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Empirical Nexus Between Industrial Sector Production And Foreign Direct Investment Inflows In Nigeria

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Abstract
This empirical work examined the causal relationship between foreign direct investment inflows and industrial production index (IPI) in Nigeria, using the Auto Regressive Distributed Lag (ARDL) model for the period 1983–2020. The co-integration test showed that the variables were co-integrated and the model analysis revealed the existence of long-run relations between the dependent variables IPI and the explanatory variable FDI. The empirical results showed that past inward foreign direct investment flows significantly improved current industrial production index. The short run dynamics as reflected in the Error Correction Model (ECM) also confirmed strong relationship among the variables and revealed a low speed of adjustment of 0.24 for the model. The paper recommended the continued promotion of policies that would attract FDI in order to assist in addressing foreign exchange constraints, stimulate domestic production and output, as well as, build capacity in the form of technology transfer, and the creation of employment in Nigeria's industrial sector.

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I. Introduction

Over two-third of empirical studies on the impact of foreign direct investment (FDI) on most economies have centered on economic growth using gross domestic product (GDP) as the major determinant of FDI. This work tend to break the paradigm by being sector-specific, focusing on industrial production using industrial production index as the main indicator. Furthermore, past researches on the Nigerian economy by Eniekezimene, Ebimowei and Joseph, 2024; Ozili, 2024; Olatunji and Shahid, 2015; and Adeleke, Olowe and Oluwafolakemi, 2014; using GDP, and Chukwuebuka, 2021; Bank-Ola, Akintaro and Adediwara, 2020; and Akpan and Eweke, 2017 using manufacturing production, all had mixed outcomes. This made their findings inconclusive, and necessitated more works.

FDI flows have potential positive spillover effects on host economies as they are expected to increase productivity, ensure transfer of technology and managerial skills, provide international production networks through access to external markets, as well as, reduce unemployment. FDI entities venture abroad where there are market failures and immense opportunities to engage their superior technology and knowledge to obtain market share in host economies (Denisia, 2010). Denisia also noted that despite the fact that many researchers have tried to explain the phenomenon and determinants of FDI, there seems to be no generally accepted theory. In addition, current researchers are becoming interested in verifying whether the casual relationship between FDI and industrial production could be uni-directional or bi-directional, thereby demanding more empirical investigations.

The massive liberalization of capital in most economies from the mid-1980 and globalization from the early 1990s, gave greater impetus for the free flow of FDIs across nations. World FDI inflows grew astronomically from an average of US$23.8 billion in the 1970s to US$92.93 billion in the 1980s to US$307.73 billion in 1990s and further to US$1,080.09 billion in 2000s. Global FDI flows was at a high of US$ 1,774.0 in 2015, dropped to US$859.0 billion in 2020 due to the COVID pandemic and rebounded to US$1,300.0 billion and US$1,485.0 billion in 2021 and 2024, respectively (UNCTAD, 2025). The tremendous increase in FDI flows globally and across regional groupings reflected the significant role this source of financing had played over the years as driver of economic growth and development. FDI inflows to Nigeria which averaged US$ 0.43 billion in the 1980s, rose to US$1.5 billion in the 1990s, averaged US$4.2 billion in the 2000s and peaked at US$ 8.9 billion in 2011, but took a down trajectory to US$3.3 billion in 2019 and further to US$1.87 billion and US$1.08 billion in 2023 and 2024, respectively (Oputa, 2025 and CBN, 2024). Despite the performance, Nigeria has a huge potential to attract FDI in the extractive mineral sector; agriculture; tourism; communication; rail transportation; financial services industry; and the social sector, basically health and housing.

Foreign direct investments (FDI) are usually made by economic entities from abroad in business controlling relationships with firms in another country referred to as the host country. These relationships are basically financial flows in the form of equity, reinvested earnings and debt from foreign entities for the establishment of new businesses (greenfield) or plough into existing enterprises with a threshold equity shares of ten percent and above (IMF, 2008). FDI provides the capital and foreign exchange needed for businesses, as well as, fill the gaps in technological knowledge, innovations in products, entrepreneurial, managerial and personnel

skills. The Nigerian industrial sector covers activities in manufacturing, mining and utilities (CBN, 2010). The indicators of industrial sector performance include the industrial production index (IPI), manufacturing capacity utilization (MCU) and the employment generated by the sector.

The a priori expectations will be that FDI will increase production, which in turn is expected to enhance industrial output and national income, as well as, higher levels of employment. Thus, the objectives of this paper will include to: investigate the empirical relationship between FDI and industrial production index (IPI) in Nigeria, reveal both the short run and long-run dynamics; and examine the directional flow of the casual relationship. The following null hypotheses are derivable from the above stated objectives:

H_O1: FDI has no significant effect on industrial production index in Nigeria for the period 1983 to 2020; and
H_O2: There exist no causal relationship between FDI and IPI in Nigeria for the period. The periodicity for this paper fell mostly within the time the country embraced the structural adjustment policy (SAP) initially monitored by the International Monetary Fund (IMF) which kick-started the liberalization of the economy in 1986, thereby allowing free movement of private capital flows.

The rest of the paper will include literature review in Section 2, Nigeria's Policies and Trends in FDI Flows and Industrial Production in Section 3, while Section 4 contains the research methodology, analysis of the results and findings. We present the conclusion and recommendations in the Section 5.

II. Literature Review

Conceptual Issues

This section will attempt to present brief insights into the two key terminology in the paper namely industrial sector production and foreign direct investment.

[a] The industrial sector is the productive economic sector in the economy that helps in the transformation of raw materials from the primary sectors into finished goods and services for consumption; and capital goods needed by other business entities for further production. Basically, the industrial sector comprises of manufacturing, mining, construction and utilities (CBN, 2010). The performance of the sector is usually monitored by the industrial sector indicators namely: industrial production index, manufacturing capacity utilization and employment rate. The industrial production index (IPI) shows the growth in output of businesses in the manufacturing, mining, construction and public utilities (electricity) sub-sectors of the economy. The IPI measures the short-term changes in the volume of production of a basket of industrial products for the aforementioned sub-sectors, usually for a given period with respect to the chosen base period. It is based on the measure of physical volume and excludes services; while the data for the computation are captured through annual surveys of industries and business entities (CBN, ibid).

[b] Aggregate investment in any open economy comprises of two components namely domestic and foreign private investments. Foreign private investment is further divided into foreign direct investment (FDI), foreign portfolio investment (FPI) and debt (IMF, 2008). Foreign direct investment (FDI) is an example of international movement of factor of production in this case capital from abroad.

$$INV_{aggregate} = INV_{domestic} + INV_{foreign} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.1)$$

$$INV_{domestic} = INV_{public} + INV_{private} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.2)$$

$$INV_{foreign} = FDI + FPI + debt \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.3)$$

We can identify two types of flows in FDI firstly those for the establishment of new enterprises (new capital), also know as greenfield flows and secondly flows through existing enterprises (reinvested earnings and loans from affiliates). The new capital helps in the initial expansion of productive capacity, and could consists of machinery and equipment as well as foreign currency imported for the establishment of the FDI enterprise, while FDI flows from existing enterprise are for the expansion of the enterprise or working capital support.

Theoretical Literature

Two relevant theoretical literature namely exogenous or Neo-classical, and new growth models seemingly explain the nexus between FDI and industrial sector output.

[a] Exogenous growth/Neo-classical Growth Model

The exogenous-growth theory or the Neo-classical growth model popularized by Solow-Swan (1956 and 1957) opined that economic growth is driven by the exogenous inputs of production, such as the stock of capital - in this case international capital; and labour. Although, most empirical studies tend to use the Cobb-Douglas production function (1928) to explain the dynamism between economic growth and factors of production namely land, capital and labour. Capital here could be domestic or foreign in the form of FDI and portfolio investment, while other variables in the functional relationship included labour input and technological progress. The combination of these variables are assumed to directly propel growth in any economy, thus the Neo-classical growth model shows that FDI should influence economic production including sector outputs in host economies.

[b] New Growth Models

The new growth models emphasizes more on the stock of human capital and long-run effects of technological progress as the main drivers of economic production and growth. These models hold that FDI can continually increase the rate of economic growth in the host country through technology transfer, diffusion, and spillover effects. In this model, technology is taken to be endogenously driven as against exogenous in the Neo-classical, and is defined to include increase in knowledge and innovation. Private capital investments by multinational corporations (MNCs) as FDI entities improve research and development (R&D) as well as human capital accumulation, thereby transferring technology in host economies. The effect generates growth spill-overs to domestic production which enhances development of enterprises in the industrial sector and assist in the creation of a more competitive business environment (OECD, 2002).

Empirical Literature

Most empirical literature on industrial production were centered on the manufacturing sector and few on the industrial production index. It is worthy of note, that manufacturing is a a subset of industrial production, consequently, due to dearth on literature directed to industrial production in Nigeria, we will predominantly use those on the manufacturing sub-sector output.

Chukwuebuka (2021) situated the role of the manufacturing sub-sector in the production of goods and services, employment generation and transformation of economies. Using both the Dynamic OLS and fully modified OLS the author investigated the impact of FDI on the manufacturing sub-sector in the Middle East and North African (MENA) Region for the period 1975-2017. The result confirmed long–run relationship among the variables used and that FDI influenced positively the growth in the manufacturing sub-sector. However, when the eight high-income countries were excluded, the result was negative and insignificant for outward FDI which are from domestic firms making investment abroad, as against positive and insignificant result for inward FDI to the recipient countries. The result for outward FDI was expected as most countries tend to expect more private capital inflows as against outflows, even if it gives a net liability position to the rest of the world in the external account.

Bank-Ola, Akintaro and Adediwura (2020) investigated empirically the impact of foreign direct investment in manufacturing sector output on economic growth in Nigeria between 1986 and 2018. The study had manufacturing output level as the dependent variable and the independent variables included foreign direct invest, gross capital formation, inflation and trade openness. The study deployed the auto-regressive distributive lag (ARDL) model and their result revealed that FDI had a positive impact on the manufacturing output growth and established a long-run relationship among the variables. However, the outcome was statistically insignificant, which reflected the dismal performance in the manufacturing sector during the period.

Akpan and Eweke (2017) empirical work centered on the impact of FDI on industrial sector performance. They used annual time series data for the period 1981-2015 using VAR econometric technique to test the sensitivity of GDP to shocks in FDI and industrial sector. The result from the Johansen co-integration test showed the absence of a long-run relationship between FDI, industrial sector output and GDP. The result however, established the existence of a bidirectional relationship between FDI and industrial sector output. The VAR estimate showed that FDI had a mild positive significant impact on GDP. The study concluded that Nigeria was yet to fully reap the benefit of FDI since its contribution to the industrial sector and by extension the GDP remained weak.

Ikechi, Nwaimo, Onyechere and Obasi (2017) study investigated the contribution of FDI to industrial productivity in Nigeria, using the dis-aggregated components of industrial productivity which included industrial, manufacturing and mining sub-sectors' productivity indices as their dependent variables. The result of the study indicated that industrial productivity in Nigeria was not FDI driven. The dis-aggregated components however, established that in the short-run, FDI had positive and significant relationship with mining sector productivity in Nigeria, confirming the domineering effect of oil in the economy in aggregate industrial production as manufacturing output had remained dismal.

Mounde (2017) examined the causal relationship between foreign direct investment and manufacturing output in Nigeria. The manufacturing output, time series data was compiled from the CBN and NBS spanning 36

years, 1981-2016. The study utilized the Vector Error Correction Model (VECM) and established a long run relationship between FDI and industrial output as well as a bi-directional causality between FDI and manufacturing output. The result revealed that a increase in FDI will improve industrial output, through GDP growth which in turn will attract more FDI into the economy. The study therefore, established that the casual relationship between the variables was bi-directional.

Rasaq, Adijat and Abubakar (2017) used a times series analysis to examine the impact of FDI on the manufacturing sector output in Nigeria. The study deployed the vector auto-regression (VAR) technique for their regression analysis because of its effectiveness in policy forecasts. The results revealed FDI in the manufacturing sector positively influenced manufacturing output and the outcomes were statistically significant. At both the pre and post crisis periods of 1980 through 2013, the results confirmed a unidirectional causality from FDI to manufacturing output.

Ebekozien, Ugochukwu, and Okoye (2015) analysis on the trends of inflows of foreign direct investment investigated another component of the IPI which is the Nigerian construction industry with a view to assess the effect of increased flow of FDI in the industry. Annual time series data from the CBN and the NBS were used for the period 1989 -2008. The data was dis-aggregated into manufacturing and processing; construction; and mining sub-sectors. Using Microsoft and SPSS the authors deplored Duncan Multiple Range test and Granger test, the result revealed a bi-directional flow between FDI and components of industrial production, and suggested that FDI was a critical and catalyst for sustainable growth and development in construction, manufacturing and mining.

Danja (2012) empirically tested the effect of FDI on economic activities and productivity in the Nigerian economy by tracing the linkages between FDI and index of industrial production (IIP); GDP; and other control variables. The study revealed that GDP was positively related to FDI and that a unit increase in FDI resulted in a more than proportionate rise of 1.24 % in GDP; while there was a much higher positive relationship between FDI and IIP. The study therefore recommended improvement of the state of infrastructure in Nigeria and need for strategic policies to attract inflow of FDI.

III. Nigeria's Policies And Trends In FDI Flows And Industrial Production

Political Economy of Nigeria's FDI and Industrial Policies

Policies and strategies in attracting FDI flows are expected to encourage synergy between FDI entities and domestic enterprises to promote competition as well as ensure that domestic enterprises are not adversely affected. Nigeria's foreign investment policies in most of the 1950s and 1960s were dictated by her economic resources. Below are relevant policies in the 1950s to 1990s, and 2000s through 2025.

A documentation of policies in the 1950s included: the Aid to Pioneer Industries Ordinance and the Income Tax (Amendment) Ordinance of 1952; Industrial Development (Import Duties Relief) Act of 1957, granted concessionary rates on imported raw materials; Industrial Development (Import Duties Relief) Act of 1958; the Customs Duties (Dumped and Subsidized Goods) Act of 1958, geared towards discouraging imported finished goods particularly those with dumping attributes or those enjoying subsidies from the country of origin; the Customs Drawback Regulations of 1959; Income Tax (Amendment) Act of 1959; and the adoption of Accelerated Depreciation Allowance on capital investment and the Tax Free Dividends, all these policies were geared towards promoting foreign participation in the industrial activities (Aremu, 2005).

In the 1960s, the first national development plan (1962-1968) vividly situated the private sector as the engine of growth, by emphasizing the need for the inflows of foreign direct investment and indigenous entrepreneurship. In same vein, the import substitution strategy in this plan was aimed at attracting more foreign investments into the economy. Consequently, government encouraged the trading companies such as United African Company (UAC), Lever Brothers, Paterson Zochonis, among others to establish manufacturing plants in the country while the economic policy stance was directed at their engagement in industrial activities through equity ownership in foreign owned companies and expansion of socioeconomic infrastructures. However, the government after independence in 1960 was threatened by the domineering activities of the Multinational Corporations especially in the commanding heights of the economy, and there were call for domesticating productive activities. Thus, the liberal investment policies was short-lived and resulted in the Immigration Act of 1963 which imposed some restrictions on the employment of foreigners in Nigeria, while all foreign investors were to obtain permission in the form of business permit from the Minister of Internal Affairs, as well as "Approval Status" and permit to employ specific number of expatriate staff (Aremu, ibid).

In the 1970s, the economic nationalism embedded in the Second National Development Plan (1970-1974), spelt out the progressive elimination of foreign dominance in the economy. As a prelude to the full implementation of this development strategy, the Companies Act of 1968; the Banking Act of 1969; the Petroleum Act of 1969; the Patents and Design Act of 1970; and the Copy Right Act of 1970 were put in place. A build up of these acts was formulation of a framework for the Nigerian Enterprise Promotion (NEP) Act of 1972 which form the commencement of the indigenization of the industrial sector in the economy. The subsequent Acts of

1977 and 1978 strengthened the provisions and classified all enterprises into three schedules namely: Schedule I comprising enterprises exclusively reserve for Nigerians; Schedule II comprising enterprises in which foreigners can invest 40% in equity; and Schedule III enterprises in which foreigners can invest 60% in equity and include enterprises with high level of sophistication in technology (Aremu, ibid) .

A major policy in the 1980s was the establishment of the Industrial Development Coordinating Committee (IDCC) following the Federal Government commission of the World Bank in 1980 to review the existing industrial incentives. The IDCC Decree 36 of 1988 was meant to promote a one – stop agency to regulate the investment environment, and grants to the industrial sector. Other functions included: approvals for the commencement of new businesses and relevant expatriate quota for businesses (foreign investors should invest in new businesses); approval status in principle for imported capital by foreign investors; business work permit to foreigners; as well as approve technology transfer agreements on equipment and components, engineering design services, plant installation and plant commissioning; and advise on the administration of various incentives design to promote industrialization. However, the IDCC decree was abrogated in 1995 and replaced with the Nigerian Investment Promotion Commission (NIPC) Act.

The 1990s further witnessed the liberalization of the economy and attracted more FDI inflows.The restrictions on capital transfers were removed in May 1992, followed by the repeal of 1989 Enterprise Promotion Decree and Exchange Control Act of 1966. They were replaced by the Nigerian Investment Promotion Council (No. 16 of 1995) and Foreign Exchange (Monitoring and Miscellaneous Provisions) Decree No. 17 of 1995. These decrees allow foreigners to invest in any sector of the economy and guaranteed unconditional transfer of funds with respect to profits and dividends, loan servicing and repatriation of capital, proceeds remittance and other related issues. The decree 17 allowed any investors (Nigerians or foreigners) to invest in any Nigerian enterprises or securities with foreign currency or imported capital through authorized dealers. The NIPC was to be the singular agency of government that would coordinate and monitor all investment promotion activities, as well as initiate and support measures which shall enhance the investment climate in Nigeria for both Nigerians and foreign investors. The Act also, guaranteed against nationalization or expropriation of any foreign investment by government. Other incentives included a 100% foreign ownership of enterprises, relief from taxation and custom duties, efficient administrative and bureaucratic procedures (no import or export licenses required), rent free land during construction of factory space, one-stop approvals, sale of up to 25% of productions permitted in the domestic market, guarantee on the repatriation of capital, profits and dividends, and foreign currency account for each investor to facilitate effective import and export transactions. Also was decrees for the establishment of export processing zones to facilitate rapid promotion of foreign investment in Nigeria (Odosola, 2002).

In most of the 2000s through 2025, policies had revolved around existing frameworks, the launched Nigerian Industrial Revolution Plan (NIRP) in 2014, the National Development Plan (NDP) of 2021 and the Nigeria's Agenda 2050. In evaluating the impact of the FDI and industrial policies, Aremu (ibid), opined that various governments in Nigeria had attempted to identify and apply the right policy mix to attract FDI flows, but they all failed because of poor implementation and policy reversals. Similarly, Odosola (ibid), in his appraisal noted that major bottlenecks to FDI inflows to Nigeria were the promulgation of the 1989 Industrial Policy, the Indigenization Decree of 1972, as amended in February and July 1976, January 1977, and January 1989, which placed ceiling on foreign capital participation in equity capital in various sectors of the economy during the 1970s and 1980s. These were drawbacks to FDI positive impact on industrialization in the Nigerian economy.

Trends in FDI Flows and Industrial Production Index in Nigeria

Global FDI flows have grown astronomically over decade, consequently flows to developing countries, Nigeria inclusive was about US$2.4 billion in 1962, rose significantly to averages of US$5.76 billion, US$20.5 billion, US$114.87 billion and US$337.82 billion in the 1970s, 1980s, 1990s and 2000s, respectively, with a recorded US$ 867.16 billion in 2024 (Table 3.1).

A cursory glance at Nigeria's share of FDI flow to developing countries showed a weak outcome, with the figure declining from 5.56 per cent in the 1970s to a mere 0.12 per cent in 2024. Similar dismal performance was recorded when compared to her share in African countries, which declined from a share of 28.57 per cent in the 1970s to 1.11 per cent in 2014. The performance revealed the existence of other preferred investment destinations in Africa and other developing economies.

The nominal FDI inflows to Nigeria increased from an average of US$0.32 billion in the 1970s, to averages of US$0.43 billion, US$1.49 billion and US$4.18 billion in the 1980s, 1990s and 2000s, respectively. The inflows in FDI peaked at US$8.91 billion in 2011 before dropping to an average of US$4.4 billion in 2013 -2016. The GDP in dollar terms which represented domestic production also maintained similar trend as it increased from an average of US$31.85 billion in the 1970s to US$38.61 billion in the 1980s and further to averages of US$61.82 billion and US$185.0 billion in the 1990s and 2000s, respectively (CBN, ibid).

The time series plots derived from the data set used for empirical regression showing the dependent (IPI) and independent variable (FDI) are presented below in Figure 3.1. The performance of the industrial sector of the

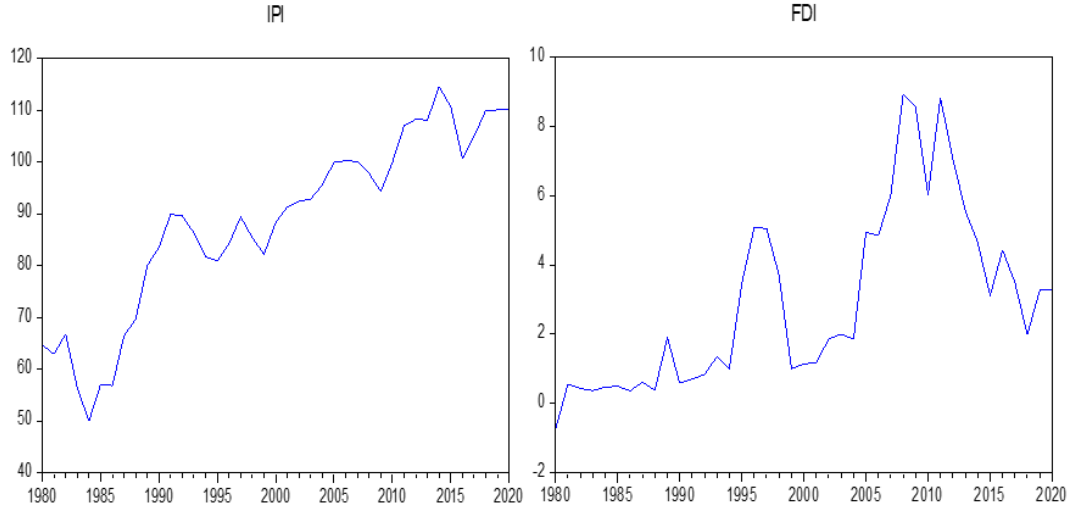
economy as reflected in the IPI, showed that the annual index declined during 1981-84 as a result of deepened economic crises occasioned by the dual effects of the crash in crude oil and external debt burden. These were consequently, reflected in decline in industrial output and acute scarcity of foreign exchange. The IPI trended upward from 1985-1993 but witnessed some intermittent declines in 1994 when the economy was regulated; as well as, 2008 and 2009 induced by the global economic crisis; but resumed upward trend from 2010 with a deep in 2016 before trending upwards in 2017 and flattened in 2018-2020.

Table 3.1: Nigeria's FDI Flows and Industrial Production Index

Year	Nigeria FDI flows (US$ billion)	Developing Countries FDI flows (US$ billion)	Africa FDI flows (US$ billion)	Africa % Share in Developing Countries	Nigeria % Share in Developing Countries	Nigeria's %Share in Africa	Industrial Production Index
1970s	0.32	5.76	1.12	19.44	5.56	28.57	45.73
1980s	0.43	20.50	2.20	10.73	2.10	19.55	64.95
1990s	1.49	114.87	6.79	5.91	1.30	21.94	85.80
2000s	4.18	337.83	30.68	9.08	1.24	13.62	96.49
2010	6.10	625.33	43.57	6.97	0.98	14.00	100.0
2011	8.91	670.15	47.79	7.13	1.33	18.64	106.99
2012	7.13	658.77	55.16	8.37	1.08	12.93	108.27
2013	5.61	662.41	52.15	7.87	0.85	10.76	108.16
2014	4.69	734.30	53.91	7.34	0.64	8.70	114.61
2015	3.06	767.53	57.56	7.50	0.40	5.32	110.69
2016	3.45	718.23	46.02	6.41	0.48	7.50	100.68
2017	2.42	750.32	41.53	5.53	0.32	5.83	105.00
2018	0.77	701.39	43.77	6.24	0.11	1.76	110.00
2019	2.31	703.48	46.66	6.63	0.33	4.95	110.1
2020	2.39	640.94	40.94	6.39	0.37	5.84	108.1
2021	3.31	899.48	82.20	9.14	0.37	4.03	90.00
2022	0.89	929.61	54.57	5.87	0.10	1.63	88.38
2023	1.87	865.41	55.42	6.40	0.22	3.37	91.70
2024	1.08	867.16	97.03	11.19	0.12	1.11	93.33

Source: UNCTAD & Author's calculations

Figure 3.1: Time Series Plots of the Dependent Variable (IPI) and independent Variable (FDI)



IV. Data And Methodology

Sources of Data and Analysis

The paper used annual time series data obtained mainly from three sources namely the Central Bank of Nigeria (CBN), National Bureau of Statistics (NBS) and United Nation Conference on Trade and Development (UNCTAD) for the period 1983-2020. The dependent variable was industrial production index (IPI), and the independent variable - inflows of foreign direct investment (FDI). The data for IPI was from and as published in the CBN Statistical Bulletin and some Staff estimates while the inflows of FDI were from the CBN and the UNCTAD.

Methodology

The auto regressive distributed lag (ARDL) approach was used for the empirical investigation. The pre-estimation tests included the unit root tests of both the augmented Dickey-Fuller (ADF) and Phillips-Peron (PP). The choice of ARDL was based on the fact that the model allows for the use of variables stationary at level, 1(0), at first difference, 1(1) or a combination of both. The Akaike information criteria (AIC) was used for the choice of the appropriate length, while the ARDL bound test approach by Pesaran, et al., (2001) was deplored to investigate the presence of co-integration in the long-run relationships. The E-Views 11 Standard Edition for Windows was used for the estimation.

Model Specification

The econometric model used in the paper is the ARDL of the form presented below in (4.1):

$$IPI = \alpha_0 + \sum_{i=1}^{m} \alpha_1^i \, IPI_{t-i} + \sum_{i=1}^{m} \alpha_2^i \, FDI_{t-i} + \alpha_3 \Delta IPI_{t-i} + \alpha_4 \Delta FDI_{t-i} + \mu_{1t} - - - \quad (4.1)$$

Where:

IPI = Industrial Production Index

FDI = Foreign Direct Investment

α_o = Intercept or autonomous parameter estimates for the variables

$\alpha_{1\text{-}4}$= Coefficient of the variables

μ_t = The residuals or error terms.

The long-run relations between the variables will be established from equation 4.1, while equation 4.2 will examine the short-run dynamics using restricted Error Correction Model (ECM) approach. The ECM is a simple transformation with sufficient number of lags which integrate the short run adjustment with the long run equilibrium without losing any information in the long run framework (Nkoro and Uko, 2016). The ECM equation or the short run dynamics is presented below:

$$\Delta IPI_t = \alpha_0 + \alpha_1 \Delta IPI_{t-1} + \alpha_2 \Delta FDI_{t-1} + \delta ECM_{t-1} + \mu_t - - - - - - - - - - - - - (4.2)$$

The δ (known as one period lagged error correction terms) captured the output evolution process by which agents adjusted for prediction errors made in the lagged period ($_{t\text{-}1}$), while $ECM_{t\text{-}1}$ represented the output evolution process by which agents adjusted for prediction errors made in the last period.

V. Results And Findings

Unit Root Analysis

The stationarity test as presented Table 5.1 below contains the results of the unit root of the variables using the Augmented Dickey-Fuller (ADF) 1979 & 1981, and Phillips-Peron (PP) 1988, techniques. These tests helped us to avoid spurious regression results that could mislead policy decisions.

The unit root test results based on the ADF and PP techniques, showed that the variables (LIPI and LFDI) were stationary after taking the first differences. The stationarity test was obtained by comparing the t-statistics with the critical values, when the t- statistic is greater than the critical values, the variable is deemed stationary but the reverse is for non stationary. The result of the unit root test showed that IPI and FDI are integrated of order one or 1(1), which implies that we reject the null hypothesis of non-stationarity for the two variables. This indicates the possibility of establishing a co-integration among the two variables.

Table 5.1: Stationarity test

	ADF		PP		Decision
	Levels	1st Diff	Levels	1st Diff	
LIPI	-1.086	-4.084**	-1.086	-5.574**	I(1) reject H_0
LFDI	-1.874	-8.283**	-1.725	-8.269**	I(1) reject H_0
$ECM^{IPI}_{t\text{-}1}$	-4.568***	-7.045***	-5.215***	-14.562***	I(0)

*Notes: ***, **, * means the rejection of the null hypothesis at the 1%, 5% and 10% level of significance, respectively. The null hypothesis is that each variable has a unit root. ADF test indicates Augmented Dickey-Fuller test, and PP test indicates Phillips-Perron test.*

Source: Author's computation using E-views

Lag length criteria

The optimal lag length determines the accuracy of the empirical model by giving precision to decision on the magnitude of the regression, as well as reveal the existence of long-run relationship between the dependant variable (IPI) and the explanatory variable FDI or any cointegrating vector in the model.

This empirical work used both unrestricted VAR and the ARDL bounds tests determine the appropriate lag lengths with three criteria namely Akaike information criterion (AIC), Schwarz criterion (SC), and Hannan-Quinn criterion (HQC) and all yielded same result. The model with the lowest value as in Table 5.2 was chosen as the appropriate lag length. Consequently, the selected ARDL result for LIPI, LFDI was (1,0) which was expected to yield the optimal outcome for the model.

Table 5.2: VAR lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-27.689	NA	0.017	1.604	1.691	1.635
1	29.432	104.981*	0.001*	-1.114*	-1.005*	-1.119*
2	33.557	7.134	0.003	-1.273	-1.504	-1.174
3	34.614	1.714	0.009	-1.266	-1.837	-1.899
4	-35.809	1.959	0.878	-1.488	-1.495	-1.822

LR: Likelihood ratio; FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz criterion; HQ: Hannan-Quinn criterion. * Optimal length.

Source: *Author's computation using E-views.*

Co-integration analysis

The results of the ARDL co-integration test in Table 5.3 revealed that the co-integrating vector had their F-statistics exceeding the upper critical bounds at the 5 percent level of significance, thus, confirming the existence of long-run relationships among the variables. Consequently, we reject the null hypotheses and affirm the existence of causal relationship among the variables used in the model.

Table 5.3: Cointegration test

Estimated model	Bond test for Cointegration test		Diagnostic Test		
	Optimal lag length	F-Statistics	Normality (Prob)	X^2 Serial	X^2 Heteroskedasticity
F_{LIPI}(LFDI)	(1, 0)	13.9342	0.1556	0.5748	0.7812

Source: Author's computation using E-views

Test Results of Hypothesis

The ARDL estimation model results of equation 4.1 for long-run equilibrium relationship and equation 4.2 for short term dynamics were used to test the two hypotheses presented at the beginning of this paper in the first chapter. The results in Tables 5.3 & 5.4 and appendices 1 & 2 revealed a direct link between the dependent variable (IPI) and explanatory variable (FDI) in Nigeria. The FDI coefficient was significant and statistically optimal in the model.

Test of Hypothesis 1

H_o 1: FDI does not positively affect Nigeria's industrial production as reflected in the country's industrial production index

[a] Long-run Result

The outcome of the result of the long-run equilibrium and the impact of FDI in the model revealed that a 1.0 per cent change in FDI accounted for 0.8591 per cent change in industrial production during the period (Table 5.3). In this case the change was positive which indicated an increase in both variables. The probability value of FDI was also less than critical 0.01 alpha value, which suggested that we reject the null hypothesis of no long run relationship. Thus, from the result, a long-run relationship was established between IPI and FDI in Nigeria. The variables in the model were highly significant while the model was robust, with almost 91.0 percent of the variations in IPI explained by the independent variable (FDI).

These results were consistent with the findings of Danji (2012) using industrial production index; and Chukwebuka (2021); Bank-ola, Akintaro and Adediwura (2020); Mounde (2017); and Rasaq, Adijat and Abubakar (2017) using manufacturing output as a subset of industrial production. Their findings showed that industrial production has the potential of improving the performance of the domestic economies' manufacturing sector by attracting more FDI into the sector thereby bolstering technology advancement, efficiency and productivity in the manufacturing sub-sector and economy.

Table 5.3: Estimated long-run coefficients using ARDL-ECM model

Variable	Coefficient	Std. Error	t-Statistic	*p*-value.
Selected Model: ARDL(1, 0); Dependent Variable (LIPI)				
C	0.4218	0.3540	1.1917	0.2412
LIPI(-1)	0.9075***	0.081	11.167	0.0000
LFDI(-1)	0.8591***	0.076	11.194	0.0000
*Note: ***, **, * denotes the rejection of null hypothesis at the 1%, 5% and 10% level of significance, respectively.* ***R-squared = 0.909175; Adjusted R-squared = 0.904130; Mean dependent var. = 4.475262; S.D. dependent var.= 0.210468*** *Source: Author's computation using Eviews*				

[b] Short-run Result

The short-run result was derived from the coefficient of the Error Correction Model (ECM) which was expected to be negative and statistically significant to confirm the model to be stable. Table 5.4 revealed that the ECM (-1) coefficient was significant at 5 percent level with a negative sign which is between 0 and –1, meaning that the model can converge back to long-term equilibrium moderately after a short-term change. The speed of adjustment value of –0.2409 was quite low and indicated that any disequilibrium of industrial production index would converge back in about two years and four months.

Table 5.4: Error Correction Model (ECM) representation for the Selected ARDL-ECM

Variable	Coefficient	Std. Error	t-Statistic	Probability
Pane A; Selected Model: ARDL(1, 0); Dependent Variable is ΔLIPI				
C	-0.6248	0.3283	1.9031	0.0648
ΔLIPI(-1)	0.8591***	0.0756	11.3523	0.0000
ΔLFDI(-1)	0.0439**	0.0159	2.7578	0.0507
ECM(-1)	-0.2409**	0.0756	-3.1833	0.0701
R-squared	0.9173	F-statistics		25.1312
Adjusted R-squared	0.9067	Probability (F-statistics)		0.0000
S.E. of regression	0.0657	Durbin-Watson stat		2.6173

In the short-run, the changes in the first lags of IPI and FDI affected the changes in current IPI.

The reported t-statistics was highly significant which supported the inference of the long-run relationship and that the null hypothesis should be rejected. Thus, FDI bolsters the productivity and performance of the manufacturing sector, as it leads to increase in the industrial production index.

Test of Hypothesis 2 (Granger Causality Test)

H_o 2 FDI does not affect or granger cause IPI in Nigeria, therefore there is no casual relationship exist between the variables

The granger causality test in Table 5.5 established the direction of relationship between the dependent variable and the independent variables. The result revealed that FDI influenced industrial production in Nigeria, however the relationship was bi-directional such that IPI also affect FDI in Nigeria. This result conformed with the findings by Bank-Ola, Akintaro and Adediwura (2020), using manufacturing output level as against the index of production in this work.

Table 5.5: Granger Causality test

Null Hypothesis:	Obs	F-Statistic	Prob.	Decision
IPI Model				
LFDI does not Granger Cause LIPI	38	4.52002	0.0049**	Reject Ho
LIPI does not Granger Cause LFDI		1.74256	0.1908	Reject Ho
Source: Author's computation using E-views ***Note: If the p-value is less than the designated value and the F-statistics is high, we reject the null hypothesis and conclude that X Causes Y (accept the alternate hypothesis)***				

Diagnostic and Stability Tests

The cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests developed by Brown, Durbin, and Evans in 1975 were deplored for the diagnostic analysis and establishing the stability of the model as shown in Table5.6. The diagnostic tests validated the pattern's reliability and significance for the IPI model.

The series association LM test showed that the chi-square and confidence values of 0.5490 and 0.5825 for the IPI model demonstrated that we do not reject the null hypothesis.

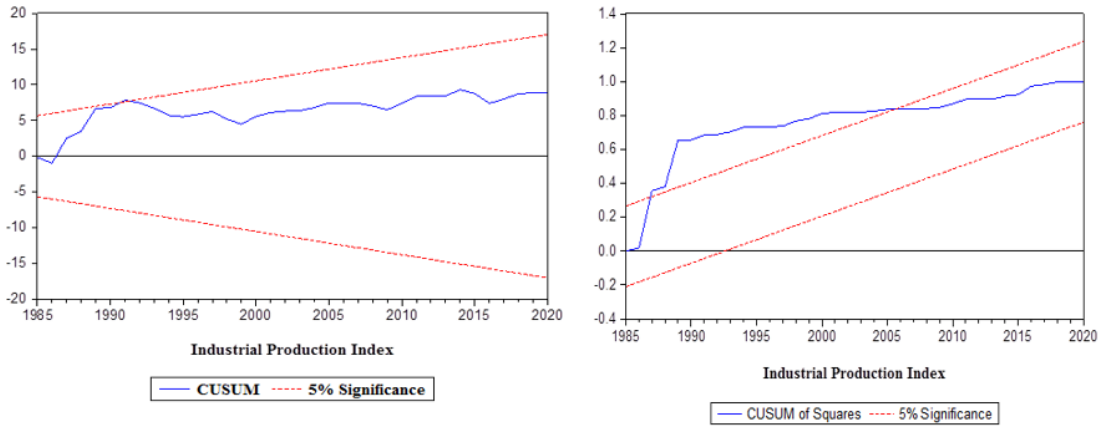
The tests of the heteroscedasticity revealed that the data structure does not posses auto-regressive conditions with both statistics and probability values of 1.3316 and 0.2767, respectively for IPI. The J-B (normal distribution) and Ramsey Reset checks had statistical rating of 2.4185 and 1.4210, respectively. The result showed that the IPI model had no anomalous evidence, as it met the normal distribution condition and there was absence of improper specification of variables in the model. Consequently we accepted the null hypotheses as shown in Table 5.6. and all the results confirmed that the data used was structurally normal and had no sign of extensive lag breaking for the model.

Table 5.6: Diagnostic and stability tests

Test	*H_o*	*Statistics*	*p-value*	*Decision*
Serial Correlation	There is no serial correlation in the residual	0.5490	0.5825	Accept H_o
Heteroscedasticity	There is no auto-regressive conditional heteroscedasticity	1.3316	0.2767	Accept H_o
Normal distribution	Normal distribution	2.4185	0.2984	Accept H_o
Ramsey RESET	Absence of model misspecification	1.4210	0.2554	Accept H_o
Source: Author's computation using E-views				

Figures 5.1, respectively, display the CUSUM and CUSUMSQ plots for long-term stability tests and short-term transfers of the ARDL Error Corrections pattern for the IPI model. If plot estimates of CUSUM and CUSUMSQ stay within critical 5 percent of the point of significance of the crucial limits, the null hypothesis is compatible and not dismissed for all coefficients of regression. The null hypothesis can, therefore, be retained for the model. The figure below revealed that estimates from CUSUM were far below the level of confidence of 5 percent, which indicated a robust coefficient in both long and short runs in the ARDL error correction model. However, in the case of CUSUMSQ, it was above the 5 percent level of significance during the period 1987 – 2005 for IPI, which showed that structurally the variable faced instability during this period but stabilized from 2006-2020. This case might require further empirical work to validate the findings.

Figure 5.1: CUSUM and CUSUM of Square



VI. Conclusion And Recommendation

This paper tried to break the paradigm of devoting most empirical investigations in this area on aggregate production in the economy proxied by the GDP. Specifically, this work was sector focused using the industrial sector output. The empirical results conformed with the a priori expectations and theoretical standpoints. The work revealed that FDI promotes industrial sector production in Nigeria, which was consistent with the findings of Danji (2012) using industrial production index; and Chukwebuka (2021); Bank-ola, Akintaro and Adediwura (2020); Mounde (2017); and Rasaq, Adijat and Abubakar (2017) usind manufacturing output as a subset of industrial production. The study also revealed that FDI granger cause IIP, as well as, IPI grange cause FDI making the casual relationship bi-directional which conformed with the findings by Bank-Ola, Akintaro and Adediwura (2020) using manufacturing output.

Nigeria has huge potentials to attract FDI especially the extractive mineral sector, agriculture, tourism, communication, rail transportation, financial services, health, and housing construction. In order to increase the inflow of foreign direct investment, Government should pursue vigorously comprehensive investment friendly policies that would encourage both domestic and foreign investors as we see Nigeria loosing investment

destination in the sub-region to Ghana and other African countries. In addition, concerted efforts must be made to improve critical infrastructure which would reduce operational cost of production to the industrial and manufacturing firms. The new infrastructure fund by the government - Nigeria Sovereign Investment Authority (NSIA) is laudable and should be fully supported by both private and public sector players.

Appendix 1: Longrun Regression

Dependent Variable: LIPI			**Long-run**	
Method: Least Squares				
Date: 06/16/21 Time: 15:01				
Sample (adjusted): 1982 2020				
Included observations: 39 after adjustments				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	0.421796	0.353956	1.191662	0.2412
LIPI(-1)	0.907464	0.081265	11.166680	0.0000
LFDI(-1)	0.859112	0.076747	11.194079	0.0000
R-squared	0.909175	Mean dependent var		4.475262
Adjusted R-squared	0.904130	S.D. dependent var		0.210468
S.E. of regression	0.065167	Akaike info criterion		-2.549917
Sum squared resid	0.152884	Schwarz criterion		-2.421950
Log likelihood	52.723370	Hannan-Quinn criter.		-2.504003
F-statistic	180.184200	Durbin-Watson stat		1.741561
Prob(F-statistic)	0.000000			

Appendix 2: Shortrun Dynamics

Dependent Variable: D(LIPI)		**Short-run**		
Method: Least Squares				
Date: 06/16/21 Time: 15:45				
Sample (adjusted): 1983 2020				
Included observations: 38 after adjustments				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-0.624800	0.328302	-1.903130	0.7871
D(LIPI(-1))	0.859119	0.075678	11.352315	0.0000
D(LFDI(-1))	0.043905	0.015920	-2.757843	0.0507
ECM(-1)	-0.240913	0.075680	-3.183310	0.0701
R-squared	0.917318	Mean dependent variance		0.013154
Adjusted R-squared	0.906760	S.D. dependent variance		0.065396
S.E. of regression	0.065740	Akaike info criterion		-2.506913
Sum squared resid	0.146940	Schwarz criterion		-2.334536
Log likelihood	51.631350	Hannan-Quinn criteria		-2.445583
F-statistic	25.131287	Durbin-Watson stat		2.617300
Probability(F-statistic)	0.000000			

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