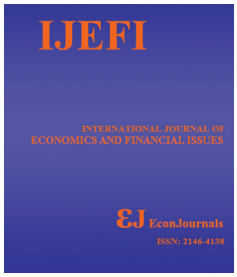

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Modelling Foreign Direct Investments to South Africa: NARDL Approach[#]

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ABSTRACT

The paper inspects inflow of foreign direct investment (FDI) into South Africa. Nonlinear autoregressive distributed method is used in this study to model the relationships between net foreign direct investment inflows and the share of goods exports to GDP (%) and the real interest rate. The study uses annual data ranging from 1985–2020. The aim is to test for asymmetric relationship between real interest rate and foreign direct investments. The research analyses the extent to which changes in real interest rates affect FDI inflows, focusing on the differential effects of rate increases versus rate decreases. The results indicate asymmetric relationship between FDI and interest rate both in the long run and short run. Inflow of FDI into South Africa behaves more noticeably to interest rate decline than to its rise. Export stimulates inward investments in short and long run. Unlike previous studies, the presented article found that repo rate does have an effect, and moreover, it is asymmetric relationship. The outcomes notify governing bodies and wider public on how important negative and positive changes in real interest rate for investment activities in South Africa are.

Keywords: Foreign Direct Investment, Real Interest Rate, South Africa, NARDL, Capital, Economic Growth
JEL Classifications: O55, F21, O40

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1. INTRODUCTION

In general, foreign direct investment is defined as the investment of a subject of one economy in a company of another economy. The objective of these investments, from the investor's point of view, is to acquire a permanent stake of at least 10% of the voting rights, which will allow them to exert influence over the company. Foreign direct investment includes reinvestment of companies, technology and knowledge transfers, mergers and acquisitions, and the construction of new facilities (Malindini, 2017). FDI plays a key role in the economic development of countries by providing essential capital, addressing the lack of domestic savings and financial resources. It also brings new technologies and knowledge, boosting local productivity and innovation, which strengthens global competitiveness. These efforts help stabilize the economy, create jobs, and improve infrastructure like transport and telecommunications, further promoting growth (United Nations Conference on Trade and Development, 1999).

This article contributes to the academic literature in the field of economic theory, as it provides a comprehensive analysis of FDI in relation to GDP and interest rates in South Africa, the leading FDI recipient on the African continent with a potential positive example for other emerging economies. The choice of South Africa stems from the availability of comprehensive data and reliable sources relevant to this nation. South Africa is not only a significant recipient of foreign direct investment but also plays a crucial role

as a major source of investment across the African continent (Kaur et al., 2018). Countries such as the United Kingdom, Netherlands, Belgium, Germany, and Luxembourg, along with nations like the United States, Japan, China, and Australia, have been significant investors in South Africa. These countries direct much of their capital into key industries, including finance, mining, manufacturing, transportation, and retail (Lloyds Bank, 2023). This means that while foreign companies invest in South Africa to expand their business operations, South African firms themselves actively invest in other African countries. According to the African Development Bank Group (2020), South African multinational corporations (MNCs) invested approximately $36 billion in 40 African countries between 2003 and 2017. The top five destinations for these investments were Mozambique, Ghana, Nigeria, Zimbabwe, and Zambia, with Mozambique leading the way by attracting 29% of total investments and generating 19% of the jobs. Sectors such as software and IT services had the highest efficiency in job creation, outperforming other sectors like communications. (ECMR, 2020). Investments from South African companies can include infrastructure development, job creation, and the improvement of business environments in these countries (Kaur et al., 2018).

Nonlinear autoregressive distributed lag (NARDL) method was used in this study to model the relationships between net foreign direct investment inflows and the share of goods exports to GDP (%) and the real interest rate. This model allows us to capture the asymmetric responses of the dependent variable to positive and negative changes in the independent variables, which is crucial for analysing the impact of macroeconomic fluctuations. The structure of the paper is as follows: first, there is an introduction, view into territorial and sectoral classification of FDI in South Africa, an overview of the relevant literature and related studies, followed by a section with a detailed description of the methodology and a discussion of the obtained results.

1.1. Investigation of FDI in South Africa

According to the Observatory of Economic Complexity (2024) South Africa was ranked the 37th largest economy in the world by GDP, the 34th in terms of total exports, and 38th for total imports in 2022. Despite being a significant exporter, it ranked 95th in GDP per capita. Furthermore, South Africa is the 59th most complex economy, as per the Economic Complexity Index (OEC, 2024).

South Africa's export strength lies in its natural resources and industrial products. It is the world's top exporter of platinum, manganese ore, and chromium ore. The country's main exports include gold, platinum, coal briquettes, cars, and diamonds. Its major trade partners are China, the United States, Germany, India, and Japan.

On the other side, he largest categories of import include refined petroleum, cars, crude petroleum, vehicle parts, and broadcasting equipment. China stands out as South Africa's largest import source, followed by Germany, India, the United States, and Saudi Arabia. This reflects South Africa's reliance on foreign energy supplies and technological goods. Until mid-2024, exports of platinum, gold and cars continued to dominate with China, the United States and Germany (OEC, 2024).

1.2. Overview of Theory

The classical theory of capital is founded on the works of economists such as Adam Smith, David Ricardo, or John Stuart Mill assuming that the return on capital was derived from the productive power of machinery. Smith (1776) claimed that profits flow from capital investment and that capital (circulating capital and fixed capital) is allocated where the greatest profit can be made. Ricardo (1817) admitted the depreciation of fixed capital but assumed that it was zero and fixed capital was infinite. Mill (1848) believed that the ultimate regulator of the money value is the cost of production. The Austrian School, represented by Menger, von Böhm-Bawer, von Wieser, has enhanced the theory of capital by drawing attention to the importance of the valuation problem in the relation of capital to interest. (Austrian School of Economics Econlib, 2020). Keynes (1933) argued that capital scarcity is caused by a positive rate of interest and that further investment is needed for a positive rate of return. Keynes also confirmed that savings did not automatically contribute to the capital accumulation as they were automatically invested (Harris, 1981; Spahn, 2019). Liang (2017) confirmed only selective increase in the productivity of domestic firms due to the FDI presence, highlighting the necessity of other factors including industrial connections, the absorption capacity of domestic firms, and geographic characteristics. Ricardo (1817) admitted the depreciation of fixed capital but assumed that it was zero and fixed capital was infinite. Mill (1848) believed that the ultimate regulator of the money value is the cost of production. (Ricardo, 2014). Neoclassical theory of capital (Samuelson, 1952; Solow, 1956) considered capital as a factor of production that is formally equivalent to factors like land and labour (Howard, 1983). Besides the recognition of the importance of market forces in the economy, it also stressed the need for government intervention in certain cases. Solow´s Neoclassical growth model (1956) is viewed as the fundamental pillar of the neoclassical theory. Model indicates that an increase in savings and investment raises the capital stock.

Empirical studies mostly acknowledge capital mobility as a key determinant of economic life and central macroeconomic component. Economic growth is linked to net inflows of foreign capital. High capital mobility stimulates economic growth, investments, and fiscal and monetary policies' efficiency in each country. The interest rate is one of the crucial economic influences on capital mobility, with a positive correlation between the variables. High capital mobility may also lead to exchange rate volatility as investors move capital across countries to profit from higher interest rates or due to speculative operations.

In classical economic theory, the basic premise of capital mobility is that capital flows from low-return areas to high-return areas (from rich countries to poor countries) because of diminishing returns of capital, with interest rate differences between countries being the key factor. The Lucas paradox contradicts the assumptions of classical theory. Lucas (1990) raised the question of why capital does not flow from rich to poor countries, or rather pointed out to relatively small capital flows from rich to poor countries, which to some extent can be theoretically explained by technological differences, lack of factors of production, government policies,

market imperfections, and high levels of risk and uncertainty in many developing countries.

Empirical research of the extent of capital mobility has proceeded along several major lines. The traditional perspective is derived from a comparison of expected yields on alternative assets. Contrary to traditional studies of relatively high capital mobility among developed countries is the study by Feldstein and Horioka 1980. The study is mainly based on the correlation between domestic savings rates and domestic investment rates. Their key finding of relatively low international capital mobility in OECD countries (capital tends to stay in its home country) was later confirmed and extended by Bayoumi, 1990; Tesar, 1991; Obstfeld, 1989. Examining the effects of capital income taxation, authors Nielsen and Sørensen 1991; Bovenberg, 1993 pointed to the low degree of international capital mobility in industrial countries. Shibata and Shintani, 1998 proposed a correlation between a country's consumption and net output to test international capital mobility, whereas their study revealed certain limitations of capital mobility in OECD countries.

As the theory assumes that international capital mobility enables countries with limited savings to attract resources or domestic investments, international capital movements have occurred over centuries and they may be classified into domestic and foreign capital; government and private; short-term and long-term; and direct and portfolio capital, whereas capital-importing countries favour portfolio investment and investing countries prefer FDI. The interest rate is the most important factor determining capital movements, followed by political conditions, marginal efficiency in investment, bank rate or speculation (Theory of capital movements, 2019). This paper explores the relationship between exports and interest rates. Capital is seen as a source of capital goods and returns to the capital owners.

As motivation is the basis of FDI, theoretical studies on FDI can be divided into 4 categories. Production Cycle Theory of Vernon (1966) emphasized the role of multinational firms in the production transfer. According to Vernon´s hypothesis, the new goods are not only developed, but also long-term manufactured in developed countries. Risk aversion approaches are reflected in the Theory of Exchange Rates on Imperfect Capital Markets presented by Itagaki (1981) and Cushman (1985). Cushman claims that the expected risk-adjusted appreciation of the real exchange rate lowers the foreign cost of capital and encourages FDI. His empirical study confirmed a significant increases FDI associated with risk. The Internationalisation Theory by Buckley and Casson (1976) explained the international business behaviour and the existence of the multinational enterprise using the concept of the internationalisation of imperfect product markets. The Internalisation theory has retained its validity over the past 40 years and has been extended by authors such as: Hennart, 1982, Rugman, 1986; Buckley and Casson, 1976, 1985, 2009; Casson, 2014. Applying the Internationalisation theory, the Eclectic Paradigm developed by Dunning (1988), analyzed the attractiveness of making a FDI. The Eclectic paradigm, based on 3 tiers: ownership, location, internalization (OLI model), assumes that companies will not pursue FDI if they can obtain the service/product internally and cost-effectively.

2. REVIEW OF EMPIRICAL STUDIES

The relationship between FDI inflows and the economic performance of developing economies has attracted much attention in the recent literature (Mwitta, 2022; Emako et al., 2022; Mwakabungu and Kauangal 2023; Seon et al., 2024). In the context of South Africa, the primary focus of the existing literature has been devoted to: the determinants of FDI (Asongu et al., 2018; Chattopadhyay et al., 2022), FDI in relation to economic growth (Padayachee, 1995; Masipa, 2018; Matekenya and Moyo, 2023), the impact of FDI on the balance of payments (Siddiqui et al., 2013; De Beer and Rangasamy, 2015), the contribution of FDI to exports (Sunde, 2017; Makhoba, 2024; Adekunle, 2024), and/or to the relationship between FDI and the (real) interest rate (Habanabakize and Meyer, 2018; Chile et al., 2023).

The existing literature on FDI in South Africa extensively addresses the issue of determinants of FDI, with economic openness, labour capital ratio, wage costs and market size fostering FDI inflows, while corruption and political and economic risks considered as the main constraints. Fedderke and Room, 2006) found that political stability favours FDI inflows to South Africa, rejecting previous studies by Morisset (2000) and Yasin (2005) who did not indicate political instability to be a significant determinant of FDI flows. The results of the panel analysis by Asongu et al., 2018 show that market size, infrastructure availability and trade openness matter the most in attracting FDI to South Africa, while the availability of natural resources and the quality of institutions are found insignificant. Along with that, a recent study by Chattopadhyay et al. (2022) has revealed that neither horizontal nor vertical motivations play a dominant role in determining FDI inflows to South Africa.

The results of empirical studies trying to unravel the impact of FDI on welfare in developing countries are inconclusive, as reflected by the mixed results presented in the existing literature. The importance of FDI in developing countries is confirmed by Chakraborty and Basu (2002) as well as by Love and Chandra (2004) finding that FDI promotion accelerates economic growth. Nonnemberg et al. (2004) in the study based on panel data of 33 developing countries over the period 1975-2000 confirmed the existence of partial causality – FDI does not cause economic growth, but GDP leads to FDI inflows. The results of a recent study by Joshua et al. (2023) show that FDI inflows have a very strong positive impact on economic growth, confirming the FDI-induced growth linkage in the South African economy.

South Africa's emergence as a gateway to emerging African economies makes the issue of the impact of FDI on the country's economic performance increasingly relevant as FDI inflows are primarily expected to generate a positive influx of foreign exchange into the economy. On the contrary, Gelb and Black (2004) used sectoral analysis to point to the relatively low contribution of FDI to savings, investment and overall economic growth in this semi-industrialized economy in the 1990s. Jensen (2002) highlights South Africa's enormous economic potential, albeit limited by the lack of investments and adequate policy reforms. Empirical studies by Javorcik (2004) or Love and Chandra (2004) also observed

that FDI is no more productive than domestic investments. An analysis of South Africa's economic growth between 1995 and 2011 by Gossel and Biekpe (2013) argues in favour of foreign investment-driven growth rather than FDI-led growth.

Multiple authors analyze the role of FDI in South Africa's long-term economic growth and development. Asafo-Adjei (2007) highlights the importance of attracting FDI for South Africa's economic growth. Similarly, Matekenya and Moyo (2023), examining the impact of FDI on South Africa's economic growth from 1991 to 2019 against the backdrop of declining FDI inflows due to the COVID-19 pandemic, emphasize its critical role in the economy. This recent study notes the FDI's contributions to production, employment, and export growth, but also cautions against the negative impact of foreign disinvestments, which can reduce capital inflows, hinder technological diffusion and economic growth in the long-term.

Despite the importance of foreign capital in South Africa in the postapartheid period, research by Padayachee (1995) reveals the limited benefits of foreign capital for economic growth, arguing that the development strategy should be based primarily on the mobilization of domestic resources. Masipa's (2018) vector error correction model examining the nexus between FDI inflows and South Africa's economic growth from 1980 to 2014 confirms a positive relationship between economic growth and FDI, while sharing a negative relationship with government expenditure in the long run. Empirical research by Muzuva et al. (2024) recognizes the potential of FDI to stimulate economic growth, but at the same time points to the risks of unequal distribution of benefits and potential human, legislative and infrastructure challenges. The recent study by Mathebula et al. (2024) also confirmed a negative nexus between FDI and South African economic growth in the long run (corruption, profit repatriation, political instability). Using the ARDL method over the time series 1985-2019, this research contradicts the modernization theory that suggests FDI leads to growth. The causality between FDI and economic growth in South Africa was also rejected by the Granger causality test.

Several academic studies have pointed to the importance of FDI flows on the BoP of developing economies in recent years. Hossain (2008) refers to the positive impact of FDI on the balance of payments, while Mencinger (2009) draws attention to the strain on the balance of payments through increased dividend and interest payments. Although the importance of attracting FDI for economic growth is widely acknowledged, the potential negative impact of FDI on the current account deficits in developing economies and the preference to promote stable and substantial foreign reserves is supported by the studies of Siddiqui et al. (2013); Sahoo et al. (2015); or by a recent panel analysis by Ali and Audi (2023).

Samuel (2013) observes that net investment income has significantly contributed to South African current account deficit in the BoP in recent years. It was already pointed out by Sen (1995) that governments should be cautious in liberalizing controls on foreign equity as FDI itself fails to reliably solve BoP problems. Using a vector autoregressive moving average (VARMA), authors Alleyne et al. (2011) demonstrate that during the global economic recession, with a simultaneous decline in domestic investment and deterioration of trade balance, FDI growth can be considered as one of the main causes of the negative current account balance. Research by De Beer and Rangasamy (2015) shows that although South Africa's FDI inflows were much smaller than portfolio flows, net dividend payments from FDI flows accounted for 36% (15%) of the current account deficit over the 2004-2012 period under study. A study by Dakhil et al. (2019) have revealed that FDI is cointegrated with the balance of payments and have observed a positive impact of FDI on the current account of the BoP.

Many academic studies have also found that FDI tends to stimulate exports. Sunde (2017) confirmed the FDI-led growth hypothesis for South Africa and the cointegration between economic growth, FDI and exports. The result of her study suggests that both FDI and exports contribute to economic growth, in contrast to certain studies that have concluded FDI does not promote growth. Granger causality analysis also confirmed a unidirectional causality (from FDI to economic growth, from FDI to exports). The recent study of Adekunle (2024) also demonstrates a positive impact of exports on FDI (source of income for the economy and catalyst of FDI inflows) and confirms that exports drive FDI (unidirectional causality between FDI inflows and export). The positive relationship between FDI and export growth in South Africa is also confirmed in Makhoba's empirical study (2024), which applied the VAR approach and the DOLS method. Makhoba (2024) indicates that a positive shock of FDI leads to an increase in export levels in South Africa's economy and GDP growth exhibits a positive response to the innovative shocks of export growth in the economy.

The empirical findings suggest that FDI inflows and capital account openness are key drivers of (long-run) interest rate changes. The study by Habanabakize and Meyer (2018) on the impact of FDI and interest rates on GDP revealed a limited impact of FDI on economic growth in South Africa in the long run. The authors came up with interesting results showing a statistically insignificant relationship between interest rate and FDI (repo rate does not have an impact on FDIs). In the short run, this study found a marginal positive impact of FDI on GDP and a significant positive relationship between GDP and the repo rate. Unlike this study, the presented article found that repo rate does have an effect, and moreover, it is asymmetric relationship. Chile et al., 2023 discovered that in the short run, both FDI inflows and outflows positively influence interest rates. In the long run, FDI inflows have a significant positive effect, however, FDI outflows, portfolio investment, and the exchange rate had no notable impact on interest rate.

Among the methods used in previous relevant studies it can be stated that different statistical and econometric methods have been mainly used by various authors. Sunde (2017) used the autoregressive distributed lag model, known as the ARDL (Autoregressive Distributed Lag) test for cointegration, the error correction model (ECM) as well as the Granger causality tests. Magombeyi and Odhiambo (2018), examining the correlation between FDI and poverty in South Africa over the period 1980-2014 using the ARDL approach confirmed the positive impact of FDI on poverty reduction in the long run, but only based on infant

mortality rates. Through the prism of household expenditure, consumption and life expectancy, neither the long- nor short-term positive relationship between FDI and poverty reduction was found. The study by Habanabakize and Meyer (2018), using the ARDL-ECM model and Granger causality tests, proved that the interest rate has no effect on FDI (or that it is a statistically insignificant relationship, e.g. due to rising investment risks). Nxazonke and van Wyk (2019), testing a vector autoregressive model, in a study focusing on the impact of FDI on domestic entrepreneurship in South Africa, confirm a short-run and long-run non-linear relationship between FDI and domestic entrepreneurship. Recent research by Jemiluyi and Jeke (2023) examining the importance of FDI in tax revenue mobilisation in South Africa over the period 1994-2021 using the ARDL-ECM model has found a statistically significant negative impact of FDI on tax revenue, noting inappropriate investment policies in the country. Khoza and Biyase (2024) employed both ARDL and NARDL techniques to explore the complex interactions of financial development and ecological footprint in South Africa. Matekenya and Moyo (2023) employed the NARDL technique (an extension of the linear ARDL approach) to examine asymmetries in the relationship between FDI stocks and economic growth. The NARDL method was used to assess the impact of declining FDI on economic growth and poverty in South Africa.

3. METHODOLOGY AND DATA

We apply the nonlinear autoregressive distributed lag method to examine the relationship between net inflows of foreign direct investment and the goods exports as well as the real interest rate. This section details the data processed and the model used. The analysis focuses on three key variables utilized in our NARDL model (FDI inflow, real interest rate, and export of goods). Data for all these variables were obtained from the World Bank database.

3.1. The Data

We use annual data ranging from 1985 to 2020, the most recent year for which data is available. Table 1 provides an overview of the variables, including their units, sources, and expected signs. Data were annually adjusted using the Census X-13 method in EViews 10.

In our analysis, the dependent variable is the net inflow of foreign direct investment expressed as a percentage of GDP.

Table 1: Description of model variables

Variable	Description	Unit	Source	Expected sign
Dependent variable	Foreign direct investment net inflows (share of GDP)	%	WB	
Independent variable	Real interest rate	%	WB	+
Independent variable	Goods exports (balance of payment, current US$)/GDP (current US$)*100	%	WB	(+/-)

The first independent variable is the real interest rate, calculated by adjusting the lending interest rate for inflation through the GDP deflator. The second dependent variable is goods exports (all transferable items, such as nonmonetary gold and net exports from merchanting, that undergo a change of ownership from residents to nonresidents). The data are presented in current U.S. dollars. Second independent variable is presented as a share of Goods exports (BoP, current US$) on GDP (current US$) in %. Table 1 provides a detailed specification of our dependent variable and two independent variables. This comprehensive description aims to clarify the characteristics and measurements of each variable included in our analysis.

3.2. The Model

3.2.1. Asymmetric approaches to modelling FDI in South Africa

Since the assumption of the symmetry between *FDI* and *RIR* may not hold in reality, it is of interest to test if, and how different are the responses of capital inflow (FDI) to positive and negative changes in the real exchange rate (whether there is symmetrical or asymmetrical relationship between these variables). One of the time series approached which is currently often applied for testing asymmetries is the distributed lag model. The nonlinear autoregressive distributed lag (NARDL) method is an asymmetric enlargement of the Autoregressive distributed lag (ARDL) model, which was elaborated by Pesaran and Shin (1999); Pesaran et al. (2001).

The ARDL approach to cointegration (the bound procedure for testing a long-run relationship) possesses the advantage, that it can be applied for modelling irrespective of whether the underlying variables are I (0), I (1) or a combination of both, however, excluding the I (2). The nonlinear autoregressive distributed lag structure was developed by Shin et al. (2013). It is a single-equation error correction model. It delivers the joint long and short run asymmetries introduced via positive and negative partial sum decompositions of the explanatory variables. Shin et al. (2014) presented the following asymmetric long run regression model:

$$y_t = \beta^+ x_t^+ + \beta^- x_t^- + \varepsilon_t, \quad (1)$$

Where β^+ and β^- are the associated asymmetric long-run parameters, x_t is a $k\times1$ vector of regressors decomposed as:

$$x_t = x_0 + x_t^+ + x_t^-, \quad (2)$$

Where x_t^+ and x_t^- are partial sum processes of positive and negative changes in x_t:

$$x_t^+ = \sum_{j=1}^{t} \Delta x_j^+ = \sum_{j=1}^{t} \max\left(\Delta x_j, 0\right) \quad (3)$$

$$x_t^- = \sum_{j=1}^{t} \Delta x_j^- = \sum_{j=1}^{t} min(\Delta x, 0) \quad (4)$$

According to Shin et al. (2014), rewriting (1) into the NARDL error correction form, we present our model as follows:

$$\Delta FDI_t = \rho FDI_{t-1} + \theta^+ RIR^+_{t-1} + \theta^- RIR^-_{t-1} + \phi EXP_{t-1} + \sum_{i=1}^{p-1}\gamma_i \Delta FDI_{t-i} + \sum_{i=0}^{q-1}(\pi_i^+ \Delta RIR^+_{t-i} + \pi_i^- \Delta RIR^-_{t-i} + \tau_i \Delta EXP_{t-i}) + \varepsilon_t. \quad (5)$$

Where FDI_t stands for foreign direct investments (dependent variable), ρ, θ^+, θ^-, ϕ are the long run coefficients, γ, π^+, π^- and τ are the short run coefficients, ε_t is an iid process with zero mean and constant variance, σ^2_ε

3.2.2. Diagnostics and cointegration tests

We performed diagnostics tests for autocorrelation (Breusch, 1978, Godfrey, 1978), normality of residuals (Jarque and Bera, 1980), and heteroskedasticity (Breusch and Pagan, 1979), and we also tested the functional form (Ramsey 1969) and parameter stability CUSUM and CUSUM of Squares (Brown et al., 1975). The long run relationship among variables (foreign direct investments, real interest rate, and export) in NARDL model (equation 5), was tested by F-test of the joint null hypothesis $\rho = \theta^+ = \theta^- = \varphi = 0$ in (5). Following Pesaran et al. (2001), if the computed F-statistic exceeds the upper bound critical value, the H_0 is rejected (the variables are cointegrated), if the F-statistic is below the lower bound critical value, then the H_0 cannot be rejected (there is no cointegration among the variables). In case when the Wald or F-statistic falls inside these bounds, the inference is inconclusive and knowledge of the order of the integration of the underlying variables is required before conclusive inferences can be made (Pesaran et al., 2001).

4. RESULTS AND DISCUSSION

Table 3 presents the results from unit root testing of foreign direct investment (FDI), real interest rate (RIR), and export (EXP) using the ADF test introduced by Dickey and Fuller (1979).

The results indicate that FDI is stationary I(0), but RIR and EXPORT are non-stationary in their levels, but they become stationary after first differencing. They are integrated of order one I(1).

Since the NARDL approach to cointegration allows to apply for modelling a combination of stationary and nonstationary variables, we proceed with the ARDL framework in its non-linear form.

The findings from the nonlinear regression expressed by (5) are reported in Table 4. The computed F-statistic (F_{PSS}) 8.078 is higher than the upper bound value 4.35 at the 5 % level tabulated by Pesaran et al. (2001). These outcomes show the existence of a long run relationship among corresponding variables. The estimations suggest that both in the long and short run, the inflow of FDI in South Africa reacts differently to positive and negative interest rate changes ($Wald_{LR}$ and $Wald_{SR}$ in Table 4). The estimated long run coefficients L_{FDI}^+ and L_{FDI}^- are 0.085 and 0.119 at 5% level of significance. These findings indicate that decline in the real interest rate impacts the inflow of FDI into South Africa more heavily compared to the rise of the interest rate. These findings reveal, that investors are more sensitive to negative changes in the interest rate. Higher export stimulates FDI both in long and short run.

Notes: Statistical significance: * at 10% level, ** at 5 % level, *** at 1 % level. L_{RIR}^+ ($\beta^+ = -\theta^+/\rho$) and L_{RIR}^- ($\beta^- = -\theta^-/\rho$)

Table 2: Descriptive statistics

Indicator	FDIIP	EXPGP	RIR
Mean	0.934	21.639	4.606
Median	0.662	22.461	4.579
Maximum	5.368	28.163	12.691
Minimum	−0.702	16.699	−2.044
Std. Dev.	1.145	2.917	3.129
Skewness	1.822	−0.094	0.485
Kurtosis	7.479	2.074	3.983
Jarque-Bera	50.002	1.341	2.858
(Probability)	(0.000)	(0.512)	(0.24)
Sum	33.635	778.991	165.831
Sum Sq. Dev.	45.911	297.802	342.724
Observations	36	36	36

FDIIP: Foreign direct investment net inflows (share of GDP), EXPGP: Goods exports (Balance of payment, current US$)/GDP (current US$)*100 and RIR: Real interest rate

Table 3: Unit root testing (ADF test).

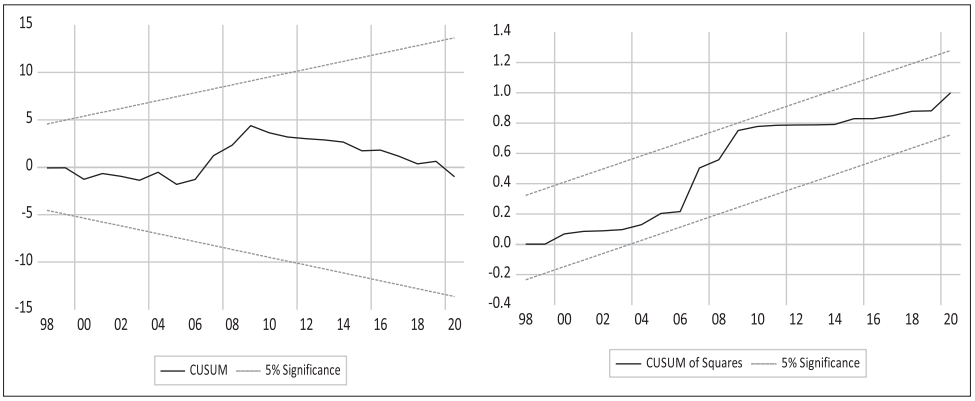
ADF							
	t-statistic				P-values		
ADF	FDI	RIR	EXP	ADF	FDI	RIR	EXP
c	−4.683	−2.383	−2.180	c	0.001	0.154	0.217
ct	−5.105	−3.287	−2.958	ct	0.001	0.086	0.158
Δc	−7.393	−6.985	−3.573	Δc	0.000	0.000	0.013
Δct	−7.418	−7.020	−3.638	Δct	0.000	0.000	0.043

c: Constant, ct: Constant and trend, Δ: Difference operator

Table 4: Results from NARDL model

Explanatory Variables	ΔFDI_t NARDL
ΔFDI_{t-1}	−1.108***
EXP_{t-1}	0.370***
RIR^+_{t-1}	0.094*
RIR^-_{t-1}	0.132 **
ΔFDI_{t-3}	−0.391***
ΔEXP	0.436***
ΔRIR^+_{t-1}	0.426**
ΔRIR^-_{t-1}	−0.481***
Constant	−6.762***
L_{RIR}^+	0.085**
L_{RIR}^-	0.119**
R^2	0.80
χ^2_{SC}	1.924 (0.382)
χ^2_{HET}	7.646 (0.469)
Jarque Bera Normality test	0.671 (0.715)
Ramsey reset test F statistics	0.720 (0.405)
$Wald_{LR}$	3.207*
$Wald_{SR}$	28.611***
F_{PSS}	8.078
CUSUM test	Stable [Figure 1]
CUSUM of squares	Stable [Figure 1]

Figure 1: CUSUM and CUSUM of squares



denote the long run coefficients associated with positive and negative changes of real interest rate (RIR). $Wald_{LR}$ refers to symmetry test (F^{+}_{RIR}-statistics) and $Wald_{SR}$ refers to the Wald test for the null hypothesis of the additive short run symmetry defined as $\sum_{i=0}^{q}\pi_i^{+} = \sum_{i=0}^{q}\pi_i^{-}$. F_{PSS} tests the null hypothesis $\rho = \theta^{+} = \theta^{+} = \varphi = 0$.

χ^2_{SC} (serial correlation LM test), Jarque and Bera (JB) normality test, χ^2_{HET} heteroskedasticity test, Ramsey test of the functional form. Values in [] are p-values. Estimations in EViews 10.

Figure 1 deploys the results from the tests of parameter stability. The first test CUSUM does not identify parameter instability since the cumulative sum moves within the area between the two critical lines. Also, the CUSUM of Squares test points to parameter stability.

5. CONCLUSION

The study focuses on the relationships between FDI inflows, real interest rates and export shares in South Africa using the Nonlinear Autoregressive Distributed Lag (NARDL) model. The objective of the study was to examine the asymmetric relationship between real interest rates and foreign direct investment over the period 1985 to 2020. The research aimed to determine how changes in real interest rates affected the flow of foreign direct investment into South Africa. The results demonstrated that there is an asymmetric relationship between FDI and interest rates not only in the long run but also in the short run. Specifically, incoming investments within the JAR reacted more significantly to the decrease in interest rates than to their increase, which points to the sensitivity of investors to more favorable financing conditions. At the same time, the research showed that exports stimulate domestic investments both in the short and long term, thus indicating that international trade has a positive effect on investment activity in the country.

The results confirm a long-term relationship between the investigated variables. Estimates suggest that foreign direct investment inflows into South Africa respond differently to increases and decreases in interest rates, both in the short and long term. A decrease in the real interest rate has a stronger effect on attracting FDI compared to an increase. This suggests that investors are more responsive to negative changes in interest rates.

Higher exports also have a positive effect on attracting FDI, both in the short and long run. The results highlight that while FDI reacts to changes in the real interest rate, it is particularly sensitive to declines in the rate.

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