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Variance Analysis and Operational Performance of Listed Manufacturing Firms in Nigeria

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Abstract

Background*: Against the backdrop of efforts by manufacturing firms to continuously reduce production costs and increase revenue to improve operational performance, this study examined the effect of variance analysis on operational performance of manufacturing firms listed on Nigerian Exchange Limited.*

Materials and Method: *For the study, ex-post facto research design and profit maximization theory was adopted. The study population was restricted to industrial and consumer goods sectors where most manufacturing firms are concentrated. Stratified sampling technique was employed to select 30 out of 33 firms based on Taro Yamane criteria. Secondary data obtained were analyzed using descriptive statistics and feasible generalised least square regression method.*

Results*: Results obtained proved that production costs (material, labour and overhead) variances have significant and negative impact on return on assets but selling price variance and leverage have a significant positive effect on return on assets. Only the firm size has an insignificant positive effect on return on assets. The gross profits margin is negatively influenced by production costs variances but only the material cost variance is significant. Selling price variance, firm size and leverage have positive impact on gross profit margin but only the leverage is insignificant.*

Conclusion: *The study concluded that firms' moderate unfavorable variances of production costs with increases in selling price. These results confirmed relevance of variance analysis in the NGX listed manufacturing firms. The study recommends that listed NGX manufacturing firms should improve on production costs control to improve operational performance.*

Keywords: *Manufacturing firms, Nigerian Exchange Limited, operational performance, variance analysis.*

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I. Introduction

From the ancient, profit maximization has remained at the center stage among business objectives. To achieve profit maximization objectives, firms would need to either maximize revenue and/or minimize costs. Likert and Seashore (1998) opined that the best way to achieve profit maximization objective is cost control and reduction. Hence, firms adopt cost control methods that avail the opportunity to achieve an effective control over costs of production. Variance analysis is one of the available management accounting tools for cost control. It compares the standard or predetermined costs, sales price and profits per unit with the actual. Variance analysis avail managers the opportunity to investigate causes of differences between the standard and actual cost, profit and selling price of a product or service (Hung & Shanmugam, 2023).

Variance analysis provides opportunity to control costs, improve efficiency and by extension, performance. Focus on operational efficiency is critical to the profitability and survival of the 21st century manufacturing firms. According to Princewill & Umoh (2022), the operational performance, production effectiveness, competitive advantage, and survival of a firm depends largely on operational efficiency. Over time, firms have relied on the application of management accounting tools such as variance analysis, just-in-time, and activity-based costing to manage costs of products and services, achieve higher operational efficiency and improve performance (Iliemena & Amedu, 2019). Since firms are price takers, the need to maintain balance between operational performance and corporate survival through efficiency has become a priority. Manufacturing firms, among others are most faced with the need to make costing choices that maximize value of available resources - human, material and machines. Competition among producers of goods and services sometimes gives rise to price war which makes manufacturing firms prioritize costs control to ensure that costs of production are kept at minimum possible. The analysis of variance is common among manufacturing firms because of its usefulness in this regard. After setting the standard production costs, selling price and profits of a unit of a product or service, firms compare the actual with the standard cost to determine the difference or variance.

Various issues have been built around the application of variance analysis in corporate performance management, with no consensus yet. Firstly, some researchers argued that it aids continuous improvements in the efficiency of firms which improves future performance (Princewill et al., 2022; Gill et al., 2014). These authors believed that variance analysis is what gave meaning to the standard costing system. Without variance analysis, firms may hardly derive many benefits from standard costing. Hence, firms can achieve a better performance through application of variance analysis as a tool to plan profit, control costs, and improve efficiency and performance. The second school of thought opined that the variance analysis is less relevant in a dynamic and ever-changing business environment (Hung et al., 2023; Mackey & Pforsich, 2019). They further argued that managing a 21st century business requires more than what traditional standard costing system and variance analysis can handle. They cited that it is less robust and offer less than required support that modern firms need to exploit growth and survival opportunities (Mackey *et al.*, 2019). In order to address the shortcomings of the variance analysis, several other cost control tools such as just-in-time and activity-based costing among others have been introduced. Despite this, Mackey et al. (2019) agreed that standard costing remains tool that managers can adopt to achieve cost control, improve efficiency and performance of firms. Hence, it is still widely used by manufacturing firms across the world including Nigeria (Ogungbade et al., 2020).

Relevant empirical evidence on the influence of variance analysis on operational performance of firms can be categorized into two. The first and most common empirical evidence focused on the influence of factors other than variance analysis of performance of manufacturing firms. They examined the influence of standard costing (Akinleye & Oluyori, 2023; Iliemina et al., 2019; Ologbenla, 2022), and inventory management practices (John et al., 2015), among others on the operational performance of firms. These are some of the most popular aspects available in the literature. Hung et al. (2023) demonstrated that standard costing and variance analysis improves cost control, operational efficiency and performance. Princewill et al. (2022) opined that operational efficiency affects operational performance while Miswanto and Oematan (2020) attributes the level of financial performance of firm to optimal utilization of assets.

The second stream of studies examined the impact of variance analysis on the performance of manufacturing firms. Akinleye et al. (2023), Ali-Momoh et al. (2022), Ogungbade et al. (2020), and Osei et al. (2020) are the examples of studies in this category. These studies provide relevant findings, but consensus is yet to emerge. For instance, Ogungbade et al. (2020) discovered that sales and labour cost variance have positive effect while material and overheads have negative effect on performance. This is contrary to findings by Ali-Momoh et al. (2022) who reported that overhead and material cost variance are favorable and affect performance positively while labour has a negative influence on performance. While Akinleye et al. (2023) found that standard costing positively affects return on asset of sampled firms, but Osei et al. (2020) found no relationship. They suggested that financial performance is a subject of other factors such as employee motivation, corruption and insufficient database contrary to submission by Hung et al. (2023) that standard costing and variance analysis are important management accounting tools for today's industry.

Empirical evidence that examined the impact of standard costing and variance analysis on performance, especially the return on assets and gross profits margin, of manufacturing firms are rare. This can be attributed to several factors including lack of adequate attention by researchers and paucity of variance analysis data of manufacturing firms. Emsley (2000) found that the some of the firms sampled for his study discard variance information after discussing it with the supervisors.

Objective of the Study

This study investigates the effect of variance analysis on the operational performance of listed manufacturing firms in Nigeria. Specific objectives are to;

i. Determine the impact of variance analysis on the return on assets of listed manufacturing firms in Nigeria.
ii. Assess the association between variance analysis and the gross profits margin of listed manufacturing firms in Nigeria.

Research Questions

This study shall answer the following research questions.

i. To what extent does variance analysis impact the return on assets of listed manufacturing firms in Nigeria?
ii. What degree of influence does variance analysis has on the gross profit margin of listed manufacturing firms in Nigeria?

Research Hypotheses

The research hypotheses are stated thus.

$H_0$1 There is no statistically significant relationship between the variance analysis and return on asset of listed manufacturing firms in Nigeria; and

$H_0$2 Variance analysis does have no statistically significant effect on the gross profits margin of listed manufacturing firms in Nigeria.

The rest of the study is structured as section 2 to 7. In section 2 which is immediately after this section, the theoretical framework of the study is discussed followed by section 3 tagged the literature review which discussed relevant concepts and existing empirical studies were reviewed. Section 4 discussed the method employed for the research and in section 5, results were presented while sections 6 and 7 discussed the conclusion and recommendations respectively.

II. Theoretical Framework

The study is premised upon the assumptions of profit maximization theory. The profit maximization theory was introduced by the neo-classical economics in the early 19th century. Hawkins (1973) opined that the main thrust of the neo-classical theorists is the management of the production costs and pricing decisions. The neo-classicals projected profit maximization objective in the short run as the foundation of output and pricing decision of firms which also agree with the view of traditional economic model (Tripathi, 2019). Profit maximization objective also underpinned the quest by firms to ensure that available resources are efficiently allocated and utilized. In other to achieve profit maximization objective, firms employ various techniques including minimization of production costs, increase of selling price, improving the economics of scale, and effective competition management, among others (Rakhsitha et al., 2023). The standard costing and variance analysis are some of the most popular techniques employed by manufacturing firms to control production costs and revenue in order to improve operational performance. The assumptions of the profit maximization theory are therefore considered relevant to explain how firms improve operational performance through variance analysis as a cost and revenue control tool.

III. Literature Review

Relevant literature to the study were discussed in this section as structured below.

Conceptual Review

The dependent and independent variables of the study are operational performance and variance analysis, respectively. They are discussed under three sub-sections such as operational performance, variance analysis, and variance analysis and operational performance.

Operational Performance

The term operational performance is used to describe the measurable outcomes of processes, efficiency and operations of a firms. Derouiche *et al*. (2020) argued that the level of efficiency defines the level of competence, experience, technology and/or technical-know-how that a firm have acquired so far in the production or provision of goods or services. It is a direct result of the level of efficiency that a firm has attained in the production of goods and services that a firm has attained for which firms adopt multiple measure (Azim et al., 2015; Panigrahi *et al.,* 2022). Empirical evidence shows that measures such as return on asset, profitability, gross profits margin, return on capital employed, fixed asset turnover, return on total assets, etc. has been used to proxy operational performance (Akinleye *et al.,* 2023; Ali-Momoh *et al.,* 2022; Azim *et al.,* 2015; Panigrahi *et al.,* 2022). For this study, return on assets and gross profits margin were adopted as measure of operational performance.

Variance Analysis

Variance analysis is an integral part and performance appraisal aspect of a standard costing system. Standard cost refers to the estimated or budgeted costs of producing a unit of a product or service. Estimated selling price per unit are usually derived by adding a margin to or mark-up on the standard cost. When these standards set as recorded in the standard costs card are compared with the actual, differences derived are referred to as the variance (Hung et al., 2023). The investigation of the causes of the variance is referred to as the variance analysis. The investigation of these variance is necessary to ensure that causes and solution of difference between standard and actual costs are identified and corrective actions taken. Variance analysis allows manufacturing firms to determine reasons for differences between the standard and actual costs of manufacturing single unit of a product or service (Ali-Momoh et al., 2022). Variance analysis help firms to identify and investigate causes of deviations from standard costs and taking of appropriate corrective actions. Without variance analysis, firms may hardly derive many benefits from standard costing.

The available types of variances are materials, labour, overhead and selling. Material variance refers to the difference in the cost, price, yield and usage of materials employed in the production of goods and services. Material cost variance refers to the total difference between the standard and actual cost of materials utilized in the production of a certain quantity of goods or services. This can be broken down into material price, yield, and usage. Material price refers to difference in the actual and standard cost of purchase while material yield reflects

the difference between the standard and actual quantity of material used traceable to quality of materials. Material usage explains difference in the quantity used due to wastages.

Labour cost variance refers to difference between the standard and actual cost of labour per unit. It is the total sum of all labour variances which include labour rate, labour efficiency and idle time variances among others. Labour rate variance refers to difference in the standard and actual labour rate per unit while labour efficiency refers to difference in the standard and actual labour hour per unit. Idle time variance is the total number of hours that labour are does not perform any task due to production stoppage.

The overhead cost variance is the difference between the standard and actual overhead cost per unit. It is the sum of all overhead variances including overhead rate, efficiency and usage. Overhead rate refers to difference between the standard and actual rate per unit while efficiency refer to the difference between the standard and actual quantity/unit per production hour required to produce a unit of a product or service. Selling price variance refer to difference between the standard and actual unit selling price.

Firms potentially derive various advantages from variance analysis. Variance analysis is costs control tool that avail managers necessary information about current level of efficiency, cost control and improve performance. Variance analysis allows manufacturing firms to determine deviation and the underlining factors responsible for deviation from standards costs of manufacturing single unit of a product or service. Variance analysis help firms to identify and investigate causes of deviation from standard costs and take corrective actions.

Variance Analysis and Operational Performance

Corporate performance and survival where there are many producers depends on the level of efficiency attained by a firm. Hence, firms manage costs of products and services through variance analysis to maintain market share and survival. Where firms are price takers such as obtainable in manufacturing industry in Nigeria, the need to maintain balance between operational performance and corporate survival cum efficiency becomes prioritized by firms. Manufacturing firms, among others are most faced with the need to make costing choices that maximize value of available resources - human, material and machines. This has given rise to the adoption of costing systems such as variance analysis to aid operational efficiency and performance. Competition among producers of goods and services sometimes gives rise to price war which makes manufacturing firms pay keen attention to products and service production costs. The analysis of variance is common among manufacturing firms because of its usefulness in this regard.

Empirical Review

The study by Ali-Momoh et al. (2022) investigated the influence of material, labour and overhead variance on the return on asset of consumer goods firms for the period 2010-2020. They employed ex-post facto design and regression method for their study. Findings by the study show that the variance analysis has a mixed influence on the return on asset. While the overhead and material cost variance have positive and significant effects on the return on assets, labour cost variance has negative and significant effect on the return on assets of consumer goods firms. This study was limited to the consumer goods sector and a sample of 5 out of 28 firms in considered inadequate for such study.

Study by Akinyele et al. (2023) on the effect of standard costing on the return on asset of listed consumer goods firms employed similar methodology used by Ali-Momoh et al. (2022). They examined the influence of cost reduction and profit margin improvements on the return on assets of consumer goods firms sampled for their study. They found that the return on asset of sampled firms has a statistically significant positive relationship with cost reduction and profit margin improvements. This establishes a strong link between return on asset and standard costing enabled cost reduction and profit margin improvements. They successfully demonstrated that the application of standard costing reflects on the cost reduction and profit margin improvements of a firm as well as financial performance. However, the study fails to analyze standard costing adoption by sampled firms which limits the application of study findings.

Findings by Hung et al. (2023) found that the standard costing and variance analysis are relevant and crucial in the management of modern firms. Its use in cost control, cost benchmarking, scarce resources allocation, production budgeting among others in various countries across the world including Nigeria are specifically noted by the study.

Gill et al. (2014) investigate the level of dependence of future performance on the operational efficiency of Indian manufacturing firms. Relevant findings by the study shows that while changes in operating expenses have positive impact, changes in asset turnover have negative impact on the future performance of Indian manufacturing firms. This is similar to findings by Mackey et al. (2019) who agreed that standard costing remains tool that managers can adopt to achieve cost control and improve efficiency and performance of firms despite its inefficiency in utilizing growth and survival opportunities in dynamic business environment. They attributed the emergence of several other cost control tools such as just-in-time and activity-based costing among others.

Milojević et al., (2015) examined application of variance analysis in a Serbian manufacturing company. They found that the standard and actual costs and revenue were compared, variance derived and investigated.

Their findings suggested that variance analysis formed part of the cost control tools applied by the firm. This further support the view by Gill et al. (2014) and Mackey et al. (2019) than variance analysis remains a management accounting tool relevant to 21st century firms.

IV. Materials and Method

This study adopted ex-post facto research design. Ex-post facto research design is suitable for research that involve the collection of data over a period of time. Since this study involve collection of data over a period of 5 years (2018 – 2022), ex-post facto research design is considered appropriate for the study. The choice of research period is premised on the need to investigate the influence of variance analysis on the operational performance of listed manufacturing firms in the most recent time to verify the criticisms that it is ineffective in achieving growth of 21st century firms.

The population of the study are manufacturing firms listed on the Nigerian Exchange Limited (NGX). The most relevant firms were listed in the consumer and industrial goods sectors of the NGX. Other relevant sectors which have mix of trading and manufacturing firms were excluded to avoid sampling bias. Hence, the study population consist of 33 firms listed in the consumer goods (20) and industrial goods (13) sectors of the NGX. The study employed stratified sampling technique to select a sample size of 30 firms based on the Taro Yamane criteria for sample size determination at 5% level of significance. This results in a sample size of 19 and 11 from consumer and industrial goods sectors respectively. Secondary data from 2018 – 2022 were obtained from financial and other documents of sampled firms.

Model Specification

For this study, the researcher adapted the methodology used by Ali-Momoh et al. (2022). They employed readily available data such as material, labour and overhead costs as proxies for material, labour and overhead variance while the return on asset employed was used to measure the operational performance of sampled firms. While this study measured operational performance as return on assets and gross profits margin, the variance was determined by finding the difference in the cost of material, labour and overheads costs per #1 of sales volume/value. The study model is stated thus.

For objective one, the research model and its econometric variant is stated as follows.

ROA = f (material, labour and overhead variance) ……..... *equation 1*

ROA = f (MaC + LaC + OhC + SeP + LeV + Fz) ……..... *equation 2*

$ROA = c + \beta_1 MaC + \beta_2 LaC + \beta_3 OhC + \beta_4 SeP + \beta_5 LeV + \beta_6 Fz + \mathscr{E}$ …… *equation 3*

For objective two, the research model and its econometric variant is stated as follows.

GPM = f (material, labour and overhead variance) ……. *equation 4*

GPM = f (MaC + LaC + OhC + SeP + LeV + Fz) ……. *equation 5*

$GPM = c + \beta_1 MaC + \beta_2 LaC + \beta_3 OhC + + \beta_4 SeP + \beta_5 LeV + \beta_6 Fz + \mathscr{E}$ ……. *equation 6*

Where; ROA is the Return on Assets
GPM is the Gross Profits Margin
MaC is the Material Costs Variance
LaC is the Labour Cost Variance
OhC is the Overhead Cost Variance
SeP is the Selling Price Variance
LeV is the Leverage
Fz is the Firm Size
c is the constant
$\mathscr{E}$ is the error term

Note: Leverage (LeV) and firm size (Fz) are added as moderating variables to account for the impact of differences in the leverage and size of sampled firms sampled for the study.

Method of Data Analysis

The descriptive statistics are employed to investigate the statistical characteristics of the research variables. The Feasible Generalized Least Square (FGLS) which fits the econometric characteristics of the dataset was applied to estimation the research model at 95% confidence interval and test research hypotheses. Results obtained are applied to determine the relationship between research variables.

Measurement of Variables

The independent variable of of this study is variance analysis proxied as materials variance, labour variance, overhead variance and the selling price variance. Return on Assets (ROA) and Gross Profits Margin (GPM) are adopted as measures of dependent variable of the study, operational performance. Research variables are measures as shown in *table 1*.

Table 1: Measurement of Research Variables

Variable	Measurement	References
Return on Asset	Measured as profit before tax divided by value of non-current assets	Ali-Momoh et al. (2022); Ogungbade et al. (2020)
Gross Profits Margin	Measured as the log of gross profits	Azim et al., 2015
Materials Cost Variance	Measured as difference in materials cost per #1 of sales	Ali-Momoh et al. (2022); Ogungbade et al. (2020)
Labour Cost Variance	Measured as difference in labour cost per #1 of sales	Ali-Momoh et al. (2022); Ogungbade et al. (2020)
Overhead Cost Variance	Measured as difference in overhead cost per #1 of sales	Ali-Momoh et al. (2022); Ogungbade et al. (2020)
Selling Price Variance	Measured as difference in sales revenue per #1 of sales	Ogungbade et al. (2020)
Leverage	Percentage of debt to total equity	Akinleye et al. (2023)
Firm Size	Log of total assets	Akinleye et al. (2023)

Source: Researchers compilation, 2025

V. Results and Discussion

Results obtained from data analysis and discussions are presented in this section.

Descriptive Statistics

Descriptive statistics and values obtained from the analysis of data obtained for the research variables are shown in *Table 2*. The mean value of the observed data ranges between -0.77 (-77%) and 7.18 (718) %. The mean variation in the dependent variables, Gross Profit Margin (GPM) and Return on Assets (ROA) were 24% and 23% respectively. This indicates average increase in the performance of sampled firms. For the independent variables, the Material Cost (MaC), Labour Cost (LaC), Overhead (OhC), Leverage (LeV) and Firm Size (Fz) variances had mean values of -25%, -77%, -34%, -30%, 718%, and 69% respectively. These results shows that only two out of these independent variables (leverage and firm size) have positive mean variances during the period examined by the study while all the cost variances (material, labour and overheads) have negative or unfavorable variances. This implies that the cost variances of sampled firms are predominantly adverse during the period examined by the study. These results suggests that the costs of production (material, labour and overheads) are rising above the standard costs, the average selling price variance is adverse while the performance variance is positive. The mean of costs is adverse at a rate higher than the positive or favourable mean of performance variances. Further examination of these results shows that cost variances are larger than the performance variances and selling price variance is adverse. This implying that performance of listed manufacturing firms in Nigeria is being gradually eroded.

The minimum changes in research variables obtained by sampled firms are -198%; -1075%; -4324%; -9470%; -4374%, -4456%; 442%; and -13% for Gross Profit Margin (GPM), Return on Assets (ROA), Material Cost (MaC), Labour Cost (LaC), Overhead (OhC), Leverage (LeV), and Firm Size (Fz). The minimum changes for all the research variables were negative except Leverage (LeV). The minimum scores of performance variables (GPM and ROA) were adverse (negative) 198% and 1075% but that of costs (material, labour, overheads) and selling price ranges between 4300 and 4500 which are more adverse (higher) than that of performance. In terms of maximum variance, Gross Profit Margin (GPM); Return on Assets (ROA); Material Cost (MaC); Labour Cost (LaC); Overhead (OhC); Leverage (LeV); and Firm Size (Fz) during the study period 2018-2022 are 100 %; 302%; 99%; 99%; 96%; 99%; 877%; and 1406% respectively. All the maximum scores are positive. The highest maximum changes of 877% and 1406% were recorded by the moderating variables; Leverage (LeV) and Firm Size (Fz) respectively. The maximum score of all the dependent and independent variables of this study are between 96 and 100% except the Return on Asset (ROA) which has maximum score of 302%. The magnitude of the minimum score (which are negative) for performance, manufacturing costs (materials, labour and overheads) and selling price variances especially are higher than that of maximum score (which are positive). This implies a dwindling performance. The performance can be said to be moving towards the negative side. Should this continue for a long time, the manufacturing firms will start making losses. These results proved that variance analysis is relevant in achieving cost control and profit planning objectives as suggested by Machey *et al.* (2019). These findings further confirm the relevance of standard costing and variance analysis systems in achievement of cost management and reduction, pricing decisions, profit planning and performance management in the 21st century firms (Princewill et al., 2022; Hung et al., 2023; Mackey *et al.*, 2019).

Table 2: Descriptive Statistics

	GPM	ROA	MAC	LAC	OHC	SEP	FZ	LEV
Mean	0.24	0.23	-0.25	-0.77	-0.34	-0.3	7.18	0.69
Median	0.27	0.14	0.11	0.08	0.08	0.09	7.33	0.21
Maximum	1.00	3.02	0.99	0.99	0.96	0.99	8.77	14.06
Minimum	-1.98	-10.75	-43.24	-94.7	-43.74	-44.56	4.42	-0.13

Std. Dev.	0.28	1.12	3.87	8.42	3.93	4.00	1.08	1.73
Skewness	-4.09	-7.20	-10.94	-11.05	-10.75	-10.83	-0.53	5.38
Kurtosis	33.72	74.47	122.09	123.8	119.3	120.33	2.42	36.16
Jarque-Bera	5347.6	28130.2	77576.5	79804.2	74017.5	75332.4	7.62	6429.9
Probability	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
Sum	31.03	29.63	-32.14	-97.27	-42.86	-38.55	912.07	87.63
Sum Sq. Dev.	9.78	158.16	1885.05	8937.22	1943.88	2012.10	147.31	377.35
Observations	127	127	127	127	127	127	127	127

Source: Researchers computation, 2025.

The values of standard deviation of the performance variables, Gross Profit Margin (GPM) and Return on Assets (ROA), are 28% and 112% respectively. Whereas the variation in the independent variables, Material Cost (MaC); Labour Cost (LaC); Overhead (OhC); and Selling Price (SeP) are 387%, 842%, 393%, and 400% respectively. The moderating variables, Leverage (LeV) and Firm Size (Fz) are 108% and 173% respectively. By these results, the variation in the costs of sampled listed manufacturing firms for the study period 2018 – 2022 which ranges between 387% and 842% are larger than the variation in the performance which ranges between 28% and 112% and moderating variables (108% and 173%). However, the higher variation in the costs must have been absorbed in the selling price variation which is 400% to maintain performance. This explains the relevance and wide application of standard costing and variance analysis to performance management and profit planning in listed manufacturing firms in Nigeria.

Skewness statistic measure whether the distribution of the dataset is symmetry while kurtosis statistic indicates the tail extremity of the distribution of the dataset. The values of skewness statistic of all the research variables are negative except leverage which has a positive value of 5.38. This indicates that the distribution is negatively skewed for all the variables except leverage (LeV). The distribution of all the research variables is leptokurtic (>3) but for the Firm Size (Fz) it is platykurtic (<3). A significant (less than 5%) p-value of Jarque-Bera statistics confirm further confirmed the results of the skewness and kurtosis statistics that the dataset is not normally distributed. This necessitates the adjustments in the type of Ordinary Least Squares technique of multiple linear regression that is applied to estimate the research variables.

Test for Heteroskedasticity

From *table 3*, the p-value of the Breusch-Pagan/Cook-Weisberg test were less than 5% and significant at 95% confidence interval. Hence, the null hypothesis was rejected and indicates that the residuals of the regression models are unequal and heteroscedastic. This necessitated the application of the GLS heteroscedastic and serially correlated regression to estimate the research models in order to counter the effect of heteroscedasticity and serial correlation on the regression results.

Table 3: Breusch-Pagan / Cook-Weisberg test for Heteroskedasticity

Variables: fitted values of	GPM	ROA
chi2(1)	85.00	250.53
Prob > chi2	0.00	0.00

Source: Researchers computation, 2025

Multicollinearity Test

From *table 4*, high Variance Inflation Factor (VIF) and low 1/VIF values indicates high level of collinearity among the regressors. This is normal for the research data because production costs (materials, labour and overheads) are directly influenced by production volume. The GLS technique was employed to mitigate the effect of regression technique was adopted to analyse the study data. This is necessary to preserve the estimates of the OLS regression as the Best Linear Unbiased Estimator (BLUE) despite that research data failed some of the assumptions of the regression model.

Table 4: Variance Inflation Factor

Variable	VIF	1/VIF
MaC	155.86	0.006416
SeP	139.28	0.00718
LaC	111.2	0.008992
OhC	48.05	0.020813
Fz	1.11	0.902345
LeV	1.06	0.940407
Mean VIF	76.09	

Source: Researchers computation, 2025

II. Discussion of Findings

The research data is heteroscedastic, autocorrelated and multicollinearity regressors are moderate. The Feasible Generalized Least Square (FGLS) regression technique which neutralizes the effect of autocorrelation, cross-sectional dependence, and heteroscedasticity in panel data was adopted to analyse the research data. Results obtained from Feasible Generalized Least Square (FGLS) regression analyses are presented in tables 5 and 6.

Objective 1: Determination of the impact of variance analysis on the return on assets of listed manufacturing firms in Nigeria.

The section discusses the regression results obtained for the assessment of the impact of variance analysis and return on assets of listed manufacturing firms in Nigeria. Table 5 shows the FGLS regression results that assess the impact of variance analysis on the return on assets of listed manufacturing firms in Nigeria. The FGLS regression results that assess the impact of variance analysis on the return on assets of listed manufacturing firms in Nigeria. Results shows that the coefficient of Material Cost (MaC); Labour Cost (LaC); Overhead (OhC); and Leverage (LeV) are negative, depicting a negative relationship with the Return on Assets of Sampled firms (see *table 5*). The Selling Price (SeP) and Firm Size (Fz) variance have positive coefficients.

Table 5: Regression Results

Cross-sectional time-series FGLS regression: Return on Assets						
Coefficients: generalized least squares				Number of obs = 127		
Panels: heteroskedastic				Number of groups = 26		
Correlation: panel-specific AR (1)				Obs per group: min = 2		
Estimated covariances = 26				avg = 4.884615 max = 5		
Estimated autocorrelations = 26				Wald chi2(6) = 62.86		
Estimated coefficients = 7				Prob > chi2 = 0.0000		
ROA	Coef.	Std. Err.	Z	P>z	[95% Conf. Interval]	
MaC	-0.6817155	0.1192257	-5.72	0.000	-0.9153936	-0.4480374
LaC	-0.1441186	0.0278891	-5.17	0.000	-0.1987801	-0.0894571
OhC	-0.1132797	0.032414	-3.49	0.000	-0.1768099	-0.0497495
SeP	1.078725	0.1492166	7.23	0.000	0.7862657	1.371184
LeV	-0.0314605	0.0147871	-2.13	0.033	-0.0604427	-0.0024783
Fz	0.0218493	0.0139669	1.56	0.118	-0.0055254	0.049224
_cons	-0.0773282	0.1007186	-0.77	0.443	-0.2747331	0.1200767

Source: Researchers computation, 2025

This implies that there is a positive relationship between Selling Price (SeP) variance and Firm Size of listed manufacturing firms in Nigeria. The p-value of all the dependent variables is less 0% except leverage and firm size which has p-values of 3.3% and 11.8% respectively. At 95% confidence interval, only the p-value of firm size is insignificant.

The obtained Wald-test chi-squared value for the model is 62.86 and has a p-value of 0%. The p-value of 0% is less than 5% which is significant at 95% confidence internal. This indicates that the model has a good fit and the explanatory or dependent variables of the model are jointly significant in the model.

Test of Hypothesis and Discussion of Results (Objective 1)

H_{01}: There is no statistically significant relationship between variance analysis and return on assets of listed manufacturing firms in Nigeria.

The hypothesis is tested at 95% confidence interval and results obtained. Results shows that there is a significant relationship between return on assets and variance analysis of listed manufacturing firms in Nigeria. However, the relationship between firm size and return on assets is insignificant. Hence, based on the p-value obtained from regression analysis, which is less than 5% critical value (see *table 5*), the null hypothesis that states that the relationship between return on assets and variance analysis is statistically insignificant is untrue and rejected except for the firm size (a moderating variable). It is therefore concluded that there is statistically significant relationship between return on assets and material cost, labour cost, overheads cost, material price, and leverage. The study findings demonstrated the influence of production costs, leverage and size on the performance of manufacturing firms. A negative effect of production costs (materials, labour and overheads) and leverage implies that unfavorable variance in production costs and leverage reduces performance or profitability of firms. Likewise, a positive impact of selling price variance and firm size on return on assets shows that favourable selling price variance and advantages conferred by size will improve return on assets.

This findings by this study corroborates and refutes findings by previous studies. The study findings are similar to the submission by Ali-Momoh et al. (2022) in part. They found that material and labour costs variance have positive effect while overhead cost variance has negative and statistically significant influence on the return on assets of consumer goods firms. While this study confirmed their position that materials, labour and overhead

variances have significant impact on return on assets, their impacts were negative. The study further corroborates Akinyele et al. (2023) who confirmed that cost reduction and profit margin improvement which is similar to selling price variance influences return on assets. However, this study discovered a statistically significant negative relationship between return on asset and costs variance (materials, labour and overheads) which is contrary to findings by Akinyele et al. (2023).

Objective 2: Determination of the impact of variance analysis on the gross profit margin of listed manufacturing firms in Nigeria.

Table 6 presents the regression results that assess the effect of variance analysis on the gross profit margin of listed manufacturing firms in Nigeria for the study period 2018-2022. The coefficient of the Material Cost (MaC), Labour Cost (LaC), and Overhead (OhC) variance are negative. This implies that the influence of Material Cost (MaC), Labour Cost (LaC), and Overhead (OhC) on the gross profit margin of sampled firms is inverse. Increases in these costs will lead to a reduction in the profit margin of listed manufacturing firms in Nigeria. For the Selling Price (SeP) variance, Leverage (LeV) and Firm Size (Fz) have positive influence on the Gross Profit Margin (GPM) of sampled firms.

The p-value obtained for the Material Cost (MaC); Labour Cost (LaC); Overhead (OhC); Selling Price (SeP); Leverage (LeV); and Firm Size (Fz) are 0.1%, 28.9%, 12%, 0%, 18.1% and 2.9% respectively. The Material Cost (MaC), Selling Price (SeP) and Firm Size (Fz) has p-value that is less than 5%. At 95% confidence interval, these p-values are statistically significant and indicates that the Material Cost (MaC), Selling Price (SeP) and Firm Size (Fz) has statistically significant influence on the gross profit margin of listed manufacturing firms sampled for the study.

The Wald test has a chi-squared value of 23.38 and a p-value of 0.07%. This p-value is less than 5% and significant at 95% confidence interval. This implies that the model has a good fit and the explanatory or dependent variables of the model are jointly significant and effectively explained the changes in the gross profit margin (GPM) of sampled firms.

Table 6 Regression Results

Cross-sectional time-series FGLS regression: Gross Profits Margin						
Coefficients: generalized least squares				Number of obs = 127		
Panels: heteroskedastic				Number of groups = 26		
Correlation: common AR (1) coefficient for all panels (0.4503)				Obs per group: min = 2		
Estimated covariances = 26				avg = 4.884615 max = 5		
Estimated autocorrelations = 1				Wald chi2(6) = 23.38		
Estimated coefficients = 7				Prob > chi2 = 0.0007		
GPM	Coef.	Std. Err.	Z	P>z	[95% Conf. Interval]	
MaC	-0.18314	0.0546885	-3.35	0.001	-0.2903235	-0.0759484
LaC	-0.01595	0.015035	-1.06	0.289	-0.0454216	0.0135144
OhC	-0.02472	0.0159029	-1.55	0.120	-0.0558933	0.0064451
SeP	0.236468	0.0657873	3.59	0.000	0.107527	0.3654084
LeV	0.007969	0.0059555	1.34	0.181	-0.0037039	0.0196414
Fz	0.027298	0.0125111	2.18	0.029	0.0027762	0.0518189
cons	0.065255	0.0917171	0.71	0.477	-0.1145072	0.2450173

Source: Researchers computation, 2025

Test of Hypothesis and Discussion of Results (Objective 2)

H_{02}: Variance analysis has no statistically significant effect on the gross profits margin of listed manufacturing firms in Nigeria.

The p-value of the Material Cost (MaC), Selling Price (SeP) variances and Firm Size (Fz) are less than 5% and significant while at 95% confidence interval. The p-values of Labour Cost (laC), Overhead Cost (OhC) and Leverage (LeV) are greater than 5% and insignificant. Therefore, Hence, the null hypothesis that assume that Material Cost (MaC), Selling Price (SeP) and Firm Size (Fz) have statistically insignificant effect on gross profits margin is rejected. The null hypothesis that Labour Cost (laC), Overhead Cost (OhC) Leverage (LeV) and Firm Size (Fz) have insignificant effect on the gross profits margin of listed manufacturing firms in Nigeria.

The Material Cost (MaC) variance, Selling Price (SeP) variances and Firm Size (Fz) have significant influence on the gross profit margin of listed manufacturing firms in Nigeria. But, the Labour Cost (laC), Overhead Cost (OhC) and Leverage (LeV) have insignificant effect on the gross profits margin of listed manufacturing firms in Nigeria. This implies that the material cost, labour cost and firm size have greater influence on the gross profit margin of manufacturing firms. A firm can improve its gross profits margin by ensuring an effective control over the material and selling price. A statistically significant relationship between firm size and gross profits margin confirmed that the economics of scale accruing through size induced scale of production will improve profitability

(gross profits margin). By this, larger firms are likely to have higher gross profits margin than smaller firms. Hence, a firm can improve its performance by increasing its production scale.

While the manufacturing costs variance (material, labour and overheads) has adverse (negative) effects on the gross profits margin of sampled firms, the moderating variables (leverage and firm size) have positive effect. A negative regression coefficient confirmed that production costs variances (material, labour and overheads) have an inverse relationship with gross profits margin. That is, the higher the variance, the lower the gross profit margin. This also implies material, labour and overhead variances of listed manufacturing firms in Nigeria sampled for the study are predominantly unfavorable during the study period. This indicates that sampled firms used increased in the selling price to counter the effect of increasing production cost to maintain their gross profits margin and remain profitable during the study period 2018 – 2022. These findings corroborate the view of Mackey et al. (2019) and Ogungbade et al (2020). While the former discovered that cost control improves efficiency and performance, the latter found that only material and overheads have negative effect on performance. Findings by this study is contrast to the opinion of Gill et al. (2014) and Osei et al (2020). Gill et al. (2014) opined that operating expensed have positive impact on future performance while Osei et al (2020) found no relationship. Based on further findings by this study, a positive coefficient of firm size indicates that manufacturing firms can increase gross profits margin through advantage that accrue from increases in leverage and size (see table 6). This agree with submission by Gill et al. (2014) that there is a positive significant relationship between changes in operating expenses and future performance.

VI. Conclusion

The following conclusions are therefore raised from the study.

The findings of this study confirmed that listed manufacturing firms in Nigeria have a higher magnitude and/or incidence of unfavourable variances. These firms are observed to have adopted adjustment (increases) in the selling price to counter the influence of rising costs of production on their performance.

The production costs (materials, labour and overheads) variances have significant negative while the selling price have significant positive impact on the return on assets of listed manufacturing firms in Nigeria. This might have resulted from general increases in price level and/or inefficiency in the production process, among other contributing factors. In order to remain profitable, results confirmed that listed manufacturing firms in Nigeria increase selling price to mitigate the effect of rising costs.

The study found that leverage reduces return on asset significantly. This agreed with expectation since interest reduces profits before tax. Likewise, the sampled firms effectively utilize the advantage conferred by economy of scale as a result of firm size to improve performance but the influence on their return on assets insignificant.

The production costs (materials, labour and overheads) variances have negative impact on the gross profits margin of listed manufacturing firms in Nigeria just like the return on assets. However, only the material costs variance influences operational performance significantly. This implies that the material cost is more significant in the costs of production and increases at a margin that is higher than that of other production costs during the study period 2018 – 2022. This has a negative and significant impact on the gross profits margin of sampled firms.

The insignificant positive effect of leverage on the gross profits margin can be attributed to the possibility of the use of debt to finance production expansion and interests does not form part of direct costs of production. Unlike the return on assets, the firm size impacts gross profits margin positively and significantly. It indicates the proper use of firms' assets and high productive power of the assets of listed manufacturing firms in Nigeria. It attests to the efficient use of economics of scale conferred resulting from size to improve performance.

VII. Recommendations

The study therefore recommends as follows;

Listed manufacturing firms in Nigeria should endeavor to improve on the control of production costs to improve performance. Strategies should be put in place to reduce the incidence of unfavourable production costs variances, seek cheaper alternative to raw materials, and adopt procurement systems that will enable them take advantage of bulk purchase discounts and other procurement incentives to reverse the incidence of prevalent adverse variances in material costs.

The management of listed manufacturing firms in Nigeria should improve on the adoption of innovative and machine-driven production methods to reduce labour and overhead costs. Obsolete production methods should be reviewed to improve labour and overhead expenditure variances.

Listed manufacturing firms in Nigeria should improve on the advantages accruing from increase in size and leverage to improve performance. This will help them take the advantage of the economics of scale they are deriving from increasing size and leverage to improve their performance.

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