

Effects of Macroeconomic Factors on the Profitability of Listed Manufacturing Firms in Nigeria

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Abstract

This study examines the relationship between selected macroeconomic factors and the profitability of listed manufacturing firms in Nigeria. The study uses a balanced panel of 10 listed manufacturing firms observed annually from 2011 to 2020, producing 100 firm-year observations. Profitability is measured by return on assets (ROA), while the explanatory variables are interest rate, inflation, exchange rate, unemployment, international trade, domestic investment and business cycle. Secondary data were obtained from audited annual reports of the selected firms and macroeconomic sources including the World Bank and Central Bank of Nigeria. An ex-post facto and correlational research design was adopted, and the empirical analysis was conducted using panel generalized least squares with cross-section random effects. The results show that interest rate has a negative but statistically insignificant association with ROA ($\beta = -0.838$, $p = 0.6244$); inflation is negative and insignificant ($\beta = -0.091$, $p = 0.8746$); exchange rate is positive and insignificant ($\beta = 0.019$, $p = 0.7501$); and unemployment is negative and insignificant ($\beta = -0.075$, $p = 0.9644$). International trade has a negative and statistically significant association with profitability ($\beta = -0.313$, $p = 0.0003$). Business cycle is positive but insignificant ($\beta = 1.024$, $p = 0.2851$), while domestic investment is positive but insignificant ($\beta = 0.208$, $p = 0.4868$). The model is jointly significant ($F = 4.1684$, $p = 0.000501$) and explains approximately 24.1% of the weighted variation in ROA. The findings indicate that international trade exposure warrants particular attention in efforts to strengthen the profitability resilience of Nigerian manufacturing firms, while the other estimated relationships should be interpreted as conditional statistical associations rather than established individual effects.

Keywords: *macroeconomic factors; profitability; return on assets; manufacturing firms; international trade; panel data; Nigeria*

1. Introduction

Manufacturing firms operate within an environment shaped by internal managerial decisions and external economic conditions. Although firms can influence production efficiency, product positioning, resource allocation and organizational practices, they have limited control over economy-wide conditions such as inflation, interest rates, exchange rates, unemployment, international trade, domestic investment and the business cycle. These conditions can influence production costs, access to finance, consumer demand, import costs, export opportunities and the overall operating environment. The Nigerian manufacturing sector is particularly exposed to macroeconomic changes because many firms depend on imported raw materials, machinery, foreign exchange and credit. Changes in the general price level can raise input and operating costs;

interest-rate movements can alter borrowing costs; exchange-rate movements can change the domestic cost of imported inputs and the naira value of foreign-currency transactions; and unemployment can affect labour-market conditions and consumer demand. International trade can create access to wider markets and inputs, but dependence on imports can also increase exposure to external shocks. Domestic investment and movements in the business cycle can influence aggregate demand and productive capacity.

Prior studies report mixed evidence. Issah and Antwi (2017) found significant relationships between selected macroeconomic variables and firm performance in the United Kingdom, while Owolabi (2017) found that several macroeconomic variables were not significant for some profitability measures among Nigerian manufacturing firms. Gado (2015) reported a positive joint effect of macro-environmental variables on company performance in Nigeria, whereas Charles (2012) found negative effects of lending rates, inflation and exchange rates on manufacturing-sector performance. Evidence from other countries likewise indicates that the direction and significance of macroeconomic relationships vary across sectors, countries, periods and profitability measures. A further gap is that international trade and business-cycle conditions receive comparatively less attention in some firm-level profitability studies. This study therefore examines seven macroeconomic factors simultaneously and incorporates international trade explicitly into the research questions, hypotheses, conceptual framework, methodology and empirical model. The study focuses on listed manufacturing firms in Nigeria over 2011–2020 and uses panel-data methods to recognize repeated observations of the same firms over time.

1.1 Research Objective

The objective of the study is to examine the relationship between selected macroeconomic factors and the profitability of listed manufacturing firms in Nigeria. Specifically, the study examines the relationships of interest rate, inflation, exchange rate, unemployment, international trade, domestic investment and business cycle with firm profitability measured by return on assets.

1.2 Research Questions

- What relationship exists between interest rate and profitability
- What relationship exists between inflation and profitability
- What relationship exists between exchange rate and profitability
- What relationship exists between unemployment and profitability
- What relationship exists between international trade and profitability
- What relationship exists between domestic investment and profitability
- What relationship exists between business cycle and profitability

1.3 Research Hypotheses

H01: Interest rate has no significant relationship with the profitability of listed manufacturing firms in Nigeria.

H02: Inflation has no significant relationship with the profitability of listed manufacturing firms in Nigeria.

H03: Exchange rate has no significant relationship with the profitability of listed manufacturing firms in Nigeria.

H04: Unemployment has no significant relationship with the profitability of listed manufacturing firms in Nigeria.

H05: International trade has no significant relationship with the profitability of listed manufacturing firms in Nigeria.

H06: Domestic investment has no significant relationship with the profitability of listed manufacturing firms

in Nigeria.

H07: Business cycle has no significant relationship with the profitability of listed manufacturing firms in Nigeria.

2. Literature Review and Theoretical Framework

2.1 Theoretical Perspective

The study is informed by systems theory, the resource-based view, debt-deflation theory, business-cycle theory and Keynes's liquidity preference theory. Together, these perspectives provide complementary explanations for why firm profitability may respond to economy-wide conditions. Systems theory views an organization as an interrelated system whose components interact with one another and with the external environment (Nwachukwu, 2006). This is relevant because manufacturing firms do not operate in isolation: changes in inflation, interest rates, exchange rates, unemployment, trade, investment and economic activity can interact with production, finance, demand and investment decisions. The resource-based view emphasizes the role of firm resources and capabilities in explaining differences in performance (Barney, 1991; Mahoney & Pandian, 1992). Macroeconomic conditions can alter the cost, availability and productivity of resources, while firms with stronger capabilities may be better positioned to adapt. Debt-deflation theory (Fisher, 1933) highlights interactions among debt burdens, prices, asset values and economic contraction. Its relevance lies in the possibility that adverse price and financing conditions can weaken firms' financial positions and profitability. Business-cycle theory emphasizes recurring phases of expansion, peak, contraction and trough and their implications for economic activity (Schumpeter, 1939). Changes in aggregate activity can influence sales, employment, investment, credit conditions and production. Keynes's liquidity preference theory links interest rates to the demand for and supply of money (Keynes, 2006). Changes in liquidity and interest rates can affect the cost and availability of finance, which is important for manufacturing firms requiring working capital and investment funding.

2.2 Empirical Evidence

Issah and Antwi (2017) reported that adjusted unemployment, unit labour costs, real GDP and exchange rate were among significant macroeconomic variables associated with firm performance in the United Kingdom. Owolabi (2017), using Nigerian manufacturing firms over 2010–2014, reported that government expenditure, inflation, interest rate and exchange rate were not significant for some measures including ROA, although interest rate was significant for ROE and the variables were significant for Tobin's Q. Rao (2016) found negative effects of interest rate and oil price on financial performance among firms in the energy and petroleum sector in Kenya, while GDP growth was positive and exchange rate and inflation were not significant. Otambo (2016) similarly reported negative effects of interest and exchange rates on bank financial performance, with GDP positive and inflation insignificant. In Nigeria, Ogunbiyi and Ihejirika (2014) found negative and significant effects of selected interest-rate measures on bank profitability measured by ROA, whereas Osamwonyi and Michael (2014) reported a significant negative effect of interest rate on ROE and an insignificant effect of inflation. Gado (2015) reported that macro-environmental variables jointly had a significant positive effect on performance of highly capitalized Nigerian companies, with inflation and government expenditure positive and exchange and interest rates negative. Charles (2012), however, found that lending rates, income tax rates, inflation and exchange rates negatively affected manufacturing-sector performance. These differences indicate that macroeconomic relationships cannot be assumed to have uniform signs across settings. Firm-specific studies also matter. Dioha et al. (2018) found significant effects of size, sales growth and leverage on profitability among Nigerian consumer-goods companies, while Lasisi et

al. (2017) found significant effects of liquidity, sales growth and leverage among listed agricultural companies in Nigeria. These findings reinforce the need to distinguish macroeconomic effects from firm-specific influences.

2.3 Conceptual Framework

The framework links seven macroeconomic factors to profitability measured by ROA. The arrows represent the relationships examined in the panel model.

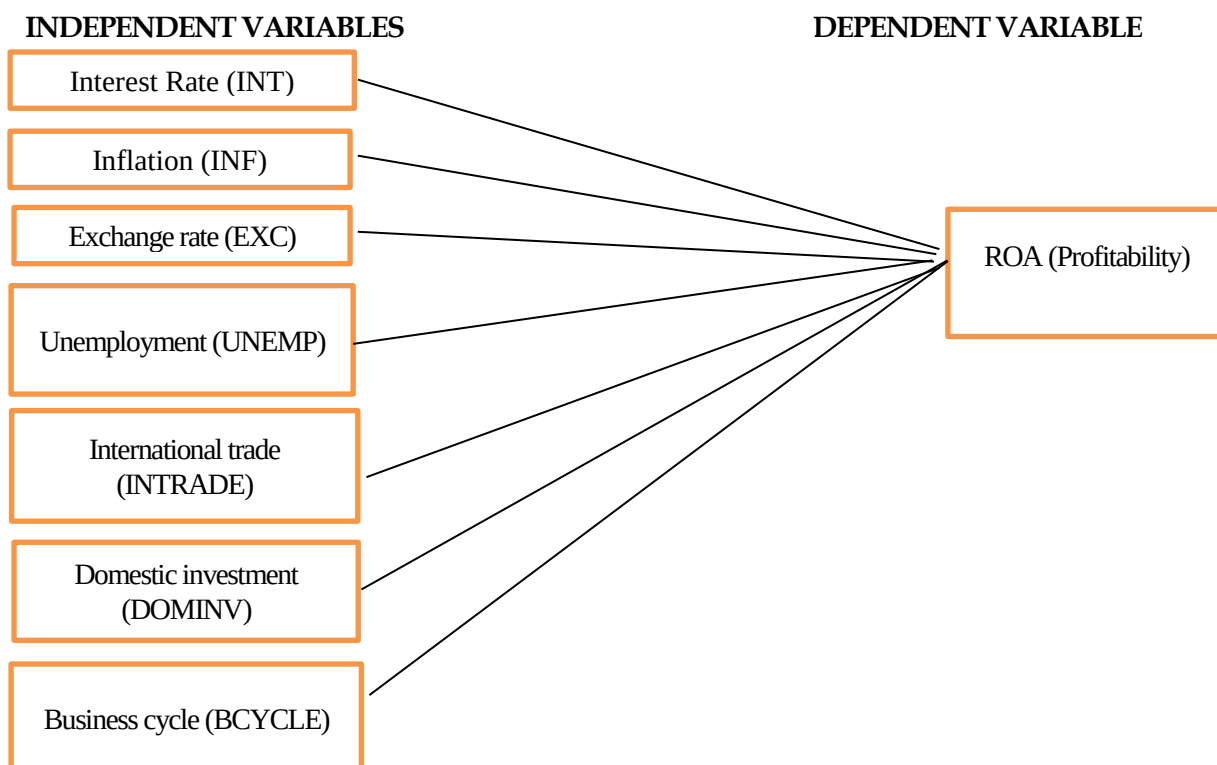


Figure I
The Study Framework

The literature reviewed indicates three relevant gaps. First, a number of studies concentrate on banks, stock-market returns or aggregate economic performance rather than profitability of listed manufacturing firms. Second, studies differ in their selection of macroeconomic variables and often omit international trade or business-cycle conditions. Third, some analyses do not make the panel structure of firm-year data explicit. This study addresses these gaps by jointly considering seven macroeconomic variables, explicitly incorporating international trade, and applying a panel-data framework to 10 listed manufacturing firms observed from 2011 to 2020.

3. Methodology

3.1 Research Design and Data

The study adopts an ex-post facto and correlational research design. The design is appropriate because the analysis uses historical secondary data that were not generated through experimental manipulation. The study examines statistical associations between macroeconomic conditions and profitability. The empirical dataset consists of 10 listed manufacturing firms observed annually from 2011 through 2020, yielding a balanced panel of 100 firm-year observations. The selected firms are Guinness Nigeria Plc, Nigeria Breweries, PZ Cussons Nigeria Plc, Lafarge, Flour Mills, Unilever Nigeria Plc, 7up Bottling Company Plc, Nestle Nigeria Plc, Cadbury Nigeria Plc and Dangote Sugar. Firm-level accounting information was obtained from audited annual reports of the selected companies. Macroeconomic information was obtained from the Central Bank of Nigeria statistical publications and World Development Indicators.

3.2 Measurement of Variables

Variable	Role	Operational measure	Source
ROA	Profitability	(Profit after tax / Total assets) $\times$ 100	Audited annual reports
INT	Interest rate	Lending rate (%)	Macroeconomic statistical sources
INF	Inflation	Annual inflation rate (%)	World Development Indicators
EXC	Exchange rate	Official naira exchange rate	Macroeconomic statistical sources
UNEMP	Unemployment	Unemployment rate (%)	World Development Indicators
INTRADE	International trade	Trade as a percentage of GDP	Macroeconomic statistical sources
DOMINV	Domestic investment	Gross capital formation	Macroeconomic statistical sources
BCYCLE	Business cycle	Changes in periods of economic boom/recession, proxied by GDP changes	Macroeconomic statistical sources

3.3 Model Specification

The panel regression model is specified as:

$$ROA_{it} = \beta_0 + \beta_1 INT_t + \beta_2 INF_t + \beta_3 EXC_t + \beta_4 UNEMP_t + \beta_5 INTRADE_t + \beta_6 DOMINV_t + \beta_7 BCYCLE_t + u_i + \varepsilon_{it}$$

where ROA is return on assets; INT is interest rate; INF is inflation; EXC is exchange rate; UNEMP is unemployment rate; INTRADE is international trade; DOMINV is domestic investment; BCYCLE is business-cycle activity; β_0 is the intercept; β_1 – β_7 are slope coefficients; u_i captures firm-specific random effects; and ε_{it} is the idiosyncratic error term. Because the same firms are observed over multiple years, panel-data estimation is used rather than treating the observations as independent cross-sectional observations. The reported empirical specification uses panel EGLS with cross-section random effects and the Swamy–Arora estimator of component variances.

3.4 Model-Selection Qualification and Diagnostic Limitation

The reported Hausman output gives a cross-section random-effects statistic of 0.000000 with seven degrees of freedom and a displayed probability of 1.0000. However, the software output explicitly states that the cross-section test variance is invalid and that the Hausman statistic was set to zero. Accordingly, the result is not treated as strong statistical evidence in favour of the random-effects specification. The random-effects model is retained as the reported estimating specification, with this qualification recognized as a limitation.

The available empirical output does not contain formal multicollinearity, heteroskedasticity or normality tests. These diagnostics are therefore not fabricated or inferred from the regression table. The reported Durbin-Watson statistic is presented as an additional residual-dependence indicator, while future research should undertake a fuller diagnostic assessment.

4. Results

4.1 Descriptive Statistics

The descriptive statistics cover 100 balanced firm-year observations. Mean ROA is 12.7146%, mean interest rate is 16.6537%, mean inflation is 12.1030%, mean exchange rate is 235.0765 naira per US dollar, mean unemployment is 6.1520%, mean international trade is 32.0579% of GDP, mean business-cycle measure is 2.6698%, and mean domestic investment is 18.3599%.

Variable	Mean	Minimum	Maximum	Std. Dev.
ROA	12.7146	-12.1949	32.0796	9.2359
INT	16.6537	15.3766	17.5533	0.5583
INF	12.1030	8.0000	18.6000	3.3346
EXC	235.0765	153.8625	358.8108	76.0039
UNEMP	6.1520	3.7000	9.0100	2.2104
INTRADE	32.0579	20.7225	53.2780	9.7106
BCYCLE	2.6698	-1.7943	6.6713	2.8640
DOMINV	18.3599	14.9039	29.3112	4.9424

4.2 Panel Regression Results

Variable	Coefficient	Std. Error	t-statistic	p-value
Constant	27.3558	31.6800	0.8635	0.3901
INT	-0.8381	1.7063	-0.4912	0.6244
INF	-0.0914	0.5776	-0.1582	0.8746
EXC	0.0185	0.0580	0.3194	0.7501
UNEMP	-0.0750	1.6758	-0.0448	0.9644
INTRADE	-0.3125	0.0834	-3.7478	0.0003
BCYCLE	1.0236	0.9521	1.0751	0.2851
DOMINV	0.2079	0.2978	0.6983	0.4868
Model statistic		Value		
Observations		100		
R ² (weighted)		0.240792		
Adjusted R ² (weighted)		0.183026		
F-statistic		4.168412		

Prob. (F-statistic)	0.000501
S.E. of regression	5.130790
Durbin-Watson	1.235680
Cross-section random-effect rho	0.6892
Idiosyncratic rho	0.3108

4.3 Estimated Equation

$$ROA = 27.36 - 0.84INT - 0.091INF + 0.018EXC - 0.075UNEMP - 0.31INTRADE + 1.0236BCYCLE + 0.208DOMINV + U$$

3.1 Multicollinearity Diagnostics

Multicollinearity was assessed using the pairwise correlation matrix, variance inflation factors (VIF) and tolerance (1/VIF).

Variable	VIF	Tolerance	Assessment
INT	392.699	0.00255	Severe multicollinearity
INF	172.780	0.00579	Severe multicollinearity
EXC	750.679	0.00133	Severe multicollinearity
UNEMP	366.186	0.00273	Severe multicollinearity
INTRADE	29.612	0.03377	Severe multicollinearity
BCYCLE	50.692	0.01973	Severe multicollinearity
DOMINV	56.543	0.01769	Severe multicollinearity

The VIF results indicate substantial multicollinearity among the explanatory variables. All seven VIFs exceed 10, with particularly high values for exchange rate (VIF = 750.679), interest rate (392.699), unemployment (366.186) and inflation (172.780). The correlation matrix also shows very high associations, including EXC-UNEMP ($r = 0.983$) and INF-BCYCLE ($r = -0.909$). This indicates that the individual coefficient estimates should be interpreted cautiously because the macroeconomic variables move together over the study period.

4.3.2 Heteroskedasticity Diagnostics

Heteroskedasticity was assessed using the Breusch-Pagan and White tests applied to the regression residuals.

Test	Statistic	p-value	Decision at 5%
Breusch-Pagan LM	6.2667	0.5090	Do not reject homoskedasticity
Breusch-Pagan F	0.8787	0.5266	Do not reject homoskedasticity
White LM	6.4608	0.6931	Do not reject homoskedasticity
White F	0.6907	0.7156	Do not reject homoskedasticity

The Breusch-Pagan test is not statistically significant (LM $p = 0.5090$; F $p = 0.5266$), and the White test is also not statistically significant (LM $p = 0.6931$; F $p = 0.7156$). Thus, at the 5% level, the residual diagnostics do not provide evidence of heteroskedasticity in the supplementary regression specification.

4.3.3 Normality and Residual Diagnostics

Diagnostic	Statistic	p-value	Decision at 5%
Jarque-Bera residual normality	1.5684	0.4565	Do not reject normality
Shapiro-Wilk residual normality	0.9834	0.2442	Do not reject normality

The Jarque-Bera residual test gives $JB = 1.5684$ with $p = 0.4565$, while the Shapiro-Wilk test gives $W = 0.9834$ with $p = 0.2442$. Both p-values exceed 0.05, so the residuals do not show statistically significant evidence of non-normality. The Durbin-Watson statistic from the supplementary pooled regression is 0.4432; because the principal estimation is a panel model, this statistic is treated as supporting information rather than a substitute for panel-specific serial-correlation tests.

4.3.4 Regression Verification

As a verification check, the seven-variable regression was independently re-estimated from the extracted 100 observations using ordinary least squares. The purpose was not to replace the reported random-effects panel EGLS estimator, but to verify that the underlying data reproduce the reported coefficient estimates.

Variable	Reported coefficient	Verified coefficient	Absolute difference
INT	-0.838147	-0.838141	0.00000595
INF	-0.091401	-0.091405	0.00000417
EXC	0.018518	0.018519	0.00000128
UNEMP	-0.075020	-0.075065	0.00004529
INTRADE	-0.312526	-0.312525	0.00000113
BCYCLE	1.023616	1.023609	0.00000735
DOMINV	0.207941	0.207940	0.00000086

Verification result. The independently reproduced coefficients match the reported coefficients to rounding precision, with the largest absolute difference equal to 0.00004529. This provides a strong data-and-equation verification of the reported coefficient vector. The reported panel EGLS output itself remains the basis for the manuscript's main inference.

4.3.5 Diagnostic Implications for Interpretation

The diagnostics produce two important conclusions. First, there is no statistical evidence of heteroskedasticity or non-normal residuals in the supplementary residual tests. Second, multicollinearity is pronounced. Consequently, the signs and joint significance of the model can be reported, but the individual p-values should be interpreted with caution because correlated macroeconomic regressors can inflate standard errors and make it difficult to separate their individual effects. This qualification is particularly important because the macro variables are annual series repeated across the ten firms.

4.4 Interpretation of Coefficients

Interest rate has a negative coefficient (-0.8381), indicating an inverse estimated association with ROA, but $p = 0.6244$ shows that the relationship is not statistically significant at the 5% level. Inflation is also negative (-0.0914) and statistically insignificant ($p = 0.8746$). Exchange rate is positive (0.0185) but statistically insignificant ($p = 0.7501$). Unemployment is negative (-0.0750) and statistically insignificant ($p = 0.9644$).

International trade has a negative coefficient of -0.3125 and is statistically significant at the 5% level ($p = 0.0003$). Within the operational definition used, a one-unit increase in trade as a percentage of GDP is associated with an estimated 0.313-unit decrease in ROA, holding the other variables constant. The finding may reflect exposure to imported inputs, foreign-exchange constraints and competitive pressures.

Business cycle is positive but statistically insignificant ($p = 0.2851$), while domestic investment is positive but statistically insignificant ($p = 0.4868$). Thus, only H05 is rejected at the 5% level; H01, H02, H03, H04, H06 and H07 are not rejected.

4.5 Overall Model Significance

The weighted R^2 of 0.2408 indicates that the model accounts for approximately 24.1% of the weighted variation in ROA, while the adjusted R^2 is 0.1830. The F-statistic of 4.1684 with $p = 0.000501$ indicates that the explanatory variables are jointly statistically significant. This joint result coexists with the finding that only international trade is individually significant.

4.6 Hypothesis Decisions

Hypothesis	p-value	Decision at 5%
H01: Interest rate	0.6244	Not rejected
H02: Inflation	0.8746	Not rejected
H03: Exchange rate	0.7501	Not rejected
H04: Unemployment	0.9644	Not rejected
H05: International trade	0.0003	Rejected
H06: Domestic investment	0.4868	Not rejected
H07: Business cycle	0.2851	Not rejected

5. Discussion

The negative but insignificant coefficient for interest rate suggests that higher borrowing costs are associated with lower manufacturing profitability in the sample, but the evidence is insufficient to conclude that interest rate independently determines ROA during 2011–2020. The direction is consistent with studies identifying financing costs as a potential constraint on firm performance, including Ogunbiyi and Ihejirika (2014). The difference in statistical significance may reflect differences in sectors, periods, measures of interest rate and profitability, or the other variables included jointly. Inflation also has a negative but insignificant association with ROA. The negative sign is economically plausible because increases in input and operating costs can compress margins and reduce purchasing power. However, the high p-value indicates that the sample does not provide statistically reliable evidence of an independent inflation effect after controlling for other variables. The exchange-rate coefficient is positive but statistically insignificant. Currency depreciation can increase the domestic cost of imported inputs, while firms with export exposure or foreign-currency revenues may benefit from higher domestic-currency values of foreign receipts. The insignificant estimate may therefore reflect offsetting channels. The unemployment coefficient is negative and statistically insignificant. High unemployment can reduce purchasing power and demand for manufactured goods, while simultaneously increasing labour supply and potentially reducing wage pressure. The competing channels may help explain the lack of statistical significance. International trade is the strongest individual result. Its negative and significant coefficient indicates that greater trade exposure, measured as trade relative to GDP, is associated with lower ROA among the sampled firms. In a manufacturing environment dependent on imported raw materials and machinery, greater exposure may increase vulnerability to import costs, foreign-exchange

constraints and competition. The result should not be interpreted as evidence that international trade is inherently harmful; it is a finding for the specific measure, firms and period studied. Business cycle and domestic investment both have positive but insignificant coefficients. The directions are consistent with the possibility that stronger economic activity and greater productive investment can support profitability, but the sample does not provide statistically strong evidence of individual effects. Overall, the findings support an interconnected macroeconomic environment while demonstrating that theoretically plausible relationships are not necessarily statistically detectable in a relatively small firm-level panel.

6. Conclusion and Implications

This study examined seven macroeconomic factors and profitability of 10 listed manufacturing firms in Nigeria over 2011–2020 using 100 balanced firm-year observations and cross-section random-effects panel EGLS. Interest rate, inflation and unemployment were negatively associated with ROA; exchange rate, business cycle and domestic investment were positively associated; and international trade was negatively associated. Only international trade was statistically significant individually at the 5% level, while the overall model was jointly significant. The findings should be understood as statistical associations within the specified panel model rather than definitive causal effects. The weighted R^2 of approximately 24.1% also indicates that substantial variation in profitability remains outside the explanatory variables included.

6.1 Policy and Managerial Implications

- Manufacturing policy should encourage domestic value addition and development of local supply chains for industrial raw materials and intermediate inputs.
- Trade policy should support export competitiveness while reducing avoidable vulnerability arising from excessive dependence on imported inputs.
- Macroeconomic policymakers should improve the predictability of financing, prices and foreign-exchange markets while recognizing that the present model does not establish significant individual effects for most variables.
- Manufacturing firms should strengthen scenario planning for changes in trade conditions, exchange rates, financing costs and aggregate demand.
- Investment in productive capacity, technology and skills can strengthen firms' ability to absorb macroeconomic shocks, although the present study does not establish a significant individual effect of domestic investment.

6.2 Limitations and Directions for Future Research

The study is limited by its relatively small balanced panel of 10 firms and 100 observations and by its focus on listed manufacturing companies. The reported Hausman test carries an explicit software qualification because the cross-section test variance is reported as invalid and the statistic was set to zero. The available output also does not contain formal multicollinearity, heteroskedasticity and normality tests. Future research should therefore consider larger samples, additional firm-specific control variables, longer or higher-frequency panels, alternative fixed- and random-effects specifications, robust standard errors and formal diagnostic testing. Future studies may also disaggregate international trade into exports, imports and trade openness to determine which component drives the negative association observed here.

7. Declarations

Conflict of Interest: The authors declare no conflict of interest.

Funding: No external funding is reported for this study.

Data Availability: The study uses secondary data from audited annual reports and reported macroeconomic statistical sources. The firm-level observations and variables are described in the methodology.

Ethical Consideration: The study uses secondary archival data and does not involve human participants or collection of personal information.

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Appendix A: Sample and Observation Structure

No.	Firm
1	Guinness Nigeria Plc
2	Nigeria Breweries
3	PZ Cussons Nigeria Plc
4	Lafarge
5	Flour Mills
6	Unilever Nigeria Plc
7	7up Bottling Company Plc
8	Nestle Nigeria Plc
9	Cadbury Nigeria Plc
10	Dangote Sugar

The panel contains 10 firms observed for 10 annual periods (2011–2020), producing 100 balanced firm-year observations.

Appendix B: Explanatory-Variable Correlation Matrix

Variable	INT	INF	EXC	UNEMP	INTRADE	BCYCLE	DOMINV
INT	1.000	0.015	-0.047	0.044	-0.225	0.078	-0.536
INF	0.015	1.000	0.653	0.651	-0.379	-0.909	0.275
EXC	-0.047	0.653	1.000	0.983	-0.451	-0.823	0.745
UNEMP	0.044	0.651	0.983	1.000	-0.432	-0.786	0.691
INTRADE	-0.225	-0.379	-0.451	-0.432	1.000	0.562	-0.113
BCYCLE	0.078	-0.909	-0.823	-0.786	0.562	1.000	-0.492
DOMINV	-0.536	0.275	0.745	0.691	-0.113	-0.492	1.000

Source: Author's computation from the 100 firm-year observations in the study dataset. Correlation values are Pearson pairwise correlations among the explanatory variables.

Appendix C: Diagnostic-Test Summary

Area	Test	p-value	Conclusion
Multicollinearity	VIF	—	Severe multicollinearity is present
Heteroskedasticity	Breusch–Pagan LM	0.5090	No evidence at 5%
Heteroskedasticity	White LM	0.6931	No evidence at 5%
Residual normality	Jarque–Bera	0.4565	No evidence against normality at 5%
Residual normality	Shapiro–Wilk	0.2442	No evidence against normality at 5%
Regression verification	Coefficient reproduction	max difference = 0.00004529	Reported coefficients reproduced