Lean Practices and Sales Performance of Listed Oil and Gas Firms in Nigeria

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Abstract

This study employs the random effects method to investigate the impact of lean inventory practices on sales performance of oil and gas firms in Nigeria. The study considers three dimensions of lean inventory practices: namely, just in time, total quality management, and total preventive maintenance, with data on these variables collected through a validated structured questionnaire instrument from 100 purposely selected managers or representatives of 10 listed oil and gas companies in Nigeria. The Cronbach Alpha method is used to determine the reliability of the research instrument, while face and content validity are based on the opinions of industry experts and teaching professionals. However, sales revenue data are obtained from the annual reports and accounts of the selected companies and consist of 80 firm-year panel observations for the period from 2010 to 2017. Our results show that all the three dimensions of lean inventory practices have a positive relationship with sales revenue performance. However, while only the effect of just in time is statistically significant, the joint explanatory power of all the three lean practices dimensions is very low at approximately 3%. These results therefore suggest that oil and gas firms that are listed in the Nigerian stock exchange have not fully embraced lean inventory as a strategy for improving their sales performance.

Key words: *Lean inventory practices, sales performance, random effects model*

Introduction

Oil and gas firms in Nigeria have recently been experiencing declining trend in performance outcomes which is now a major concern to industry stakeholders including managers, investors, government at both national and state levels, as well as researchers. Available statistics from the annual reports of the individual firms show that most of the companies in this sector have been experiencing declining profits in recent years. For example, in 2017, Total Nigerian PLC, which is a major industry player, recorded an operating profit of ₦12.3billion and a profit after tax of ₦8.0billion compared with the operating profit of ₦20.9billion and the profit after tax of ₦20.4billion recorded in the previous year. This clearly shows a decline in operating profit and profit after tax by 41.4% and 60.6% respectively. This declining trend continues in 2018 as both operating profit and profit after tax further declined to ₦9.8billion and ₦7,96billion respectively. Similarly, for MRS PLC, the operating profit and profit after tax, which stood at ₦3.3billion and ₦2.3billion respectively in 2016, declined to ₦101million and -₦997million in 2017, and further to -₦1.5billion and -₦1.3billion in 2018.

The declining profitability of these companies obviously has an adverse effect on the Nigerian economy, given that the oil and gas sector is the main contributor of federal government revenues and economic growth in Nigeria. The question is: what can be a plausible and dependable way out? We argue that lean inventory practices such as just in time practice, total quality management and total productive maintenance would help turnaround this ugly trend, since it is well documented in the literature that inventory leanness leads to higher marketing and financial performance (Bayou & Korvin, 2018; Lenny Koh et al., 2007; Lwiki et al., 2013).

This study investigates the effect of lean inventory practices on sales performance in the Nigerian oil and gas industry. Specifically, the study uses a random effects model to examine the effects of just-in-time, total quality management, and total preventive maintenance on sales revenue of listed oil and gas firms in Nigeria.

The study has three specific objectives as follows:

1. To determine the effect of just-in-time on sales revenue performance.
2. To determine the effect of total quality management on sales revenue performance.

3. To determine the effect of total preventive maintenance on sales revenue performance.

This study is significant in two ways. First, we employ the random effects modeling approach to examine the empirical relationship between lean inventory practices and sales performance. This approach is scarce in the Literature as much of the previous empirical studies, especially those that are domiciled in Nigeria, are based on cross-sectional regression. A classic example is the study by Nnadi and Ndu Oku (2021), which links just-in-time, total quality management, and total preventive maintenance to productivity and delivery performance using cross-sectional regression. By using the random effects framework, this study has expanded the methodological literature on panel data, and thereby contributes significantly to knowledge. Secondly, our empirical analysis combines both cross-sectional data obtained from primary sources mainly through a structured questionnaire instrument, and panel data obtained from secondary sources. This is clearly novel since much of the previous studies are based only on survey cross-sectional data.

The remainder of the study is structured as follows: The next section reviews the extant literature on lean-performance relationship. This is followed by the section that describes the methodology used for empirical analysis, and then by the section that contains the empirical analysis and discussion of findings. The final section contains summary and conclusion.

Literature Review

Theoretical Foundation

The resource-based theory of Barney (1991) offers a natural fit with lean inventory research because it emphasizes the positive role of valuable and distinctive resources and capabilities in firm performance and competitiveness. According to this theory, firms should enhance their competitiveness by focusing on their internal resources and by acquiring new capabilities that are rare and not easily imitated. These resources and capabilities can be tangible or intangible. While tangible resources include land, machines, technology, and geographical locations, intangible resources comprises managerial skills, knowledge, and technical knowhow.

In the context of inventory leanness, firms can acquire new technologies that will speed up the production process with minimum waste while standardizing their products to conform with the expectations of their customers. Managers can also use their managerial skills to improve their supply chain management and to deliver near zero defect quality, near zero variance quantity and precise on-time delivery (Green & Inman, 2005). This implies that improve customer relations and thereby makes the firm more competitive in the market.

Empirical Review

Kannan and Tan (2005) investigate the extent to which just in time (JIT) praactice, total quality management (TQM) and supply chain management (SCM) are related, and how they affect organizational performance. The empirical analysis is based on 556 survey responses from senior operations and material managers in North America and Europe identified through the Institute for Supply Management (ISM) and American Production and Inventory Control Society (APICS). JIT practices was measured in terms of material flow, commitment to JIT and supply management, while TQM is measured in terms of product design, strategic commitment to quality and supplier capability. Further, SCM was measured using four dimensions; namely, supply chain integration, supply chain coordination, supply chain development and information sharing. The results show that JIT practice, TQM and SCM have significant interactions at both strategic and operational levels, and that commitment to quality and understanding of supply chain dynamics have the highest effects on performance.

Koumanakos (2008) use cross sectional regression to investigate the effect of lean inventory management on the financial performance of medium and large manufacturing firms in three industrial sectors: food, textiles and chemicals, in Greece between. The study is based on a sample comprising 3727 firm-year unbalanced panel observations (1358 firms) from 2000 to 2002. Two measures of financial performance: gross margin and net operating margin, were examined. The results show that there is a linear relationship between inventory management and firm financial performance.

Dal Pont et al. (2008) seek to investigate the complex relationships among lean bundles and operational performance using structural equation modeling. Operational performance is measured by a single latent construct with six observed variables; unit cost of manufacturing, conformance to product specifications, on-time delivery, fast delivery, flexibility to change product mix and flexibility to change volume. On the other hand, lean bundles include

just-in-time, total quality management and human resource management. The empirical analysis is based on a survey sample of 266 plants across three industries; electronics, machinery, and transportation, in nine countries; Germany, Italy, Finland, Japan, Spain, South Korea, USA and Austria. The study finds that while both just in time and total quality management have a direct and positive effect on operational performance, the effect of human resource management is mediated by both just in time and total quality management.

Fullerton and Wempe (2009) consider the effect of lean practices on financial performance of 121 manufacturing executives in US using the structural equation modeling. The study also considers the role (mediating or moderating) of non-financial manufacturing measures (NFMP) in the relationship between lean manufacturing practices and firm financial performance. Dimensions of lean practices include setup reduction, cellular manufacturing, and quality improvement while financial performance is measured by return on sales. The study confirm that shop-floor employee involvement is critical to the successful adoption of lean production, and that lean production methods encourage the use of NFMP measures. The study finds that lean practices have varied direct effects on profitability, and that NFMP measures have significant direct effect on profitability. The study also finds that the use of NFMP measures mediate the effects of lean production initiatives on firm profitability.

Rahman et al. (2010) examine lean management practices and their effects on the operational performance of manufacturing firms in Thailand using multiple regression analysis. The study considers 13 lean practices which are grouped into three higher constructs: just in time, waste minimization and flow management, using factor analysis. On the other hand, four operational performance measures are considered including unit cost of products relative to competitors, quick delivery compared to competitors, overall productivity, and customer satisfaction. The sample comprises 187 middle and senior managers from 187 manufacturing firms, while the data were collected using a survey questionnaire. The study examines both SMEs and large firms which are further grouped into local, foreign, and joint venture firms. The results show that the three lean practices all have a significant relationship with operational performance. However, while just in time has a higher effect for large enterprises compared with SMEs, waste minimization has a higher significance level for SMEs compared with Large Enterprises. The effect of flow management is much lower for both SMEs and large enterprises. In terms of ownership, just in time has a higher effect on operational performance for all three ownership categories, while both waste minimization and flow management have a much higher effect for foreign-owned companies compared with both local and joint venture companies.

Baird et al. (2011) use structural equation modeling to examine the relationships between organizational culture, total quality management and firm operational performance in manufacturing and service industries in Australia. The total quality management practices examined are quality data and reporting, process management, supplier quality management and product/service design, while operational performance was measured by quality and inventory management. Further, organizational culture is measured using six dimensions; namely, stability, outcome oriented, attention to detail, aggressiveness, teamwork/respect for people and innovation. The empirical analysis is based on data obtained from a survey sample of 138 managers (general managers, operations managers and managing directors) of randomly selected business enterprises (110 manufacturing and 28 service). The findings show that the most important cultural dimension for total quality management is teamwork/respect for people. The findings also suggest that three total quality management factors; process management, supplier quality management and quality data and reporting, can lead to higher operational performance.

Hofer et al. (2012) investigate the effect of lean production implementation on financial performance as well as the mediating role of inventory leanness effect of inventory leanness on the link between lean production and financial performance. They also consider the interaction effect of different lean practice bundles on both financial and inventory performance. The empirical analysis based on a combination of survey and secondary data shows amongst others that inventory leanness mediates the effect of lean production on financial performance.

Nawanir et al. (2013) employ the multiple regression framework to analyze the effects of lean practices on operational and business performance focusing on manufacturing companies in Indonesia. They measure operational performance in terms of quality of products and services, inventory reduction, fast and timely delivery, and cost reduction, while sales, profitability, and customer satisfaction are used as measures of business performance. Their empirical results show evidence that lean practices in terms of resource flexibility, cellular layout, pull systems, quick setup, uniform production level total quality management and total productive maintenance) positively and significantly affect both operational and sales performance.

Khanchanapong et al. (2014) use structural equation modeling to examine the effects of manufacturing technologies and lean practices on four dimensions of operational performance; namely, cost, quality, lead time and flexibility.

The sample comprises 186 manufacturing plants in Thailand. Lean practices are measured in terms of production flow management, supplier management, workforce management, process management and customer focus, while manufacturing technologies are measured using three dimensions: namely, design technologies, process technologies and administrative technologies. The findings suggest that manufacturing technologies and lean practices both can lead to higher operational performance, both individually and synergistically.

Fullerton et al. (2014) investigate the relationship between lean manufacturing and firm performance in the US manufacturing industry using structural equation modeling. They argue that lean manufacturing has a positive relationship with lean management accounting practices (MAP) and that the extent of lean manufacturing practices has a direct relationship with firm operational performance. They evaluate the validity of these arguments using a survey sample of 244 US manufacturing firms. The study has six constructs; namely, extent of lean manufacturing, simplified and strategically aligned MAP, visual performance measures, operations performance, and financial performance, which are validated using both principal component-based exploratory factor analysis and confirmatory factor analysis. They find that lean manufacturing has both direct and indirect effects on firm operations performance. The indirect impact of lean manufacturing on operations performance occurs through management accounting practices.

In a case study research, Shah et al. (2017) examine the impact of lean practices on the performance of firms in the service sector. The lean practices considered are just in time, value stream mapping, Pokayoke (automation) and Kanban. The study finds that lean practices positively affect performance, and that the implementation of a just-in-time strategy has a higher impact towards improving quality, speed, flexibility, and supplier costs. The study also identifies lack of commitment from top management as among the important factors affecting the implementation of lean practices.

Panwar et al. (2018) examine the effect of lean practices on the performance of firms in the process industries in India using multiple regression. The study evaluates 18 lean practices and groups constructs them into five higher level lean using principal component factor analysis. The first group, which is termed lean practices set 1, comprises quality control, visual control, supplier integration and partnership, long term relationships and supplier rationalization. The second group, which is labelled lean practices set 2, includes just in time purchasing, lot size reduction, bottleneck/constraint removal and quick change over techniques. The third group, which is termed lean practices set 3, comprises 5S, total productive maintenance and statistical quality control. The fourth group, which is termed lean practices set 4, consists of work standardization, flexible and cross functional teams, new equipment and technology and continuous improvement programmes. The fifth group, which is named lean practices set 5, includes production levelling and pull production. The sample comprises 121 survey participants who are mostly production managers, operations managers, and general managers in both large and small firms across different industries in India. Further, the study examines two performance improvement factors; operational improvement, which comprises inventory levels, timely deliveries, level of various costs, level of wastes, productivity and demand management, and quality improvement, which comprises defect levels and first pass yield. The empirical results show that lean practices have a positive relationship with productivity, timely deliveries, elimination of waste, first pass yield, reduction in inventory, cost reduction, defects reduction and improved demand management. However, lean practices related to pull production are found to be marginally associated with performance improvement.

Khan and Siddiqui (2019) use structural equation modeling (SEM) to examine the effects of investment management factors on the efficiency of departmental stores in Karachi. The inventory management factors are lean inventory, inventory accuracy, stock availability and capacity utilization. The study is based on a sample of 250 employee at departmental stores that have a significant relationship between inventory and income. The instrument used to collect the empirical data is a well-structured questionnaire, with Likert type questions. The results show that lean inventory, inventory accuracy and stock availability all have a positive and statistically significant effect on firm efficiency, while the effect of capacity utilization appears to be insignificant.

Summary of Literature Review

Although, there is a scanty but growing literature on the relationship between lean inventory and firm performance, much of the existing studies focus on manufacturing firms in developed countries such as US, Japan, and European countries. Also, previous studies largely focus on operational performance and profitability, leaving out sales dimension of firm performance in the lean-performance relationship. Therefore, considering the empirical

relationship between lean inventory practices and sales revenue performance in the Nigerian oil and gas industry would fill an important knowledge gap.

Methodology

Sample, Data and Measurement

The study sample comprises 10 listed oil and gas companies in Nigeria. These include Total, Oando, Eterna, Conoil, MRS, Rak Unity, Forte Oil, Japaul Oil, Seplat, and Capital Oil. Sales revenue data have panel structure and are sourced from the published annual reports of the individual companies for the period from 2010 to 2007. Hence, our panel data comprises 80 firm-year observations. However, lean inventory data have cross-sectional structure and are sourced through a questionnaire instrument structured in Likert format with 5 ordered questions from (1) very low extent to (5) very great extent. Respondents are senior managers, middle managers, or persons with satisfactory knowledge and/or relevant experience on lean inventory practices and management. Each of the twelve sampled companies had 10 representatives, two purposely chosen from each of the five functional departments to include: marketing, procurement/purchasing, production, customer-service, and quality assurance departments. The reliability of the data is determined based on the Cronbach Alpha method, while both face and content validity are based on opinions of industry experts and teaching professionals.

Figure 1 plots the mean and standard deviation for sales revenue performance for the selected companies, while Table 1 shows the descriptive analysis (mean and standard deviation) for the three dimensions of lean inventory practices.

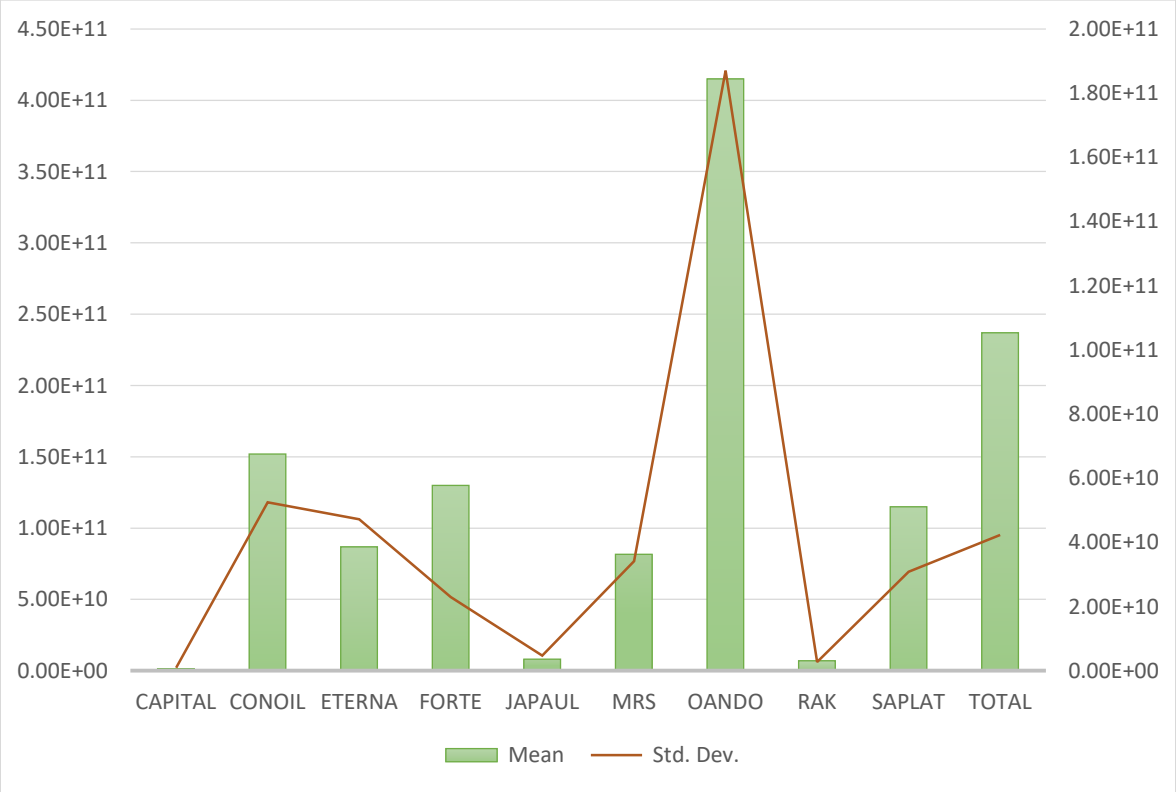

Figure 1: Mean and Standard Deviation for Sales Revenue Performance

Table 1: Descriptive Analysis of Lean Inventory Dimensions

Item/Measure	Description	$\bar{x}$	σ	Remark
Just in Time (JIT): Cronbach Alpha = 0.872				
JIT1	Just in Time Production	4.39	0.901	Great Extent
JIT2	Continuous process flow production	3.93	0.871	Great Extent
JIT3	Pull Systems	4.22	1.020	Great Extent
JIT4	Cycle-time reductions	3.94	0.930	Great Extent
JIT5	Just in Time Purchasing	4.19	0.896	Great Extent
Total Preventive Maintenance (TPM): Alpha = 0.850				
TPM1	Autonomous maintenance	3.79	0.534	Great Extent
TPM2	Planned maintenance	3.75	0.564	Great Extent
TPM3	Safety, Health and Environment	3.79	0.606	Great Extent
TPM4	Maintenance reduction	3.77	0.639	Great Extent
TPM5	Employee Training	3.79	0.629	Great Extent
Total Quality Management (TQM): Alpha = 0.859				
TQM1	Competitive Benchmarking	4.30	0.972	Great Extent
TQM2	Quality management programs	4.18	1.057	Great Extent
TQM3	Process capability measurements	4.31	1.088	Great Extent
TQM4	Formal continuous improvement program	4.12	0.822	Great Extent
TQM5	Supplier quality management	4.34	0.900	Great Extent

Empirical Strategy

To examine the effects of just in time, total preventive maintenance, and total quality management on sales revenue performance, we specify the following panel data regression model:

$$SRP_{it} = \phi_0 + \phi_1 JIT_i + \phi_2 TQM_i + \phi_3 TPM_i + \gamma_i + w_{it} \quad (1)$$

Where α_0 is the regression intercept which captures the average sales revenue performance (SRP) when all the right-hand side variables are jointly zero; α_1, α_2, and α_3 are the main slope coefficients representing the individual effects of just-in-time (JIT), total quality management (TQM), and total preventive maintenance (TPM); and ϵ_i is the error term that represent factors that are not included in the model. Also, γ_i represents cross-sectional heterogeneity arising from the unobserved differences in organizational culture, leadership, and management styles across firms. However, we assume that γ_i is an error process that is uncorrelated with JIT, TQM, and TPM, hence, the above model is a random effects specification.

Empirical Analysis and Discussion

Table 2 reports the panel (pooled and random effects) regression results for the relationship between dimensions of lean inventory practices and sales revenue performance. The upper panel shows the estimated model coefficients, while the lower panel shows the model fit and diagnostic statistics. Table 3 shows the estimated random effects (heterogeneity parameter for different firms). All empirical analysis are done in EViews.

Table 2: Panel estimation results; p-values in parenthesis

Variable	Panel Data Methods	
	Pooled Regression	**Random Effects**
Constant (ϕ_0)	41.617*** (0.0000)	40.918*** (0.0004)
JIT (ϕ_1)	4.1259*** (0.0000)	3.9061** (0.0477)
TQM (ϕ_2)	0.5340** (0.0153)	0.5589 (0.4249)
TPM (ϕ_3)	0.8955** (0.0200)	0.9438 (0.4375)
R^2	0.4012	0.0657
$\bar{R}^2$	0.3755	0.0257
F-statistic	15.636*** (0.0000)	1.6430 (0.1872)
Jarque-Bera (JB)	1.4686 (0.4798)	1.6331 (0.4419)
LM (statistic)	187.96*** (0.0000)	–

*****indicates 5% level significance**
****indicates 10% level significance**

Table 3: Estimated Firm-Specific Random Effects

S/N	FIRM	RANDOM RFFECTS
1	TOTAL (γ_1)	-0.0599
2	OANDO (γ_2)	1.5919
3	MRS (γ_3)	-0.1489
4	SEPLAT (γ_4)	-0.6080
5	CONOIL (γ_5)	0.4842
6	FORTE (γ_6)	2.2614
7	JAPAUL (γ_7)	-1.7011
8	CAPITAL (γ_8)	-2.3197
9	ETERNA (γ_9)	0.1787
10	RAK_UNITY (γ_{10})	0.3213

From Table 2, the estimated coefficients all have the expected positive sign for both pooled regression and random effects methods. This shows that just in time, total quality management and total preventive maintenance all move in the same direction with sales revenue performance. However, the p-values indicate that the estimated pooled regression coefficients are all statistically significant, while only the coefficient on just-in-time is statistically significant for the random effects regression. The constant term has almost zero p-value for both methods, indicating

that the average sales performance would be highly significant even when the three lean dimensions are not implemented.

From the lower panel of Table 2, although, it appears that the pooled regression model $\bar{R}^2 = 0.3755$) has a much higher goodness of fit than the random effects model $\bar{R}^2 = 0.0257$), the LM statistic is highly statistically significant, thereby accepting the null hypothesis of no omitted random effects in the model. This clearly shows that the random effects method provides the best estimates for the relationship between lean inventory practices and sales revenue performance. From Table 3, we can see that the firm-specific random effects are different for different companies, with TOTAL ($\gamma_1 = -0.0599$), MRS ($\gamma_3 = -0.1489$), SEPLAT ($\gamma_4 = -0.6080$), JAPAUL ($\gamma_7 = -1.7011$) and CAPITAL ($\gamma_8 = -2.3137$) having negative unobserved random effects, while OANDO ($\gamma_2 = 1.5919$), CONOIL ($\gamma_5 = 0.4842$), FORTE OIL ($\gamma_6 = 2.2614$), ETERNA ($\gamma_9 = 0.1787$)and RAK UNITY ($\gamma_{10} = 0.3213$) are associated with positive unobserved random effects.

Just-in Time and Sales Revenue Performance

The first objective of this study is to determine the effect of just in time on sales performance. According to Lenny Koh et al. (2007), just in time delivery practices help to reduce delivery lead time as well as increase responsiveness, and thus provide competitive advantage to the firm. This implies that implementing just in time strategy can enhance sales performance. Therefore, we expected, *apriori*, that just in time would exert a positive and highly significant effect on sales revenue performance of oil and gas firms in Nigeria.

Consistent with our expectation, *apriori*, we found that just in time strategy has a positive and significant effect on sales revenue performance. As evident in Table 2, the random effect coefficient on JIT is 3.9061 and its associated probability is 0.0477, showing that just in time and sales revenue performance are positively and significantly related. This implies that implementing more just in time strategies would improve sales revenue performance, thereby making the firm highly competitive in the market. This finding is consistent with the findings by Nawanir et al. (2013) that lean practices including just-in-time is significant in the sales performance model.

Total Quality Management and Sales Revenue Performance

The second objective of this study is to determine the effect of total quality management on sales performance. Boon-Itt and Yew Wong (2011), lean practices including total quality management has a positive impact on customer delivery performance on the grounds of the sharing of reliable and real-time data both within and across firms in a supply chain. This implies that implementing just in time strategy can enhance sales performance. Therefore, we expected, *apriori*, that total quality management would exert a positive and highly significant effect on sales revenue performance of oil and gas firms in Nigeria.

Our finding shows that total quality management has no significant effect on sales performance. This is evident in Table 2, which shows that random effect TQM has a coefficient of 0.5589 with a p-value of 0.4249, indicating that although, total quality management has a positive relationship with sales performance, its effect is not statistically significant. However, the size of the TQM coefficient suggests that the positive effect of total quality management is economically significant. This implies that implementing more total quality management strategies would lead to higher sales performance. This finding agrees with Losonci and Demeter (2013) and Nawanir, et al. (2013). Both authors find that implementing total quality management can lead to higher business and sales performance.

Total Preventive Maintenance and Sales Revenue Performance

The third objective of this study is to determine the effect of total preventive maintenance on sales performance. Literature suggests that total preventive maintenance practices have a positive relationship with sales performance (Losonci & Demeter, 2013; Nawanir, et al., 2013). This implies that implementation of total preventive maintenance strategy can enhance sales performance. Therefore, we expected, *apriori*, that total preventive maintenance would exert a positive and highly significant effect on sales revenue performance of oil and gas firms in Nigeria.

Our finding shows that total preventive maintenance has no significant effect on sales performance. This is evident in Table 2, which shows that random effect TPM has a coefficient of 0.9438 with a p-value of 0.4375, indicating that although, total preventive maintenance has a positive relationship with sales performance, its effect is not statistically significant. However, like the case of TQM, the size of the TPM coefficient suggests that the positive effect of total preventive maintenance is economically significant. This implies that implementing total preventive maintenance strategies would lead to higher sales performance. This finding agrees with (Losonci and Demeter

(2013) and Nawanir et al. (2013). Both authors find that implementing total preventive maintenance can lead to higher business and sales performance.

Summary and Conclusion

The aim of this study is to examine the empirical linkage between lean inventory practices and sales performance of listed oil and gas firms in Nigeria. Three dimensions of lean inventory practices are examined: namely, just-in-time, total quality management, and total preventive maintenance, while sales performance is measured in terms of total sales revenue. The study employs the panel data regression framework while the empirical analysis is based on both cross-sectional survey data and secondary data obtained from firms' annual reports and accounts.

There is evidence that while all the three dimensions of lean inventory practices are positively associated with sales revenue performance, only the effect of just in time is statistically significant. Also, the combined effect of the three dimensions of lean inventory practices is not statistically significant and explains only approximately 3% of the total variation in sales revenue performance. Our results therefore suggest that listed oil and gas firms in Nigeria have not fully embraced lean inventory as a strategy for improving their sales performance.

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