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THE IMPACT OF INTEREST RATES ON THE SOUTH AFRICAN EQUITY MARKET

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Abstract

This paper investigates the effects of interest rate fluctuations on the South Africa's equity market. The Johannesburg Stock Exchange (JSE) - All Share Index (ALSI) was used as a proxy for the equity market, whilst treasury bill rates were used to represent interest rates. The Vector Auto Regression (VAR) model was applied to analyze the relationship between interest rates and the equity market. The Vector Error Correction Model (VECM) augmented the analysis by assessing the short and long-run dynamic relationship between the two variables. Monthly data was collected from Thomson Reuters and the South African Reserve Bank from 2002 to 2020. The results indicate that the relationship between interest rates and the equity market was significant but negative; that is, equity or share prices fall when the interest rates rise. A fall in share prices resembles poor or negative performance of the equity market; therefore, the market capitalization and share face value of listed companies is negatively affected. The outcomes of this study may assist the central bank in understanding the relationship between interest rates and equity prices, which can assist in the implementation of monetary policy tools that control interest rates volatility and reduce negative impact on the equity market. Policymakers and authorities could use the knowledge attained from this study to understand the relationship between interest rates and the equity market because an unnecessary increase in interest rates may negatively affect the equity market, leading to slow economic growth.

Keywords: Interest Rates, Equity Markets, VAR, VECM, Johansen Cointegration

JEL Classification: E43, C58, E44

1. Introduction

Central banks control the operations of the economy by using monetary policy. Sustained economic development can be attained when central banks adopt a financial strategy to regulate the economy's money supply (Onyeiwu, 2012). Therefore, the currency supply may be controlled by increasing or reducing interest rates. Due to increases in interest rates, the central bank implements a contractionary monetary policy, while a cut in interest rates leads to an expansionary monetary policy (Brock, 2021). Interest rates through open market operations have an influence on money supply, and changes in interest rates affect investors' decision-making. Investors are big players in the equity market and the equity market is deemed as the engine of an economy in that when there is good equity market performance, the economy will grow.

The equity market is also named the stock market or stock exchange, which deals with the buying and selling of shares. There are two main types of markets, which are the primary market, where initial shares are sold for the first time, and the secondary market, where old or previously sold shares can be exchanged. Changes in a country's monetary policy can affect the equity market (Hojat, 2015). Thus, changes in the monetary policy framework have a strong influence on financial markets and companies. The monetary policy framework involves the use of interest rates as an instrument that can be increased or decreased by a central bank when controlling the country's money supply (Brock, 2021). Hence, the use of interest rates has raised concerns about their impacts on equity markets. These concerns have motivated the assessment of the relationship between interest rates and financial or stock markets.

Interest rates changes can pose as interest rate risk and affect financial markets leading to financial crisis and chase away investors. Huang and Chang (2022) highlighted that those unnecessary changes in interest rates may negatively affect the equity market leading to slow economic growth.

There are many types of financial crises, including banking crises, currency crashes, currency conversions, defaults on external debt, defaults on domestic debt, and equity market crises (Huang and Chang, 2022). The focus of this study is on interest rates and the equity market to check if interest rate movements may result in an equity market crisis. Huang and Chang (2022) demonstrated that equity market crises have an independently negative real impact on economic growth, even controlling the impact of other types of financial crises like banking crises, currency crises, and debt crises. Thus, according to Huang and Chang (2022), the equity market crises hurt consumption and investment, and through this have a negative impact on total economic growth or performance.

Figure 1 shows the visual performance of South Africa's economic growth. Following the global financial crisis of 2007/2008, the South African economy's growth underperformed, and growth could not rebound to levels prior to the crisis. Although the economy recovered, it failed to perform as it had done in the years before 2008. Furthermore, the COVID-19 pandemic had an adverse effect on the growth of the economy as shown in Figure 1 below. The statistics presented in Figure 1 show that Bloomberg forecasted a negative growth in 2020.

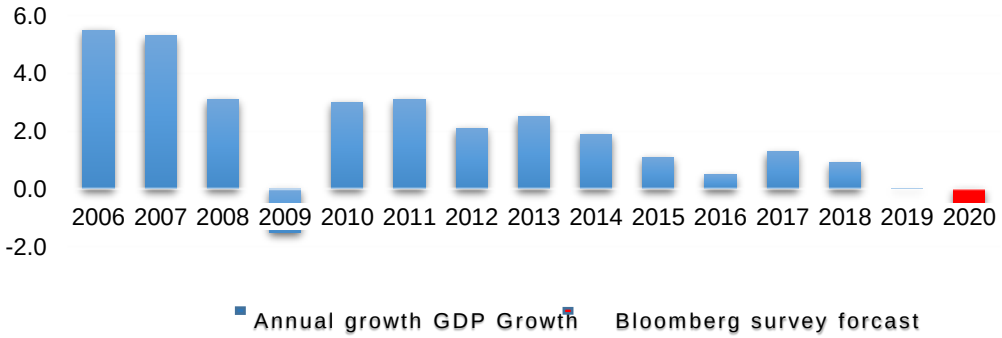

Figure 1. South Africa's economic performance
Source: Statistics South Africa (2020)

The equity market plays a crucial role in a firm's market value. Wang and Liu (2022) defined total market value or capitalization as to how much a company is valued by the stock or equity market, which basically is the total market value of all outstanding shares. In finance, an equity market's performance reflects the performance of stock exchange-listed companies and factors that affect equity market performance or share prices (Wang and Liu, 2022). Hence, any factors that affect the equity market can influence the soaring or plunging of share price values. A firm's market value is affected by its share price and managerial decision-making. Moreover, a firm's market value impacts the firm's position, influence, or strength during a merger or acquisition with another firm (Nautiyal and Kavidayal, 2018). The purpose of this study was to investigate the impact of interest rates on South Africa's equity market while focusing on the Johannesburg Stock Exchange's All Share Index (ALSI). The aggregate performance of the JSE equity market is represented by the All-Share Index (ALSI), including the performance of the best top 40 companies listed on the JSE. ALSI is a composite index that measures the stock price performance of all JSE-listed companies in the Development Board and Main Board and of the JSE. Figure 2 illustrates the upward movement of the JSE ALSI from 1990 to 2022 and a forecast of movement to 2025.

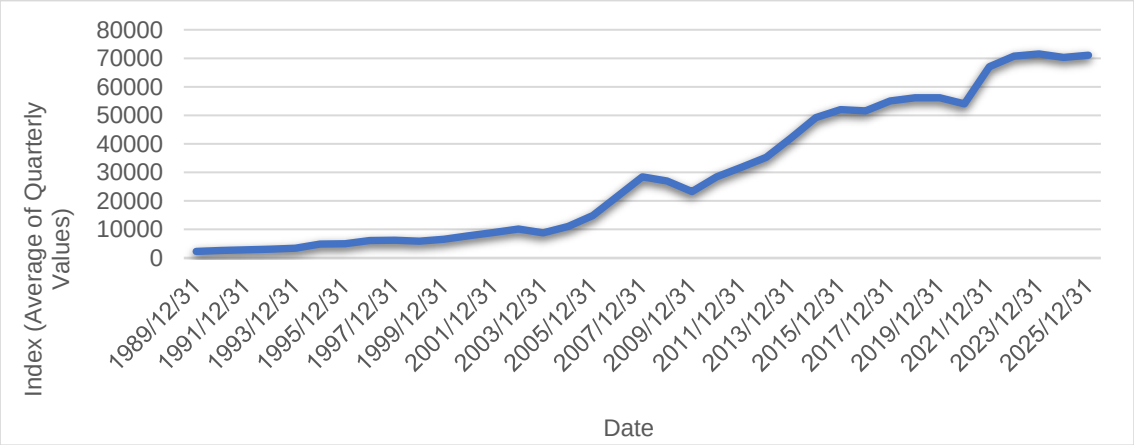

Figure 2. JSE: All Share index - Price index
Source: Quantec Easy Data (2022)

The equity market has grown to become an essential and inseparable part of the South African economy as well as in other countries. The healthiness of a country's economic or financial sector is determined by stock market indices illustrating how important the stock market is in a country. According to Setiawan (2020), the stock market reflects expectations about financial and economic conditions in the future because stock markets highlight investors' willingness to purchase shares at higher prices when expecting firms to be profitable. The investors' expectations for the economy to grow rapidly are indicated by a rise in stock prices, whereas if they expect an economic slowdown, stock prices decrease. The government is expected to pay attention to stock market efficiency or else intervene to boost efficiency since a decline in the equity markets may induce a recession (Setiawan 2020).

Meanwhile, in South Africa, interest rates have been declining gradually since 1998 as the country's central bank focused on reviving the economy with a monetary policy that has continued to lower interest rates (Habiyaremye et al., 2022). Figure 3 is a graphical representation of the interest rate cycle. The COVID-19 outbreak caused central banks to reduce interest rates further. Thus, the central bank responded by lowering interest rates to revive the economy (Habiyaremye *et al.* 2022). "The average interest charge on government debt was 15.2% in the years before the pandemic and the South African Reserve Bank (SARB) lowered the key interest rate with 300 basis points to respond to the Covid-19 crisis, our baseline assumptions are based on lowering future borrowing rates by the same 300 basis points" (Habiyaremye *et al.* 2022, p. 553). Interest rates are loanable fund costs, which are the prices of funds deposited, lent or

borrowed over varying amounts of time. Interest rates have been moving downward as they fell each year, as shown in Figure 3.

Figure 3. Interest rate fluctuations
Source: Trading Economics (2020)

Interest rates refer to the cost of borrowing (Hall, 2021). If the anticipated rate of return on securities rises, higher interest rates trigger equity prices to decrease, leading to a reduction in stock prices. Decisions by monetary policymakers have a significant influence on equity markets and increases in interest rates suggest that investors have solid or insufficient information (Khan *et al.* 2012). The cost of borrowing rises as interest rates grow, and this discourages borrowers from borrowing and investing. A decline in consumer spending contributes to a reduction in firms' profitability. Companies also face a decrease in their market values as earnings decrease (Hall, 2021; Chitumbura and Takawira, 2021).

The relationship between interest rates changes and equity market returns is founded on financial theory. Moya-Martínez *et al.* (2015, p. 95) said that "modern financial theory assumes that any firm generates a stream of future cashflows, and the stock price of that firm is equal to the present value of all expected future cash flows discounted at the appropriate discount rate." There are two (2) ways in which interest rates affect the equity market; firstly, interest rates directly influence the discount rate used in the valuation of equities. Secondly, by altering the cost of funding or financing especially on heavily indebted companies affects the companies' future cashflow expectations (Moya-Martínez *et al.* (2015). Therefore, interest rates are expected to be a significant determinant of equity or stock prices (Moya-Martínez *et al.* 2015).

The South African financial markets have faced a volatile interest rate situation in the recent past accompanied by a frequent weakening of the South African currency as observed against the dollar in foreign exchange markets (van der Westhuizen *et al*. 2022). The onset of the novel coronavirus pandemic (COVID-19) and previous crises have heightened interest in the interaction of the equity market, inflation rate, and exchange rate volatility (Javangwe and Takawira, 2022). Uncertainty on interest rate movements increases exposure to interest rate risk which may chase away investors. High-interest rates increase the cost of borrowing as well as reduces the money supply. Consumers shun borrowing or taking loans and this reduces consumption and investment.

Understanding the linkage between interest rates and the equity market is a critical issue in many areas of finance, including asset allocation, portfolio management, risk management, asset pricing, and monetary policy transmission, and it may be, therefore, of special interest to investors, portfolio managers, corporate managers, and policymakers (Moya-Martínez *et al.*

2015). This will be used to advise policy makers, authorities, and investors on the effects of interest rates, how to adjust interest rates in order to influence the equities market, as well as assist investors in making financial investment decisions and circumventing interest rate risk.

The specific objective of this study is to check econometrically whether a relationship between interest rates and the equity market exists in South Africa and assess its impact. Therefore, answer the question if a relationship exists between interest rates and the equity market and whether interest rates impact the equity market. The hypothesis to be tested is that interest rates do not affect the equity market.

2. Literature review

This section presents the literature review on the relationship between interest rates and the equity market of South Africa.

2.1. Theoretical literature

2.1.1. Interest rates

Interest is a fee paid by a debtor of goods to the holder as a sort of return for the use of the assets (Ali, 2014; Conrad, 2021). It is basically the cost paid for the utilization of someone's money or any physical goods. Interest can take the form of accumulated or earned money from financial deposits for a period. Ali (2014) defines an interest rate as the price at which interest is charged to or paid by a debtor for the use of borrowed money, asset, or property by or from a creditor, respectively. Interest rates are mostly set yearly. For example, if one borrows one hundred rand with the interest rate of three percent (3%) per annum, then the person must pay back after one year one hundred and three rand (Ali, 2014). Setiawan (2020) highlighted that there are two types of interest rates, namely nominal interest rates and real interest rates. The nominal rate is given or announced by a country's central bank whereas real interest rates are adjusted for inflation (Setiawan 2020). According to Setiawan (2020) and Ali (2014), changes in interest rates can positively and negatively influence the stock markets.

Sharpe and Suarez (2021) reiterated that a sizable increase in interest rates on the order of one to two percentage points, ceteris paribus, will result in a sizable negative effect on capital expenditures by businesses generally, in accordance with the fundamental tenet of investment theory and the traditional view of monetary policy transmission. The market interest rate is traditionally fused as a key element in measuring companies' cost of capital, which, together with the anticipated stream of cash flows, are the main determinants of investment decisions (Sharpe and Suarez, 2021).

In the 1970s, money supply was used by the South Africa Reserve Bank (SARB) to directly influence liquidity conditions, and then in the early 1980s moved to a more mixed system where short-term interest rate adjustments were used indirectly to control the money supply (MacFarlane, 2011). A new framework in South Africa named inflation targeting for monetary policy was then introduced in 2000, with interest rates as the predominant driver (MacFarlane 2011).

2.1.2. The equity market and theories

According to Shah *et al.* (2019), the Efficient Market Hypothesis (EMH) is one of the stock market theories mostly popular and highly debated. The EMH theory argues that the market price of a stock or asset incorporates all information provided concerning the asset at any given time (Shah *et al.* 2019). That is, the asset or stock being sold has an accurate pricing value until something changes (Shah *et al.* 2019). The EMH is made up of three (3) market systems namely the weak form, semi-strong form, and the strong form (Shah *et al.* 2019).

2.1.2.1. Asset pricing

On the other hand, Zhong and Enke (2017) and Shah *et al.* (2019) stated that financial variables like equity prices, stock market index values, and the prices of financial derivatives are generally

believed to be predictable. Putting a price on a stock, equity, instrument, or asset is highly technical but a crucial phase for investors in the stock markets to predict the future price of the stock in which they are investing (Afzal and Haiying 2020). Chong *et al.* (2017) pointed out that many empirical studies are widely accepted and show that financial markets are predictable to some extent. There has been an increase in the number of studies that question the validity of EMH due to great criticism of the EMH theory and researchers have introduced new, sophisticated, and successful approaches that combine technical analysis indicators and chart patterns with methodologies from statistics, econometrics, machine learning, data mining, and artificial intelligence (Arévalo *et al.* 2017; Shah *et al.* 2019).

Yunita *et al*. (2020) asserted that investors, when investing, consider the trade-off between the level of return and risk. To determine which stocks are suitable for buying in the equity market, investors need the ability to estimate the expected rate of return (Yunita *et al*. 2020). Investors have tried different techniques over the years to predict the expected prices of assets, and equity market investors always look for specialized instruments that capture the risks associated with their investments in order to maximize their return or profit regardless of risk levels (Afzal and Haiying, 2020). According to Yunita *et al.* (2020), investors and other equity market stakeholders use the Capital Asset Pricing Model (CAPM) and the Arbitrage Pricing Theory (APT) to estimate the expected rate of return. Afzal and Haiying (2020) stated that the most efficient methods through which the risk and return can be calculated are the CAPM and APT as they are useful in predicting the expected stock values and as well as helpful to institutional and individual investors vis-à-vis the pricing of stocks.

The CAPM model involves using the interest rate, which is identified as the risk-free rate in the calculation. A risk-free rate is a portion of the return required, and a higher risk-free rate means a higher required rate of return. Future interest rates are required to discount future cash flows; hence, projected interest rates are used. In these functions, the interest rate is exogenous. It directly influences the price directly, by changing the rate of return expected and indirectly by its effect on other macroeconomic factors and expectations (Norfeldt, 2014).

Chen *et al.* (1986) referred to the fact that stock markets and related macroeconomic factors have a long-term equilibrium relationship. In the multi-factor APT framework, Hamao (1988) replicated Chen *et al.* (1986). Hamao's (1988) study showed that the shifts in expected inflation and the unexpected changes in the risk premium and the slope of the term interest rate structure significantly influenced Japanese stock returns.

The APT, therefore, assumes that the return on assets or investments is a function of different macroeconomic variables or market indices, where a factor-specific beta coefficient is a proxy for vulnerability causing changes in each factor. The APT is thus distinguished by forecasting a short-run relationship between macroeconomic factors and the performance of equities. Another theory is the Present Value Model (PVM), which incorporates the discounted cash flow concept, where asset prices are correlated to projected future cash flows and the cash flow discount rate in the future.

2.1.3. The effect of interest rates on the equity market

Eldomiaty *et al.* (2019) and MacFarlane (2011) raised that interest rates alter the discount rate directly in the valuation model and impact future cash flows. If interest rates rise, the required rate of return rises, which, in turn, inversely affects the value of an asset (Eldomiaty et al., 2019; MacFarlane, 2011). In addition, the opportunity cost will increase from a portfolio allocation perspective of holding equities, encouraging investors to buy alternative assets rather than equities (MacFarlane 2011). Companies that are leveraged through debt are highly influenced by rising and decreasing and this may restrain or liberate firms that use gearing aggressively. JSE companies in South Africa are more conservative on leverage use and so reducing or weakening the effect of changes in interest rates on the equity market (Eldomiaty et al., 2019; MacFarlane, 2011).

Increases and decreases in interest rates garner further expectations about future rate movements (Eldomiaty *et al.* 2019; MacFarlane, 2011). The inverse stock market reaction may not occur after interest rates either rise or fall, but the negative causality of interest rates on stock

prices may be influenced by uncertainty (MacFarlane 2011). Eldomiaty *et al.* (2019) claimed that prices in the equity market respond negatively to discount rate changes. Moreover, Eldomiaty *et al.* (2019) went on to clarify that the stock market is negatively impacted by long-run interest rates.

However, Hajilee and Al-Nasser (2017) found a positive relationship between interest rates and equity returns over time, becoming more and more insensitive to risk-free rates. Nevertheless, Eldomiaty *et al.* (2019) concluded that the relationship between these two variables is negative. Furthermore, Eldomiaty *et al.* (2019) also pointed out that there are two (2) main channels that transmit the effects of interest movements to the equity market. These channels include the interest rate channel and the signaling channel.

The interest rate channel denotes that a conventional policy influences the present value of future net cash flows, which affects equity prices (Petrakis *et al.* 2022). Cutting interest rates decreases the risk-free rate, which is used as a discounting factor and so decreases the risk premium of equities, boosting cash flows projected (Petrakis *et al.* 2022). On the contrary, when interest rates and firms' financing costs rise, investors will reduce their stock and choose other financial assets, resulting in a fall in share prices (Gu *et al.* 2021).

Announcements by the South African Reserve Bank (SARB) cutting interest rates positively and significantly impact equity market returns, although this impact takes effect two (2) months after the announcement (Petrakis *et al*. 2022). Investors and other agents aim for higher returns, so low-interest rates make riskier securities more attractive (Petrakis et al., 2022).

According to Petrakis *et al.,* (2022), the signaling channel deals with investors' expectations based on the anticipated interest rate path. Low-interest rates remove market volatility and lower market uncertainty, which is crucial for investment. Subsequently, the spread on the risk premium among riskier assets, such as equities, shrunk, causing equity price recovery (Petrakis *et al.* 2022).

2.3. Empirical studies

Studies conducted to examine the relationship between interest rates and the equity market include cross-country studies, country specific and a plethora of macroeconomic variables (Haider, 2018; Mbulawa, 2015; Kumuda *et al.* 2016; Herranz, 2017; Brooks, 2014; Muriuki, 2014; Barakat *et al.* 2015; Habiyaremye *et al.* 2022; Mutheu, 2016; Liang *et al.* 2022; Boachie *et al.* 2016; Msindo, 2015; Michlian, 2014; Kganyago and Gumbo, 2015; Teitey, 2019; Ali, 2014; Tursoy, 2019). These studies were carried out in different regions and different countries with varying results as the relationship was found to be either insignificant or significant, either positive or negative and having a causal effect.

Some studies found a negative relationship between interest rates and equity markets. The studies include Haider (2018), Laichena and Obwogi (2015), Okech and Mugambi (2016), Okechukwu *et al.* (2019), Fang *et al.* (2016), Shula (2017), Bature *et al.* (2019), Pilinkus and Boguslauskas (2015), Khalid (2017), Ibrahim and Musah (2014), Teitey (2019), Florackis *et al.* (2014), Marfatia (2014), Hashim *et al.* (2018); Najaf and Najaf (2017); Osei (2016); Khan and Khan (2018), Shrestha and Subedi (2014), Msindo (2015), Dima (2015), Mutheu (2016), Mahzabeen (2016), Ali (2014), Gu *et al.* (2021), Setiawan (2020), and Mapolisa (2019).

Studies like Mbulawa (2015), Khalid (2017), Asamoah *et al*. (2016), Aggarwal and Agarwal (2017), Toraman and Basarir (2014), Hajilee and Al-Nasser, (2017), Muriuki (2014), and Eldomiaty *et al.* (2019) found a positive relationship between interest rates and the equity market.

Studies like Barakat *et al.* (2015), Kganyago and Gumbo (2015), and Moya-Martínez *et al.* (2015) concluded that there is a causal relationship between interest rates and the equity market. Their findings stated that interest rate movement causes changes in equity market prices or performance.

Some studies found different results in terms of the significance of the relationship between interest rates and the equity market. Studies like Al-Abdallah and Aljarayesh (2017), Kumuda *et al.* (2016), Tursoy (2019), and Petrakis *et al.* (2022) highlighted that the relationship between interest rates movement causes changes in equity market prices or performance was significant. On the other hand, we have studies that found no significant relationship between interest rates and equity markets, their movements cause no changes in equity market prices or

performance, and these include Muthukumaran and Somasundaram (2014), Boachie *et al*. (2016), John *et al.* (2020), Akpan and Chukwudum (2014), and Michlian (2014).

2.4. Analysis of literature

The literature reviewed in this section of the study has shown the different ways that exist in which interest rates may influence the equity market. As was highlighted by Eldomiaty *et al.* (2019), changes in interest rates influence investor's decisions on a country or the stock market. The review of the literature has demonstrated that changes in interest rates may have an impact on the equity market in terms of investment, prices, and performance.

On the empirical front, the literature revealed that interest rates affect the equity market differently. Some studies found the relationship between interest rates and the equity market positive, while others found it negative, raising the need for more research. Some studies found the relationship insignificant, whereas others found it existing and significant, showing varying results from previous studies.

3. Methodology

This section outlines the methodology that was used in analyzing the relationship between interest rates and the stock market. The study used time series monthly data and so had 217 observations using a time frame between 30 June 2002 to 30 June 2020. This is the time span during which the South African economy also went through a series of fluctuations in the equity market. The data utilized in this analysis was taken from Thomson Reuters and the Reserve Bank of South Africa.

3.1. Definition of variables and expected apriori

The narrative follows the study conducted by Sahu and Pandey (2020) and Ali (2014). Table 1 identifies the dependent and independent variables that the study applied.

Table 1. Variables used in the study

Dependent Variable	Independent Variables
All Share Index (ALSI) which a composite index reflecting all Equity Market prices, indices, and overall performance.	Interest Rate as indicated by Treasury Bill rates.

Source: Author's own preparation

The null hypothesis (H_0) states that there is no relationship between interest rates and the equity market whilst the alternative hypothesis (H_1) states that there is a relationship between interest rates and the equity market.

3.2. Model estimation

To analyze the impact of different interest rates on the stock market, a regression model was created and is presented below in Equation (1).

$$ALSI_t = \beta_0 + \beta_1 TBR_t + \varepsilon_t \quad (1)$$

where ALSI is the All-Share Index a composite index for all shares or equities traded on the JSE and TBR is the Treasury Bill Rate as a proxy for interest rates in South Africa.

3.2.1. VAR and VECM models specifications

The vector error correction model (VECM) is used when there is co-integration but, when cointegration does not exist, the vector auto regression (VAR) model is used (Nihayah *et al.*

2022). According to Nihayah *et al.* (2022), Sahu and Pandey (2020), Ali (2014) and Maparu and Mazumder (2017); the general model for the regression is shown as in Equation (2).

$$y_t = \sum_{i=1}^{p} \beta_i y_{t-i} + \gamma x_t + u_t \quad (2)$$

where, y_t = the vector of the non-stationary variable k I (1), x_t = the vector of the deterministic variable, β and γ = the parameters to be calculated, u_t = the innovation vector, and VAR sequence.

If the variables show cointegration, the vector error correction model (VECM) can be used instead of the VAR model. According to Nihayah *et al*. (2022), Sahu and Pandey (2020), Ali (2014) and Maparu and Mazumder (2017); the general model for VECM is shown in Equation (3).

$$\Delta y_t = \sum_{i=1}^{q} \beta_i y_{t-i} + \emptyset x_t + \gamma ECT_t + u_t \quad (3)$$

where, ∆ is the first difference operator, β and ∅ = the parameters to be calculated, ut = ms, and q = the maximum lag length follows (Nihayah *et al.* 2022; Sahu and Pandey, 2020; Ali 2014; Maparu and Mazumder, 2017).

The model can be utilized for VAR and is accurately computed utilizing the Ordinary Least Square strategy on the off chance that the null hypothesis that unit root exists is rejected and the factors are stationary and coordinate within the same arrange. However, a first difference level will be used if the unit root exists until the unit root no longer exists in the VAR (Brooks, 2014).

3.3. VAR and VECM

According to Musawa and Mwaanga (2017), the VAR modeling tool is commonly used by researchers to analyze the nature and complexities between variables. Musawa and Mwaanga (2017) explains that the VAR exploits available knowledge and reveals that all variables are potentially endogenous. The interactions between the variables of the VAR system are dynamically interconnected. The interconnection means that economic variables in VAR settings affect each other. To better understand and identify the relationship between interest rates and equity markets, VAR is calculated to obtain impulse response analysis, and variance decomposition. The computer program E-Views was utilized to calculate both impulse response functions and different decomposition.

The study follows the methodology of Sahu and Pandey (2020). The first step is understanding the nature of the quantitative data and its properties using econometric methods like descriptive statistics and unit root test. This allows us to get knowledge on the characteristics of the data and if the data series is stationary or non-stationary (Desiree'Motseta and Takawira, 2021). Once the status of the data series is identified if non-stationary, the analysis can apply vector error correction model (VECM), cointegration test in this case Johansen Cointegration, variance decomposition test and impulse response analysis to establish the long- and short-run dynamic relationship between the variables (Sahu and Pandey, 2020).

Figure 1 illustrates the steps that the process will adopt in applying the quantitative method to analyze the relationship and impact of interest rates and the equity markets in South Africa.

Prior to estimation using autoregressive models, the appropriate lag length was determined as these models are sensitive to the lag length. The study introduces VAR-based approach of cointegration test to determine the long-run relationship between the interest rates and equity market. According to Sahu and Pandey (2020), the cointegration test approach, likelihood ratio test (or trace test) and maximum eigenvalue test is applied to decipher the stated long-term dynamics. If the data under analysis have non-stationary time series in level and all the variables utilized in the study are integrated in the same order, then the concept of cointegration is applicable and more relevant. Cointegration exists if two or more variables share a common trend from an econometric viewpoint. The cointegration test thus gives information whether the variables are moving together in the long run. Sahu and Pandey (2020, p. 112) reiterated that "the presence of cointegration indicates interdependence of the endogenous variables, which may be the result of economic linkage between the markets and the arbitrage activities among investors".

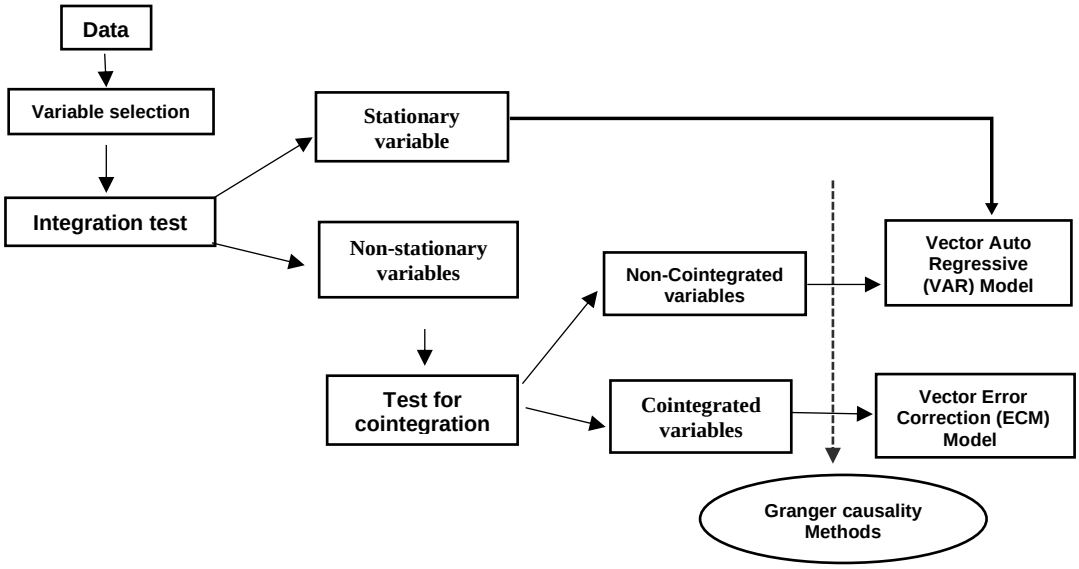

Figure 1. Methodological process
Source: Nihayah *et al.* (2022)

Disequilibrium may exist in the short run between two or more variables, but most often, there is an existing equilibrium relationship in the long run. The nature of the relationship between interest rates and the equity market in the short run can be explored by considering the vector error correction mechanism. A VECM is a restricted VAR model with built-in specifications and restrictions of cointegration to cater to non-stationary series that are cointegrated. The specification of the error correction term in the VECM model indicates the rate at which it amends its former period disequilibrium or speed of correction to restore the long-run equilibrium relationship (Sahu and Pandey, 2020).

3.4. Johansen co-integration analysis

This study used the co-integration approach to determine the presence of a long-run relationship between the variables. According to Mohanasundaram and Karthikeyan (2015), when co-integration exists, the variables prove that equilibrium constraints exist, preventing the variables from diverging too much in the long run. Co-integration among the variables also proves that the variables have similar driving forces in the long run. However, when there is no long-run relationship between the variables, it can be interpreted as the absence of co-integration.

A co-integration analysis is applied to prove if a linear combination of variables has a long-run relationship. Co-integration is present if there is stationarity of the linear combination of variables. Co-integration can determine the non-stationary existence of data without missing useful information as differentiation is implemented. All variables are treated as endogenous (Adjasi and Biekpe, 2006).

The vector autoregression (VAR) of order ‘p’ is the starting point for Johansen's methodology. In some instances, Johansen's approach is applied where all of the system's variables are I(1). The presence of stationary variables in the system, on the other hand, is technically insignificant, and Johansen in 1995 claimed that pre-testing the variables in the system to determine their order of integration is counterproductive. A cointegrating vector whose space is spanned by the only stationary variable in the model proves that the single variable is I(0) and not I(1) (Hjalmarsson and Österholm, 2007). After testing for co-integration, the Vector Error Correction Model (VECM) was applied. The VECM is used to determine whether the variable has a short-term relationship and a long-term causality. The VAR and VECM models were specified. This was also complemented with a discussion on the variables used in the study. Given that the data used in this study was found to be mixed when it comes to the order of integration, thus there

are variables which were found to be stationary after first differencing and some which are stationary at level, the Johansen cointegration was utilized.

4. Analysis of empirical findings

The study seeks to assess the impact of interest rates on the equity market. In this regard, the equity market is measured by JSE All-Share Index, whilst interest rates are represented Treasury Bills.

4.1. Descriptive statistics

Descriptive statistics for the variables used were established and summarized in Table 2.

Table 2. Descriptive statistics

	ALSI	Interest Rate
Mean	34.5172	0.0733
Median	32.1190	0.0707
Maximum	59.7730	0.1275
Minimum	7.5100	0.0402
Std. Dev.	16.3702	0.0192
Skewness	-0.0619	1.1385
Kurtosis	1.6599	3.8268
Jarque-Bera	16.3761	53.0635
Probability	0.0002	0.0000
Sum	7490.233	15.8981
Sum Sq. Dev.	57884.11	0.0795
Observations	217	217

Source: Author using Eviews 11

The variables presented in Table 2 convey that the sample means proved that, on average, the ALSI grew at 34.52 percent monthly whilst the interest rate grew at a positive 0.07% on average every month during the sample period. The sample also proved that the ALSI deviated by 16.37% from the mean. The deviation proved that the data points were spread out over an extensive range. Thus, ALSI was highly volatile. Meanwhile, interest rates deviated by 0.02% from their mean, indicating that the data was closely spread, meaning that the variable was less volatile. Furthermore, based on the skewness results, the ALSI proved that it mirrored the normal distribution, but it was negative skewness, thereby proving that the variable had a long left tail.

The slope of interest rates, as shown in Figure 1, showed that there was a downward trend in the movement of the interest rates. Towards the end of 2002, interest rates fell gradually, and an ambiguous movement was shown as they fluctuated between 2004 and 2006, when they suddenly began to increase as the economy was affected by the financial crisis. After 2008, interest rates began to fall. The decline was due to the contractionary monetary policy. As the economy started to recover, interest rates began to decrease.

4.2. Johansen co-integration results

Once the optimal lag length had been established, the Johansen Co-integration test was applied to test the model for co-integration. The null hypothesis of co-integration is that there is no co-integration in the model. The alternative hypothesis is that there is co-integration within the model. The existence of co-integration in the model can be interpreted as the presence of a long-run relationship. At the same time, the absence of co-integration means that there is no long-run relationship between the variables.

The Trace interpreted the Johansen Co-integration analysis and Maximum EigenValue statistics presented in Tables 3 and 4. According to the Trace test, the null hypothesis can be rejected at the 0.05 level as co-integration exists. The existence of co-integration, therefore, proved that there is a long-run relationship between the variables. The Maximum EigenValue also

proved that co-integration was present. Therefore, the null hypothesis that no co-integration was present, was rejected.

A further step was taken while looking at the normalized co-integration for the long-run relationship of the variables. The interest rate's coefficient of 0.19 showed that in the long run, the interest rate had a negative and significant impact on the ALSI on average, ceteris paribus. The coefficient of interest rate was statistically significant at the 5% level. Therefore, any 1% increase in interest rate led to a 1% decrease in the ALSI. Thus, when interest rates increase, investors will withdraw their investments opting for safer investments with higher returns. Results are presented in Table 3.

Table 3. Unrestricted co-integration rank test (trace)

Series: DLOG(ALSI), Interest Rate Lag intervals (in first differences): 1 to 1				
Hypothesized No of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob.****
None^	0.1989	54.5229	15.4947	0.0000
At most 1^	0.0348	7.5185	3.8415	0.0061
Normalized Interest Rate: cointegrating coefficients (standard error in parentheses)				
DLOG(ALSI)	**INTEREST_RATE**			
1.0000	0.192040 (0.17067)			

Note: Trace test indicates two co-integration eqn(s) at the 0.05 level. ^ denotes the rejection of the hypothesis at the 0.05 level.

Source: Author using Eviews 11

The Maximum EigenValue test also proved that co-integration was present, and a long-run relationship existed. Therefore, the null hypothesis was rejected at a 0.05 level. Table 4 presents the results for the Maximum EigenValue.

Table 4. Unrestricted co-integration rank test (Maximum EigenValue)

Hypothesized No of CE(s)	Eigenvalue	Trace Statistic	0.05 Crit. Value	Prob.**
None^	0.1989	47.0044	14.2646	0.0000
At most 1^	0.0348	7.5185	3.8415	0.0061

Note: Max-eigenvalue test indicates 1 co-integration eqn(s) at the 0.05 level. ^ denotes rejection of the hypothesis at the 0.05 level.

Source: Author using Eviews 11

4.3. Vector error correction model results

The Vector Error Correction model analyzes the short-term relationship between interest rates and the equity market – ALSI. Given the above evidence from Johansen co-integration test of testing the presence of a long-run co-integration relationship, the model was tested for error correction. The Vector Error Correction model was applied to test for the short-run co-integration relationship by applying the VECM. The error correction coefficient determined the speed at which the model adjusts to equilibrium after any shocks. The results showed that the previous year's deviation from the long-run equilibrium can be corrected at a speed of 92% in the short run. Thus, the adjustment coefficient of 92 percent towards the long-run equilibrium in case of a disequilibrium situation of the ALSI, which is the dependent variable, was negative and statistically significant. Therefore, the results indicated that there was a convergence from short-run dynamics towards the long-run dynamics. Furthermore, the first lag or interest rates showed that a percentage increase in interest rate is associated with a 0.62% decrease in the ALSI in the short run ceteris paribus. The results obtained after running the series for vector error correction are presented in Table 5.

Table 5. Vector error correction model

Co-integration Equation		**Co-integration Eq1**
D(DLOG(ALSI)(-1))		1.0000
D(INTEREST_RATE(-1))		0.1920
		(0.1707)
		[1.1252]
Constant		-0.0218
Error Correction	**D(DLOG(ALSI)**	**D(INTEREST_RATE)**
CointEq1	-0.9221	0.0234
	(0.1393)	(0.0088)
	[-6.6175]	[2.6566]
D(DLOG(ALSI(-1)))	-0.1693	-0.0190
	(0.1235)	(0.0078)
	[-1.3705]	[-2.4308]
D(DLOG(ALSI(-2)))	-0.1106	-0.0112
	(0.1023)	(0.0065)
	[-1.0810]	[-1.7316]
D(DLOG(ALSI(-3)))	-0.0336	-0.0033
	(0.0707)	(0.0045)
	[-0.4744]	[-0.7392]
D(INTEREST_RATE(-1))	-0.6155	0.3147
	(1.0994)	(0.0694)
	[-0.5599]	[-0.7392]
D(INTEREST_RATE(-2))	-1.9349	0.0031
	(1.1424)	(0.0722)
	[-1.6937]	[0.0432]
D(INTEREST_RATE(-3))	-1.3834	0.1530
	(1.1398)	(0.0720)
	[-1.2137]	[2.1246]
Constant	-0.0008	-0.0002
	(0.0031)	(0.0002)
	[-0.2731]	[-1.1691]

Notes: *** denotes the 0.01 level of significance; ** denotes the 0.05 level of significance; and * denotes the 0.1 level of significance.

Source: Author

4.4. Impulse response function (IRF) analysis

The impulse response function was applied to trace the dynamic response of the ALSI's reaction to shocks from interest rates. Figure 2 presents the results that were obtained. The results showed that ALSI responded negatively to the shocks that were caused by the interest rates. The negative response proved beyond doubt that the relationship between interest rate and ALSI was a negative long-run relationship. Meanwhile, ALSI responded negatively to its shocks from a period ranging from 1 to 2. This decline might have been influenced by the world financial crisis, which led to the crash of the financial system and stock markets.

The data was found to be integrated of order 1 and I(0). The Johansen Cointegration was estimated, and the results showed that there is evidence of cointegration. The long run as well as short-run models for both regressions were estimated. The results demonstrated that interest rates have a negative effect on the equity market in South Africa. These results in other words suggest that interest rates have an influence on the JSE ALSI. The VECM Models were estimated to check the short-run relationships. The results demonstrated that if there is disequilibrium, the variables will cointegrate again after some time.

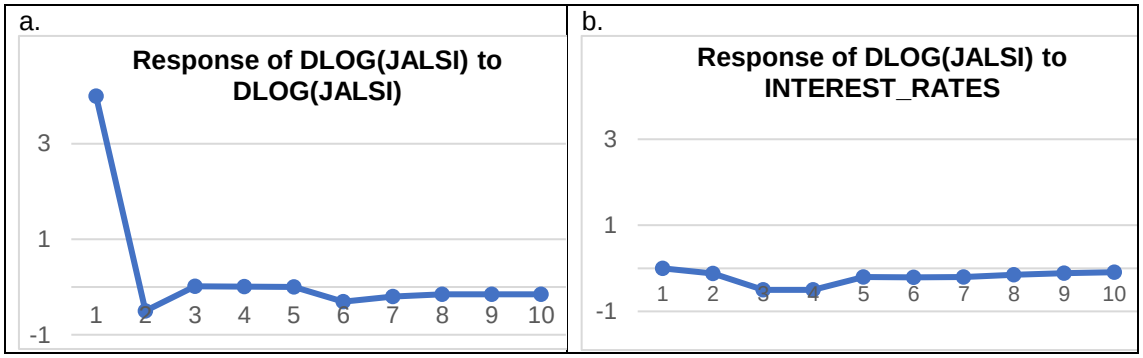

Figure 2. Impulse response functions
Source: Author using Eviews 11

In line with the earlier findings made by Akileng *et al.* (2019), Alam and Uddin (2009), Conrad (2021), Gu *et al.* (2021), Fernando (2016), Kaluarachchi and Fernando (2017), Huang and Chang (2022), Jihadi *et al.* (2021), Makuve (2017), Petrakis *et al.* (2022), Sahu and Pandey (2020), Setiawan (2020), Maswere and Kaberuka (2013), and Williams (2014), the study based on Johansen's cointegration test confirms the existence of a significant and negative long-run co-movement between interest rates and the equity market stock prices in South Africa. The VECM result also indicates that in the short run, interest rates negatively influence the movement of the equity market in South Africa. However, the error correction term of the VECM framework indicates that in the long run, the interest rate rise causes a negative movement of the equity market all-share index in South Africa. The reasoning behind this is typical, higher interest rates decrease investment because higher rates raise the cost of borrowing and require investment to have a higher rate of return to be profitable. If interest rates are raised, it tends to suppress investment because investment has a higher opportunity cost. With higher rates, it is more expensive to borrow money from a bank.

5. Conclusion

This study aimed to investigate the impact of interest rates on the equity market and analyze how this impact could affect listed companies. The negative impact of the interest rates on the equity market proves that the equity share prices will fall when the interest rates rise. When the share prices fall, the equity's performance is also negatively affected. The decline or fall in the equity market's performance negatively affects listed companies' market capitalization and share face value. The negative effect on the companies' face value can negatively affect the company's position and power when faced with a merger or acquisition deal that involves exchanging shares (stock deals) between the companies. Therefore, mergers and acquisitions that involve stock deals will be expensive for the companies.

For the company whose face value has fallen, it becomes exposed to a takeover by its competitors. Based on the estimated models, a negative relationship exists between the South African equity market, as represented by ALSI, and the bill rates as proxy interest rates. In other words, all the various equity market indicators employed were found to be significantly impacted by interest rates. Therefore, this suggested that lower interest rates are related to rising equity prices and good equity market performance. Thus, based on this finding, the constant sharp surge in interest rates, both in the short and long run, may erode the value of shares, and the SARB may have to intervene for financial stability purposes. There is a strong negative relationship between the equity market and interest rates.

Understanding how interest rates and the equity market relate helps policymakers formulate and implement policies that foster financial stability and investment. According to van der Westhuizen *et al.* (2022), the government frequently intervenes in the economy, which directly affects equity markets as they intervene to maintain swift price declines in the stock market and restore investor confidence but sometimes seriously endanger the integrity of the market as tampering with it can transmit incorrect signals about the state of a nation's economy. This study

can assist governments on when to intervene to avoid disturbing smooth operations of the equity market and maintain confidence and stability, as the equity market is a leading financial indicator of the economy and its performance.

The SARB, as a financial regulator in South Africa, is in control of the monetary policy and is highly interested in the knowledge of volatility in interest rates and the subsequent impact on the equity market. The outcomes of this study may assist the SARB in understanding the relationship between interest rates and equity prices, which can assist in the implementation of monetary policy tools that control interest rate volatility and reduce negative impact on the equity market. Policymakers could use the knowledge attained from this study to design successful monetary policies as well as establish a conducive environment for investment in the equity market. Unnecessary interest rate changes may pose an interest rate risk and chase away investors. As an area for further study, there may be a need to explore if there is a non-linear relationship between interest rates and the equity markets. Moreover, the study encourages the use of non-quantitative macroeconomic indicators as dummy variables like corruption, governance, social unrest, sovereign credit ratings, the COVID-19 pandemic, the 2007-2008 global financial crisis, and political factors.

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Appendix

A1. Correlation matrix

Correlation matrices were also used to evaluate the correlation between the dependent variable and independent variables. The results can be seen in Table A1.

Table A1. Correlation matrix

	ALSI	Interest Rate
Interest rate	-0.4766	1.0000
ALSI	1.0000	-0.4766

Source: Author using Eviews 11

The results in Table A1 shows that there is a negative correlation between interest rates and the equity market – ALSI. The relationship and correlation between the ALSI and Interest Rate was moderately strong and negative. Therefore, as interest rates increase, the ALSI decreases.

A2. Time series plots

The variables were analyzed firstly through visual inspection using time series graphical plots. These are presented in Figure A2.

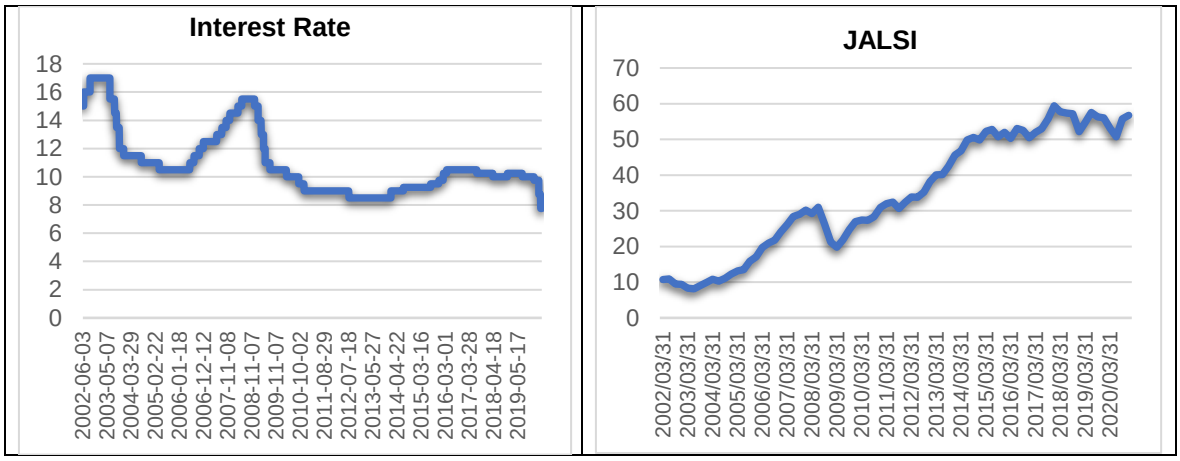

Figure A2. Visual inspection (level series)
Source: Author using Eviews 11

Figure A2 shows that all the series to a greater extent are trending. Brooks (2014) asserted that when variables under study are trending that could be a signal for non-stationarity but when stationary the variables revolve around the mean.

The ALSI graph showed that the variable moved upward since 2002, a downward spike is shown in 2008 however, and this was because of the index's exposure to financial bubbles such as the asset bubble, which led to the global recession from 2007 to 2008. However, as the economy began to recover after 2008, there has been an upward spike proving that the index has been performing well.

The two graphs prove that the ALSI and interest rate trend seem to be trending in different directions. Thus, it can be an indication that a negative relationship existed between the two variables. However, the graphs alone cannot prove the relationship between the two variables. As indicated in the previous chapter, the stationarity of the data was tested using the ADF tests.

A3. Stationarity Tests

Table A3. Stationarity tests

	Type of Test	Variable	Deterministic Term	ADF test stat.	Test Critical values: 1%	5%	10%	Prob
Level	ADF	ALSI	Intercept and Trend	-0.9251	-3.4606	-2.8747	-2.5739	0.7789
		Interest Rate	Intercept and Trend	-1.9735	-3.4607	-2.8748	-2.5739	0.2985
First Diff.	ADF	ALSI	Intercept and Trend	-15.9472	-3.4607	-2.8748	-2.5739	0.0000
		Interest Rate	Intercept and Trend	-9.8406	-3.4607	-2.8748	-2.5739	0.0000

Note: *** = 0.01 level of significance, ** = 0.05 level of significance, * = 0.1 level of significance.
Source: Author using Eviews 11

As shown in Table A3 above, the variables were tested for stationarity at using the Augmented Dickey-Fuller (ADF) at both at level and at first difference. The results show that all the series for interest rates and ALSI are stationary at first difference. This therefore authorizes that differencing the series once is what was needed to ensure that the data is stationary. The ALSI and Interest rate had p-values of 0.0000 and 0.0000, respectively. The results indicated that the variables had no unit root. Therefore, the null hypothesis that unit root exists was rejected, and the alternative hypothesis that stationarity is present was accepted. Furthermore, the results proved that the variables were stationary at level one I(1). The next segment first determines the lag length, which was used in this study. This is then followed by the Johansen Co-integration Test.

A4. Lag Length Selection

In any regression choosing the appropriate lag length is very important as this will ensure that the model is adequate. To determine the optimal lag length for the VAR, EViews was used where the following five criteria were used: likelihood ratio (LR) test, final prediction error criterion (FPE), the Akaike information criterion (AIC), the Schwarz information criterion (SIC) and the Hannan-Quinn information criterion (HQ). Selection of the most suitable lag length was determined by the Schwarz Information Criterion and the Akaike Information Criterion.

The Schwarz Information Criteria is strongly consistent but ineffective while the Akaike Information Criterion is inconsistent but is considered more effective (Brooks, 2014). Furthermore, Brooks (2014) asserted that when selecting the best model using the selection criterion between the Akaike information criterion and the Schwarz criterion, the best model is the one that has the lowest value. The lag with the lowest values between the two criteria was chosen. Thus, the optimal lag length of 3 was suggested by the final Akaike Information Criterion. The VAR model was therefore estimated based on this lag length.

Table A4. Lag length selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	907.7138	NA	5.66e-1	-8.7088	-8.6767	-8.6958
1	1264.521	703.3221	1.90e-1	-12.1012	-12.0049	-12.0622
2	1282.995	36.0594	1.66e-1	-12.2403	**-12.0799***	**-12.1755***
3	1288.083	9.8336	**1.64e-1***	**-12.2508***	-12.0262	-12.1600
4	1291.761	7.0382	1.64e-1	-12.2477	-11.9589	-12.1309
5	1292.595	1.5796	1.70e-1	-12.2173	-11.8643	-12.0745
6	1294.731	4.0055	1.73e-1	-12.1993	-11.7821	-12.0307
7	1302.332	**14.1046***	1.67e-1	-12.2340	-11.7526	-12.0393
8	1305.432	5.6940	1.68e-1	-12.2253	-11.6798	-12.0047

Source: Author using Eviews 11