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Asymmetric Effects of Trade Openness on Foreign Direct Investment in Botswana: Evidence from a Nonlinear Autoregressive Distributed Lag (NARDL) Model

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ABSTRACT:

Foreign direct investment (FDI) plays a critical role in promoting economic growth, technology transfer, employment creation, and economic diversification in developing economies. Trade openness is widely regarded as an important determinant of FDI because it enhances market access and facilitates integration into global markets. However, existing studies largely assume that trade openness affects FDI symmetrically, overlooking the possibility that increases and decreases in trade openness may generate different investment responses. This study investigates the asymmetric effects of trade openness on FDI in Botswana using annual time-series data and the Nonlinear Autoregressive Distributed Lag (NARDL) model. The findings reveal the existence of a long run cointegrating relationship among FDI, trade openness, labour force participation, population, and exchange rate. The results further show that positive changes in trade openness significantly reduce FDI in the long run but significantly increase FDI in the short run, while negative changes in trade openness have no significant effect in either period. The study concludes that trade openness affects FDI asymmetrically in Botswana and recommends that policymakers complement trade liberalisation with economic diversification, investment promotion, and productive capacity enhancement measures to maximise the benefits of foreign investment.

Keywords: Foreign direct investment, trade openness, asymmetry, nardl, botswana, investment policy.

1. INTRODUCTION

Foreign direct investment (FDI) has become one of the most important drivers of economic growth and development in both developed and developing countries. FDI contributes to economic growth through capital accumulation, employment creation, technology transfer, productivity enhancement, and integration into international markets (Borensztein *et al*., 1998 1998; Asiedu, 2002). Consequently, attracting foreign investment remains a central objective of economic policy in many developing economies seeking sustainable growth and economic diversification.

Among the various determinants of FDI, trade openness has received considerable attention in both theoretical and empirical literature. Trade openness refers to the degree to which an economy is integrated with the global economy through international trade. Economies characterised by fewer trade restrictions, lower tariffs, and greater market accessibility tend to attract higher levels of foreign investment because multina-

tional enterprises seek locations that facilitate efficient production and access to international markets (Helpman *et al.*, 2004 2004; Saini & Singhania, 2021). According to Dunning's (1988) Eclectic Paradigm, trade openness enhances location-specific advantages that influence multinational firms' investment decisions.

The relationship between trade openness and FDI remains inconclusive in empirical literature. While many studies report a positive relationship between trade openness and FDI (Akinlo, 2022; Musah *et al*., 2023; Asamoah *et al*., 2023), others suggest that the impact depends on institutional quality, market size, macroeconomic stability, and investor confidence (Busse & Hefeker, 2007; Nguyen & Su, 2022; Abdi *et al.*, 2024). More importantly, existing studies largely assume a symmetric relationship between trade openness and FDI. Such an assumption implies that increases and decreases in trade openness have equal but opposite effects on investment inflows.

However, foreign investors may react differently to trade liberalisation and trade restrictions. For instance, an increase in trade openness may gradually attract foreign investment through improved market access and reduced transaction costs, while a decline in openness may trigger immediate reductions in investment due to heightened uncertainty and increased business risks (Shahbaz *et al.*, 2021). Consequently, the assumption of symmetry may mask important dynamics in the trade openness-FDI relationship.

Recent developments in nonlinear econometric modelling have emphasised the importance of investigating asymmetric relationships among macroeconomic variables. The Nonlinear Autoregressive Distributed Lag (NARDL) framework developed by Shin *et al.*, (2014) allows researchers to distinguish between the effects of positive and negative shocks and has increasingly been applied in studies examining trade, investment, and economic growth relationships. Understanding whether positive and negative changes in trade openness affect FDI differently is particularly important for Botswana as the country continues implementing policies aimed at promoting export competitiveness, economic diversification, and private sector development.

Botswana presents an interesting case for examining the relationship between trade openness and FDI. Since independence in 1966, Botswana has transformed from one of the poorest countries in Africa into an upper-middle-income economy. This remarkable economic transformation has largely been driven by prudent macroeconomic management, political stability, strong institutions, and effective utilisation of mineral resources (Acemoglu *et al*., 2003; World Bank, 2024). Botswana has also pursued trade liberalisation through participation in regional and international trade agreements, including the Southern African Customs Union (SACU), the Southern African Development Community (SADC) Protocol on Trade, and the World Trade Organization (WTO), with the objective of enhancing economic integration and investment attractiveness (UNCTAD, 2024).

Despite these efforts, FDI inflows into Botswana have remained relatively low and highly volatile compared to other emerging economies. A significant proportion of foreign investment continues to be concentrated within the diamond mining sector, exposing the economy to external shocks associated with fluctuations in global commodity markets (IMF, 2025). Recent declines in global diamond demand, increasing competition from synthetic diamonds, and persistent global economic uncertainty have further highlighted the need for Botswana to attract diversified foreign investment into non-mining sectors (Reuters, 2025; African Development Bank, 2025).

Empirical evidence on the asymmetric effects of trade openness on FDI in Botswana remains scarce. Existing studies have primarily focused on the linear determinants of FDI and have not adequately considered the possibility that positive and negative trade openness shocks may generate different investment responses. Consequently, there remains a knowledge gap regarding the nature and magnitude of asymmetries in the trade openness-FDI nexus within the Botswana context.

It is against this background that this study investigates the asymmetric effects of trade openness on foreign direct investment in Botswana using annual time-series data covering the period 1980-2023. The study employs the Nonlinear Autoregressive Distributed Lag (NARDL) modelling framework to examine both the short-run and long-run asymmetric effects of trade openness on FDI while controlling for Gross Domestic Product growth, population, exchange rate, and labour force participation rate.

2. LITERATURE REVIEW

This section presents the literature pertaining to the study. This study is anchored on the Eclectic Paradigm, Market Size Theory, and Investment Development Path Theory. The Eclectic Paradigm (OLI Theory) developed by Dunning (1977, 1988) explains foreign direct investment through ownership, location, and internalisation advantages. The theory argues that multinational firms invest in countries that offer favourable location advantages such as access to markets, stable institutions, and supportive trade policies. Trade openness enhances these location advantages by reducing trade barriers and improving access to regional and international markets. The theory is relevant to this study because it explains how changes in trade openness can influence Botswana's attractiveness to foreign investors and consequently affect FDI inflows (Dunning, 1988; Narula & Dunning, 2010).

Market Size Theory posits that multinational enterprises are attracted to countries with larger and more accessible markets because they offer greater profit opportunities and economies of scale (Krugman, 1985; Markusen, 2002). Trade openness expands market access by connecting domestic economies to regional and global markets, thereby increasing investment opportunities. The theory is relevant to this study as it suggests that increased trade openness can attract FDI by enlarging the effective market available to foreign investors, while reduced openness may discourage investment inflows (Asiedu, 2002; Chakrabarti, 2001).

The Investment Development Path (IDP) Theory developed by Dunning & Narula (1996) argues that countries attract more FDI as they become increasingly integrated into the global economy and improve their competitiveness. Trade openness facilitates this integration by promoting international trade and economic cooperation. The theory is relevant

to this study because Botswana's trade liberalisation efforts are expected to enhance its investment attractiveness and support higher FDI inflows. Consequently, changes in trade openness may significantly influence the country's ability to attract foreign investment (Dunning & Narula, 1996; Narula & Dunning, 2010).

Empirical evidence on the relationship between trade openness and foreign direct investment (FDI) has generated mixed findings across countries and regions. The conventional view suggests that trade openness promotes FDI by reducing trade barriers, expanding market access, lowering transaction costs, and enhancing integration into global value chains. Using a panel of developing countries, Saini &Singhania (2021) found that trade openness significantly increases FDI inflows by improving the investment climate and facilitating international business operations. Similarly, Akinlo (2022) reported that countries with more liberal trade regimes tend to attract higher levels of foreign investment due to improved market accessibility and increased investor confidence. In a study of African economies, Asamoah et al. (2023) concluded that trade liberalisation enhances foreign investment by creating export opportunities and strengthening participation in international production networks.

Despite these positive findings, several studies argue that the effect of trade openness on FDI is not uniform across countries and depends on economic, institutional, and structural conditions. Nguyen and Su (2022) found that the positive effect of trade openness weakens in countries characterised by political uncertainty, weak governance, and inadequate infrastructure. Similarly, Saha *et al.*, (2024) reported that trade openness alone is insufficient to attract FDI unless accompanied by strong institutions, stable macroeconomic conditions, and supportive investment policies. Their findings suggest that domestic economic fundamentals play a crucial role in determining whether countries benefit from trade liberalisation through increased foreign investment.

Recent empirical literature has increasingly focused on the possibility of asymmetric relationships between trade openness and foreign direct investment. Traditional linear models assume that increases and decreases in trade openness exert equal but opposite effects on investment inflows. However, this assumption has been challenged by studies employing nonlinear econometric techniques. Shahbaz *et al*., (2021) found that positive and negative trade openness shocks affect investment differently, with investors responding more strongly to adverse policy changes than to liberalisation measures. Similarly, Nguyen & Su (2022) reported significant asymmetries in the trade openness–FDI relationship, showing that reductions in trade openness generate larger investment responses than equivalent increases. Using a nonlinear framework, Le and Nguyen (2024) found that positive trade openness shocks stimulate investment in the short run, whereas their long-run effects depend on structural economic characteristics and institutional quality. These studies highlight the importance of accounting for asymmetries when analysing the impact of trade openness on foreign investment.

Empirical evidence from Africa generally supports the view that trade openness is an important determinant of FDI. Adjei *et al*. (2023) examined 35 African countries and found that trade openness significantly increases FDI inflows by improving access to regional and international markets. Similarly, Osei & Kim (2024) reported that countries with more open trade regimes attract higher levels of foreign investment because multinational firms benefit from reduced trade costs and greater export opportunities. However, the authors noted that the magnitude of the effect varies depending on institutional quality and economic diversification. These findings suggest that trade openness is more effective in attracting FDI when supported by favourable domestic conditions.

In Botswana, empirical evidence on the determinants of FDI remains relatively limited. Existing studies generally identify market size, macroeconomic stability, trade openness, infrastructure development, and institutional quality as important drivers of foreign investment. Using time-series data for Botswana, Mbulawa (2015) found that trade openness positively influences FDI inflows by enhancing the country's attractiveness to international investors. Similarly, Seetanah &Khadaroo (2018) reported that openness to international trade contributes significantly to foreign investment by improving economic integration and reducing transaction costs. More recent evidence from the IMF (2025) and the World Bank (2024) highlights Botswana's continued efforts to promote trade liberalisation through regional agreements such as SADC, SACU, and the African Continental Free Trade Area (AfCFTA), with the objective of attracting diversified foreign investment beyond the mining sector. Selelo (2012) noted that FDI was better explained by economic growth in Botswana. Maduo (2003) established that government incentives, particularly financial ones, primarily benefit citizen or domestic firms also positively influence investment. Gutu *et al.*, (2017) identified that Botswana ability to attract FDI was premised on stability of the political and legal environments, high human capital and governance that promotes technological adoption.

However, despite the growing literature on FDI determinants in Botswana, existing studies have largely adopted linear modelling approaches (Gutu *et al*., 2017; Maduo, 2003; Selelo, 2012) and have not examined whether positive and negative changes in trade openness affect FDI differently. This omission is important because investors may respond asymmetrically to trade policy changes. While trade liberalisation may gradually encourage investment through improved market access, reductions in openness may trigger stronger and more immediate negative reactions due to increased uncertainty and investment risk. Consequently, the nature and magnitude of asymmetries in the trade openness-FDI relationship in Botswana need to be unexplored. This study contributes to the literature by employing the Nonlinear Autoregressive Distributed Lag (NARDL) model to investigate both the short-run and long-run asymmetric effects of trade openness on FDI, thereby addressing an important gap in the Botswana literature and providing new evidence for trade and investment policy formulation.

3. METHODOLOGY

This study investigates the asymmetric effects of trade openness on foreign direct investment (FDI) in Botswana using time-series data. The study adopts a quantitative research

approach and employs the Nonlinear Autoregressive Distributed Lag (NARDL) model developed by Shin *et al.* (2014), which allows for the estimation of both short-run and long-run asymmetries between variables. The NARDL framework is particularly suitable because it captures the possibility that positive and negative changes in trade openness may affect foreign direct investment differently, thereby overcoming the limitations of conventional linear models that assume symmetric responses.

The study utilises annual secondary data covering the period 1980-2023. Data on foreign direct investment (fdi), trade openness (trad), labour force participation (lfpr), population (pop), and exchange rate (exrate) are obtained from the World Development Indicators (WDI), and the United Nations Conference on Trade and Development (UNCTAD). These sources provide reliable and internationally comparable macroeconomic data suitable for time-series econometric analysis.

Following the Eclectic Paradigm (Dunning, 1988), Market Size Theory (Markusen, 2002), and the Investment Development Path Theory (Dunning & Narula, 1996), FDI is specified as a function of trade openness, labour force participation, population, and exchange rate:

$$fdi_t = (trad_t, lfpr_t, pop_t, exrate_t)$$

To capture asymmetry, the trade openness variable is decomposed into positive and negative partial sums following Shin et al., (2014):

$$trad_pos = \sum_{j=1}^{t} \max(\Delta\, trad_j, 0)$$

$$trad_neg = \sum_{j=1}^{t} \min(\Delta\, trad_j, 0)$$

where trad_pos represents cumulative positive changes in trade openness and trad_neg represents cumulative negative changes in trade openness.

The long-run asymmetric model is specified as:

$$fdi_t = \beta_0 + \beta_1 trad_pos_t + \beta_2 trad_neg_t + \beta_3 lfpr_t + \beta_4 pop_t + \beta_5 exrate_t + \varepsilon_t$$

where: fdi= Foreign Direct Investment (% of GDP), trad_pos = Positive changes in trade openness, trad_neg= Negative changes in trade openness, lfpr= Labour Force Participation Rate, pop= Population, exrate= Exchange Rate and ε_t= Error term

The corresponding NARDL error-correction representation is expressed as:

$$\Delta fdi_t = \alpha + \lambda ect_{t-i} + \sum_{i=1}^{s} \theta_i\, \Delta trad_pos_{t-i} + \sum_{i=1}^{s} \phi_i\, \Delta \text{trad_neg}_{t-i} + \sum_{i=1}^{r} \gamma_i\, \Delta lfpr_{t-i} + \sum_{i=1}^{s} \delta_i\, \Delta pop_{t-i} + \sum_{i=1}^{v} \psi_i\, \Delta exrate_{t-i} + u_t$$

where ECT_{t-1} represents the lagged error correction term, λ measures the speed of adjustment towards long-run equilibrium, and $u_t$is the stochastic error term.

Table 1. Variable description and expected signs.

Variable	Measurement	Expected Sign
fdi	Net FDI Inflows (% of GDP)	Dependent Variable
trad_pos	Positive changes in Trade Openness (%)	±
trad_neg	Negative changes in Trade Openness (%)	±
lfpr	Labour Force Participation Rate	+
pop	Total Population	+
exrate	Official Exchange Rate	±

Source: Own Computation.

The analysis follows several sequential steps. First, descriptive statistics are computed to examine the distributional properties of the variables. Second, the Augmented Dickey-Fuller (ADF) unit root test is employed to determine the order of integration of the variables. The NARDL model requires variables to be integrated of order zero, I (0), or order one, I (1), but not order two, I (2) (Shin *et al*., 2014).

Third, the Bounds Test for cointegration is conducted to determine whether a long-run relationship exists among the variables (Pesaran *et al*., 2001). Once cointegration is established, the NARDL model is estimated to obtain both long-run and short-run asymmetric coefficients. The positive and negative components of trade openness are then examined separately to determine whether increases and decreases in trade openness exert different effects on FDI.

To validate the model, diagnostic tests including the Ramsey RESET specification test and the Breusch-Pagan/Cook-Weisberg heteroscedasticity test are conducted. Furthermore, parameter stability is assessed using the CUSUM stability test. These diagnostic procedures ensure that the estimated coefficients are unbiased, efficient, and suitable for policy recommendations.

Based on international trade and investment theories, positive changes in trade openness are expected to promote FDI by enhancing market access and reducing transaction costs, while negative changes may discourage investment by increasing uncertainty and limiting access to international markets (Dunning, 1988; Shin et al., 2014). Population is expected to positively influence FDI through market-size effects (Markusen, 2002), whereas the impact of exchange rate movements may be either positive or negative depending on investor expectations and competitiveness effects. Labour force participation is expected to positively influence FDI by increasing the availability of productive labour and improving the attractiveness of the host economy to foreign investors.

4. RESULTS PRESENTATION AND DISCUSSION

This section presents the results of the study.

Table 2. Descriptive statistics.

Statistic	fdi	top	lfpr	pop	exrate
Mean	1.906857	94.72944	759700.2	1881949	6.878084
Median	1.728061	91.83577	758634.0	1874516	6.327792
Maximum	7.501519	125.7830	1173288	2480244	13.59638
Minimum	-6.897609	68.85721	448456.0	1270274	1.860466
Std. Dev.	2.474525	11.72723	203876.9	361799.7	3.470936
Skewness	-0.854805	0.581679	0.230384	-0.033403	0.333055
Kurtosis	6.239877	3.491387	2.040930	1.805389	2.020260
Jarque-Bera	19.57020	2.325840	1.651012	2.087691	2.046907
Probability	0.000056	0.312572	0.438013	0.352098	0.359352
Sum	66.74001	3315.530	26589507	65868232	240.7329
Sum Sq. Dev.	335.4550	318754.3	2.16E+13	1.28E+14	2065.393
Observations	44	44	44	44	44

Source: Own Computation.

Table **2** presents the descriptive statistics for fdi, trade openness (trad), labour force participation (lfpr), population (pop), and exchange rate (exrate) in Botswana from 1980-2023. FDI recorded a mean value of 1.91, ranging from -6.90 to 7.50, with a standard deviation of 2.47, indicating significant fluctuations in foreign investment inflows. The variable is negatively skewed and not normally distributed (Jarque-Bera probability = 0.000056), suggesting the presence of extreme observations. Similar volatility in fdi has been reported by Asiedu (2002) and Anyanwu (2012), who attributed fluctuations in developing countries to policy changes, economic instability, and external shocks. Trade openness (trade) averaged 94.73%, reflecting Botswana's high integration into the global economy, a finding consistent with Shahbaz *et al*., (2016) and Zahonogo (2017), who found that trade liberalisation enhances international economic participation.

Labour force participation rate (lfpr) and population (pop) recorded mean values of 759,700 and 1.88 million respectively, indicating sustained growth in Botswana's labour force and market size over the study period. These findings support World Bank (2023) observations that demographic expansion can strengthen a country's attractiveness to foreign investors. The exchange rate averaged 6.88 and exhibited moderate variability, consistent with Baharumshah and Thanoon (2006), who found exchange rate fluctuations to be a common feature of developing economies. The Jarque-Bera test results further show that trad, lfpr, pop, and exrate are normally distributed, suggesting that the variables are suitable for econometric analysis. Overall, the substantial variation observed in the data supports previous studies which identify trade openness and macroeconomic factors as key determinants of foreign direct investment (fdi) inflows in developing economies.

Table 3. Augmented dickey-Fuller (ADF) unit root test results.

Variable	Level ADF Statistic	Prob.	First Difference ADF Statistic	Prob.	Order of Integration
fdi	-5.121674	0.0001	-		I (0)
exrate	1.983575	0.9998	-5.588590	0.0000	I (1)
lfpr	1.919730	0.9997	-6.015761	0.0000	I (1)
pop	-2.151827	0.2262	-3.709340	0.0502	I (1)
trad	-1.137083	0.6938	-5.861213	0.0000	I (1)

Source: Own Computation.

Table **3** presents the Augmented Dickey-Fuller (ADF) unit root test results used to determine the stationarity properties of the variables before estimating the NARDL model. The results show that fdi is stationary at level and is therefore integrated of order zero, I (0), while trade openness (trad), exchange rate (exrate), labour force participation (lfpr), and population (pop) become stationary after first differencing, indicating that they are integrated of order one, I (1).

Table 4. ARDL bounds test.

Test	Statistic	Calculated Value	10%		5%		1%	
			I (0)	I (1)	I (0)	I (1)	I (0)	I (1)
Bounds Test	F-statistic	8.144	2.72	3.77	3.23	4.35	4.29	5.61
Bounds Test	t-statistic	-4.424	-2.57	-3.46	-2.86	-3.78	-3.43	-4.37

Source: Own Computation

The mixture of I (0) and I (1) variables, together with the absence of any I (2) variable, satisfies the key requirement for the application of the NARDL model. According to Shin et al. (2014), NARDL is appropriate when variables are integrated of different orders and allows the examination of both short-run and long-run asymmetries by decomposing trade openness into positive and negative changes. Therefore, the unit root results justify the use of the NARDL framework to investigate the asymmetric effects of trade openness on foreign direct investment in Botswana.

The ARDL Bounds Test results confirm the existence of a long-run relationship between foreign direct investment, trade openness, labour force participation, population, and exchange rate in Botswana (Table **4**). The calculated F-statistic exceeds the upper bound critical values at all significance levels, while the t-statistic is more negative than the corresponding upper bound critical values. Consequently, the null hypothesis of no cointegration is rejected, indicating that the variables move together in the long run despite short-run fluctuations.

The presence of cointegration validates the use of the NARDL model to estimate both long-run and short-run asymmetric effects. This finding is consistent with Shin et al. (2014), who emphasised that cointegration is a prerequisite for NARDL estimation. The result also supports studies by Anyanwu (2012), Shahbaz *et al*., (2016), Tsaurai (2018), and Zahonogo (2017), which found that trade openness and macroeconomic fundamentals maintain significant long-run relationships with FDI and economic performance in developing economies. Therefore, the study can proceed with NARDL estimation to examine whether positive and negative changes in trade openness have asymmetric effects on FDI inflows in Botswana.

The NARDL model was estimated using annual observations covering the period 1980-2023. The model exhibits a good fit, with an R^2 of 0.9448 and an adjusted R^2 of 0.7912, indicating that approximately 94.5% of the variation in FDI is explained by trade openness, labour force participation, population, and exchange rate (Table **5**). The Root Mean Square Error (RMSE) of 1.0400 further suggests satisfactory predictive performance.

The error correction term (ECT) is negative and statistically significant confirming the existence of a stable long-run relationship among the variables. The coefficient implies that approximately 60.1% of short-run disequilibrium is corrected each year, indicating a relatively fast adjustment towards long-run equilibrium. This finding is consistent with Shin *et al.* (2014), who argue that a significant negative ECT confirms cointegration within the NARDL framework.

The long-run results reveal asymmetric effects of trade openness on FDI. Positive changes in trade openness significantly reduce FDI, while negative changes are statistically insignificant. This suggests that increases and decreases in trade openness affect FDI differently. Although this finding contrasts with studies by Anyanwu (2012) and Zahonogo (2017), which reported a positive relationship between trade openness and FDI, it may reflect Botswana's dependence on a narrow export base and increased exposure to international competition. Labour force participation negatively and significantly affects FDI whereas population has a positive and significant effect, supporting the view that market size attracts foreign investment. Exchange rate effects are statistically insignificant in the long run.

In the short run, positive changes in trade openness significantly increase FDI in the current period and through the first and second lags, indicating that trade liberalisation initially stimulates foreign investment inflows. This finding is consistent with Shahbaz et al., (2016) and Tsaurai (2018), who found that greater openness improves investor confidence and market access. Conversely, negative changes in trade openness remain insignificant, further confirming the presence of asymmetry. Labour force participation and population exhibit significant effects in some periods, while exchange rate changes are largely insignificant except at the second lag. Overall, the results suggest that positive trade openness shocks have stronger effects on FDI than negative shocks, justifying the application of the NARDL model to capture these asymmetric relationships in Botswana.

The diagnostic test results confirm the adequacy of the estimated NARDL model as shown in Table 6. The Ramsey RESET test produced an F-statistic of 1.92 ($p = 0.2450$), which is greater than 0.05, indicating that the model is correctly specified and does not suffer from omitted variable bias or functional form misspecification. This suggests that the estimated coefficients are reliable and consistent with recent NARDL studies that emphasise proper model specification for robust inference (Adebayo *et al*., 2022; Le & Nguyen, 2024). Similarly, the Breusch-Pagan/Cook-Weisberg test yielded a χ^2 statistic of 0.55 ($p = 0.4598$), implying the absence of heteroscedasticity. The residuals therefore have constant variance, ensuring efficient and unbiased estimates. These findings support the reliability of the model and are consistent with recent studies that reported stable residual behaviour in well-specified NARDL models (Rahman *et al*., 2023; Sinha *et al*., 2024). Overall, the diagnostic tests confirm that the estimated model is suitable for statistical inference and policy recommendations.

Table 5. NARDL estimation results and model summary.

Variable	Coefficient	Std. Error	t-Statistic	P-value
Error correction Term (ADJ)				
fdi (-1)	-0.6008	0.1338	-4.49	0.002
Long-run Coefficients				
trad_pos	-1.8864	0.6458	-2.92	0.019
trad_neg	-0.1997	0.2982	-0.67	0.522
lfpr	-0.0003	0.0001	-3.02	0.016
pop	0.0002	0.0001	3.28	0.012
exrate	-1.1890	1.4030	-0.85	0.421
Short-run Coefficients				
D(trad_pos)	0.9510	0.2120	4.49	0.002
LD(trad_pos)	0.6201	0.1372	4.52	0.002
L2D(trad_pos)	0.2114	0.0635	3.33	0.010
D(lfpr)	0.0002	0.0001	3.05	0.016
LD(lfpr)	-0.0002	0.0001	-4.53	0.002
L2D(lfpr)	0.0001	0.0000	3.50	0.008
D(pop)	0.0014	0.0005	2.98	0.018
L3D(pop)	0.0014	0.0004	3.34	0.010
L2D(exrate)	2.0323	0.7420	2.74	0.025
Constant	-109.8562	25.8896	-4.24	0.003
Model Summary				
R^2 0.9448	Adjusted R^2 0.7912		Root MSE 1.0400	

Source: Own Computation

Table 6. Diagnostic tests.

Test	Statistic	Test Value	Degrees of Freedom	*P*-value
Ramsey RESET Test	F-statistic	1.92	F (3,5)	0.2450
Breusch-Pagan/Cook-Weisberg Test	χ^2-statistic	0.55	χ^2 (1)	0.4598

Source: Author's Computation (STATA).

Table 7. Stability test.

Statistic	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Recursive CUSUM	0.4287	1.1430	0.9479	0.8500

Source: Author's Computation (STATA).

The CUSUM stability test was conducted to examine the stability of the estimated NARDL model parameters over the sample period (Table 7). The calculated CUSUM test statistic of 0.4287 is lower than the critical values at the 1%, 5%, and 10% significance levels. This indicates that the null hypothesis of parameter stability cannot be rejected, implying that the estimated coefficients remain stable throughout the study period. The stability of the model suggests that the relationship between trade openness and FDI in Botswana did not experience significant structural changes during the sample period. Consequently, the estimated long-run and short-run coefficients can be considered reliable for inference and policy formulation. This finding is consistent with recent studies that emphasise the importance of parameter stability in nonlinear ARDL models, arguing that stable coefficients enhance the credibility of estimated asymmetric effects and long-run policy recommendations (Adebayo et al., 2022; Le and Nguyen, 2024). Overall, the CUSUM results confirm that the estimated NARDL model is structurally stable and suitable for analysing the asymmetric effects of trade openness on FDI in Botswana.

5. CONCLUSION AND RECOMMENDATIONS

This study examined the asymmetric effects of trade openness on foreign direct investment (FDI) in Botswana using the Nonlinear Autoregressive Distributed Lag (NARDL) model. The findings confirmed the existence of a long-run cointegrating relationship among FDI, trade openness, labour force participation, population, and exchange rate. The results also revealed the presence of asymmetry in the trade openness-FDI relationship. Specifically, positive changes in trade openness significantly reduced FDI in the long run but increased FDI in the short run, while negative changes in trade openness had no significant impact in either the short run or long run. Population was found to positively influence FDI, whereas labour force participation exerted a negative effect, while exchange rate effects remained largely insignificant. Diagnostic and stability tests confirmed that the estimated model was well specified, free from heteroscedasticity, and structurally stable. These findings suggest that the effects of trade openness on FDI in Botswana are not uniform and vary across time horizons, highlighting the importance of considering asymmetries when formulating trade and investment policies.

Based on these findings, the study recommends that Botswana should continue implementing trade liberalisation policies while simultaneously strengthening domestic productive capacity to ensure that increased openness translates into sustainable foreign investment inflows. The government should intensify economic diversification efforts by promoting investment in non-mining sectors such as manufacturing, tourism, agriculture, and technology-based industries to reduce dependence on mineral exports. Investment promotion strategies should also be complemented by improvements in infrastructure, regulatory efficiency, and the overall business environment to enhance Botswana's attractiveness to foreign investors. Furthermore, greater investment in human capital development and labour market reforms is necessary to improve workforce productivity and align labour skills with investor requirements. Finally, Botswana should leverage regional integration initiatives such as SADC and the African Continental Free Trade Area (AFCFTA) to expand market access and strengthen its competitiveness as a destination for foreign direct investment.

REFERENCES

Abdi, A. H., Sheik-Ali, I. A., Mohamed, F. H., & Mohamoud, S. Sh. A. (2024). Drivers of FDI inflows in Africa: do trade openness, market size, and institutional quality matter? Cogent Economics & Finance, 12(1). https://doi.org/10.1080/23322039.2024.2416993

Acemoglu, D., Johnson, S., & Robinson, J. A. (2003). An African success story: Botswana. In D. Rodrik (Ed.), *In search of prosperity: Analytic narratives on economic growth* (pp. 80-119). Princeton University Press.

Adebayo, T. S., Akinsola, G. D., & Odugbesan, J. A. (2022). Asymmetric effects of economic growth and trade openness on environmental quality in developing economies. *Environmental Science and Pollution Research, 29*(18), 26754-26770.

Adjei, M., Mensah, I., & Frimpong, P. (2023). Trade openness and foreign direct investment in Africa: A panel data analysis. *African Development Review, 35*(4), 589-604.

African Development Bank. (2025). *African economic outlook 2025: Botswana country profile*. African Development Bank.

Akinlo, A. E. (2022). Trade openness and foreign direct investment in developing economies. *Journal of Economic Integration, 37*(2), 215-233.

Anyanwu, J. C. (2012). Why does foreign direct investment go where it goes? New evidence from African countries. *Annals of Economics and Finance, 13*(2), 425-462.

Asamoah, L. A., Mensah, E. K., & Ofori, D. (2023). Trade liberalisation and foreign direct investment in Africa. *African Development Review, 35*(3), 412-428.

Asiedu, E. (2002). On the determinants of foreign direct investment to developing countries: Is Africa different? *World Development, 30*(1), 107-119.

Baharumshah, A. Z., & Thanoon, M. A. (2006). Foreign capital flows and economic growth in East Asian countries. *China Economic Review, 17*(1), 70-83.

Borensztein, E., De Gregorio, J., & Lee, J. W. (1998). How does foreign direct investment affect economic growth? *Journal of International Economics, 45*(1), 115-135.

Busse, M., & Hefeker, C. (2007). Political risk, institutions and foreign direct investment. *European Journal of Political Economy, 23*(2), 397-415.

Chakrabarti, A. (2001). The determinants of foreign direct investment: Sensitivity analyses of cross-country regressions. *Kyklos, 54*(1), 89-114.

Dunning, J. H. (1977). Trade, location of economic activity and the multinational enterprise: A search for an eclectic approach. In B. Ohlin, P. O. Hesselborn, & P. M. Wijkman (Eds.), *The international allocation of economic activity* (pp. 395-418). Macmillan.

Dunning, J. H. (1988). The eclectic paradigm of international production: A restatement and some possible extensions. *Journal of International Business Studies, 19*(1), 1-31.

Dunning, J. H., & Narula, R. (1996). *The investment development path revisited: Some emerging issues*. Oxford University Press.

Gutu, M., Anastasiadou, C., Omar, M., & Osei, C. (2017). Foreign Direct Investment in Zimbabwe and Botswana: The Elephant in the Room. In *Managing Knowledge and Innovation for Business Sustainability in Africa* (pp. 167-194). Cham: Springer International Publishing.

Helpman, E., Melitz, M. J., & Yeaple, S. R. (2004). Export versus FDI with heterogeneous firms. *American Economic Review, 94*(1), 300-316.

International Monetary Fund (IMF). (2025). *Botswana: Article IV consultation report*. International Monetary Fund.

Krugman, P. R. (1985). *Market structure and foreign trade: Increasing returns, imperfect competition and the international economy*. MIT Press.

Le, H. P., & Nguyen, C. P. (2024). Trade openness, foreign investment and economic performance: Evidence from emerging economies. *Economic Analysis and Policy, 81*, 428-442.

Maduo, P. G. (2003). Foreign direct investment in the manufacturing sector in Botswana: key determinants and deterrents. Master's Thesis

Markusen, J. R. (2002). *Multinational firms and the theory of international trade*. MIT Press.

Mbulawa, S. (2015). Determinants of foreign direct investment in Botswana. *Botswana Journal of Economics, 13*(1), 1-15.

Musah, M., Kong, Y., Mensah, I. A., & Antwi, S. K. (2023). Trade openness and FDI inflows in Africa: The role of institutions and macroeconomic stability. *Heliyon, 9*(7), e17864.

Narula, R., & Dunning, J. H. (2010). Multinational enterprises, development and globalisation: Some clarifications and a research agenda. *Oxford Development Studies, 38*(3), 263-287.

Nguyen, T. T., & Su, D. T. (2022). Asymmetric effects of trade openness on foreign direct investment: Evidence from emerging economies. *International Economics, 171*, 120-135.

Osei, K., & Kim, J. (2024). Trade openness and foreign direct investment in Africa: The moderating role of institutions. *Journal of African Business, 25*(1), 45-63.

Rahman, M. M., Khanam, R., & Velayutham, E. (2023). Asymmetric impacts of trade and financial development on economic growth: Evidence from developing countries. *Journal of International Trade and Economic Development, 32*(4), 562-580.

Reuters. (2025). Botswana faces challenges from weakening global diamond demand and increasing competition from synthetic diamonds. Reuters.

Saha, S., Sen, K., & Montalbano, P. (2024). Trade openness, institutions and foreign direct investment in developing countries. *The World Economy, 47*(2), 487-509.

Saini, N., & Singhania, M. (2021). Determinants of foreign direct investment in developed and developing countries: A comparative analysis. *Global Business Review, 22*(2), 346-364.

Seetanah, B., & Khadaroo, J. (2018). Trade openness and foreign direct investment in Southern Africa. *African Finance Journal, 20*(2), 67-84.

Selelo, S. E. (2012). Determinants of fixed foreign direct investment in Botswana. *Journal of Economics and Behavioral Studies, 4*(7), 414-422.

Shahbaz, M., Balsalobre-Lorente, D., Kumar, R. R., & Jiao, Z. (2021). Nonlinear effects of trade openness on investment and economic growth. *Resources Policy, 72*, 102061.

Shahbaz, M., Nasreen, S., Ahmed, K., & Hammoudeh, S. (2016). Trade openness–carbon emissions nexus: The importance of turning points of trade openness for country panels. *Energy Economics, 61*, 221-232.

Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. In R. C. Sickles & W. C. Horrace (Eds.), *Festschrift in honor of Peter Schmidt: Econometric methods and applications* (pp. 281-314). Springer.

Sinha, A., Shahbaz, M., & Sengupta, T. (2024). Nonlinear dynamics of trade openness and macroeconomic performance in developing economies. *Resources Policy, 89*, 104632.

Tsaurai, K. (2018). The impact of trade openness on foreign direct investment in emerging markets. *International Journal of Economics and Finance Studies, 10*(1), 1-15.

United Nations Conference on Trade and Development (UNCTAD). (2024). *World investment report 2024: Investment facilitation and sustainable development*. United Nations.

World Bank. (2023). *World development indicators database*. World Bank.

World Bank. (2024). *Botswana economic update*. World Bank.

Zahonogo, P. (2017). Trade and economic growth in developing countries: Evidence from Sub-Saharan Africa. *Journal of African Trade, 3*(1-2), 41-56.

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