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Impact of Environmental Quality on Foreign Direct Investment Inflows into Ghana, Kenya, Nigeria and South Africa

***Onwuka Irene Nkechi (PhD); *Ozoh Joan Nwamaka (PhD); **Ezeife Agbachukwu Okeife; ***Madueke Chinwe Monica (PhD); & ****Udeze Chike Romanus (PhD)**

*Department of Economics, Nnamdi Azikiwe University Awka, Anambra State, Nigeria. **Department of Entrepreneurship Studies, Nnamdi Azikiwe University Awka, Anambra State, Nigeria. ***Department of Economics, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria. ****Department of Economics, Enugu State University of Science and Technology, Enugu State, Nigeria.
Corresponding Author: in.onwuka@unizik.edu.ng
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Abstract

This study examined the impacts of the surrounding business environment on the inflow of foreign direct investment into Ghana, Kenya, Nigeria and South Africa. Finding out how much the environment has impacted FDI inflow into South Africa, Ghana, Nigeria, and Kenya is the goal. The population density, land/air pollution rate, and investment climate (nitrous oxide emissions) are included in the variable scope as independent variables. The inflows of foreign direct investment served as the dependent variable. The data was analyzed using time series analysis, more precisely the multiple panel regression analysis method, with the Cobb Douglass model serving as the theoretical framework. The World Bank Statistics and the Statistical Bulletin of the nations under study were the sources of the data. According to the findings, population density dramatically reduced foreign direct investment (FDI), whereas nitrous oxide emission put forth a significantly positive effect on FDI inflow into these countries. It was suggested that the governments of South Africa, Ghana, Nigeria, and Kenya should work to improve their economic standing by bolstering their economies through significant export-oriented production, which will increase economic growth and draw in more foreign direct investment.

Keywords: Environmental Quality, Foreign Direct Investment, Ghana, Kenya, Nigeria, South Africa.

INTRODUCTION

The likelihood that banks, financial institutions, and private investors will provide loans to or acquire equity stakes in indigenous enterprises is largely influenced by the prevailing business climate of a particular nation or region. A wide range of interconnected factors shape the global investment climate and determine the level of confidence investors have in an economy. These challenges include issues related to national security, weak government accountability, unpredictable tax regimes, and persistent political instability, all of which tend to discourage investment activities and heighten investor uncertainty.

Despite the existence of these unfavourable conditions, some investors are still willing to tolerate the high levels of risk and volatility associated with investing in such regions because of the possibility of earning substantial returns on their investments (Qokweni, 2021). Over several years, this willingness to assume risk has contributed to a relatively active investment environment across Africa, particularly in countries such as South Africa, Ghana, Nigeria, and Kenya. Africa's attractiveness to global investors increased significantly following the 2008 global financial crisis, largely due to strong economic growth rates, the expansion of the middle class, rapid population growth, perceived improvements in macroeconomic management and socio-political stability, vast areas of arable land, and favourable geological endowments.

As a result of these factors, foreign investment inflows into the continent experienced notable growth, with investment inflows rising by approximately 22 percent between 2010 and 2014. However, this upward trend was reversed when the global commodities "super-cycle" came to an end in 2015, leading to a sharp decline of about 31 percent in foreign direct investment (FDI) inflows into Sub-Saharan Africa (SSA), particularly in major economies such as Nigeria, Ghana, Kenya, and South Africa (KPMG, 2015). Given the likelihood of future changes in the investment environment of South Africa, Ghana, Kenya, and Nigeria, it is therefore appropriate to examine how the prevailing investor climate has influenced foreign direct investment flows across these countries. Understanding these dynamics is essential for assessing how environmental and institutional qualities shape investment decisions.

There is a methodological research gap as this work dealt with the absence of a robust econometric procedure used to analyse previous works. For instance, Asiamah, et al (2018) used the cointegrating regression while Njuguna and Nnadozie (2022) employed the two stage least square regression. The resolve was to use the Panel regression model to assess the

interconnection between investment climate and FDI inflows in the selected African countries. Additionally, there is topical gap. Most of the former studies concentrated on the study of foreign direct investment and economic growth, rather than the effect of investment climate on foreign direct investment. Some of these works include Moolman, et al (2016), Gelb and Black (2018), Kimotho (2019), Nyamwange (2019), Asiamah, et al (2018), Abiola (2019) and so on.

This study therefore seeks to provide insight into the manner in which the environmental quality influences foreign direct investment (FDI) in Ghana, Kenya, Nigeria, South Africa. Specifically, the study aims to critically assess the impact of environmental quality on foreign direct investment inflows into some selected African countries. In order to achieve this objective and adequately address the research questions guiding the study, the following null hypothesis is formulated and tested:

H_{01}: Environmental quality has no discernible impact on foreign direct investment inflow into Ghana, Kenya, Nigeria and South Africa.

A REVIEW OF RELATED LITERATURE

Conceptual Literature

Foreign Direct Investment (FDI)

Foreign direct investment (FDI) may occur in several forms, including the establishment of a new business, the acquisition of real estate, or the purchase of equity in an already existing enterprise. Rao and Dhar (2017) define foreign direct investment as an "investment from a foreign country into another country, typically undertaken by a company rather than a government." When the assets of a firm or organization are located outside its home country, effective control over business operations in the host country is achieved.

Foreign direct investment is distinct from Foreign Portfolio Investment (FPI), which involves the purchase of financial assets issued by one country by residents of another country without acquiring managerial control. The defining feature that differentiates FDI from FPI is the element of control, as FDI allows investors to influence business decisions and operational outcomes. Although a minimum ownership threshold of 10 percent of voting shares is commonly used to classify an investment as FDI, it is often possible for investors to exercise substantial influence over publicly traded companies with a much smaller shareholding.

In addition to ownership transfer, foreign direct investment typically involves the transfer of complementary assets such as managerial expertise, advanced technology, organizational capabilities, and technical know-how. From a strategic standpoint, Achugamonu, Okoye, and Agwu (2017) identify three main types of foreign direct investment. The first is horizontal FDI, which occurs when a firm carries out the same type of activities abroad as it does in its home country, such as Toyota operating automobile assembly plants in both Japan and the United Kingdom. The second type is vertical foreign direct investment, which takes place when different stages of a firm's production process are conducted in a foreign country. Forward vertical FDI occurs when a company invests in downstream activities such as

distribution or sales outlets, as exemplified by Toyota's investment in automobile distributorships in the United States. Conversely, backward vertical FDI involves investment in upstream activities that bring production closer to raw material sources, such as Toyota's investment in rubber plantations or tyre manufacturing companies.

Ghana, Kenya, Nigeria, and South Africa's Investment Climates

Economists often assess the economic, financial, and socio-political conditions that affect the willingness of individuals, banks, and institutions to lend to or acquire ownership stakes in businesses operating within a particular country or region. According to the European Bank for Reconstruction and Development (EBRD, 2021), the investment environment consists of a combination of factors that shape the likelihood of both domestic and international investment in a specific location.

These, collectively suggest that the investment climate encompasses a broad range of interrelated factors, extending from economic and financial considerations to environmental and socio-political conditions. Ultimately, sustained economic growth and development are driven by a synergy of private and public investments operating within a business-friendly environment.

South Africa

The World Bank's 2021 Ease of Doing Business Report addresses several energy-related challenges, including issues surrounding pricing transparency, the reliability of power supply, and the cost and duration associated with connecting to the national electricity grid. Another significant concern highlighted in the report is the absence of clear regulations governing the integration of privately generated power into the national grid.

In addition to energy constraints, South Africa faces challenges related to slow internet bandwidth and high connectivity costs. According to the National Treasury (2019), South Africa ranked 119th globally in terms of download speeds. The World Economic Forum's 2019 Annual Report further emphasizes the relatively low proportion of adults who have access to and regularly use the internet. These findings are corroborated by the 2021 Business Survey results, which identify inadequate information and communications technology (ICT) infrastructure and poor public transport systems as major obstacles facing businesses. High operational costs and frequent service interruptions continue to undermine productivity and discourage investment in South Africa. These structural challenges collectively weaken the country's overall investment climate and reduce its attractiveness to foreign investors.

Nigeria

Nigeria's investment climate is significantly shaped by infrastructural insufficiencies, insecurity, corruption, a difficult tax system and government policies, particularly those related to foreign ownership and participation in key sectors of the economy. The indigenization process began in 1972 with the enactment of the Nigerian Enterprises

Promotion Decree (NEPD), which imposed substantial restrictions on foreign direct investment. Under this decree, approximately 22 different economic sectors were reserved exclusively for Nigerian citizens.

The Nigerian Enterprises Promotion Decree of 1977 introduced additional restrictions on foreign direct investment by further limiting foreign participation in several sectors. Under this policy, only Nigerian investors were permitted to operate in businesses such as bus services, travel agencies, wholesale distribution of home products, newspaper distribution, radio and television broadcasting, movie distribution, and hairdressing services. Subsequent amendments to the policy led to the removal of certain exclusionary provisions and a reduction in the maximum allowable foreign ownership in restricted activities from 60 percent to 40 percent.

Since the restoration of democratic governance in 1999, Nigeria has had increased opportunities to pursue economic reforms and implement policies designed to attract foreign investment. With an estimated five million Nigerians residing abroad, diaspora contributions have been recognized as an important component of the reform process. The gradual implementation of new policies has begun to yield positive outcomes, and if sustained, these reforms are expected to improve the private investment climate and enhance Nigeria's attractiveness as a destination for foreign direct investment.

Ghana

Over the past two decades, Ghana has remained an attractive investment destination due to its sustained political stability and improved macroeconomic conditions. The country's inflation rate remained relatively stable at 1.7 percent in 2018, consistent with projections contained in the World Economic Outlook (WEO) October 2017 report.

Key sectors with strong investment potential in Ghana include agribusiness and food processing, textiles and apparel, downstream oil and gas processing, mineral processing, construction and real estate development, as well as mining-related service industries. To further enhance its investment climate, the Ghanaian government undertook bold reforms aimed at restructuring regulatory frameworks, simplifying business processes, and restoring fiscal discipline in order to attract increased foreign direct investment.

Foreign Direct Investment in South Africa

When compared with other developing and emerging economies, South Africa appears to attract relatively lower levels of foreign direct investment. The country's share of global foreign direct investment inflows has experienced noticeable fluctuations since 1999. In the immediate aftermath of its democratic transition, South Africa recorded an improvement in foreign direct investment inflows, following nearly a decade of modest but positive investment that marked the economy's recovery from the net disinvestment experienced during the late 1980s.

Despite the global surge in foreign direct investment between 1998 and 2000, which was largely driven by large-scale cross-border mergers and acquisitions and predominantly favoured developed economies, South Africa did not experience a corresponding significant increase in investment inflows. This global expansion therefore had limited impact on the country's overall foreign direct investment performance. The European Union (EU) remains the dominant source of foreign direct investment in South Africa. Since 2000, the proportion of EU-originated investment has expanded considerably, increasing from 47 percent during the period 2000–2010 to 66 percent between 2011 and 2020. Several corporations that were formerly South African-owned but are now headquartered in the United Kingdom, including Anglo American, BHP Billiton, Old Mutual, and SABMiller, have made substantial investments within South Africa in recent years. These investments have reinforced the European Union's influence on the country's economic landscape.

As a result of their re-domiciliation and continued capital commitments, these firms have emerged as some of South Africa's most prominent foreign investors. Even after excluding investments made by these re-domiciled entities, the European Union has consistently remained South Africa's largest regional source of foreign direct investment over the past decade (Qokweni, 2021).

Foreign Direct Investment in Ghana

Although Ghana's foreign direct investment inflows are largely sourced from technologically advanced economies, a notable proportion also originates from developing countries such as China and India (Yeboah & Anning, 2020). The majority of foreign direct investment projects in Ghana are concentrated in Asia, with China and India serving as the leading contributors in terms of project numbers.

However, when assessed based on the overall volume of foreign direct investment projects, the Netherlands frequently emerges as the largest contributor. In contrast, investment inflows from the United States and the United Kingdom have declined in relative terms. Nonetheless, Ghana's economy continues to receive substantial support from direct investments originating from various European countries.

When comparing foreign direct investment flows across continents, China and India surpass their European counterparts in terms of the number of investment projects they finance. Ghana's principal sources of foreign direct investment therefore include China, India, Lebanon, the United Kingdom, the United States of America, Germany, Nigeria, the Netherlands, Italy, and South Korea.

Theoretical Review

Theory of Endogenous Growth

Romer's (1990) endogenous growth theory presents a fundamental departure from the neoclassical growth framework, which posits that foreign direct investment and capital accumulation exert only temporary effects on income growth due to diminishing returns to

capital. In contrast, the endogenous growth model emphasizes that long-term economic growth is driven by internal mechanisms, particularly technological progress and the accumulation of human capital.

According to the endogenous growth perspective, foreign direct investment can influence sustained income growth by enhancing technological advancement and improving the quality of human capital within the host economy (Belloumi, 2014). In addition to these channels, Bailliu (2000) identifies the development of financial markets in the host country as a critical pathway through which foreign direct investment can be efficiently allocated and effectively utilized.

These interrelationships are derived from the implications of the endogenous growth model, which replaces the conventional production function with a closed-economy AK framework. Under this model, output at time t is expressed as:

$$\mathbf{Y_t = AK^{\alpha}_t} \qquad (2.1)$$

In this formulation, **yt** denotes the output per worker at time, **A** denotes the degree of technological advancement within the economy, whereas **K** captures the combined contribution of both human capital and physical capital resources**,** and **α** indicates the elasticity of output as it patterns capital (Lucas, 1988). Within this context, the framework serves as a structured analytical foundation for explaining how movements in capital and patterns of investment activity shape income levels and economic performance over time.

$$\mathbf{I_t = K_{t+1} - (1-\delta)K_t} \qquad (2.2)$$

When the concept is applied, it specifically relates to the pace at which capital assets lose value over time through depreciation or formal write-offs. This theoretical perspective places strong emphasis on the role of financial markets and financial intermediation, as it assumes that these mechanisms constitute the primary pathways through which a country's accumulated savings are transformed into productive and income-generating investments. According to this model, the volume of total investment within a well-functioning capital market is determined by net national savings multiplied by the proportion of those savings that can be effectively channelled into investment opportunities, which is represented by the parameter (ϕ).

$$\mathbf{\phi S_t = I_t} \qquad (2.3)$$

Consequently, GDP growth rate g is equal to:

$$g = A\left(\frac{I}{Y}\right) - \delta = A\varphi s - \delta \qquad (2.4)$$

The parameter used to denote the rate of saving within the economy is represented by s. In line with the assumptions of the AK model, output growth and technological advancement occur as capital is allocated in a more efficient and productive manner across the economy. Bailliu (2000) describes this outcome as the "A effect," highlighting the role of improved capital allocation in enhancing overall productivity. The structure of this model also permits the incorporation of net international capital flows (NCF) into the analysis of global financial markets. In this context, the examination of NCF in the present study is narrowed specifically

to foreign direct investment (FDI). Consequently, the condition for gross investment equilibrium is expanded upward, reflecting the inclusion of foreign capital inflows.

$$\varphi^{\bullet}(S_t + NCF) = I_t \qquad (2.5)$$

which, as the following calculation shows, then has an effect on the growth rate in steady state:

$$g^{\bullet} = A^{\bullet}\left(\frac{I^{\bullet}}{Y}\right) - \delta = A^{\bullet}\varphi^{\bullet}\left(\frac{S + NCF}{Y}\right) - \delta = A^{\bullet}\varphi^{\bullet}S^{\bullet} - \delta \qquad (2.6)$$

Using the formula previously presented, it becomes possible to draw logical conclusions about the manner in which foreign capital inflows influence economic growth, as well as the specific channels through which these effects materialize within an economy over time.

Review of Empirical Literature

Empirical Studies on FDI Inflows and Nigeria's Investment Climate

In a broader continental context, Njuguna and Nnadozie (2022) explored foreign direct investment inflows into Africa by examining the relationship between investment climate variables and the ease of doing business. Their analysis accounted for potential indigeneity between FDI, economic growth, and the ease of doing business through the application of instrumental variable estimation and the control function approach. In addition to FDI and the Ease of Doing Business Index (EDBI), the study incorporated variables such as natural resources, GDP, inflation, population density, trade openness, mobile phone penetration, and business regulatory quality. The findings demonstrated that business-friendly environments play a significant role in attracting foreign direct investment. The authors concluded that ongoing efforts by African countries to improve their investment climate are well justified, as such reforms enhance the likelihood of attracting productive and growth-enhancing FDI.

Empirical Research on Ghana's Investment Climate and Foreign Direct Investment Inflows

Yeboah and Anning (2020) carried out a comprehensive assessment of the impact of foreign direct investment on employment generation in Ghana. Their study provided an extensive overview of FDI trends in the Ghanaian economy by analysing the monetary value of FDI component projects, local currency contributions, the total number of registered investment projects, and the volume of employment created. The researchers adopted a descriptive statistical approach to facilitate quantitative analysis of the data. The results indicated that a substantial proportion of Ghana's total FDI value was derived from component-based investments. Although wholly foreign-owned firms accounted for approximately 72 percent of all registered projects, joint ventures involving Ghanaian and foreign partners represented a higher overall investment value. Importantly, the findings showed that Ghanaians occupied

more than 85 percent of the jobs created through FDI-related activities, highlighting the employment benefits of foreign investment.

Barthel et al. (2022) conducted a detailed investigation into the determinants of foreign direct investment in Ghana and the broader implications for national economic growth. Drawing on data from the World Bank's 2007 Enterprise Survey, the study employed a mixed-methods approach that combined qualitative and quantitative analyses. One of the most significant findings was that foreign-owned firms differ markedly from domestic firms in key areas such as firm size, managerial expertise, and access to credit facilities. Despite these advantages, the study found no substantial evidence that foreign firms contributed to higher productivity or export growth. However, the presence of multinational enterprises (MNEs) was found to enhance the efficiency of local competitors through competitive pressure. Additionally, multinational firms were shown to provide training opportunities and social benefits to domestic suppliers, thereby contributing indirectly to capacity building within the local economy.

Empirical Studies on South Africa's Investment Climate and FDI Inflows

Maduku and Zerihun (2021) examined the relationship between foreign direct investment and economic growth in South Africa using time series data covering the period from 1980 to 2018. Their analysis employed the autoregressive distributed lag (ARDL) model alongside the vector autoregressive error correction mechanism. The results revealed no evidence of either unidirectional or bidirectional causality between FDI and economic growth in South Africa. These findings contrast with prevailing policy approaches that prioritize attracting foreign investment without adequately strengthening domestic enterprises. Instead, the results support the argument that FDI tends to follow economic growth rather than initiate it. Furthermore, Granger causality tests identified a significant relationship between economic growth and unemployment, with high unemployment levels exerting a negative effect on GDP. The study recommended that policymakers shift greater attention toward domestic investment, as supporting small and medium-sized enterprises can lower capital costs for new ventures and foster sustainable long-term growth.

Arvanitis (2021) investigated the underlying factors contributing to the recent decline in foreign direct investment in South Africa. The study emphasized the role of political and economic conditions, which have historically contributed to South Africa's partial isolation from global capital markets. These conditions include the imposition of trade and financial sanctions during the mid-1980s, subsequent financial crises, tightened capital controls, and the declaration of a moratorium on external debt payments. Using panel data from 17 countries covering the period 1984 to 2019, the study drew on information from the International Monetary Fund's World Economic Outlook and the World Bank's World Development Indicators. Variables examined included real exchange rates, trade openness, illiteracy rates, lagged GDP, tax revenue, telephone lines per 1,000 people, and country risk indices. The findings revealed that infrastructure development, trade liberalization, availability of skilled

labor, and market size significantly influence FDI inflows among countries comparable to South Africa. The study concluded that for South Africa to attract levels of foreign direct investment similar to those of its peer economies, substantial improvements are required in economic growth performance, telecommunications infrastructure, workforce skills, and overall market expansion.

Empirical Evaluations of Kenya's Investment Climate and FDI Inflows

Kinuthia (2020) conducted an in-depth examination of foreign direct investment in Kenya with the aim of identifying the major factors that influence both the inflow and outflow of foreign direct investment into the country. The study also assessed how foreign direct investment relates to these determining variables over time. To achieve this, a range of macroeconomic indicators were incorporated into the analysis, including gross domestic product measured in Kenyan shillings, total external debt expressed in United States dollars, real interest rates measured in percentage points, the level of economic openness, inflation measured using the GDP deflator, the current account balance denominated in United States dollars, and foreign exchange reserves also stated in United States dollars. The data gathered were analysed using multiple regression techniques. The results showed that foreign direct investment inflows into Kenya increased when the economy became more open, real interest rates declined, inflationary pressures eased, external debt levels reduced, and foreign exchange reserve conditions improved.

METHODOLOGY

Theoretical Framework

This study is grounded in the Cobb Douglas production function, which serves as the theoretical foundation for the analysis. The Cobb Douglas production function is widely applied in empirical research because it clearly explains the relationship between production inputs and output or income levels within an economy. The model establishes how variations in the inputs of production translate into changes in output. In particular, the Cobb Douglas framework emphasizes the importance of labour efficiency and capital investment in enhancing productivity and output growth. Capital, often proxy by investment, and labour are treated as fundamental inputs whose effective utilization contributes significantly to increased production. The functional form of the Cobb Douglas production function is presented as follows:

$$\text{Because } Q = AK^{\beta}1L^{\beta 2} \qquad (3.1)$$

In this context, K denotes the stock of capital resources employed in the production process, L represents labour input, and Q signifies the level of output generated. The responsiveness of output to changes in labour and capital is captured by the coefficients β1 and β2 respectively, while A represents a constant term that reflects the underlying level of technology. For the purpose of this study, labour is operationalized as the total number of workers or employees, whereas capital is proxied by the monetary value of fixed assets. On the basis of these

definitions and assumptions, the theoretical framework of the model can be expressed in mathematical terms after linearization as follows:

$$A + \beta 1 \log K + \beta 2 \log L = \log Q \quad (3.2)$$

An additional econometric specification of equation (3.2) would be as follows:

$$\log Q = A + \beta 1 \log K + \beta 2 \log L + \mu \quad (3.3)$$

where the error term is μ.

Because it explicitly connects the most critical productive inputs to output levels within a firm's production process and constitutes one of the core theoretical foundations of the theory of the firm, the Cobb Douglass production function is considered suitable for this study. This model has been widely applied in empirical research to examine firm behaviour and production relationships, which further justifies its relevance. Consequently, the theoretical relationship embodied in the Cobb Douglass production function provides the conceptual basis upon which this investigation is anchored.

Model Specification

A wide range of empirical models has been developed in the economics literature to identify and explain the factors that attract foreign direct investment. This study adopts the analytical framework proposed by Njuguna and Nnadozie (2022), who established that certain investment climate variables constitute the primary determinants of foreign direct investment inflows. According to their framework, the following investment climate characteristics were identified as the key drivers of FDI:

$$FDI = f(Xj, Yk, Wp, Zq) \quad (3.4)$$

Where:

The economic variables, 1 … J, including inflation, exchange rates, and other macroeconomic aspects, are denoted by the symbol Xj Y_k = stands for policy variables, 1 … K, including corporate norms and regulations and trade openness.

W_p = denotes political risk or governance factors, 1 … P, like conflict, war, corruption, etc. Z_q = denotes additional variables, 1 … Q, including market size, labour cost, human capital, and endowment of natural resources.

According to the World Bank (2021), a number of important environmental qualities are considered when evaluating investments, such as pollution, energy efficiency, lower emissions, and adherence to legal and environmental safety requirements. Consequently, we modify the model in this way:

$$FDI = f(X_j, Q_k, K_q) \quad (3.5)$$

Where:

The economic investment climate variables, 1 … J, such as the GDP, inflation rate, and ease of doing business index, are denoted by Xj =. Q_k = stands for political investment variables, 1 … K, including the quality of institutions, corruption perception index, and political stability

index. Kq = stands for environmental investment climate variables, 1 … q, including population density, rate of air and land pollution, and nitrous oxide emissions.

We create a new variable called political investment climate variables (Q_k) by combining policy variables (Y_k) and governance variables (W_p) in the model of Njuguna and Nnadozie (2022). We also include environmental investment climate variables (K_q) to the modified model.

In an econometric relationship, the functional equation 3.5 above can be written as follows:

$$FDI_t = \mu + \alpha'xt + \beta'qt + \lambda'kt + \varepsilon t \quad (3.6)$$

Where:

μ is a constant. The vectors of parameters that need to be estimated are α', β', and λ′. The foreign direct investment value at time t is known as FDIt, and it is determined by the explanatory variables (xit, x2t,...,x3t) = x't, (qit, q2t,...,q3t) = q't, and (kit, k2t,...,k3t) = q't) = k't as previously defined; and the stochastic error term is denoted by εt. The following is a mathematical representation of the a-priori expectation:

They are $\alpha'1 > 0$, $\beta' > 0$, and $\lambda' > 0$.

The economic, political, and environmental investment climate factors should all be greater than zero, meaning they should be positively correlated with foreign direct investment inflows into South Africa, Ghana, Nigeria, and Kenya.

Sources of Data

Ghana, Kenya, Nigeria, and South Africa are all in Africa, were the subjects of the study. The World Bank's World Development Indicator (WDI) database is the source of the data. The data collected from the WDI database spanned the years 2000 through 2021.

Method of Analysing Data

Panel ARDL, or Panel Least Square Analysis

Prior to undergoing a regression analysis, data is gathered over an extended period of time and across several dimensions (or businesses). The following is the related equation: By adding b1X1n and b2X2n, Y = α +.... bnXn plus e [iv] where n is the data dimension, α is the estimated slope, b1 is the estimated intercept of the first predictor, b2 is the estimated intercept of the second predictor, etc., and Y is the response (dependent variable), X1 is the first predictor (first independent variable), and X2 is the second predictor (second independent variable). The error term, or a collection of additional variables that may have an impact on the model but are not part of the current model, is represented by the letter e.

Estimation of Panel ARDL Models

The t-statistics, which will be utilised to test the study's hypotheses, are obtained by dividing the coefficient by the standard error. Below is a detailed discussion of these:

The degree to which the data fits the model is indicated by the coefficient of determination R^2 or its modified form $\bar{R}^2$. This is provided by:

$$R^2 = \frac{\hat{B}^T X^T Y - (\sum Y)^2 / n}{Y^T Y - \left(\frac{\sum Y}{n}\right)^2}$$

Or its adjusted form:

$$\bar{R}^2 = (1 - R^2)\frac{(n-1)}{n-k}$$

If R^2 or its adjusted form $\bar{R}^2$ is high (i.e., above 50%), it shows a good fit for the model. The higher the R^2 or $\bar{R}^2$ the better the model fitness.

A high R^2 or its modified form $\bar{R}^2$ (over 50%) indicates that the model fits the data well. The better the model fitness, the higher the R^2 or $\bar{R}^2$.

Hypothesis test:

The variables' individual significance is ascertained using the t-statistics. This is how the t-statistic is calculated; where the standard error of bi is denoted by $SE(b_1)$. Here are the statements for the alternative and null hypotheses:

H0: X and Y don't significantly relate to one another.

H1: X and Y have a substantial link.

The probability value of the t-calculated or t-statistic is equivalent to the risk that the t-test table indicates for the computed t-value. The following is the decision rule:

Decision Rule: The null hypothesis is rejected if the t-statistic's probability value is less than the 0.05 critical value. Nonetheless, we accept the null hypothesis if the t-statistic's probability value is higher than the 0.05 crucial threshold. An alternative method is to compare the t-calculated and t-tabulated, where table = tα/2,n-k. If the t-statistic value is higher than the t-table value at the 5% level of significance, the null hypothesis is rejected; if not, the null is accepted.

The F-test, or joint test: This examines the explanatory variables' combined importance. We attempted to determine the importance of the combination of the explanatory factors, which is why the joint test is required. The F-statistic's calculation is displayed below.

Source of variation	Degree of freedom	Sum of squares	Mean square	F- ratio
Regression	k-1	$RSS = \hat{B}^T X^T Y - 1/n\left(\sum y\right)^2$	$RSS/(K-1)$	$\frac{RSS/(K-1)}{ESS/(n-k)}$

Source of variation	Degree of freedom	Sum of squares	Mean square	F- ratio
Residual (Error)	n-k	$ESS = Y^T Y - \hat{B}^T X^T Y$	$ESS/(n-k)$	
Total	n-k	$TSS = Y^T Y - 1/n\left(\sum y\right)^2$		

F-statistic = RMS/EMS

And the F-table is = Fα;n-k, where k is the number of variables in the model, n is the number of years investigated, and α is 5%. All of the variables are jointly significant if the F-statistic is higher than the F-table at the 5% level (Fcal > Ftab).

Test for Autocorrelation: The model's error terms will be tested for serial correlation using the Durbin Watson (DW) statistic. The following is the DW statistic:

$$d = \frac{\sum_{t=2}^{n}\left(e_t - e_{t-1}\right)^2}{\sum_{t-1}^{n} e_t^2}$$

The general statistical guideline holds that when the Durbin Watson statistic (d) is approximately equal to 2, the data set does not exhibit any noticeable autocorrelation. Conversely, when the value of d approaches 4, it suggests the presence of negative autocorrelation in the error term, whereas values close to zero indicate that the error term is affected by positive autocorrelation.

Root Test for Panel Units (Stationarity Test)

The data employed in this study combine both time series and cross sectional dimensions, thereby constituting panel data. In view of this structure, the study adopts the panel unit root testing procedure developed by Levin, Lin, and Chu (2002). The Levin, Lin, and Chu panel unit root test is widely recognized as a standard and reliable approach for assessing stationarity in panel data sets. Accordingly, this test is applied in the present study to minimize the risk of spurious regression results. To accurately establish the order of integration of the variables, the unit root test is conducted on each variable individually, given that the presence of unit roots is a common issue in time series data. It is a well-established econometric practice to transform non stationary data into stationary form before proceeding with estimation or modelling.

PRESENTATION AND ANALYSIS OF RESULTS

Unit Root Test for Panel Data

For panel regression analysis to produce valid and meaningful results, it is essential that the variables under consideration are stationary. When time series data lack stationarity, the

effects of shocks tend to persist indefinitely, which may lead to misleading or spurious regression outcomes. Table 1 below therefore presents a summarized report of the panel unit root test results obtained for the variables used in this study.

Table 1: Summary of the panel unit root test [*p-value in parenthesis*]

Variables	LLC test statistic			
	@Level	**@First Difference**	**Order of Stationarity**	**Decision**
FDI	-1.7847 [*0.3372*]	-2.7023 [*0.0034*]*	I(1)	Stationary at 1st difference
GDP	-3.4965 [*0.0002*]*	-3.0832 [*0.0010*]*	I(0)	Stationary at Level
INF	-4.1482 [*0.0000*]*	-5.7674 [*0.0000*]*	I(0)	Stationary at Level
PSI	0.3900 [*0.6517*]	-2.7901 [*0.0026*]*	I(1)	Stationary at 1st difference
CPI	0.1716 [*0.5681*]	-3.3029 [*0.0005*]*	I(1)	Stationary at 1st difference
POP	-4.0183 [*0.0000*]*	6.1452 [*0.0000*]*	I(0)	Stationary at Level
NO2	-1.1611 [*0.1228*]	-6.3250 [*0.0000*]*	I(1)	Stationary at 1st difference

Note: *Probabilities of the tests statistics are presented in parenthesis.*
***** *Indicates that the test statistic is significant at the 5% level*

Based on the panel unit root results reported in Table 1 above, more than half of the variables demonstrate stationarity at first difference, that is, at order one I(1), which reflects a fairly consistent pattern across the data set. Specifically, after taking the first difference, foreign direct investment (FDI), the political stability index (PSI), the corruption perception index (CPI), and nitrous oxide emissions (NO2) all become stationary, and their order of integration is therefore classified as I(1). In contrast, gross domestic product (GDP), inflation (INF), and population (POP) were found to be stationary in their level form without differencing, and as a result, their order of stationarity is denoted as I(0). The outcomes of this stationarity assessment suggest that the variables included in the model do not suffer from unit root problems and that their statistical properties remain stable over time. This further implies that there is no indication of a structural break within the series under consideration.

Cross Sectional Dependency Test

Furthermore, when estimated panel data exhibit cross sectional dependence, there is a strong possibility that conventional tests may lose statistical power. In light of this concern, the present study applies the cross sectional dependency test in order to ascertain whether cross sectional dependence exists among the variables in the panel.

H0: *There is cross-section independence*
H1: *There is cross-section dependence.*
The result is summarized in the Table 2 below.

Table 2: Cross-Sectional Dependency Test

Test	Statistic	d.f.	p-value
FDI	4.0542	6	0.0001
GDP	10.8232	6	0.0000
INF	-4.4437	6	0.0488
PSI	9.1209	6	0.0023
CPI	2.4437	6	0.0145
POP	11.7099	6	0.0000
NO2	3.9944	6	0.0461

Source: Extracted from EViews Output

Table 2 presented above provides strong empirical grounds for rejecting the null hypothesis of cross-sectional independence in the residuals of the panel data. This outcome indicates that the cross-sectional units included in the panel model are mutually dependent. In practical terms, this means that an inflow of foreign direct investment into one country is likely to exert spill over effects on other countries within the panel. For example, changes in FDI inflows in country A may influence investment dynamics in country B, and vice versa. This observed interdependence further justifies the selection of countries drawn from different parts of Africa, as these economies tend to share similar structural features and economic trajectories. Given that the variables in the model exhibit mixed orders of integration, specifically I(0) and I(1), the analysis therefore proceeds to examine whether a long run equilibrium relationship exists among them.

Panel Cointegration Test

In analysing panel data, the Johansen Fisher panel cointegration approach posits that for a long run relationship to be established, the set of variables under consideration must yield at least one cointegrating equation. This testing procedure relies on two key statistics, namely the Trace statistic and the Maximum eigenvalue statistic, to determine the presence and number of cointegrating relationships. The results of the Johansen Fisher panel cointegration test applied in this study are presented in Table 3 below.

Table 3: Summary of the Johansen Fisher Panel Cointegration Test

Hypothesized	Fisher Stat.*		Fisher Stat.*	
No. of CE(s)	**(from trace test)**	**Prob.**	**(from max-eigen test)**	**Prob.**
None	39.61	0.0000	39.61	0.0000
At most 1	172.7	0.0000	77.20	0.0000
At most 2	101.6	0.0000	51.36	0.0000

Hypothesized	Fisher Stat.*		Fisher Stat.*	
At most 3	60.03	0.0000	23.71	0.0026
At most 4	42.70	0.0000	16.03	0.0420
At most 5	37.04	0.0000	21.25	0.0065
At most 6	36.66	0.0000	36.66	0.0000

Source: Extracted from EViews's Output (See Appendix)

All the estimated cointegrating equations report statistically significant p values. This outcome implies the existence of a stable long run relationship across all meaningful linear combinations of the variables included in the model. Given that the model is capable of generating up to six cointegrating vectors, the results obtained at the 5 percent level of significance provide clear and convincing evidence that cointegration exists among the variables. The presence of this long run equilibrium relationship confirms that investment climate related factors exert a sustained influence on foreign direct investment inflows in South Africa, Ghana, Nigeria, and Kenya over time. This also indicates that the magnitude and direction of the influence of the investment climate on foreign direct investment inflows are not uniform, but rather vary and fluctuate across South Africa, Ghana, Kenya, and Nigeria.

Panel ARDL Long Run Estimates

Presented below is a summary of the estimated long run coefficients, which illustrate the manner in which key investment climate variables influence foreign direct investment inflows into Ghana, Kenya, Nigeria and South Africa over the long term.

Table 4: Summary of the Panel ARDL long run estimates

Variables	Coefficient	Std. Error	t-Stat.	*p-value*
GDP	2.013834	0.425887	4.728562	0.0000
INF	0.426898	0.223089	1.913578	0.0641
PSI	-0.095517	0.018024	-5.299434	0.0041
CPI	-0.136758	0.041052	-3.331336	0.0414
POP	-10.71465	3.698794	-2.896796	0.0065
NO2	6.801914	1.459327	4.660995	0.0000

Source: Extracted from Eviews Output (See Appendix),

Note: *Fixed and Random effects (FE and RE) were not considered since the model assumes CD dependence. This indicates that what occurs in any of the selected countries is extremely independent of the others.

The estimation results presented above reveal that patterns of economic growth exert a positive and substantial long run influence on foreign direct investment inflows into South Africa, Ghana, Kenya, and Nigeria. This effect is reflected in the estimated coefficient of 2.014 percent, which suggests that variations in economic growth trends, as captured by gross domestic product, account for a corresponding increase of 2.014 percent in foreign direct

investment inflows. In addition, the inflation rate appears to be associated with an increase of approximately 0.427 percent in foreign direct investment inflows within the region; however, the reported probability value of 0.064 indicates that this relationship does not attain statistical significance at conventional levels. Based on these outcomes, it can be inferred that although the effect of inflation is relatively weak and statistically insignificant, the overall economic investment climate plays a favourable role in stimulating foreign direct investment inflows into Ghana, Kenya, Nigeria and South Africa.

Panel ARDL short run estimates

Table 5: Summary of the short run estimates

Variables	Coefficient	Std. Error	t-Stat.	*p-value*
COINTEQ01	-0.675870	0.266549	-2.535630	0.0160
D(GDP)	-2.326154	2.633808	-0.883191	0.3833
D(GDP(-1))	-0.236237	0.841599	-0.280700	0.7806
D(INF)	-0.074654	0.385579	-0.193616	0.8476
D(PSI)	0.647437	0.334904	1.933203	0.0616
D(PSI(-1))	0.299241	0.685016	0.436838	0.6650
D(CPI)	-1.723937	1.256941	-1.371534	0.1792
D(CPI(-1))	-0.398749	1.290587	-0.308968	0.7592
D(POP)	-42.51690	45.17984	-0.941059	0.3533
D(POP(-1))	-20.80223	14.61900	-1.422958	0.1639
D(NO2)	-1.862271	3.109794	-0.598841	0.5532
D(NO2(-1))	-1.499360	3.815828	-0.392932	0.6968
C	-35.83262	15.41612	-2.324361	0.0262

Source: Extracted from Eviews Output

Note: *Fixed and Random effects (FE and RE) were not considered since the model assumes CD independence

The long run estimates that illustrate the manner in which investment climate determinants influence the inflow of foreign direct investment into South Africa, Ghana, Nigeria, and Kenya are presented in summary form below.

The error correction term of the panel model, denoted as CointEq01, provides clear evidence of long run convergence within the system. In particular, the estimated error correction coefficient (CointEq01 = −0.6759) is appropriately signed, meaning that it is negative and statistically meaningful, which confirms the existence of a stable long run relationship among the variables. This long run convergence implies an expected annual speed of adjustment of approximately 67.59 percent, indicating that deviations from long run equilibrium in foreign direct investment inflows are corrected at a relatively fast rate. In practical terms, this suggests that foreign direct investment inflows into Ghana, Kenya, Nigeria and South Africa adjust upward by about 67.59 percent toward equilibrium when other investment climate variables are held constant.

Given that the lag selection criterion based on the Akaike Information Criterion (AIC) favoured only two lagged effects, the estimated short run coefficients reveal the presence of just two lagged influences of the explanatory variables on foreign direct investment. The results indicate that the panel ARDL framework relies on a single lag from the preceding year to capture the dynamic adjustment of lagged effects. Accordingly, it is observed that the political stability index in the current year and the immediately preceding year increases foreign direct investment inflows into the selected African countries by 0.2992 percent and 0.6474 percent, respectively. Although these coefficients are not statistically significant, they nonetheless indicate that political stability exerts a positive influence on foreign direct investment inflows in the short run. It is also noteworthy that all investment climate variables related to economic and environmental conditions exhibit negative effects in the short run. Since the associated probability values exceed the 0.05 level of significance, this outcome implies that gross domestic product, inflation rate, population density, and nitrous oxide emissions temporarily reduce foreign direct investment inflows into Nigeria, Ghana, Kenya, and South Africa, albeit in a manner that is not statistically significant.

Test of Hypothesis

The evaluation of the study's hypothesis is anchored on the t statistic values obtained from the long run estimates of the panel model. Based on the reported results, the null hypothesis, which posits that certain variables exert no observable influence on specific countries, is rejected. Consequently, the alternative view is upheld, indicating that environmental investment climate factors have a statistically significant impact on selected countries. This conclusion is supported by the significant probability values associated with nitrous oxide emissions and population density, which are reported as 0.0000 and 0.0065, respectively. On this basis, it is concluded that foreign direct investment inflows into Nigeria, Ghana, Kenya, and South Africa are significantly influenced by environmental investment climate factors, particularly population density.

SUMMARY OF FINDINGS, CONCLUSION, AND RECOMMENDATIONS

Summary

This study examined the effect of the investment climate on foreign direct investment inflows in South Africa, Ghana, Kenya, and Nigeria, with particular emphasis on economic and environmental qualities. The modified Cobb Douglas production model provided the theoretical foundation for the analysis, as foreign direct investment growth was treated analogously to output, while the investment climate variables were regarded as key inputs driving growth. The empirical analysis, conducted using the panel ARDL model, produced several notable findings. Specifically, population density was found to significantly reduce foreign direct investment inflows, whereas nitrous oxide emissions were observed to significantly increase foreign direct investment inflows across Nigeria, Ghana, Kenya, and South Africa.

Conclusion

An increasing population density was identified as a factor that constrains economic growth, largely because it diverts limited resources away from productive efficiency. While the prevailing economic climate within the region has facilitated foreign direct investment inflows, the sustainability of this trend remains uncertain, as environmental degradation and episodes of political instability may deter prospective investors. In addition, the study established that nitrous oxide emissions exert a substantial influence on foreign direct investment inflows in these countries as it reflects an increased industrialization which attract FDI seeking for expansion of production.

Recommendations

Based on the findings of the study, several policy recommendations are proposed. First, governments in South Africa, Ghana, Nigeria, and Kenya should intensify efforts aimed at expanding export-oriented production, as higher export output is likely to stimulate economic growth and enhance the attractiveness of these economies to foreign direct investors. Second, the challenge of rising population density, particularly in Nigeria, Ghana, Kenya, and South Africa, should be addressed through deliberate policies that promote increased productive capacity, especially in agriculture, as well as through sustained investment in skills development programs. Finally, environmental emissions, including nitrous oxide and similar pollutants, should be adequately disclosed, monitored, and regulated. Given that mining activities constitute a major source of environmental degradation, appropriate coordination of mining operations and strict enforcement of environmental standards are necessary to prevent health related concerns from discouraging foreign investors. In general, all forms of harmful emissions should be closely monitored and systematically reduced.

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