, indicating that past squared errors have no long-term effect on current volatility. The GARCH term is significant indicating that the past conditional variance has persistence effect on the current conditional variance. The model does not violate the non-negativity conditions, the intercept, ARCH term and GARCH term (ω, α, β) on the variance equation are all greater than zero. The sum of ARCH and GARCH terms is less than but closer to one implying the persistence of volatility and stationarity. The interaction term (θ) is insignificant and negative indicating that there are no leverage effects, meaning that positive and negative shocks have similar impact without any substantial asymmetry. The findings of this study on SBY and Exchange rate volatility suggest that the impact of positive shocks on Exchange rate affect SBY more than that of the negative shocks. The study of Arslanalp (2016) found this to be true in the short run, because he believed that the supply and demand dynamics will revert exchange rate to equilibrium position in the long run.

In addition, Table 5 also shows univariate GJR-GARCH (1,1), where in the variance equation, the intercept (μ) and the ARCH term are insignificant and positive. The GARCH term is significant and positive indicating that the past conditional variance has persistence effect on the current conditional variance. The model does not violate

the non-negativity conditions, the intercept, ARCH term and GARCH term (ω, α, β) on the variance equation are all greater than zero. The sum of ARCH and GARCH terms is less than but closer to one implying persistence of volatility and stationarity. The GJR-GARCH term is significant and negative indicating that there are leverage effects, meaning that positive and negative shocks do not have similar impact with any substantial asymmetry. The presence of leverage effects this model suggests that the impact of positive shock is less than that of negative shock in line with study of Kim and Kwon (2014), Meyer and Hassan (2020), Moodley, Ferreira-Schenk and Matlhaku (2024).

4.3. VECM

4.3.1. Beta Matrix (Long Run)

SBY = -0.664535FDI +16.81373

Table 6 reveals the coefficient of FDI in the VECM cointegrating equation with SBY as the dependent variable is significant and negative, indicating that FDI has a negative impact on SBY in the long term. A 1% increase in FDI decreases SBY by 0.66% and vice versa. The findings also imply that SBY discourages FDI.

4.3.2. Alpha Matrix (Short-Run)

The short-run dynamics results reveals that the coefficients of all lags except the FDI lag (-2) are significant when SBY is a dependent variable. That is, both SBY lags and one FDI lag, have an effect on SBY. All lags are insignificant when FDI is the dependent variable.

Table 6. VECM Model between SBY and FDI

Beta Matrix		
Variable	**Coefficient**	**T-Statistics**
FDI	-0.664535	3.833621*
Intercept	16.81373	-

Alpha Matrix				
	SBY		**FDI**	
	Coefficient	**T-Statistics**	**Coefficient**	**T-Statistics**
CointEq1	-0.00032	-0.1071	-0.113952	-3.49037*
SBY (-1)	0.270025	4.9466*	-0.588064	-0.98726
SBY (-2)	-0.170892	-3.152*	-0.032637	-0.05513
FDI (-1)	-0.01289	-2.537*	0.03876	0.69877
FDI (-2)	0.002624	0.51366	0.030571	0.54811
INTERCEPT	-0.00096	-0.5332	0.004843	0.24648

**** 10%, ** 5%, and * for 1% level of significance*

Authors' estimation (2024)

5. Discussion

Using GARCH models, this study illustrates how exchange rate fluctuation affects FDI and SBY. Additionally, it uses the VECM to investigate the relationship between FDI and SBY in order to determine their dynamic relationship over the short and long terms. Under the univariate model, it is quite interesting to note that exchange rate volatility does not have any impact on SBY.

The variance equation of the multivariate model of the GARCH (1,1) model reveals where exchange rate volatility, CPI and GDP are the independent variables. Where the ARCH term is insignificant, implying that the past error have no long-term effect on the current volatility, however, the GARCH term is significant and positive. This confirms the impact of both positive and negative shocks on the conditional variance is different. These findings corroborate with Moodley, Ferreira-Schenk and Matlhaku (2024). Moreover, the result is in line with Sharifi-Renani and Mirfarah (2021) who found FDI to have positive correlation with macroeconomic factors such as GDP and the exchange rate.

Interestingly, the GJR-GARCH model under the GED distribution in Table 9 shows a significant intercept, this indicates that there is a systematic and meaningful component of volatility that cannot be explained by the independent variables exchange rate, CPI and GDP. Haven revealed that the GARCH term is significant depicting the past conditional variance has persistence effect on the current conditional variance. With an insignificant negative interaction term (θ), it indicates that there are no leverage effects meaning that positive and negative shocks have similar impact without any substantial asymmetry. The findings of this study on SBY and Exchange rate volatility suggest that the impact of positive shocks on Exchange rate affect SBY more than that of the negative shocks. However, same table 9 shows that the univariate GJR-GARCH term is significant and negative indicating that there are leverage effects, meaning that positive and negative shocks do not have similar impact with any substantial asymmetry. The presence of leverage effects this model suggests that the impact of positive shock is less than that of negative shock in line with study of Kim and Kwon (2014), Meyer and Hassan (2020), Moodley, Ferreira-Schenk and Matlhaku (2024).

The VECM results shows a significant negative relationship between the dependent variable SBY and the independent variable FDI on the long-run, revealing that a 1% increase in FDI decreases SBY by 0.66% and vice versa. This strongly establishes the fact that SBY does not encourage FDI. Moreover, South Africa has witnessed a significant deterioration in its bond yield, as risk are seen as skewed heavily to the downside for the country. Furthermore, the South African reserve bank (SARB) warns the risk of capital outflows and declining market liquidity with decrease foreign participation. This strengthens the proof of the long-run results of a negative relationship between FDI and SBY (Investec 2023).

In the short-run result, the error correction term (ECT) is negative and significant. Therefore, the past errors are to be corrected in the current period if the long run relationship exist. In table 9 the ECT satisfies this criterion, implying that any past period deviations from the long-run equilibrium would be corrected, this confirmed by the study of Conterius, Akimov, Su and Roca (2023).

6. Conclusion

This paper intended to empirically analyse the impact that exchange rate volatility has on FDI and SBY in South Africa using monthly data from 1995 to 2022. The study stretches further to determine the connection between FDI and SBY. GARCH models were used to extract exchange rate volatility and to determine the impact it has on FDI and SBY. On the other hand, VECM was used to determine how FDI and SBY interact with each other. An observation from the results showed that exchange rate volatility decreases FDI in South Africa. Improving financial instruments and derivatives to hedge against exchange rate volatility will attract FDI and boost investor confidence as exchange rate volatility would no longer be a negative factor that influences investor decisions as it would be hedged against using better methods. VECM results showed that FDI has a negative impact on SBY in the long term. A 1% increase in FDI decreases SBY by 0.66% and vice versa. Short-run dynamics results indicated that the coefficients of all lags except the FDI lag (-2) were significant when SBY was a dependent variable.

Both SBY lags and one FDI lag influence SBY, and all lags were insignificant when FDI was the dependent variable. These results imply that FDI impacts SBY negatively, but SBY has no effect on FDI. There is a gap in literature with studies that analyze the relationship between Sovereign bond yields and foreign direct investment especially in Sub-Saharan Africa. The findings of the paper highlight the need for proper exchange rate management and controlling inflation especially by the countries monetary policy. A stable exchange rate is a good measure for future investment injections. The rand needs to be stabilized to the US dollar as the most exchanged currency in global trade, the need to have sufficient reserves is also great in order for the central bank to intervene to control foreign exchange flows. Decreasing public debt can also mitigate the volatility of the exchange rate.

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