Innovations

Cost Implication of Oil Spillage and Gas Flaring by Oil Companies in Nigeria on the Nigerian Economy (2016-2023)

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Abstract: *The study investigated the cost implicationof oil spillage and gas flaring by oil companies in Nigeria on the Nigerian economy by examining 12 selected oil and gas companies in Nigeria over 8-year period (2016–2023), focusing on their financial performance. The population includes all oil and gas companies listed on the Nigerian Stock Exchange (NSE). The area of study is Nigeria, a major player in the global oil and gas industry. The study aims to analyse the effect of cost implication of oil spillage and gas flaring on economic growth, with proxy variables such as exchange rate and foreign direct investment. Secondary data was used from the annual reports of these companies, the Nigerian Stock Exchange, and other relevant industry reports.A panel regression model was used for data analysis. Specifically, a fixed effects model was employed to control the unobserved factors that may vary across companies but remain constant over time. The Hausman test was applied to determine whether a fixed or random effects model is more appropriate. Research results suggest balance of payments does not exhibit a unit root and is thus stable over time withs a coeff-6.64731, (P-value of 0.000, Results also show that coefficient for FDI is -4.04E-05 with a p-value of 0.7826, also suggesting insignificance. These findings imply that the financial costs associated with environmental damage in the oil and gas sector do not have a notable effect on macroeconomic indicators such as the exchange rate or foreign direct investment. The results emphasise those environmental costs, while significant in their own right, have a limited direct impact on these broader economic variables. The study recommends that promoting environmental sustainability in foreign direct investment (FDI) decisions and diversifying the economy can further reduce dependency on oil. The study also recommends developing compensation mechanisms for affected communities, increasing public awareness, and leveraging technology for environmental monitoring are crucial steps toward managing environmental risks and achieving long-term sustainability. Lastly, strengthening environmental regulations and ensuring compliance will help internalise the environmental costs of oil production.*

Keywords*: Oil Spillage, Gas Flaring, Balance of Payments, Exchange Rate, Foreign Direct Investment, Poverty, Human Development, Downstream Oil Activities*

Introduction

1.1 Background of Study

Since the Industrial Revolution, when crude oil was discovered, there have been oil spills all over the world. An estimated 0.7–1.7 million metric tonnes of petroleum are released into rivers, seas, and oceans annually because of human activity (www.science.irank.org). The environment in oil-producing regions has been seriously threatened by oil leaks, which, if left unchecked, might destroy entire ecosystems. According to Nwuba (2018), Niger Delta is one of the world's top ten crucial marine and wetland ecosystems. While the oil industry in this region has undeniably fueled national growth and progress, reckless oil exploration has placed the Niger Delta among the five most heavily degraded ecosystems globally as a result of petroleum exploitation. The Niger Delta in Nigeria's town of Oloibiri yielded crude oil discoveries in 1956,For Shell British Petroleum (now Royal Dutch Shell) (Anifowose, 2008; Onuoha, 2008), commercial crude oil production commenced in 1958. In Nigeria's Niger Delta, eleven oil companies operate 1,481 wells and 159 oil fields (The Guardian, 2006).

According to Agbola and Olurin (2003), the Niger Delta releases 1.8 billion cubic feet of gas into the atmosphere each day, generating temperatures high enough to support human habitation in a sizable area. This amounts to around 45.8 billion kilowatts of heat. One of the policies that oil firms are obliged to follow is the full utilisation of produced associated gas, the decrease of flaring, and the creation of greenhouse gases, with the complete cessation of gas flaring by 2004 or 2008. According to Ukoli (2005), 84.60% of the gas produced is still flared, and 14.86% is solely consumed locally.

Oil spillage is the term used to describe the seeping away of oil in the form of waste due to equipment failure during transportation and pollution during exploration and production. Many Nigerians are concerned that the massive amount of money wasted because of oil spills and gas flaring by Nigerian oil corporations' merits attention. 2,159 oil spills were reported between 1991 and 1996, according to data provided by the Department of Petroleum Resources (DPR) through NDEs vol. 1, p. 249 (Azaiki, 2009).

1.2 Statement of the Problem

Nigeria loses billions of naira a year as a result of waste and pollution from petrol flaring, smoke, oil spills, and effluent emissions from the oil extraction process. Every productive endeavour involves labour, and any environmental effects that have a detrimental influence on human health also directly harm the producing sector. Therefore, any business whose methods of production endanger the environment has a direct impact on the productive sector, which accounts for a significant portion of the GDP. The economic loss of aquatic life in riparian areas due to oil spills is a major factor in the study. Even at the subsistence level,

agricultural development has been negatively impacted in several economic sectors. According to reports, the town of Oloibiri, for example, was "raped, abused, and exploited; the once-bubbling oil-rich community is now a barren land, sucked dry of its natural endowment and its environment devastated by serial oil spillages and pollution." According to a 2006 United Nations Development Programme (UNDP) report on the effects of gas flaring on agriculture, there is a direct correlation between the two.

1.3 Objectives of the Study

The general objective of the study is to evaluate the cost implications of oil spillage and gas flaring by oil companies in Nigeria on the Nigerian economy between 2006 and 2023. The specific objectives are:

1. Evaluate the cost implications of oil spillage and gas flaring on the exchange rate in Nigeria between 2006 and 2023.
2. The cost implications of oil spillage and gas flaring have no significant positive impact on foreign direct investment (FDI) in Nigeria between 2006 and 2023.

1.4 Statement of the Hypotheses

The following hypotheses formulated in null forms are in line with the specific objectives of the study:

1. The cost implications of oil spillage and gas flaring have had no significant positive impact on the exchange rate in Nigeria between 2006 and 2023.

2. The cost implications of oil spillage and gas flaring have no significant positive impact on foreign direct investment (FDI) in Nigeria between 2006 and 2023.

1.5 Limitation of the study

Part of the limitations whichwere encountered along the course of this research:
Accuracy and Availability of Data: Reliable data on the frequency, scale, and economic impactof oil spills, and gas flaring costs are either hard to come by or are inconsistent. There is a high rate of underreporting and unreported occurrences, and the data that is provided may be inaccurate or out of date.

Review of Related Literature

2.0 Conceptual Review

2.1.1 Oil Spillage

An estimated 9 million-13million (1.5million tons) of oil has been spilled into the Niger Delta ecosystem over the past 50years; 580 times the estimated volume spilled in ExxonValdez oil spill in Alaska 1989 (FME, NCP, WWF UK,

CEESP-IUCN 2006). The first oil spill in Nigeria was at Araromi in the present Ondo state in 1908 (Tolulope, 2004). In July 1979 the Forcados tank 6 Terminal in Delta state incidence spilled 570,000 barrels of oil into the Forcados estuary polluting the aquatic environment and surrounding swamp forest (Ukoli, 2005; Tolulope, 2004). The Funiwa No. 5 well in Funiwa Field blew out an estimate 421,000 barrels of oil into the ocean from January 17th to January 30th, 1980, when the oil flow ceased (Ukoli, 2005; Gabriel, 2004; Tolulope, 2004), 836 acres of mangrove forest within six miles off the shore was destroyed. The Oyakama oil spillage of 10th May 1980 with a spill of approximately 30,000bbl (Ukoli, 2005).

In August 1983 Oshika village in River state witnessed a spill of 5,000 barrels of oil from Ebocha-Brass (Ogada-Brass 24) pipeline which flooded the lake and swamp forest, the area had previously experienced an oil spill of smaller quantity; 500 barrels in September 1979 with mortality in crabs, fish, and shrimp. Eight months after the occurrence of the spill there was high mortality in embryonic shrimp and reduced reproduction due to oil in the lake sediments (Gabriel, 2004). The Ogada-Brass pipeline oil spillage near EtiamaNembe in February 1995 spilled approximately 24,000 barrels of oil which spread over freshwater swamp forest and into the brackish water mangrove swamp. The Shell Petroleum Development Company (SPDC) since 1989 recorded an average of 221 spills per year in its operational area involving 7,350 barrels annually (SPDC Nigeria Brief, May 1995:).

2.1.2 Gas Flaring

The burning of natural gas that could have been processed into products that could be used is known as gas flaring (Bankoff, 2003). High, towering pipes and surface flaring are used to flare gas. Around 4% of gas flares occur worldwide on average. According to a 2004 Human Rights Watch research, flares account for more than 70% of associated gas in Nigeria. A record 25% of the world's gas flares occurs in Nigeria. Gas flares were to be banned by the year 1985. The Federal Ministry of Environment established a 2004 deadline for gas flare outs in 2002. Shell proposed 2008 as an additional deadline, whereas Exxon Mobil proposed 2006 as the date. As of 2014, not one of the several flare sites has been shut down. Nigeria possesses enough gas to last for 35 years, or 29 billion barrels of crude oil. Approximately 5.5 billion cubic feet of gas are produced daily in Nigeria. Roughly 40%, or 2.6 beef, is used, and 60%, or 2.9 beef, is wasted due to flaring (NNPC, 2002), which degrades the environment.

2.1.3 Poverty

Lack of needs is poverty in the broadest sense. Based on common ideals of human dignity, most people believe that basic needs including food, shelter,

healthcare, and safety are essential (Bradshaw, 2007). Relative deprivation is the fundamental definition of poverty, according to Valentine (1968). Gordon (2005) argues that poverty is essentially a loss of possibilities and choices, a violation of human dignity. It denotes a fundamental inability to engage in productive social interaction. It entails not having enough to provide for a family's food and clothing, not being able to attend a clinic or school, not owning a piece of land where one can grow food or a job that pays well, and not being able to obtain credit. It denotes uncertainty, helplessness, and social marginalisation for people as individuals, families, and communities. It often indicates living in a precarious setting without access to clean water or sanitary facilities, as well as being vulnerable to assault.

2.1.4 Foreign Direct Investment (FDI)

Foreign direct investment (FDI) refers to an investment characterised by a long-term commitment and sustained influence by an entity from one economy (known as the foreign direct investor or parent company) in a business based in a different economy (referred to as the FDI enterprise, affiliate, or foreign affiliate). This type of investment suggests that the investor has considerable influence over the management of the enterprise in the host economy. FDI includes not only the initial transaction between the two entities but also all subsequent dealings, including those among foreign affiliates, whether incorporated or not. Individuals and business entities alike can engage in FDI. (Vella and Sammut-Bonnici, 2015).Foreign direct investment (FDI) occurs when residents from one country (the source country) obtain ownership of assets to oversee the production, distribution, and other operations of a business in a different country (the host country). According to the International Monetary Fund's Balance of Payments Manual, FDI is defined as an investment made to secure a lasting interest in a business that operates outside the investor's own economy, with the goal of obtaining a significant say in the enterprise's management (Moosa, 2002).

2.1.5 Balance of Payment

The balance of payment is a report detailing a country's international transactions for a specific time frame (Lagoarde, Segot, 2023). According to Imoisi (2012), a country's trading position and foreign financial transactions are documented in its balance of payments. In the field of international economics, the notion of balance of payments (BOP) is crucial. All a country's monetary dealings with other countries are documented in it. The current account and the capital account are the two primary components of it (Haekal, 2022). If more money is flowing into the country, the balance of payments (BOP) will be in surplus. If more money is flowing out, the BOP will be in deficit. The value of a country's currency and its stock of foreign currency reserves can both drop if its balance of payments is negative (Lioudis, 2022).

According to Arnold (2011), economic growth is associated with enhancing people's quality of life through improving packaged goods and services, reducing risk, and fostering innovation and entrepreneurship. This is achieved using recent technological developments and improvements in infrastructure. The primary goal of economic development, according to Afuberoh and Okoye (2014), is to ensure that local communities and regions can produce goods in sufficient quantities to be exported to other countries, while also providing a favourable environment for businesses to thrive. In addition to indicators like water supply, transport networks, health, and education that can be used to gauge economic development, the human development index (HDI) is a globally accepted metric for measuring long-term progress and the welfare of citizens (Grace David and Oliver, 2016).

2.1.6 Exchange Rate

The theoretical value of one currency relative to another is known as its exchange rate; in Nigerian terms, this would be the number of naira required to buy one US dollar (Campbell, 2010). Foreign exchange policy encompasses all the measures and institutional frameworks put in place by a government to influence the exchange rate in a specific way, with the goals of stimulating production, reducing inflation, maintaining internal stability, increasing exports, and attracting FDI and other forms of capital inflows (Obaseki, 2001). As a reflection of the institutional framework, system of determining and allocating foreign exchange rates, and policy options for managing these fluctuations, exchange rate policy also establishes the mechanism for channeling foreign exchange to end-users. An expanding economy can generate more commodities and services in comparison to a previous period (Amadeo, 2018).

2.2. Theoretical Review.

2.2.1 ConflictTheory

The conflict theory was developed by Karl marx in 1840s-1860s. The theory explains that competition for scarce resources is an inevitable part of any society, according to German philosopher Karl Marx, who initially put the idea forward in the nineteenth century. Marx utilised the theory to elucidate how capitalist systems oppress the working class. There is, in his view, a bourgeoisie at the top and a proletariat at the bottom. Domination, not consensus, is how the bourgeoisie keeps society in order. Since then, conflict theory has been utilised by contemporary sociologists to elucidate gender, racial, religious, and occupational power dynamics. Ralf Dahrendorf (1929-2009), a prominent sociologist who developed class conflict further in his work emphasised the importance of authority and power in modern society and argued that conflicts exist in many institutions beyond just economic structures.

2.2.2 Dispersion Theory

The dispersion theory on economic development was developed by Walter W. Rostow (1960) According to the dispersion theory, sectorial changes in demand that necessitate time for labour reallocation could explain a significant portion of the unemployment rate. During this process, fiscal variables and specialisedlabour and capital are allocated as a result of exogenous allocative shocks. The rate of allocation can be affected by the type of disruptions (Davis, 1987). Assuming a constant relative price of oil, Loungani (1986) argues that fiscal factors and the distribution of unemployment have minimal residual explanatory power for changes in the aggregate unemployment rate. Consequently, he reasoned that this finding could suggest that shocks to oil prices could have major real-locational effects on the US economy. Further, Loungani noted that, as was the case at the time, a great deal of inter-industrial reallocation of labour and fiscal factors may have been engaged in the oil price shocks of the 1950s and 1970s.

2.3. Empirical Review

2.3.1 Oil Spillage, Gas Flaring andExchange Rate in Nigeria

Yuan and Chen (2023) conducted research examining the dynamic link between global crude oil prices and the RMB exchange rate, focusing on the two-way spillover effects of these fluctuations. The study aimed to assess how changes in international crude oil prices impact the RMB exchange rate. To analyze this relationship, the researchers employed a two-way spillover model, vector autoregression (VAR) models, Granger causality tests, and spillover index methods. The findings indicated that fluctuations in international crude oil prices significantly influence the RMB exchange rate.

Shakibaei et al 2009 examined the long-term relationship between oil prices and exchange rates within the OPEC region. The research sought to determine whether a stable, long-term equilibrium exists between oil prices and exchange rates among OPEC countries. Using a Panel Random Effects model, the study found that oil prices are the primary driver of exchange rate fluctuations and that a lasting relationship exists between the two.

Abwaku, Omolari, and Ogunleye (2010) conducted research on the link between oil prices and exchange rate volatility in Nigeria, specifically analyzing how oil price changes influence the stability of the Nigerian naira. The study aimed to assess the effects of oil price shocks on exchange rate stability in Nigeria, utilizing the co-integration technique and vector error correction model (VECM). Findings indicated that oil price fluctuations significantly affect exchange rate volatility, underscoring Nigeria's reliance on oil exports.

Hung (2019) examined the relationship between oil prices and exchange rates in China, India, and South Korea, aiming to understand the interdependence between these variables. The study employed a Copula-based Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model. Results showed that the effects of rising oil prices on exchange rates differ from those of falling prices, underscoring the need to consider asymmetry in policy development.

Zankawah and Stewart (2020) conducted research on the volatility spillover effects of crude oil prices on Ghana's exchange rate and stock market. The study aimed to assess how global oil price fluctuations affect the Ghanaian cedi and stock market performance. Using a Multivariate Generalized Autoregressive Conditional Heteroskedasticity (MGARCH) model, the study found that oil prices have a substantial spillover effect on exchange rates, with the Ghanaian cedi showing significant sensitivity to changes in oil prices.

2.3.2 OilSpillage, Gas Flaring andForeign Direct investment (FDI)

Alavinasab (2009) conducted research to identify the economic factors influencing foreign direct investment (FDI) in Iran. The study aimed to uncover the various economic determinants affecting FDI inflows into the country. Utilizing a straightforward econometric model and least squares method, the findings indicated that real GDP growth, the ratio of imports to GDP, return on investment, and infrastructure positively and significantly impact foreign direct investment (FDI).

Barrage, Chyn, and Hastings (2020) conducted a study to examine the impact of corporate advertising on public perception and consumer behavior in the context of environmental stewardship, using the BP oil spill as a case study in theUnited States. The study aims to evaluate the consumer response to the 2010 British Petroleum (BP) oil spill and test how BP's investment "Beyond Petroleum" green advertising campaign affected this response. The study utilized the use of empirical analysis and econometric techniques for these. The results revealed that firms may have incentives to engage in green advertising without investments in environmental stewardship.

Ikechukwu (2013) conducted a study to examine the effects of gas production., utilization, and flaring on Nigeria’s economic growth. He claims that a nation's development is dependent on its resources and that this is proven by the fact that nations' development policies have been shaped by the money that comes from natural resources, particularly the oil and gas industry.This study uses multiple linear regression analysis to determine how gas production, utilisation, and flaring affect the projected monetary worth of Nigeria's goods and services (GDP). The results revealed that gas usage boosts GDP, whereas gas production and flaring have the opposite effect.

Samuel, Mills, Zhao, and Mills (2013) conducted a study on the relationship between foreign direct investment (FDI) and economic growth in Ghana. The study seeks to analyse how foreign direct investment affects various indicators of economic growth, including GDP, GDP growth rate, GNI, manufacturing value added, external debt stock, inflation, trade, and value added by industry. Using empirical evidence from Ghana. Annual data from IMF International Financial Statistics tables and ordinary least squares (OLS) regressions were used. The results revealed that if there is an increase in FDI inflow, there is also a lead which in turn enhances the economic growth in Ghana.

Udoayang (2013) carried out a study examining the economic impact of oil spills and gas flaring on the socio-economic development of Nigeria's Niger Delta region. The research aimed to evaluate the financial losses resulting from gas flaring and oil spills and their effects on the region's socio-economic progress. The study utilized a survey research method, and the findings indicated that total revenue losses from oil spills and gas flaring were influenced by the frequency of spills and the volume of gas and oil flared.

Al-Khouri (2015) conducted research to identify the factors influencing foreign direct investment (FDI) flows in the Middle East and North Africa (MENA) region. The study aimed to analyze the determinants of FDI among the 16 economies in the MENA region. Utilizing panel data from 1984 to 2012 and the generalized method of moments (GMM) technique, the findings confirmed the agglomeration effect, suggesting that countries with existing FDI are more likely to attract additional FDI in the future.

3 Methodology

3.1 Research Design

The research employs panel datawhich allows for the examination of both cross-sectional (across companies) and time-series (over time) aspects of the dataset.This study examines 12 selected oil and gas companies in Nigeria over 8-year period (2016–2023), focusing on their financial performance.

3.2 Area of Study and sources of data

The area of study is Nigeria, a major player in the global oil and gas industry. The study aims to analyse the effect of cost implication of oil spillage and gas flaring on economic growth, with proxy variables such as exchange rate and foreign direct investment. Secondary data was collected from the annual reports of these companies, the Nigerian Stock Exchange, and other relevant industry reports.

3.3 Population of the study

The population includes all oil and gas firms registered on the Nigerian Stock Exchange (NSE). Panel data was used, which allows for the examination of both cross-sectional (across companies) and time-series (over time) aspects of the dataset. This combination of data types helps address issues like heterogeneity and provides more accurate insights into company performance.

3.4 Method of data analysis

A panel regression model was used for data analysis. Specifically, a fixed effects model was employed to control unobserved factors that may vary across companies but remain constant over time. The Hausman test was applied to determine whether a fixed or random effects model is more appropriate.

3.5 Model specification

The basic panel regression model specification is;

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 Z_{it} + \alpha_i + \epsilon_{it}$$

Where;
Y_{it}= Dependent variable (e.g., FDI and EXR) at time t
X_{it}= Vector of independent variables (oil spillage and gas flaring)
β_0= Intercept,
β_1, β_2= Coefficient of the independent variables,
α_i= Unobserved industry specific effect (fixed effect)
ϵ_{it}= Error term

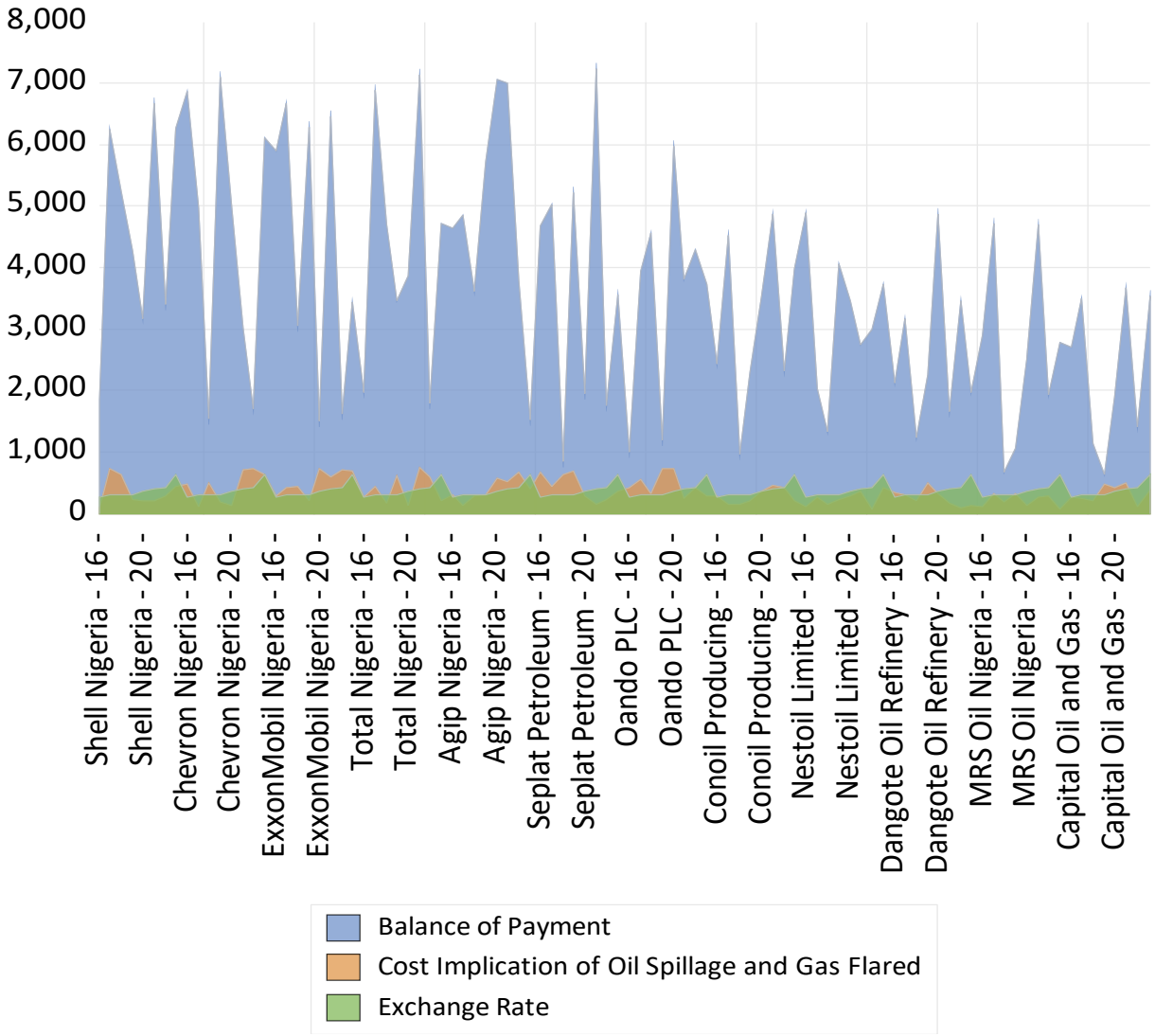

Fig 1: Line plot of the study variable

4 Data Presentation And Analysis

Table 1: Descriptive Statistics

	Balance of payment	**Cost Implication of oil spillage and gas flaring**	**Exchange Rate**
Mean	3649.104	354.5544	374.1831
Median	3521.850	302.6032	332.8659
Maximum	7237.225	741.1487	635.2360
Minimum	634.8812	67.69046	253.4920
Std.Dev	1829.846	196.2032	112.5031
Skewness	0.284565	0.524924	1.359662
Kurtosis	2.093947	2.160520	3.926659
Jarque-Bera	4.579368	7.227626	33.01366
Prob.	0.101298	0.026949	0.000000

Source: Eview 13.0

Table 1 is the result of the descriptive statistics which reveal important trends in the balance of payments, cost of oil spillage and gas flaring, and exchange rate for the period under study. The balance of payments has a mean of 3,649.104, indicating that on average, the country maintained a positive balance during the period. However, with a standard deviation of 1,829.846, there were significant fluctuations, suggesting periods of both surplus and deficit. These fluctuations could be driven by changes in trade, capital flows, or macroeconomic conditions.
The cost of oil spillage and gas flaring has a mean of 354.5544, reflecting the financial burden of environmental damage in the oil and gas sector. A relatively high standard deviation of 196.2032 indicates that the cost of environmental damage varies significantly, likely due to differences in the frequency and scale of oil spills or gas flaring events across time. These findings highlight the environmental and financial challenges faced by the oil and gas industry in addressing such issues.
Lastly, the exchange rate shows a mean of 3,741,831, suggesting significant depreciation of the local currency. Despite the high mean, the standard deviation is 112.5031, indicating that the exchange rate has remained relatively stable, with only minor fluctuations during the period studied. This stability might be attributed to government interventions or policies in the foreign exchange market, even though the high average exchange rate points to underlying macroeconomic challenges such as inflation or currency devaluation.

3.0 Result of panel unit root test

This study employs the Levin and Chu test (LLC), ImPesaran and Shin test (IPS), and Phillip Perron (PP) Chi-Square Panel unit root statistics to examine whether the balance of payments, cost implications of oil spills and gas flaring, and exchange rates contain a unit root. For the sake of convenience, we focus on the Levin and Chu (LLC) test statistics, as they are likely to yield more reliable results regarding the panel integration properties of the variables. The other tests, including the ImPesaran and Shin (IPS) test and the Phillip Perron (PP) Chi-Square Panel unit root statistics mentioned in Table 1, are included solely for academic interest. Ultimately, this study uses the Levin and Chu (LLC) test, as shown in Table 1 below, to assess the stationarity of the variables. The results from the panel unit root test indicate that the balance of payments, the cost implications of oil spills and gas flaring, and exchange rates are all stationary at the level stage.

Table 2: Panel Unit Root Test

	LLC	IPS	PP Test	Integration Order
Balance of payment	-6.64731 [0.0000]	-2.37659 [0.0087]	117.309 [0.0000]	**I (0)**
Cost Implication of oil spillage and gas flaring	-6.2715 [0.0000]	-0.93571 [0.1747]	55.1191 [0.0003]	**I (0)**
Exchange Rate	19.3953 [0.0001]	8.56057 [0.0001]	0.00019 [1.0000]	**I (0)**

Source: Eview 13.0

The panel unit root test using the Levin, Lin, and Chu (LLC) method reveals that all three variables balance of payments, cost implications of oil spillage/gas flaring, and exchange rate are stationary. The balance of payments shows a negative coefficient of -6.64731 and a highly significant probability value of 0.000, indicating that the series does not have a unit root. This suggests that the balance of payments data is stable over time, making it suitable for further time-series analysis. For the cost implications of oil spillage and gas flaring, the LLC test result shows a coefficient of -6.2715 and a p-value of 0.000, confirming stationarity. The absence of a unit root implies that the financial impacts of environmental damage in the oil and gas sector remain consistent across the study period, allowing for reliable econometric modeling and trend analysis in this context.

The exchange rate presents a positive coefficient of 19.3953, but with a probability value of 0.000, which also leads to the rejection of the null hypothesis of a unit root. This result confirms that the exchange rate data is stationary, despite the fluctuations in value over time. As with the other variables, this stationarity supports the use of the exchange rate in further regression analysis without the risk of spurious correlations.

Table 3: Bivariate Correlation of all the variables

Correlation	Balance of payment	Cost Implication of oil spillage and gas flaring	Exchange Rate
Balance of payment	1		
Cost Implication of oil spillage and gas flaring	0.1229852	1	
Exchange Rate	0.0246566	0.0499567	1

Source: Eview 13.0

Table 3 is the correlation between the cost implication of oil spillage/gas flaring and the balance of payment shows a weak positive relationship, with a coefficient of 0.1229852. This indicates that as the environmental costs in the oil and gas sector rise, there is a slight improvement in the balance of payments, though the relationship is not strong. This suggests that while there may be some connection,

other factors likely play a more significant role in determining the balance of payments.

Similarly, the correlation between the cost of oil spillage/gas flaring and the exchange rate is extremely weak, with a coefficient of0.0246566**.** This near-zero positive relationship indicates that changes in the environmental costs have almost no effect on the exchange rate. Overall, the results show that the cost implications of oil spillage and gas flaring have a very limited impact on both the balance of payments and the exchange rate.

Table 4: Model Summary.

	Variable	**Fixed Effect**	**Random Effect**	**Pooled OLS**
Model 1	CIOSGF	0.037076 [0.6054]	0.028645 [0.6495]	0.028645 [0.6288]
Model 2	CIOSGF	-0.52E-05 [0.7537]	-4.04E-05 [0.7826]	0.500374 [0.0309]

Source: Eview 13.0

The result from the above table 4 is the model summary; presented with the coefficient of the fixed effect model, random effect model and pooled OLS. The panel regression results using the random effect model show that the cost implication of oil spillage and gas flaring has a very weak and statistically insignificant effect on the exchange rate. The coefficient of0.028645 suggests a slight positive relationship, but the high probability value of0.6495indicates that this result is not statistically significant. This means that changes in the environmental costs associated with oil spillage and gas flaring have no meaningful or reliable impact on the exchange rate. Similarly, the effect of the cost implication of oil spillage and gas flaring on foreign direct investment (FDI) is also statistically insignificant. The coefficient of -4.04E-05 suggests a very small negative relationship, but with a p-value of 0.7826, this result is not significant. Conclusively, the findings indicate that the environmental costs in the oil and gas sector do not have a notable impact on either the exchange rate or foreign direct investment.

Table 5: Hausman Test

Model	Test cross-section random effect		
Model 1	Test Summary	Chi-Sq. Statistic	Prob
	Cross-section random	0.06116	0.8047
Model 2	Test Summary		
	Cross-section random	0.02253	0.8807

Source:Eview 13.0

As indicated in Table 5 above, we accept the null hypothesis of the Hausman test, leading us to conclude that the most suitable regression model for estimating the unobserved effects in our analysis is the random effects model, rather than the fixed effects model, for both Model 1 and Model 2.

4.1 Discussion of findings

The results from the panel regression analysis using the random effect model suggest that the environmental costs related to oil spillage and gas flaring in Nigeria's oil and gas sector have a statistically insignificant effect on both the exchange rate and foreign direct investment (FDI). The coefficient for the exchange rate (0.028645) indicates a slight positive relationship between environmental costs and the exchange rate, but the high probability value (p = 0.6495) reveals that this effect is not statistically significant. Likewise, the coefficient for FDI (-4.04E-05) reveals a marginal negative relationship, but with a p-value of 0.7826, the effect is also statistically insignificant. Thus, the findings indicate that environmental costs in the oil and gas sector do not have a significant impact on either the exchange rate or FDI.

These results align with existing literature that highlights the complexity of the relationship between environmental costs and macroeconomic indicators. For example, Adewuyi andOyejide (2019) argue that environmental degradation in oil-producing regions can have profound social and ecological impacts but may not directly influence key economic metrics like exchange rates due to the resilience of the oil market and the dominance of other macroeconomic factors. Similarly, Eze and Nwafor (2020) assert that the exchange rate in oil-dependent economies like Nigeria is more influenced by fluctuations in global oil prices than by domestic environmental costs, explaining why the cost of oil spillage and gas flaring has little effect on the exchange rate.

Another study by Babatunde et al. (2017) suggests that FDI inflows to the oil sector in Nigeria are driven by long-term strategic interests, such as access to natural resources, rather than by short-term environmental costs. This is further supported by Igbinoviaand Okoro (2021), who found that despite the high environmental costs associated with oil exploration, investors continue to perceive Nigeria's oil sector as lucrative, leading to minimal shifts in FDI based on environmental factors alone.

Furthermore, Olagunju et al. (2018) demonstrate that foreign investors often prioritise profitability over environmental risks in resource-rich countries. In such cases, while environmental degradation can pose long-term risks, it does not

immediately deter FDI inflows, aligning with the present study's findings of an insignificant relationship between environmental costs and FDI.

The results also find support in Nwankwo et al. (2019), who highlight that Nigeria's exchange rate is more sensitive to external macroeconomic shocks, such as changes in global oil prices or currency fluctuations in major trading partners, than to environmental issues. This is corroborated by Obafemi et al. (2022), who demonstrate that exchange rate movements in oil-dependent economies are more responsive to external economic variables than to domestic environmental degradation.

Additionally, Ugwuanyi et al. (2020) examined the role of environmental costs in FDI and found that while environmental concerns are rising in importance globally, the oil sector in developing countries often operates under looser regulatory frameworks, making environmental costs a secondary concern for investors. This aligns with the present study's finding that environmental costs, although significant from a sustainability perspective, do not have an immediate or significant impact on FDI flows.

Aluko and Adeyemi (2020) further note that the lack of significant impact of environmental costs on macroeconomic variables may be due to weak enforcement of environmental regulations in Nigeria's oil sector, allowing companies to externalise these costs without substantial financial repercussions. In the same vein, Okafor and Olayiwola (2021) found that while oil spillage and gas flaring pose long-term economic risks, these environmental costs are often overlooked in the short-term financial assessments made by both local governments and international investors.

In a broader context, Udoh and Adeniyi (2019) emphasise that the growing global emphasis on sustainable development has yet to fully penetrate the oil sector in Nigeria, which remains largely driven by profit considerations over environmental sustainability. This is reflected in the findings of the current study, which show that despite significant environmental degradation, there is no significant effect on FDI or the exchange rate.

5 Summary of Findings

The analysis provides a comprehensive overview of the impact of environmental costs in the oil and gas sector on key macroeconomic variables in Nigeria, specifically the balance of payments, exchange rate, and foreign direct investment (FDI). Table 1 reveals critical insights from the descriptive statistics. The balance of paymentshas a mean of3,649.104**,** indicating an overall positive balance during the study period. However, the standard deviation of1,829.846 suggests considerable volatility, reflecting periods of surplus and deficit. These

fluctuations are likely influenced by factors such as trade dynamics, capital flow variations, and broader macroeconomic conditions. The high variability indicates that while Nigeria generally maintains a positive balance, external shocks or policy changes can significantly impact this balance. Thecost of oil spillage and gas flaring shows a mean of 354.5544, underscoring the substantial financial burden of environmental damage in the oil sector. The standard deviationof 196.2032 highlights the variability in these costs, which may be due to inconsistent occurrences and scales of oil spills and gas flaring events. This variability emphasizes the ongoing environmental and financial challenges faced by the oil industry in managing and mitigating the impacts of these incidents. These findings stress the need for improved environmental management practices and regulations to control the financial and ecological costs associated with oil and gas operations. For the exchange rate**,** the mean value of 3,741,831 suggests significant depreciation of the local currency. Nonetheless, the standard deviationof 112.5031 indicates relative stability in the exchange rate, with only minor fluctuations. This stability could be attributed to governmental interventions or policies aimed at stabilizing the currency, despite the high average rate indicating underlying economic challenges such as inflation or currency devaluation.

5. 2 Conclusion

The study concludes that environmental costs associated with oil spillage and gas flaring in Nigeria's oil and gas sector do not have a significant impact on the selected macroeconomic indicators such as the exchange rate and foreign direct investment (FDI). Despite the environmental degradation caused by these activities, the findings reveal only a weak and statistically insignificant relationship between these costs and the exchange rate or FDI. This suggests that, in the short term, the Nigerian oil sector's resilience, driven by global oil demand and weak environmental regulation, allows the economy to remain largely unaffected by environmental costs.

5.3 Recommendation

To address these issues, several recommendations were made.

i. Strengthening environmental regulations and ensuring compliance will help internalise the environmental costs of oil production.
ii. Promoting environmental sustainability in FDI decisions and diversifying the economy can further reduce dependency on oil.
iii. Developing compensation mechanisms for affected communities, increasing public awareness, and leveraging technology for environmental monitoring are crucial steps toward managing environmental risks and achieving long-term sustainability.

5.4 Suggestions for Further Studies

In-depth Regional Analysis: Future studies should consider conducting region-specific analysis to explore the varying effects of oil spillage and gas flaring on different parts of Nigeria. Oil-producing regions such as the Niger Delta are particularly affected by environmental degradation, and localised studies could provide more detailed insights into how these activities influence regional economic development, health, poverty levels, and FDI patterns.

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