



Pandemic Profits and Pitfalls: A Canonical Correlation Analysis of Stock Market Sectors and Macroeconomic Variables Amid COVID-19

AYODEJI, I. O.¹, OSUNRO, O. V.² AND OLAPADE, A. K.³

¹Department of Statistics, Obafemi Awolowo University, Ile-Ife, Nigeria.

¹Corresponding author: ioayodeji@oauife.edu.ng, idowu.sayo@yahoo.com,

ORCID ID: 0000-0001-8671-5637

²uwugbeosarieme@gmail.com, ³akolapad@oauife.edu.ng

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Abstract: This paper utilizes canonical correlation analysis to investigate the complex interplay between stock market performance and macroeconomic variables amidst the global economic disruptions caused by COVID-19 pandemic. While the immediate effects of the pandemic have subsided, the crisis highlights the urgent need to understand how economic shocks are transmitted through financial markets—especially in emerging economies. Using data from January 2020 to December 2023, the study focuses on five major sectors of the Nigerian stock market to provide insights into these dynamics. Our findings challenge the conventional narrative by demonstrating that the pandemic's influence on stock market performance was not immediate or direct, but rather mediated through broader macroeconomic channels—most notably, exchange rate volatility emerged as the primary conduit. The analysis also uncovers pronounced sectoral vulnerabilities within the Nigerian Stock Exchange, particularly in the Banking, Consumer Goods, and Oil & Gas sectors. These results lend empirical support to the Arbitrage Pricing Theory, affirming that stock markets in emerging economies remain acutely sensitive to macroeconomic fluctuations, even during periods of global economic upheaval. The study's insights carry significant implications for other emerging markets, offering valuable guidance for policymakers and investors in navigating the complexities of the COVID-19 era.

Keywords: COVID-19 pandemic; Stock market sectors; Macroeconomic variables; Emerging markets; Canonical correlation analysis

1. INTRODUCTION

The relationship between stock markets and macroeconomic variables has long been a focal point of both theoretical and empirical research. Foundational financial theories, such as the Efficient Market Hypothesis (EMH), suggest that stock prices inherently encapsulate all available information, including macroeconomic indicators, making the stock market a comprehensive gauge of economic health (Chong, 2003). The Arbitrage Pricing Theory (APT) further posits that stock returns are influenced by a range of macroeconomic factors, including interest rates, inflation, and exchange rates, which collectively shape asset prices (French, 2003). Empirical studies, such as that of Mazuruse (2014), corroborate these theoretical assertions, demonstrating strong linkages between stock market performance and macroeconomic conditions, particularly in emerging markets where economic volatility is more pronounced.

The COVID-19 pandemic, however, introduced a new dimension to these established relationships. Global economic disruptions, widespread lockdowns, and fluctuating government policies created an unprecedented macroeconomic environment. This necessitated a multidimensional approach to understand how various sectors of the stock market interacted with the rapidly shifting macroeconomic landscape during the pandemic. The pandemic's effects on factors such as crude oil exports, interest rates, inflation, and indicators of stock market sectors call for an integrative model to capture these complex dynamics and interactions holistically.

Previous research has predominantly focused on pre-pandemic data (Olowe, 2007; Mazuruse, 2014) or examined singular economic variables (Oyelami *et al.*, 2020) or one-dimensional relationships (Bello *et al.*, 2022; Ncube *et al.*, 2023). In contrast, this study integrates a comprehensive set of stock market, macroeconomic, and health indicators, including those specific to COVID-19, to offer a nuanced understanding of their interactions under the pandemic's influence.

In exploring the “profits” and “pitfalls” of the pandemic within the interplay between stock market sectors and macroeconomic variables, this study aims to identify which sectors demonstrated resilience or profitability during the COVID-19 pandemic. It examines how macroeconomic variables influenced stock market sectors, identifying those that adapted successfully to pandemic-related challenges. These insights are valuable for informing strategic adjustments applicable in future crises. Conversely, the study also exposes sectors that were particularly vulnerable, detailing

how macroeconomic disruptions adversely affected these sectors and highlighting areas for potential policy or strategic improvement. It draws attention to sectors that were less influenced by critical macroeconomic variables, which may suggest areas of poor management or missed opportunities to leverage favorable conditions.

Nigerian stock market presents an ideal case to explore how the pandemic influenced sectoral performance in conjunction with broader macroeconomic indicators due to the country's unique economic and structural characteristics. As Africa's largest economy and most populous nation, Nigeria's economic health significantly impacts the broader West African region. However, Nigeria is also highly susceptible to both internal and external macroeconomic shocks due to its dependence on crude oil exports, fluctuating exchange rates, and structural vulnerabilities such as inflation.

Historically, the Nigerian stock market has been influenced by macroeconomic factors such as exchange rates, inflation, and interest rates (Olowe, 2007), but the onset of COVID-19 created unprecedented disruptions. Lockdowns, oil price volatility, inflation spikes, and government policy responses compounded the economic uncertainty in ways that were far more pronounced in Nigeria than in many other emerging markets (Ncube *et al.*, 2023). The pandemic severely disrupted key economic sectors like banking, consumer goods, and oil and gas - sectors that are central to the Nigerian Stock Exchange.

Given Nigeria's dependence on oil, the pandemic's impact on global oil prices had a particularly acute effect on its economy. Additionally, Nigeria's distinct approach to managing public health and economic policies during the pandemic - characterized by a combination of monetary interventions, border closures, and varying approaches to COVID-19 case management - renders the Nigerian context highly relevant for exploring the interrelation between sector-specific stock market performance and macroeconomic variables during a global crisis. Understanding the Nigerian experience during COVID-19 is crucial from a policy perspective. Insights derived from this study can inform more effective macroeconomic and financial policies, as well as risk management strategies for an economy marked by significant underperformance relative to its potential. These insights may also hold relevance for other African economies facing similar vulnerabilities.

The interactions between various stock market sectors and numerous macroeconomic variables during the pandemic are inherently complex, necessitating a robust analytical framework. This study employs Canonical Correlation Analysis

(CCA), which allows for the simultaneous examination of the multidimensional co-movement and interdependence between macroeconomic indicators and stock market indices in a computationally efficient manner (Sherry & Henson, 2005). Unlike traditional correlation and regression models, CCA offers an integrative approach capable of uncovering latent connections that transcend simple cause-effect relationships. This method enables a more holistic understanding of how clusters of economic factors interact with different sectors of the stock market, capturing the depth and complexity of these interactions, particularly in a context as dynamic as the COVID-19 era.

The study contributes to the existing literature as it offers new insights into how the pandemic has influenced financial markets. It also extends the understanding of pandemic-induced changes in financial and economic relationships. By applying CCA, the study provides comprehensive empirical evidence on the multi-layered interactions between stock market and economic fundamentals in times of extreme economic disruption. The study's focus on Nigeria adds a regional dimension to the literature, offering insights into how specific markets respond to global shocks. This is particularly relevant given Nigeria's unique economic and financial landscape, which may exhibit different dynamics compared to other countries. Overall, the study reinforces and expands upon existing research, providing valuable insights into the complex interplay between stock markets and macroeconomic variables during the COVID-19 era.

2. LITERATURE REVIEW

2.1. Canonical Correlation Analysis (CCA) and Its Applications

Canonical Correlation Analysis (CCA) is a sophisticated multivariate statistical technique that seeks to understand the relationship between two sets of variables by identifying linear combinations within each set that are most strongly correlated (Rencher, 1998). Introduced by Hotelling (1935, 1936), CCA has been a staple in multivariate statistics for decades. It was first applied to the analysis of multivariate time series by Akaike (1976), who aptly described canonical variables as "the information interface channels between past and present," with the canonical correlations representing the "strength" of these channels.

CCA is widely employed when researchers aim to explore relationships between different groups of variables (Abdulazeez & Gulumbe, 2013). It also

serves as a tool for data reduction and variable selection by pinpointing the most significant variables within each set that drive the overall correlation. Unlike other multivariate techniques, CCA imposes fewer restrictive conditions (Kumru *et al.*, 2022). Consequently, it stands out as the most suitable and potent multivariate technique in scenarios involving multiple dependent and independent variables (Hair *et al.*, 2005). CCA's versatility extends beyond studying linear dependence between variables. Anderson & Vahid (1998) demonstrated its applicability in nonlinear multivariate modeling by incorporating variables modeled non-linearly, such as through Fourier series and Tchebyshev polynomials.

This method has been utilized across various disciplines, including psychology, demography, sociology, and economics, to analyze intricate interrelationships between datasets (Sherry & Henson, 2005; Kumru *et al.*, 2022). In financial studies, for instance, CCA has been employed to investigate the linkage between financial indicators and economic variables, thereby providing insight into the interactions between different economic sectors and broader macroeconomic conditions. Arnold (1996) showed how CCA could effectively capture the relationship between stock market returns and macroeconomic factors in developed markets, revealing significant canonical correlations that underscore the interconnectedness of financial and economic systems. Similarly, Azhar (2006) and Mazuruse (2014) applied CCA to emerging stock markets, illustrating how changes in economic indicators like inflation, interest rates, and GDP growth influence stock market performance.

In the context of this research, CCA is used to unveil the key variables driving correlations within the dataset, offering insights into the interrelationships and potential patterns among subsectors and economic fundamentals during the pandemic. Given how the pandemic has reshaped both the financial and real sectors of the economy, CCA is well-suited to capture the depth and complexity of these interactions, particularly in the highly dynamic environment of the COVID-19 era.

2.2. The Impact of COVID-19 on Financial Markets and Macroeconomic Variables

The COVID-19 pandemic has had profound effects on global financial markets, shifting economic dynamics. The pandemic led to severe disruptions in global supply chains, labor markets, and economic policies, causing significant fluctuations in stock market indices (Fernandes, 2020; He *et al.*, 2020). The immediate market reactions to COVID-19, characterized by sharp declines followed by rapid rebounds,

underscored the heightened sensitivity of financial markets to macroeconomic and health-related shocks.

Research by Nwosa (2020) and Qureshi (2022) illustrated that the pandemic intensified the correlations between financial markets and macroeconomic indicators, suggesting that traditional models of financial analysis might need adjustments to account for pandemic-induced changes. The unique nature of COVID-19, with its global reach and varying national responses, presents a new challenge for analyzing stock market dynamics and macroeconomic interactions.

2.3. The Impact of COVID-19 on Stock Markets

In econometrics literature, the Black Swan Theory (BST) has been frequently invoked to describe the effect of COVID-19 on stock exchanges (Ncube *et al.*, 2023). The BST describes an unexpected event with a severe impact, which cannot be predicted in advance but is often explained retrospectively (Taleb, 2007). COVID-19 embodies all three characteristics of a black swan event: its rarity, severe impact, and the inability to predict its occurrence beforehand.

There is a wealth of empirical research examining COVID-19's impact on stock markets. Studies from both developed (Fernandes, 2020; Elhini & Hammam, 2020) and emerging markets (Nwosa, 2020; Ncube *et al.*, 2023) concur that the virus and related containment measures had severe global impacts on stock markets. Although markets in both regions recovered following the introduction of safety protocols, developed markets demonstrated a more proactive approach in managing the crisis, which facilitated a faster recovery compared to emerging markets (Topcu & Gulal, 2020; Uddin *et al.*, 2021).

Topcu & Gulal (2020) further documented that the impact of COVID-19 on emerging markets varied by region, with Asian markets experiencing more severe consequences than their European counterparts. A few studies have undertaken sector-specific analyses of the pandemic's effect on stock markets. Notable examples include Elhini & Hammam (2020), who examined the impact on the S&P 500 index; Alam *et al.* (2021), who analyzed the varied effects on the Australian Securities Exchange; Izzeldin *et al.* (2021), who studied sectoral responses within the G7 countries; Mazur *et al.* (2021) in the U.S. market; and Ncube *et al.* (2023) for four Sub-Saharan African stock exchanges, including Johannesburg, Nigerian, Zimbabwean, and Lusaka.

2.4. The Impact of COVID-19 on Nigerian Stock Market

Adenomon *et al.* (2020) and Oyelami *et al.* (2022) are among the few studies documenting the economic impact of COVID-19 on the overall performance of the Nigerian stock market. Additionally, Ncube *et al.* (2023) conducted a sector-by-sector analysis of the pandemic's impact on Nigerian stock indices. The National Bureau of Statistics (NBS, 2020) reported a 6.10 percent decline in Nigeria's real GDP in the second quarter of 2020, attributed to the effects of the COVID-19 pandemic and the resultant decline in oil prices. The All Share Index (ASI) of the Nigerian Stock Exchange (NSE), which stood at 29,710.56 on January 20, 2020, fell by 13.1 percent to 25,816.57 by March 2, 2020, and further declined to 24,930.88 by June 26, 2020 (NSE, 2020).

Almost all sectoral indices experienced declines in the early days of the pandemic. For instance, the NSE's Banking, Industrial, and Oil & Gas market indices were at 409.23, 1,228.22, and 248.99 points, respectively, on January 20, 2020. By March 2, 2020, these indices had fallen to 303.94, 1,199.75, and 234.101 points, respectively. By June 26, 2020, the indices had further declined to 289.31 for Banking, 1,194.99 for Industry, and 198.55 points for Oil & Gas (NSE, 2020).

3. METHODOLOGY

3.1. The dataset

This study utilizes monthly data from the Nigerian stock market and macroeconomic variables to investigate the interrelationships between different stock market sectors and economic indicators during the COVID-19 era. The data covers the period from January 2020 to December 2023. The selection of this period captures the impact of the pandemic.

Stock Market Data: Following the Global Industry Classification Standards (GICS), the stocks were categorized into five pivotal sectors: Banking, Consumer Goods (Cons. Goods), Food, Beverages, and Tobacco (FBT), Insurance, and Oil and Gas. Each sector plays a distinct role in the market's dynamics and responds differently to macroeconomic variables. Additional indices include the volume of shares sold in the five sectors.

Macroeconomic Variables: The macroeconomic data comprises several key indicators such as the Exchange rate (USD/NGN), Interest rates (91 days Treasury bill rate), Crude oil exports and Inflation rates (12 months average change).

COVID-related Statistics: Number of confirmed cases and deaths were originally obtained on daily basis and aggregated to monthly.

Data Sources: Stock market indices and volumes were obtained from the official website of investing.com, macroeconomic variables were sourced from the website of the Central Bank of Nigeria, COVID-related statistics were obtained from the website of Our World in Data.

Time Series Plots: The first two plots in Figure 1 show the time-series data for COVID-19 deaths and confirmed cases. The plot for deaths shows a series of fluctuations, with noticeable spikes early in the period and some stabilization later. This suggests that the number of deaths was more variable in the initial stages of the timeline but became more consistent or lower over time. The confirmed cases plot shows large, sharp peaks followed by a steady decline. This indicates a period of intense case growth followed by a significant reduction, likely after interventions or as the pandemic began to wane.

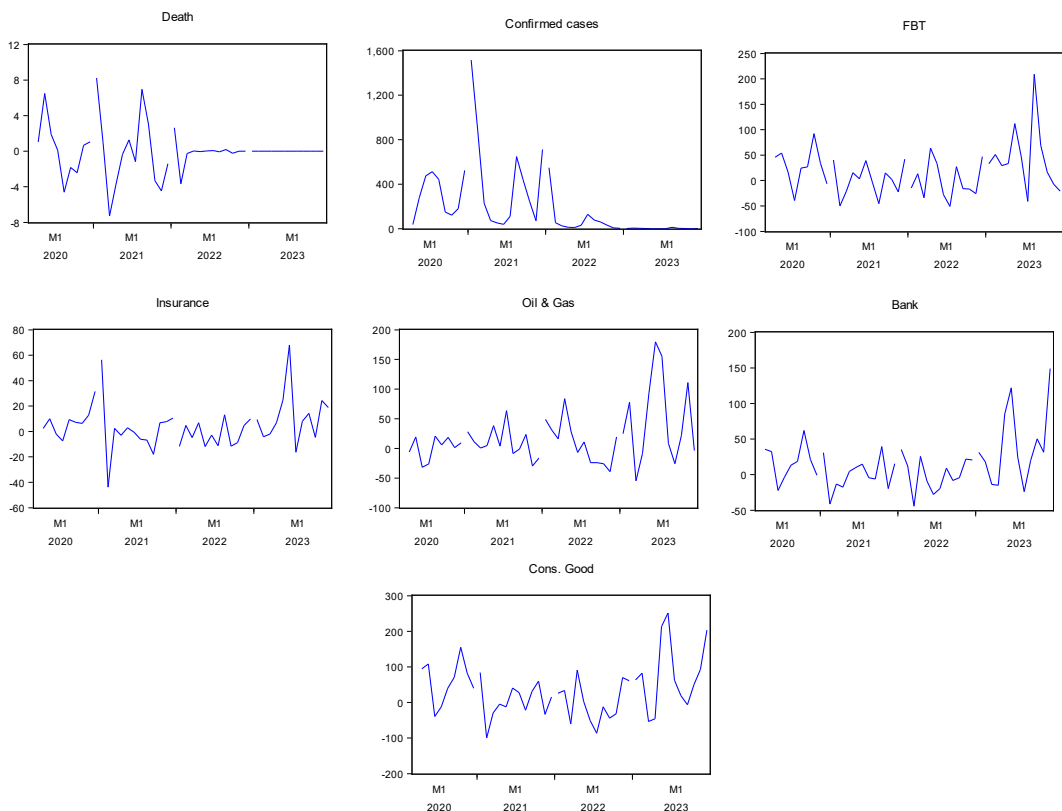


Figure 1: Plots of the sectors of NSE and COVID-19

The Banking, Consumer Goods, and Oil & Gas sectors are more reactive compared to the remaining sectors. The peaks and troughs indicate strong reactions to economic changes or demand shifts over the period. The Insurance and FBT sectors exhibit less variation, suggesting that they also experienced fluctuations but perhaps not as pronounced as others during the period.

Unit root tests: To ensure stationarity of series, Augmented Dickey-Fuller tests are conducted. Table 1 shows the number of times each series were differenced to remove unit roots.

Table 1: Differencing of Series

<i>Variable Name</i>	<i>No. of times differenced</i>
<i>Sectors of NSE</i>	
Banking	1
Consumer Goods	1
FBT	1
Insurance	1
Oil & Gas	1
<i>COVID variables</i>	
Confirmed cases	1
Death	1
<i>Volume of shares sold</i>	
Banking	1
FBT	1
Insurance	1
Oil & Gas	1
Consumer Goods	1
<i>Macroeconomic variables</i>	
Crude Export	1
Inflation	3
Interest rates	1
Exchange rates	1

3.2. Conceptual Framework

The relationship between stock markets and macroeconomic variables has been a subject of extensive research in both developed and developing economies. Prior studies have demonstrated that key macroeconomic indicators such as exchange rates, interest rates, inflation, and commodity prices can significantly influence

stock market performance, revealing intricate patterns of co-movement (Mazuruse, 2014). However, the onset of the COVID-19 pandemic introduced unprecedented disruptions, altering both market dynamics and macroeconomic conditions in ways not previously observed. The pandemic's global scale, coupled with varying national responses, made the link between the macroeconomy and the stock market particularly unpredictable.

Given this context, this study adopts canonical correlation analysis to explore the intricate relationships between different sectors of the Nigerian stock market and key macroeconomic variables during the COVID-19 era, a period marked by substantial economic instability and health crises. Figure 2 illustrates the CCA model of the study variables. The first canonical set is dominated by the five prominent sectors of the Nigerian stock exchange, while the second canonical set includes COVID-related variables and macroeconomic variables. The figure depicts the various interactions within each of the two canonical sets; and between the two categories. The analysis provides insights into how specific economic variables intersected with stock market activity during this critical period.

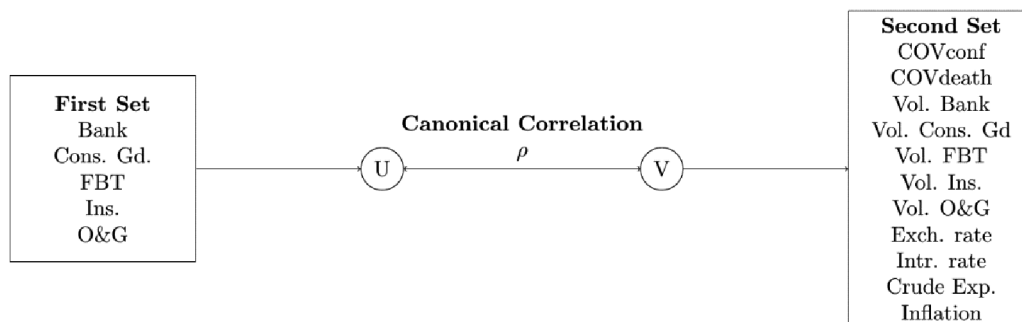


Figure 2: CCA model of study variables

3.3. Canonical Correlation Analysis

Canonical correlation analysis (CCA) was been proposed by Hotelling in 1935 as a viable tool in large-scale data visualization. Ayodeji & Obilade (2018) later introduced a predictive approach to the method such that CCA can be viewed as a multiple regression of two Gaussian random vectors. The new approach was an alternative and simpler composition for CCA such that its coefficients can be interpreted as the familiar regression beta coefficients.

CCA is a statistical investigation of the strength and degree of association between two sets of variables. The set of dependent variables (DVs) are the five sectors of the NSE and the set of independent variables (IVs) are COVID-related statistics and selected macroeconomic variables. Essentially CCA seeks to maximize the linear association between the two sets of variables (Rencher, 1998).

Specification: CCA predictive model can be written as (Ayodeji & Obilade, 2018):

$$Y\beta = X\alpha + \varepsilon, \varepsilon \sim N(0,1) \quad (1)$$

where X and Y are the sets of IVs and DVs, respectively. α and β are the parameters of Model (1). The goal of CCA is to maximize the loglikelihood function l subject to $Var(U) = Var(V) = 1$ (Brown *et al.*, 2012):

$$\max_{\alpha, \beta} l \quad (2)$$

$$s.t \ Var(U) = Var(V) = 1 \quad (3)$$

where

$$l = -\frac{N}{2} \ln 2\pi - \frac{1}{2}(V-U)'(V-U) \quad (4)$$

and

$$U = X\alpha \text{ and } V = Y\beta \quad (5)$$

are the canonical variates. Model parameters (α, β) are estimated using the Lagrange multiplier and maximum likelihood techniques.

Ayodeji & Obilade (2018) proved that Equation (2) corresponded to Hotelling's (1935) original statement of CCA, that is:

$$\max_{\alpha, \beta} l = \max_{\alpha, \beta} \rho \quad (6)$$

where

$$\rho = Corr(U, V) \quad (7)$$

is the canonical correlation between the canonical variates U and V .

The first pair of canonical variates (U_1, V_1) is obtained so that the correlation between sets X and Y was maximum. The second pair (U_2, V_2) is also obtained so that the maximum association between X and Y not accounted for by the first

pair is exhibited. Similarly, the third pair (U_2, V_3) is derived so that the maximum association between X and Y not accounted for by the second pair is exhibited. In like manner, successive pairs of canonical variates are extracted from residual variance using the properties of block matrices and eigenvalues (Hotelling, 1935). Succeeding canonical correlations diminished as each additional correlation was extracted.

Analysis: The outputs of CCA are several canonical loadings and correlation coefficients. **Canonical Loadings:** Canonical loadings are computed for each set to understand the contribution of each variable to the canonical variates (Sherry & Henson, 2005). Loadings with absolute values close to 1 or -1 are considered strong. These values indicate a significant relationship between the variable and the canonical variate. In particular, if the loading is around ± 0.7 or higher, it is often considered strong. Loadings between ± 0.3 and ± 0.7 indicate moderate relationships.

Canonical Correlations: The strength of the relationship between the two sets of variables is assessed through canonical correlations. Canonical correlations close to 1 suggest a strong relationship between the canonical variates from the two sets.

Eigenvalues and Wilks' Lambda: Eigenvalues measure the variance explained by each canonical variate, while Wilks' Lambda tests the null hypothesis that the correlations between canonical variates are zero.

Cross Loadings: Cross loadings help in understanding how variables from one set relate to the canonical variates of the other set.

Model Evaluation: The metric, proportion of variance explained, indicates how much of the variance in each set of variables is explained by the canonical variates.

4. PRESENTATION OF RESULTS

Correlation Chart: The correlation matrix visually represents the relationships between various stock market indices, COVID-19 variables, and macroeconomic indicators. The color scale ranges from blue (negative correlation) to red (positive correlation), with neutral (zero correlation) represented by white. The matrix reveals strong sectoral interdependencies within the Nigerian stock market, particularly between Banking, Consumer Goods, Insurance, and Oil & Gas. The influence of COVID-19 variables on stock market performance appears weak, while macroeconomic variables, especially the exchange rate, play a more significant role in sectoral performance.

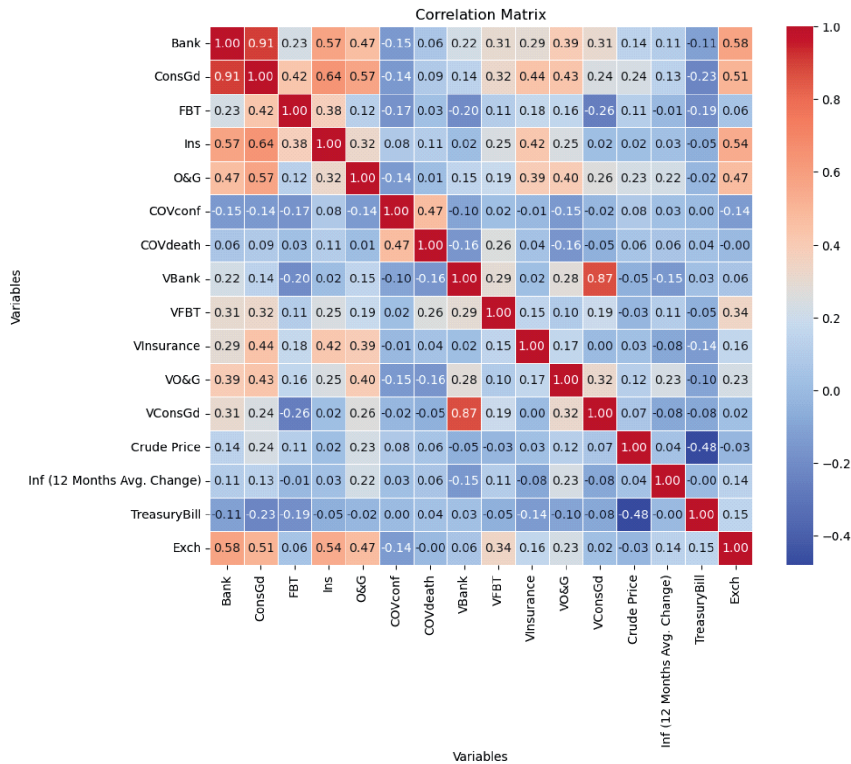


Figure 3: Correlation chart for the sectors of NSE and COVID statistics

Canonical correlation results: Table 2 presents the canonical correlation results, while Figure 4 displays the helioplots of the first set of canonical variates. Together, these highlight the critical variables driving the relationship between stock market indices and macroeconomic factors, emphasizing their importance in understanding the interaction between these domains. The key observations are as follows:

The first canonical correlation is notably high at 0.870, indicating a strong relationship between the two sets of variables—stock market sectors and macroeconomic factors—represented by the first canonical dimension. This is further reinforced by an eigenvalue of 3.110, which reflects the substantial variance shared between the two sets. The Wilks Lambda value of 0.091 and its significance level ($p = 0.018$) confirm that this relationship is statistically significant, leading to the rejection of the null hypothesis, which posited that no significant canonical correlations exist.

Subsequent canonical correlations, while capturing some variance, are not statistically significant, indicating that these relationships are weaker and less reliable.

The first canonical variate explains 51.7% of the variance in the stock market sector set (Set 1) and 39.1% of the variance in the macroeconomic variable set (Set 2). This suggests that the first canonical dimension captures the most significant relationships between stock market sectors and macroeconomic variables during the COVID-19 period. Therefore, only the first set of canonical loadings will be interpreted.

The first canonical variate reveals a strong negative correlation between the macroeconomic environment and key stock market sectors, such as Banking, Consumer Goods, and Oil & Gas. These sectors exert a substantial influence on the first canonical variate, indicating their critical role in stock market analysis during the pandemic. The negative relationship suggests that these sectors were significantly impacted during periods of economic or financial stress, reflecting broader financial instability or shifts in investor sentiment.

The Insurance sector also shows a moderate negative loading, signifying that it has a notable but lesser impact on stock market performance compared to the most influential sectors. The Food, Beverage, and Tobacco (FBT) sector, however, has much lower loadings, indicating it is less influential. This may suggest that consumer staples, such as food and beverages, are less volatile and more resilient during economic cycles, positioning them as defensive investments during downturns.

Among the macroeconomic variables, the exchange rate emerges as the most influential, with a strong negative loading. Other variables, such as sectoral share volumes and crude oil exports, exhibit moderate loadings. In contrast, COVID-19-related variables and other macroeconomic indicators have minimal impact.

The strong negative loading of the exchange rate indicates that fluctuations in currency values significantly affect the macroeconomic variate. A depreciating currency may increase import costs and disrupt economic stability, which in turn negatively influences the stock market. This highlights the profound impact of exchange rates in shaping sectoral performance during the pandemic. Macroeconomic policies affecting exchange rates had the most immediate and significant influence on the Nigerian stock market during this period.

The moderate negative loadings for sectoral share volumes suggest that changes in trading volumes also affect stock performance, reflecting investor behavior and market liquidity. However, these volumes do not dominate the relationship between the macroeconomic environment and stock performance as much as the exchange rate does.

The minimal influence of COVID-19-related variables on the canonical variate suggests that, despite the pandemic's significant economic and health consequences, its direct impact on the canonical relationship between stock indices and macroeconomic variables was limited. This could imply a delayed or indirect effect, where COVID-19's immediate consequences are less prominent in these correlations compared to other factors. Traditional macroeconomic variables, particularly exchange rates, drove market performance more significantly during the study period.

The moderate loading of crude oil exports reflects its lesser yet notable influence on sectoral performance. The low loadings for interest rates and inflation suggest that these macroeconomic factors played a minor role in the canonical variate, indicating that variables like exchange rates and sector-specific factors were more critical in shaping the stock market–macroeconomic relationship during the period studied.

High cross-loadings in Set 1 (e.g., -0.757 for Banking and -0.776 for Consumer Goods) and Set 2 (e.g., -0.646 for Exchange Rate and -0.451 for Volume of Oil & Gas) further underscore the strong relationships between stock market sectors and macroeconomic factors. These cross-loadings emphasize that shifts in macroeconomic indicators significantly influence the performance of specific sectors.

Table 2: Canonical correlations

<i>Correlation</i>	<i>Eigenvalue</i>	<i>Wilks' Statistic</i>	<i>Significance</i>
.870	3.110	.091	.018
.580	.507	.374	.785
.507	.345	.563	.864
.408	.199	.757	.901
.303	.101	.908	.864

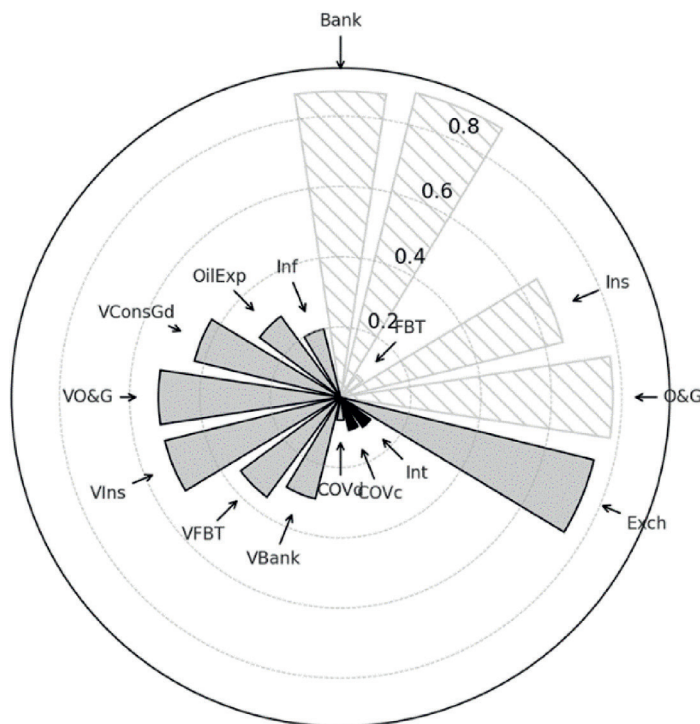


Figure 4: Helioplot of the first canonical loadings

The bars representing variables in the first set (NSE sectors) are patterned, while those in the second set (macroeconomic variables) are solid-filled. Variables with negative loadings are light grey, whereas those with positive loadings are black

4.1. Discussion

Canonical Correlation Analysis (CCA) has been widely used in financial research to examine relationships between multiple sets of variables. Prior studies, such as those by Azhar (2006) and Mazuruse (2014), have applied CCA to explore the interaction between economic indicators and stock market performance. In contrast to research that emphasizes a direct and significant impact of the pandemic on stock markets (e.g., Barro *et al.*, 2020; Fernandes, 2020; Bello *et al.*, 2022; Ncube *et al.*, 2023), our findings indicate that these effects were predominantly transmitted through macroeconomic channels—most notably, exchange rate volatility.

Importantly, despite the scale of the COVID-19 shock, our results offer empirical support for the Arbitrage Pricing Theory (APT), revealing that sectoral performance

within the Nigerian stock market remained highly responsive to macroeconomic indicators. This does not suggest that COVID-19 had no impact; rather, it implies that its direct effects on the market may have been muted or transient. As noted in prior research, swift and coordinated policy interventions by governments likely facilitated a relatively rapid recovery (Topcu and Gulal, 2020; Uddin *et al.*, 2021). It is also plausible that the pandemic's influence was primarily indirect or that its economic consequences manifested with a lag.

Another standout finding is the critical role of the exchange rate during the pandemic. The strong negative canonical loading of this variable indicates its profound impact on stock market sectors, aligning with past research, such as Ibrahim and Aziz (2003) and Mazuruse (2014), which highlight exchange rate fluctuations as a key determinant of stock market performance. The findings suggest that exchange rate volatility likely exacerbated economic instability, affecting investor sentiment and stock valuations. This underlines the need for macroeconomic stability, particularly through exchange rate management, to create a more conducive environment for market recovery and growth.

Conversely, the vulnerability of key stock market sectors, such as banking and consumer goods, was another crucial observation. The strong negative cross-loadings for these sectors during the pandemic suggest that they were particularly susceptible to macroeconomic pressures. These sectors, being closely tied to both consumer behavior and broader economic activity, were likely more sensitive to the downturn caused by the pandemic. Importantly, none of the sectors showed strong positive cross-loadings, highlighting their overall inability to thrive or take advantage of the prevailing macroeconomic conditions.

The Food, Beverages, and Tobacco (FBT) sector showed minimal responsiveness to key macroeconomic variables, suggesting that it played a more defensive role during the pandemic. This finding aligns with the traditional view that consumer staples tend to be less volatile in times of economic stress. Nevertheless, the limited influence of this sector on the broader economic landscape raises important questions about its capacity to contribute to recovery efforts.

Additionally, the minimal influence of interest rates and inflation further suggests that the Nigerian stock market's response to macroeconomic variables during the pandemic was dominated by more immediate concerns, such as the exchange rate. This finding contrasts with Josiah and Akpoveta (2019), who noted

stronger correlations between stock market performance and these variables in previous periods.

Overall, the findings highlight the intricate interdependence between macroeconomic variables and sector-specific stock market indices. Understanding these relationships can provide policymakers and investors with critical insights into how to mitigate risks and harness opportunities in times of economic turmoil.

5. CONCLUSION AND RECOMMENDATIONS

Emerging markets are a complex and dynamic environment influenced by a myriad of macroeconomic factors and sector-specific developments. This study provides an in-depth analysis of how stock market indices in Nigeria responded to macroeconomic variables during the COVID-19 pandemic, with a particular focus on the banking, consumer goods, food, beverages and tobacco (FBT), insurance, and oil and gas sectors. Using Canonical Correlation Analysis (CCA), the study uncovers key relationships that reflect the complex interplay between these sectors and broader economic indicators such as exchange rates, interest rates, and COVID-19-specific variables.

Unlike previous studies that attributed stock market disruptions directly to the COVID-19 pandemic, our findings indicate that sectoral vulnerabilities—particularly in Banking, Consumer Goods, and Oil & Gas—alongside exchange rate fluctuations, played a more immediate and influential role in shaping market dynamics. In contrast, other macroeconomic variables such as crude oil exports, inflation, and interest rates exhibited relatively muted effects. The pronounced negative responses observed in these key sectors underscore their heightened sensitivity to economic shocks and highlight the critical importance of ensuring sectoral resilience as a means of mitigating broader market instability. This perspective contrasts with earlier research that examined stock market sectors in isolation, and it underscores the added value of Canonical Correlation Analysis in revealing interdependent market responses, rather than focusing solely on sector-specific effects.

While the study offers valuable insights into the stock market-macroeconomic nexus during the pandemic, it is important to note some limitations. The analysis did not explicitly account for external factors, such as global economic conditions or geopolitical events, which may have influenced Nigeria's stock market performance during this period. Future research should seek to incorporate these external factors, providing a more comprehensive picture of the influences at play.

Given the study's findings, several recommendations can be made for policymakers and investors seeking to navigate similar crises in the future. Firstly, stabilizing the exchange rate should be a top priority for policymakers, as the study highlights its significant impact on the stock market. Measures aimed at reducing exchange rate volatility, such as improving foreign currency reserves and managing inflationary pressures, would help create a more stable environment for investors and reduce market fluctuations.

Secondly, targeted support for vulnerable sectors, particularly banking and consumer goods, is crucial. These sectors, which are closely tied to the broader economy, should be provided with financial relief during times of crisis. This could include measures such as low-interest loans, tax breaks, or sector-specific subsidies aimed at enhancing their resilience. In particular, bolstering the banking sector's stability during downturns can have a ripple effect on the broader economy, as it plays a central role in credit provision and financial services.

Thirdly, encouraging economic diversification is essential. The strong sectoral responses to macroeconomic fluctuations during the pandemic underscore the need for Nigeria to diversify its economic base. Investing in less cyclical sectors, such as technology, infrastructure, and renewable energy, can provide a buffer against future shocks and contribute to long-term economic stability. Policymakers should promote policies that facilitate investment in these emerging sectors, helping reduce the country's dependence on volatile industries like oil and gas.

Finally, future studies should build upon the insights gained from this research by developing more sophisticated forecasting models that integrate a broader set of macroeconomic indicators, both domestic and international. Such models could serve as early-warning systems, enabling policymakers to better anticipate and mitigate potential economic disruptions. By incorporating global economic conditions, geopolitical risks, and other sector-specific developments, future research can provide more detailed guidance for navigating stock market performance during global crises.

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