

Innovative Investments and Productivity of Manufacturing Firms in Nigeria: The Causality Approach

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Abstract

This study examines the causal influence among Innovative Investments and the productivity of manufacturing firms in Nigeria (2010-2023). Manufacturing output was utilised as measure of production of manufacturing firms, while Investments on Research & Development (IRD), Investments on New Equipment & Technology (INET), likewise Investments on Employee Skills & Knowledge Development (IESKD), were utilised as proxies of innovative investments, with their data sourced from the annual reports and accounts of 15 selected manufacturing firms quoted in the Stock Exchange Group. The structural equation was estimated utilising the Pairwise Granger Causality technique. The Pairwise Granger Causality results, reveal that only Investments on Research & Development, substantially promote manufacturing output in Nigeria, while manufacturing output substantially supports INET. Therefore, the study concluded that only investments on employee investments on research and development among the selected elements of techno-innovative investments strongly determine the promotion of manufacturing output in Nigeria. Thus, the study recommended that: Research and Development departments of manufacturing firms should embark on increasing investments on R&D that only align with both short and long-term goals of their firms, capable of yielding remarkable results. Also, the manufacturing firms should priorities investments on either to make or acquire new equipment and machines capable of boosting the production. In addition, the personnel department should intensify the development of employees with relevant productive skills and knowledge.

Keywords: Investments, Research & Development, Equipment & Technology, Human Capital Development, Manufacturing Output, Nigeria.

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1. INTRODUCTION

It has been established that growth in the manufacturing sector boosts a country's output level of goods and services, in addition to creating job opportunities, raising the standard of living, increasing national income, and promoting the balance of payment (Nnyanzi *et al.*, 2022). In congruent with Ogundipe (2022), the production of products for sale or use through manufacturing necessitates the employment of apparatus, machinery, and labour, likewise the implementation of chemical or biological processes. Innovativeness has been required to maintain a sustainable position in the market amidst the increasing number of competitors.

Despite the fact that the manufacturing sector in Nigeria is primarily occupied by small and medium-sized enterprises, Adekoya (2020) and Oluwaseun *et al.*, (2016) acknowledge that its total output is frequently decreasing. In contrast, it has been argued that the productivity of a firm is primarily determined by its investment intensity and size (Tello (2017)). This piques the interest of researchers to examine the degree of causality between innovative financing and the productivity of firms in the Nigerian manufacturing sector. Hai *et al.*, (2022) have contended that more money results in increased innovation, which is a prerequisite for improved firm performance. Therefore, the assumption in this study is that manufacturing output is not a direct result of investments in research and development, new technology, and technology, likewise

employee skills and knowledge development. Conversely, manufacturing output is not a direct result of investments in research and development, new technology, and technology, likewise employee skills and knowledge development.

2. LITERATURE REVIEW

Investments in R&D have traditionally been considered as leading to innovative investments because they fund the creation of new knowledge and the introduction of more efficient methods of being creative and productive. This new knowledge and technological discoveries are essential for making new products or better versions of old ones, starting new production processes, or improving old ones (Ilorin, 2018). Therefore, creative investments lead to new goods, services, or methods of doing business. This means that companies can put their money into innovation with the hopes of achieving product innovation, process innovation, organisational innovation, or marketing innovation. The former aims to increase internal competence, meet market demand, and provide good customer service; the latter aims to introduce new or improved manufacturing and distribution processes; the former aims to reduce administrative costs and maximise the use of human resources; and the latter aims to improve or introduce new marketing methods within the company.

Notable works i.e. Coccia (2021) and Oluwaseun *et al.*, (2016) support the idea that innovations may be either radical or gradual. When a process or methodology's technology is completely different from one another, it is radical. In contrast, incremental innovation entails making small, incremental changes to an existing technology in an effort to make it better. Even if incremental innovation is slow and subtle, Oluwaseun *et al.*, (2016) said that it often has a greater techno-economic effect than radical innovation. The former aims to expand existing markets, whereas the latter seeks to establish entirely new ones.

The main obstacles that prevent innovative activities in Nigeria from flourishing, in congruent with research by Akintayo *et al.*, (2020), Nassar and Faloye (2015), and Onwualu (2006), are as follows: a lack of political will and motivation, a culture that does not value intellectual property, a bias towards foreign products and technologies, a lack of funding, inadequate infrastructure, poorly planned and executed educational curricula, a failure to recognise and reward local innovators and their work, and a security issue. The fact that industrial firms in emerging economies are far from the technological frontier and that there are few incentives for innovation investment may be to blame for the weak correlation between R&D, innovation outcomes, and productive activities (Tello, 2017).

One hypothesis that helps explain the necessity for coordinated investment into creative activities is the

Big Push theory by Paul Rosentein-Rodan. To get from a condition of backwardness or stagnation to a path of advancement, an undeveloped economy must receive a minimal quantum of coordinated investment in infrastructure, education, and other critical components, in congruent with the idea. Without this bare minimum of investment, developing countries would struggle to achieve self-initiating growth and development that is ubiquitously sustainable. This means that the BPT's belief that a gradual investment approach is pointless since it cannot spark the growth process necessary for a country's development—that is, that it cannot alter the narrative of the country's economic conditions—is correct (Oladosu, 2024). There are three main assumptions upon which this theory bases its postulates. All three of these presumptions—that the production function, demand, and savings are distinct entities—must be satisfied.

A number of scholars have taken an interest in determining the direct correlation between innovative investments and productivity. One such study is Kwon-Ndung *et al.*, (2014), which looks at the correlation between research and innovation initiatives and the development of Nigeria's economy and industry. This has all been an empirical study. The results showed that new ideas may come from anyone. A nation may develop the capacity to produce novel products and services as its economy grows and its citizens' educational attainment rises. The study's findings, as per an examination of innovation's developmental function in economic activities, indicate that it is essential for economic progress.

Oluwaseun *et al.*, (2016) analysed questionnaires provided to SME manufacturers in Nigeria utilising the OLS method to determine the impact of innovation on these businesses. The writers utilised a sample of 365 manufacturing SMEs and found out what they thought by surveying them. In their analysis of SMEs' revenue, the authors utilised product and process innovation to stand in for technical innovation, whereas marketing innovation captured firm size and non-technological innovation. Their regression research revealed that product, process, and marketing innovation were the three main drivers of turnover for SMEs. The impact of organisational innovation, however, was not statistically substantial. The authors came to the conclusion that in order for SMEs to increase their total production, they need use both technical and non-technology forms of innovation.

Research and development (R&D) and information technology (IT) investments were the primary foci of Khanna and Sharma's (2021) study, which aimed to determine the relative importance of these two factors in driving productivity growth in India. utilising panel data taken from 900 manufacturing enterprises for the period 2000–2016, they utilised the panel least square method for analysis. They discovered

that: i) manufacturing firms with high technology usage are more productive than those with low technology usage; ii) investing in both research and development and information technology leads to greater productivity growth; iii) export-oriented firms are more likely to employ high technology investments and greater productivity than non-export-oriented firms; and iv) firms with an export orientation make more money from their IT investments than non-export-oriented firms.

Okoh *et al.*, (2023) did a research on the effects of human capital development on Nigeria's manufacturing sector from 1981 to 2021 and found a negative but substantial correlation between HRD and the value added of Nigerian manufacturing firms. Their results were as per secondary data collected from the CBN statistics bulletin and analysed utilising OLS and ARDL methods. Development of human capital is crucial to the expansion of the industrial sector, in congruent with the study's results.

A related research by Nweke (2023) looked at the impact of human capital development on Nigeria's industrial sector's performance from 1990 to 2018. The impact of women's education on industrial performance was the primary topic of the research. In an effort to gauge the success of the manufacturing sector, we looked at its production, and the number of female students enrolled in secondary and higher education were considered as indicators of women's education. Furthermore, confounding factors including the percentage of working-age women, the average lifespan of women, and bank loans to factories all have a role. Analysing time series data from the World Bank Development Indicator, CBN annual report and statements of account, and CBN Statistical Bulletin, the author utilised the ARDL approach. The short-term effects of female education on manufacturing sector production are positive and statistically substantial, in congruent with the ARDL estimations. On a related note, the long-term impact of women's education on industrial production is beneficial, but insubstantial.

Similarly, Akpoghelie and Chiadika (2023) compared the pre- and post-Covid-19 periods in Australia to determine the degree to which human development affected the performance of the industrial sector. We utilised the Inequality Adjusted HDI, the Human Development Index, the Gender Development Index, and the Multi-dimensional Poverty Index as stand-ins for human development, while we utilised Industry Value Added and Earnings before Interest, Tax, Depreciation, and Amortisation to gauge industrial performance. World Bank Indicators, the Australian Bureau of Statistics, and the United Nations Development Report were the sources from which they culled their data. Human quality was higher before the COVID-19 era than after it, in congruent with the authors. In an effort to boost industrial production, they

advocated, among other things, for unwavering policies on human development.

Ojo *et al.*, (2017) looked at how innovation affects business owners' chances of success. The writers relied on original data collected from 216 small and medium-sized enterprises (SMEs) in Nigeria, drawn from the country's agricultural, industrial, and construction industries. The writers analysed the data utilising one-way analysis of variance. Their findings clearly show that innovation has a favourable effect on the firm's success. As per their results, the authors of the research advocated for the promotion of both innovation and entrepreneurship. The ability to innovate and be creative as an entrepreneur is the driving force behind a company's competitiveness.

Using data from 1999–2009, Hai *et al.*, (2022) examined the impact of innovation production on financial performance of Chinese manufacturing enterprises. We looked at data from 142,972 observations from Chinese manufacturing companies that utilised several sources. The authors developed the Profiting from Innovation (PFI) model to address the substantial impact of budgetary restrictions. They argued that there is a U-shaped link between innovation production and financial success of enterprises due to the liability of newness, which differentiates financial performance throughout innovation commercialisation. Furthermore, the authors discovered that both individual and market-based financial constraints moderate the curvilinear connection. The researchers also found that small and medium-sized businesses that are not state-owned get more advantages from the reductions in IFC and MFC when they work together than do state-owned businesses.

During the COVID-19 epidemic, Prasetyaningtyas *et al.*, (2021) primarily looked at how technology innovation affected employee performance. The writers gathered their information from publicly and privately run financial institutions that have utilised technological innovations. This study utilised social media to recruit 123 people with less than 40 years of job experience, who then filled out questionnaires. In an effort to assess the data, the writers utilised PLS-SEM in conjunction with SmartPLS 3. Their research proved that technological innovation boosts bank workers' performance. The results suggest that implementing technological improvements improves workers' happiness, helps them maintain a healthy work-life balance, increases their productivity, and decreases their risk of burnout.

In an effort to investigate how technology advancements have affected accountants' and managers' levels of work happiness in Owerri, Njoku *et al.*, (2023) found that cloud computing and mobile applications had a substantial and positive effect on employees' levels of job satisfaction in entrepreneurial enterprises in Owerri.

Their study's overarching goal was to learn how entrepreneurial enterprises' use of cloud computing and mobile applications affected employee happiness on the workplace. The writers utilised a survey research strategy as per a five-point Likert Scale structured questionnaire. Analysis comprised descriptive statistics, mean, and standard deviation in addition to the correlation test. The writers draw the conclusion that technological advancements have a substantial role in determining the level of satisfaction among Owerri's managers and accountants.

Another research that looked at the impact of innovation and technology on employee performance in Saudi Arabia was Aliane and Zakariya (2023). The authors utilised a cross-sectional technique, surveying 231 participants by online questionnaire. This work makes use of structural equation modelling. Process innovation and technology were determined to have no direct impact on employee performance, in congruent with their findings. Furthermore, they discovered that change preparedness moderated the effect on employee performance. Because dissatisfied workers are less likely to accept and even welcome change, they argued that companies should gauge employee happiness before launching any kind of change project.

Using secondary data on investments in R&D, new equipment and technology, and staff skills and knowledge development in Nigeria, the reviewed studies found no evidence of a causal correlation between innovative investments and manufacturing productivity. We conducted this research to fill this void in the literature. As a result, this research will add to what is already known by creating a model that shows how Innovative Investments affect the productivity of Nigerian manufacturing enterprises.

3. METHODOLOGY

Researchers were able to track the variables of interest from 2010 all the way up to 2023 because to the study's ex post facto finametric methodology. utilising Econometric View 10.0, we estimate the correlation between indicators of innovative investments and measures of productivity of manufacturing enterprises. Figure 1 displays time series and cross-sectional data culled from the financial records of fifteen chosen Nigerian industrial companies listed on the Stock Exchange Group. The availability of data on the

employed variables dictated the selection of these industrial organisations. The research therefore made use of a convenience sampling approach. We gathered information on three factors that stand in for creative investments: spending on R&D, new equipment and technology, and training and education for employees. Furthermore, the chosen manufacturing businesses' annual reports and accounts also comprised data on manufacturing output, a metric for assessing manufacturing firms' productivity. As a surrogate for creative expenditures, the explanatory variables utilised here comprise spending on R&D, new equipment and technology, and staff skill and knowledge development.
 $MO = (IRD, INET, IESKD) \quad (1)$

For estimation purpose, the study expresses the models as below:

$$LnMO_t = \alpha_0 + \alpha_1 LnIRD_t + \alpha_2 LnINET_t + \alpha_3 LnIESKD_t + \epsilon_t \quad (2)$$

MO = Manufacturing Output

IRD = Investments on Research and Development

INET = Investments on New Equipment and Technology

IESKD = Investment on Employee Skills and Knowledge Development

Ln = Logarithm of the variable

α_0 = Constants;

$\alpha_1, \alpha_2, \alpha_3$ are Coefficients;

ϵ_t is error term.

t = time t

The a priori expectations are that $\alpha_1, \alpha_2,$ and $\alpha_3 > 0$

This research employs Granger Causality statistical tests on the data for both the explained variable and the explanatory factors. This indicates that findings and suggestions were as per the results of the Pairwise Granger causality test.

4. RESULTS AND DISCUSSION

Granger Causality Results

The following table illustrates the interactions and influences among all employed variables, with particular emphasis on the proxies of techno-innovative investments—Investments in Research & Development (IRD), Investments in New Equipment & Technology (INET), and Investments in Employee Skills & Knowledge Development (IESKD)—and Manufacturing Output (MO) of selected manufacturing firms in Nigeria from 2010 to 2023. This is detailed in Table 4.1, which presents the estimates of the F-Statistic and the corresponding probability values for the model.

Table 4.1: Pairwise Granger Causality Test (Manufacturing Output)

Null Hypothesis:	Obs	F-Statistic	Prob.
IRD does not Granger Cause MO	179	3.35310	0.0373
MO does not Granger Cause IRD		1.48129	0.2302
INET does not Granger Cause MO	179	2.61002	0.0764
MO does not Granger Cause INET		3.69248	0.0269
IESKD does not Granger Cause MO	179	2.69021	0.0707
MO does not Granger Cause IESKD		0.45729	0.6338

Source: Author's computation from Eviews 10

As observed in Table 4.1, Panel 1 of the Pairwise Granger Causality output reveals the evident of substantial unidirectional correlation between:

- i) Investment on Research & Development (IRD) and Manufacturing Output (MO)

This indicates a substantial unidirectional association between the aforementioned variables, with causation originating from Investments in Research & Development to Manufacturing Output. This indicates that investments in research and development enhance manufacturing output throughout the study period.

Panel 2 of the Pair Wise Causality output reveals the evident of substantial unidirectional correlation between:

- i) Investments on New Equipment & Technology (INET) and Manufacturing Output (MO)

This indicates that a substantial unidirectional link exists between the aforementioned variables, with causation originating from Manufacturing Output to Investments in New Equipment and Technology. This indicates that Manufacturing Output facilitates Investments in New Equipment and Technology over the research period.

Panel 3 of the Pair Wise Causality output reveals the evident of substantial independent correlations between:

- i) Investments on Employee Skills & Knowledge Development (IESKD) and Manufacturing Output (MO)

This indicates that the aforementioned factors have not affected one another during the research duration.

4.2 Discussion of Findings

A notable unidirectional causal association was identified between investments in research and development and manufacturing output, suggesting that the explanatory variable enhances the output level of manufacturing activities in Nigeria. The findings highlight the significance of research and development in the industrial industry. Innovative activities enhance the success of the manufacturing sector, since new or enhanced goods get more clientele. Wellener *et al.*, (2019) said that an increase in research and development spending improves the performance of the manufacturing sector, particularly when aligned with the company's long-term objectives.

A unidirectional association was identified between investments in new equipment and technology and the manufacturing output of the chosen enterprises in Nigeria, as shown by the Pairwise Granger causality results, with causation originating from manufacturing output. This indicates that the output level of the manufacturing sector facilitates investments in new equipment and technology; nevertheless, such investments do not enhance manufacturing production in the chosen businesses in Nigeria over the research

period. In the context of Nigeria's manufacturing sector, it may be said that substantial expenditures have not been directed towards acquiring new equipment and technology; instead, the nation favours foreign-made items over domestic production (Adolphus *et al.*, 2021; Balogun, 2020). Even when new equipment is required, there is a preference for foreign options over investing in domestic manufacture of such industrial equipment.

Ultimately, the Pairwise Granger causality analysis indicated no causal association between investments in employee skills and knowledge development and the output of the industrial sector in Nigeria. This indicates that efforts in employee skill and knowledge development have not enhanced the output level of the manufacturing sector, despite the manufacturing output not justifying further expenditures in these areas.

5. CONCLUSION AND RECOMMENDATIONS

Taking into consideration the findings presented above, it can be concluded that there exists a causal correlation between innovative investments and the productivity of manufacturing enterprises in Nigeria. As a result, it is possible to draw the conclusion that among the many parts of creative investments, the only ones that greatly impact the promotion of manufacturing output in Nigeria are spending on research and development. In light of this, it can be deduced that variations in the amount of money spent on research and development have a substantial impact on the amount of output produced by the manufacturing sector. The following suggestions are worthy of consideration in light of the findings of this research:

- a) The research and development departments of manufacturing companies should begin increasing their investments in R&D that only align with both short-term and long-term goals of their companies, and that are capable of producing remarkable results;
- b) Manufacturing companies should prioritise their investments on either the production of new equipment and machines that are capable of increasing production, or the acquisition of new equipment and machines;
- c) Additionally, the personnel department should intensify the development of employees.

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Appendix 1: Selected Manufactured Companies Employed in the Study

- i. Guinness Nig Plc.,
- ii. Nigerian Brew. Plc.,
- iii. International Breweries Plc.,
- iv. Honeywell Flour Mill Plc.,

- v. Nasco Allied Industries Plc.,
- vi. N Nig. Flour Mills Plc.,
- vii. Flour Mills Nig. Plc.,
- viii. Champion Brew Plc.,
- ix. Cadbury Nigeria Plc.,
- x. Nestle Nigeria Plc.,
- xi. Nigerian Enamelware Plc.,
- xii. Dangote Sugar Refinery Plc.,
- xiii. Vitafoam Nig Plc.,
- xiv. P Z Cussons Nigeria Plc., and
- xv. Unilever Nigeria Plc.