Board Attributes and Financial Reporting Quality of Listed Oil and Gas Firms in Nigeria

Muhammad Kabir Musa, Abubakar Modibbo*

Department of Accounting, Federal University Birnin Kebbi, Nigeria

***Corresponding Author**

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ABSTRACT

This study examined whether specific board attributes are systematically associated with financial reporting quality (FRQ) in Nigerian-listed oil and gas firms over 13 years (2012–2024). FRQ was proxied by discretionary accruals estimated using a performance-matched approach, and governance mechanisms were captured through board size, board independence, board industry expertise, board activity (meeting frequency), and audit committee size, with firm size included as a control. Guided by Agency Theory and Resource-Dependence Theory, the analysis employed multivariate panel techniques suitable for firm-level data observed across time, with standard controls for scale effects and unobserved heterogeneity. The results indicate that board independence, board industry expertise, and audit committee size are each negatively and significantly associated with discretionary accruals, consistent with enhanced monitoring incentives, superior domain knowledge, and greater audit committee capacity improving reporting outcomes. Firm size is also negatively and significantly related to discretionary accruals, suggesting stronger information environments and internal controls in larger issuers. By contrast, board size and board meeting frequency are statistically insignificant after accounting for other governance attributes and controls, implying that headcount and raw meeting tallies are weak stand-alone proxies for effective oversight. The study recommends, among others, that Oil and Gas firms should embed independence first in nomination policies; adopt rigorous conflict-of-interest and tenure-refresh practices; periodically rotate committee membership to sustain challenge. It is also recommended that oil and gas firms in Nigeria should recruit and retain industry/financial experts on their boards.

Keywords: Board Independence; Board Expertise; Audit Committee Size; Financial Reporting Quality; Corporate Governance, Earnings Management

INTRODUCTION

Financial reporting quality (plays a vital role in enhancing transparency, accountability, and informed decision-making in corporate entities. High-quality financial reports reflect the true economic performance and position of a company, thereby enabling investors, regulators, and other stakeholders to make accurate evaluations and informed decisions. However, in many emerging markets such as Nigeria, the reliability of financial reports has been persistently undermined by poor governance practices and limited board oversight, especially in sensitive sectors like oil and gas.

The Nigerian oil and gas industry is one of the most economically significant sectors, accounting for approximately 65% of government revenue and over 80% of export earnings. Despite its importance, the sector is riddled with challenges such as corruption, regulatory lapses, and financial irregularities. A critical concern in this regard is the quality of financial reporting, as several listed firms in the sector have been involved in earnings manipulation and other financial reporting infractions (Okoye, Okaro & Okoye, 2023; Ahmed, 2024).

One of the most widely recognized proxies for assessing financial reporting quality is accrual-based earnings management (AEM). It involves the intentional manipulation of accruals within generally accepted accounting principles to achieve desired financial outcomes without altering actual cash flows. This practice distorts the quality of earnings and misleads stakeholders about a firm's performance (Dechow, Ge & Schrand, 2010; Omodero & Ogisi, 2024). The use of discretionary accruals as a proxy for FRQ allows researchers to identify

instances where management may have opportunistically adjusted reported earnings, making it a critical measure in governance research.

Corporate governance, particularly the role of the board of directors, has been identified as a crucial mechanism for mitigating earnings management and enhancing FRQ. The board is tasked with overseeing management and ensuring the integrity of financial reports. However, the effectiveness of this oversight function depends heavily on the attributes of the board, including board size, independence, activities, industry/financial expertise, and audit committee structure (Musa & Dauda, 2023; Udo & Eyo, 2023).

Board size, for instance, may enhance decision-making by incorporating diverse perspectives, yet excessively large boards may suffer from coordination challenges. Similarly, board independence is theoretically associated with objectivity and strong oversight, but in Nigeria, this ideal is often compromised by political appointments and weak enforcement of governance codes. Directors with industry-specific knowledge and financial expertise are expected to understand complex financial transactions and detect manipulative accounting behavior. Unfortunately, many Nigerian oil and gas companies lack such expertise on their boards, which limits their ability to oversee financial reporting effectively (Ahmed, 2024). The audit committee, a statutory requirement under CAMA and the Nigerian Code of Corporate Governance (2018), is another vital governance structure. While its existence is widespread, its effectiveness in enhancing, especially regarding its size and composition not been sufficiently examined in the oil and gas context.

Despite a growing body of literature on corporate governance and FRQ, sector-specific studies remain limited, and few have used accrual-based measures to assess the impact of board attributes on financial reporting practices in Nigeria's oil and gas industry. Furthermore, many prior studies have relied on cross-sectional or short-term data, often overlooking the dynamic nature of board effectiveness and the multi-dimensional characteristics of financial reporting quality.

Given the strategic importance of the oil and gas sector and its susceptibility to financial reporting abuses, it becomes imperative to examine how board characteristics influence FRQ using accrual-based earnings management as a proxy. This study aims to fill this practical and methodological gap by evaluating the impact of board size, board independence, board industry expertise, audit committee size, and board financial expertise on the quality of financial reporting of listed oil and gas companies in Nigeria.

Statement of the Problem

The oil and gas sector in Nigeria plays a critical role in the country's economic stability, accounting for over 80% of export revenues and nearly 65% of government income. Yet, despite its strategic significance, the sector has been repeatedly undermined by financial scandals, governance failures, and poor-quality financial reporting. Over the past decade, cases of earnings management and financial reporting irregularities have raised serious concerns about the effectiveness of board oversight mechanisms in the sector.

Practical evidence of earnings management and corporate failure is visible in the collapse or near-collapse of several firms. For instance, the financial restatements by Oando Plc, following SEC investigations in 2017 and 2018, revealed significant earnings overstatements and governance lapses that damaged investor confidence (Okoye, Okaro & Okoye, 2023). Similarly, Afren Plc (though listed on the London Stock Exchange) faced massive asset write-downs and financial misreporting, exposing deficiencies in internal governance despite operating extensively in Nigeria. These incidents point to weak board oversight and poor internal controls, especially regarding the quality and integrity of financial reports.

A central mechanism expected to mitigate these issues is the board of directors, whose effectiveness is determined by specific attributes such as board size, independence, financial expertise, and industry expertise. However, many Nigerian oil and gas companies have been found to lack sufficient board expertise and independence, resulting in inadequate monitoring and a higher tendency for earnings manipulation (Ahmed, 2024). Despite the regulatory expectations set by the Financial Reporting Council (FRC) and the Nigerian Code of Corporate Governance (2018), several boards remain poorly constituted and largely symbolic.

From an empirical perspective, numerous studies have investigated corporate governance and financial reporting quality, but their findings remain mixed and inconclusive. For example, while Omodero and Ogisi (2024) found that board independence and size have a positive effect on financial reporting quality among Nigerian listed firms, Musa and Dauda (2023) reported that these same variables had no significant impact within the oil and gas sector. Furthermore, most studies focus on aggregate industries or financial services firms, offering limited sector-specific insights into oil and gas companies whose operations are inherently complex, capital-intensive, and risk-laden.

There also exists a significant methodological gap. Many prior studies rely heavily on governance disclosure indices or simple accounting-based measures such as return on assets, ignoring deeper proxies of earnings quality. The use of accrual-based earnings management (AEM) as a more direct proxy for financial reporting quality is relatively underutilized in Nigerian oil and gas studies. Moreover, most existing research employs cross-sectional designs or short timeframes, failing to capture long-term board performance and trends in earnings management behavior.

In addition, there is a time gap in the current literature. The fast-evolving nature of financial reporting practices, coupled with recent regulatory changes such as the revised CAMA (2020) and the ongoing implementation of International Financial Reporting Standards (IFRS), means that many earlier studies have become outdated. New empirical evidence is needed to reflect the post-COVID era, recent oil price shocks, and the dynamic governance landscape within Nigeria.

Consequently, this study seeks to fill these gaps by providing a contemporary, sector-specific, and methodologically robust analysis of the impact of board attributes, board size, board independence, industry expertise, financial expertise, and audit committee size on financial reporting quality, using accrual-based earnings management as the primary proxy. This will offer both academic and policy-level insights into the governance-performance nexus in Nigeria's oil and gas industry.

Research Questions

The following research questions are raised to find answers:

i. To what extent board of directors' size affect the financial reporting quality of listed oil and gas firms in Nigeria?
ii. How does the board of directors' independence affect the financial reporting quality of listed oil and gas firms in Nigeria?
iii. To what extent board of directors' activities affect the financial reporting quality of listed oil and gas firms in Nigeria?
iv. What is the impact of the board of directors' industry expertise on affect financial reporting quality of listed oil and gas firms in Nigeria?
v. To what extent does audit committee size affect the financial reporting quality of listed oil and gas firms in Nigeria?

Objectives of the Study

The main objective of the study is to examine the impact of board of directors attributes on the financial reporting quality of listed oil and gas firms in Nigeria. The specific objectives of the study are to:

i. Assess the impact of the board of directors' size on the financial reporting quality of listed oil and gas firms in Nigeria.
ii. Evaluate the impact of the board of directors' independence on the financial reporting quality of listed oil and gas firms in Nigeria.
iii. Examine the impact of the board of directors' industry expertise on the financial reporting quality of listed oil and gas firms in Nigeria.
iv. Determine the impact of the board of directors' activities on the financial reporting quality of listed oil and gas firms in Nigeria.

v. Investigate the impact of audit committee size on the financial reporting quality of listed oil and gas firms in Nigeria.

Hypotheses of the Study

The study formulated the following research hypotheses in null form;

H01: Board of directors' size has no significant impact on the financial reporting quality of listed oil and gas firms in Nigeria.

H02: Board of directors' independence has no significant impact on the financial reporting quality of listed oil and gas firms in Nigeria.

H03: Board of directors' activities have no significant impact on the financial reporting quality of listed oil and gas firms in Nigeria.

H04: Board of directors' industry expertise has no significant impact on the financial reporting quality of listed oil and gas firms in Nigeria.

H05: Audit committee size has no significant impact on the financial reporting quality of listed oil and gas firms in Nigeria.

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

The relationship between board attributes and financial reporting quality (FRQ) is grounded in several complementary theories of corporate governance. Agency theory (Jensen & Meckling, 1976; Fama & Jensen, 1983) provides the primary foundation, emphasizing the monitoring role of boards in mitigating managers' opportunism. It predicts that board independence, optimal board size, frequent meetings, and active audit committees reduce earnings management (EM) and strengthen FRQ. This perspective is particularly relevant in Nigeria's oil and gas firms, where complex accounting estimates and ownership concentration create significant agency problems.

While agency theory focuses on control, resource dependence theory (Pfeffer & Salancik, 1978) highlights the role of boards as providers of knowledge, skills, networks, and legitimacy. Directors with financial and industry expertise can better evaluate complex transactions, challenge management's accounting judgments, and ensure compliance with standards. Similarly, board diversity contributes to broader perspectives and enhances disclosure quality. Complementing this, stewardship theory (Davis et al., 1997) views managers as stewards aligned with organizational success, positioning the board's role as advisory and supportive. From this lens, larger boards and more frequent meetings provide management with valuable guidance and collaborative support that can enhance transparency and reporting quality.

Broader accountability is explained by stakeholder theory (Freeman, 1984), which extends the board's duty to creditors, employees, regulators, and communities. In the oil and gas sector, where host community relations and regulatory legitimacy are sensitive, board diversity—such as gender inclusion and international exposure—can reduce opportunistic reporting and promote credibility. Finally, upper echelons theory (Hambrick & Mason, 1984) underscores the influence of directors' demographic and cognitive attributes, including expertise, tenure, age, and gender, on organizational outcomes. Heterogeneous boards are less prone to groupthink and more effective in demanding transparent and high-quality reporting.

Taken together, these theories suggest that no single framework fully explains board–FRQ dynamics. Agency theory provides the strongest foundation, but resource dependence, stewardship, stakeholder, and upper echelons theories enrich the analysis by accounting for expertise, diversity, collaboration, and director heterogeneity. The integrated perspective indicates that board size, independence, expertise, activity, and diversity all play critical roles in constraining both accrual-based and real earnings management, thereby shaping the quality of financial reporting in Nigerian oil and gas firms.

The effect of board size on financial reporting quality (FRQ) and earnings management (EM) has attracted wide

scholarly attention, but empirical evidence remains inconclusive. Klein (2002), in a U.S. study, reported no consistent association between board size and abnormal accruals, suggesting that increasing board membership does not automatically enhance monitoring. Conversely, Xie, Davidson, and DaDalt (2003) found that larger boards, when complemented with independence and activity, constrain accrual-based EM. Similar evidence from emerging economies, such as Malaysia and Singapore, demonstrated that large boards, in conjunction with effective audit committees, reduce abnormal working capital accruals (Peasnell, Pope & Young, 2005).

In India, Almaqtari, Hashed, Shamim, and Al-ahdal (2020) revealed that board characteristics (size, independence, diligence, and expertise) significantly affect FRQ, though board diligence exhibited a negative effect. Attia, Ismail, and Mehafdi (2022), using Egyptian data, reported that board size is negatively correlated with real earnings management (REM), while board meetings showed a positive relationship with REM. Githaiga, Kabete, and Bonareri (2022), analyzing East African firms, found a positive and significant relationship between board size and EM, suggesting larger boards may encourage opportunism unless moderated by firm size. Similarly, Hasan, Aly, and Hussainey (2022), comparing Pakistan and the UK, found that board size harms FRQ, while Alrawashedh et al. (2024) reported that larger boards in Jordan significantly mitigate EM. These diverse findings suggest that the role of board size is highly contextual, varying with institutional and regulatory frameworks.

Board independence has generally been associated with enhanced monitoring and reduced EM. Klein (2002) documented that boards with fewer independent directors exhibit higher income-increasing accruals. Subsequent studies (Xie et al., 2003; Peasnell et al., 2005) confirmed that independent directors constrain EM in both U.S. and U.K. settings.

Empirical evidence from emerging economies, however, presents mixed results. Almaqtari et al. (2020) demonstrated that board independence significantly influences FRQ under Indian standards. Qawqzeh et al. (2021) found that independence negatively influences FRQ in Jordan, while board expertise improves it. In the East African Community, Githaiga et al. (2022) reported a negative association between independence and EM, whereas Attia et al. (2022) found mixed results in Egypt depending on REM proxies used. In Nigeria, Akinkunmi, Salako, and Fola (2024) confirmed that board independence significantly enhances FRQ in deposit money banks, while Usman and Yahaya (2024) showed that higher proportions of independent directors reduce discretionary accruals. Together, these findings underscore independence as a critical governance mechanism, though its effect differs across institutional contexts.

Board expertise, especially financial and industry-specific expertise, is considered essential for monitoring complex transactions and improving FRQ. Abubakar and Ishak (2017) found that board expertise in Nigerian financial institutions positively influences REM. Almaqtari et al. (2020) confirmed that expertise significantly affects FRQ in Indian firms. In East Africa, Githaiga et al. (2022) revealed that financial expertise significantly reduces EM, while Akinkunmi et al. (2024) found that expertise enhances FRQ in Nigerian banks. These findings highlight that directors with accounting, auditing, or industry knowledge are instrumental in curbing earnings manipulation.

Board activity, typically measured by frequency of meetings, is another determinant of FRQ. Vafeas (1999) demonstrated that frequent meetings enhance monitoring and reduce EM. Xie et al. (2003) similarly linked active boards with lower discretionary accruals in U.S. firms.

In Nigeria, Abubakar and Ishak (2017) reported that frequent board meetings increase REM in financial institutions, while Attia et al. (2022) found similar positive associations in Egypt. In contrast, Yahaya (2024) provided updated evidence from Nigeria showing that frequent board meetings improve FRQ, suggesting that effective meeting dynamics may mitigate opportunism. These contradictions reinforce that board activity must be considered alongside board effectiveness and institutional enforcement.

Audit committees (ACs) serve as the cornerstone of board oversight. Bedard, Chtourou, and Courteau (2004) established that larger committees with financial expertise reduce aggressive accruals. Nigerian evidence provides mixed results. Umobong and Ibanichuka (2017) found that independence and expertise enhance FRQ, while size negatively affects it. Bala (2018) reported that AC attributes such as expertise and tenure reduce EM, with audit fees mediating this relationship. More recent studies (Tanko & Siyanbola, 2019; Oyedokun et al.,

2020; Haruna et al., 2021; Danjuma, 2021) also provide divergent results, depending on sector and methodology. Across jurisdictions, however, AC effectiveness is consistently emphasized as a critical safeguard for FRQ.

The reviewed literature highlights several gaps. First, empirical findings are inconsistent, with board size, independence, and activity showing both positive and negative relationships with FRQ depending on country and methodology. Second, most studies are contextually limited, focusing on developed economies, Asia, and banking/consumer goods sectors in Nigeria, with oil and gas firms underexplored. Third, many rely exclusively on accrual-based measures of EM (e.g., Modified Jones Model), neglecting REM and combined proxies. Fourth, understudied board attributes such as gender diversity, industry expertise, and board dynamics warrant more empirical attention. Finally, much of the Nigerian evidence predates recent reforms such as CAMA 2020 and the revised NGX governance codes.

Therefore, this study addresses these gaps by examining multiple board attributes (size, independence, expertise, and activity) and their impact on FRQ of listed Nigerian oil and gas firms, using both accrual- and real-based measures within an updated regulatory context.

METHODOLOGY

This study adopts the positivist research paradigm. Therefore, this study considers a quantitative research strategy to be the most suitable for conducting the research. It involves the application of a methodological approach for gathering data that can be measured, interpreted, and tested objectively. The study applied the correlational ex-post facto research design. The design is considered suitable because it is very effective in a cause-and-effect study; this is consistent with the objectives of this research, which is to determine the impact of board of directors attributes on the FRQ of the listed oil and gas firms in Nigeria. This design is chosen because it is consistent with the positivists' research paradigm and also in agreement with the quantitative research strategy and the deductive approach adopted in this study. The hypotheses developed based on relevant theory are to be tested using quantitative data to be collected.

This study adopted a two-stage design in which, in the first stage, a proxy of FRQ was generated based on the Modified Jones Model by Kothari et al. (2005). In the second stage, the impact board of directors on the FRQ of the listed oil and gas firms in Nigeria was determined.

The population of the study covers all nine (9) listed companies operating in the Oil and Gas sector of the NGX Market as at 31st December, 2024 (see Table 1). This population is considered useful for the study because of the incidents related to FRQ that have been happening in the sector, as it provides an appropriate opportunity to examine the research problem.

Table 1: Population of the Study

SN	Company Name	NGX Sector	Year Listed
1	11 Plc (Mobil Oil)	Petroleum & Petroleum Products	1978
2	Aradel Holdings Plc	Integrated Oil & Gas	2023
3	Seplat Energy Plc	Exploration & Production	2014
4	Oando Plc	Integrated Oil & Gas Service	1992
5	MRS Oil Nigeria Plc	Petroleum & Petroleum Products	1978
6	Conoil Plc	Petroleum & Petroleum Products	1989
7	TotalEnergies Marketing Nig. Plc	Petroleum & Petroleum Products	1979
8	Japaul Gold & Ventures Plc	Energy Services & Mining	2005
9	Eterna Plc	Integrated Energy	1998

Source: NGX (2024)

The sample size of the study consists of eight (8) Firms, which was arrived at using a filter. One firm (Aradel Holdings Plc) was not on the NGX lists for some years during the period covered by the study (2012-2024), and was dropped.

Table 2: Sample Size of the Study

SN	Company Name	NGX Sector	Year of Listing
1	11 Plc (Mobil Oil)	Petroleum & Petroleum Products	1978
2	Seplat Energy Plc	Exploration & Production	2014
3	Oando Plc	Integrated Oil & Gas Service	1992
4	MRS Oil Nigeria Plc	Petroleum & Petroleum Products	1978
5	Conoil Plc	Petroleum & Petroleum Products	1989
6	TotalEnergies Marketing Nig. Plc	Petroleum & Petroleum Products	1979
7	Japaul Gold & Ventures Plc	Energy Services & Mining	2005
8	Eterna Plc	Integrated Energy	1998

Source: NGX (2024)

The study used secondary sources of data to test the research hypotheses and achieve the objectives of the study. The choice of the secondary data reflects the philosophies of the positivists' paradigm as well as the norms of the quantitative research strategy adopted. The data for the study is collected from the audited annual reports and accounts of the sample listed oil and gas firms.

The data analysis techniques employed in this study have a theoretical relationship with the research objectives and hypotheses stated in previous chapters of the study. The techniques employed are the Panel Regression technique of data analysis. To ensure valid and reliable results and findings, robustness tests such as the Normality Test, Multicollinearity Test, Heteroscedasticity Test, Normality Test of Error Term, and Hausman Specification Test will be conducted. In view of the foregoing, therefore, STATA 15.0 software is used as the instrument for the analysis.

The variables of the study are the Dependent Variables, Independent Variables, and the Control Variable. The dependent variable is the FRQ (which is measured by the earnings management), and the independent variables are the Board attributes (Board Size, Board independence, Board industry expertise, Board activities, and audit committee size). The variable measurements are presented in Table 3

Table 3: Variables Measurement

Variable	Proxy/Measurement	Source
Dependent Variable		
Financial Reporting Quality (FRQ)	Measured using Earnings Management (Accrual-based) Discretionary accruals estimated using Modified Jones Model (Dechow, Sloan & Sweeney, 1995; Kothari, Leone & Wasley, 2005)	Dechow et al. (1995); Kothari et al. (2005)
Independent Variables		
Board Size (BSZE)	Total number of directors on the board of a firm at year's end.	Klein (2002); Xie et al. (2003); Githaiga, Kabete & Bonareri (2022).

Board Independence (BIND)	Proportion of independent non-executive directors to total board members (measured as %).	Klein (2002); Peasnell, Pope & Young (2005); Usman & Yahaya (2024).
Board Industry Expertise (BIEX)	Number/proportion of directors with relevant financial, accounting, or industry-specific experience on the board.	Abubakar & Ishak (2017); Githaiga et al. (2022); Akinkunmi, Salako & Fola (2024).
Board Activities (BACT)	Frequency of board meetings in a financial year (measured as the count of meetings held annually).	Vafeas (1999); Xie et al. (2003); Yahaya (2024).
Audit Committee Size (ACSZ)	Total number of members on the audit committee of a firm at year's end.	Klein (2002); Umobong & Ibanichuka (2017); Tanko & Siyanbola (2019).
Control Variable		
Firm Size	Natural logarithm of total assets of the firm at year-end.	Klein (2002); Kothari, Leone & Wasley (2005); Githaiga, Kabete & Bonareri (2022).

The two-stage design adopted in this study determines the proxy of FRQ in the first stage and uses it in the second stage to investigate the impact of institutional ownership on the relationship between Ac and FRQ of listed consumer goods firms in Nigeria.

Therefore, the Modified Discretionary Accruals Jones Model by Kothari et al. (2005) is used. They suggest using the Modified Jones Model after introducing an additional independent variable, the current Return on Assets, to control for the impact of firm performance on discretionary accruals. Under this model, total accruals are defined as follows:

$$TAC_{it}/TA_{it-1} = \beta_0(1/TA_{it-1}) + \beta_2(\Delta REV_{it}-\Delta REC_{it}/TA_{it-1}) + \beta_3(\Delta PPE_{it}/TA_{it-1}) + \beta_4 ROA_{it-1} + \varepsilon_{it} \ldots 1$$

Where

TAC_{it} = Total accruals of firm I in year t, measured as Net income minus Cash flow from operations

TA_{it-1} = Lag of total assets of firm I in year t

ΔREV_{it} = Changes in revenue of firm I in year t from the current year to last year

ΔREC_{it} = Changes in receivables of firm I in year t from the current year to last year

PPE_{it} = Property, plant, and equipment of firm I in year t at the end of the year

ROA_{it} = Return on assets of firm I in year t at the end of the year.

β_0 is the regression intercept, β_1- β_4 are estimators, while ε_{it} is the residuals (absolute discretionary accruals-earnings management).

Therefore, the residuals of Model 1 represent the measure of FRQ (earnings management based on discretionary accruals). The models of the study are mathematically expressed as follows;

$FRQ_{it} = \beta_0 + \beta_1 BSZE_{it} + \beta_2 BIND_{it} + \beta_3 BACT_{it} + \beta_4 BIEX_{it} + \beta_5 ACSZ_{it} + \beta_6 FSZ_{it} + \varepsilon_{it}$…….2

Where;

FRQ_{it} = Financial Reporting Quality of firm I in year t

$BSZE_{it}$ = board size of firm I in year t

$BIND_{it}$ = board independence of firm I in year t

$BACT_{it}$ = board activities of firm I in year t

$BIEX_{it}$ = board industry expertise of firm I in year t

$ACSZ_{it}$ = audit committee size of firm I in year t

FSZ_{it} = Size of firm I in year t

β_0 is the regression intercept, β_1- β_6 are estimators, while ε_{it} is the residuals

RESULTS AND DISCUSSION

Descriptive Statistics

The descriptive statistical analysis of the data obtained on the dependent, explanatory, control, and moderating variables of the study is presented in this sub-section. It provides summary statistics of the collected data, including the mean, standard deviation, skewness, kurtosis, and minimum and maximum values of the variables. The descriptive statistics of the variables are presented in Table 4.

Table 4: Descriptive Statistics

Variable	Mean	Std. Dev.	Minimum	Maximum	Skewness	Kurtosis	N
FRQ	1.0646	0.2070	0.5700	1.5200	-0.1305	2.6340	104
BSZE	13.202	2.0355	10.000	16.000	-0.1161	1.7197	104
BIND	0.5743	0.1060	0.3333	0.8000	-0.9171	3.4919	104
BACT	3.9903	0.2954	3.0000	6.0000	1.9897	27.275	104
BIEX	0.1850	0.0450	0.1300	0.2900	0.4508	2.3287	104
ACSZ	4.1731	0.5109	4.0000	6.0000	2.8898	10.033	104
FSZ	18.692	1.0801	16.000	20.000	-0.5269	2.5145	104

Source: Results Output from STATA

The descriptive results from Table 4 revealed that the mean value of FRQ (absolute Discretionary Accruals) for the sampled listed oil and gas firms in Nigeria is 1.0646, with a standard deviation of 0.2070. The mean value shows a high level of discretionary accruals in the sampled firms. The minimum and maximum values of FRQ are 0.5700 and 1.5200, respectively. The standard deviation of indicates that there is a significant deviation of

the data for FRQ from both sides of the mean value by 1.5200 during the period of the study. Similarly, the table revealed that the value of skewness of -0.1305 indicates that the data is negatively skewed and is not normally distributed, while the kurtosis of 2.6340 shows the peakedness of the data.

On the board attributes, Table 4.1 revealed that the average Board Size (BSZE) of the sampled listed oil and gas firms during the period was 13 members (from the mean value of 13.202) with a standard deviation of 2.0355, indicating that the data deviates from the mean value by 2.0355. The minimum BSZE was 10 members, and the maximum was 16 members. The range of board size signifies that, on average, sample oil and gas firms are well-composed in line with the CAMA 2020 and Nigerian Corporate Governance Code's (NCGC, 2018) minimum requirements for every public company. On the other hand, the coefficients of Skewness and Kurtosis, -0.1161 and 1.7197, imply that the data for the variable is not normally distributed, as the data is negatively skewed and exhibits peakedness.

Table 4 revealed that the average Board Independence (BIND) of the sampled listed oil and gas firms during the period was 57.43% (from the mean value of 0.5743) with a standard deviation of 0.1060, indicating that the data deviates from the mean value by 0.1060. The minimum BIND was 33.33%, and the maximum was 80% independent members. The composition of independent directors signifies that, on average, sample oil and gas firms are well-composed in line with the CAMA 2020 and Nigerian Corporate Governance Code's (NCGC, 2018) minimum requirements for every public company. That required independent directors equal to at least one-third of the board. The coefficients of Skewness and Kurtosis, -0.9171 and 3.4919, imply that the data for the variable is not normally distributed, as the data is negatively skewed and exhibits peakedness.

The descriptive statistics Table revealed that the average Board Activities (BACT) measured by the board meetings frequency of the sampled listed oil and gas firms during the period was 4 times (from the mean value of 3.9903) with a standard deviation of 0.2954, indicating that the data deviates from the mean value by 0.2954. The minimum BACT was 3 times, and the maximum was 6 times. The range of board meetings signifies that, on average, sample oil and gas firms are in line with the CAMA 2020 and Nigerian Corporate Governance Code's (NCGC, 2018) minimum requirements of one meeting every quarter for every public company. On the other hand, the coefficients of Skewness and Kurtosis, 1.9897 and 27.275, imply that the data for the variable is not normally distributed, as the data is positively skewed and exhibits peakedness.

The descriptive statistics Table revealed that the average Board Industry Expertise (BIEX) of the sampled listed oil and gas firms during the period was 18.50% directors with industry expertise (from the mean value of 0.1850) with a standard deviation of 0.0450, indicating that the data deviates from the mean value by 0.0450. The minimum BIEX was 13% and the maximum was 29%. The coefficients of Skewness and Kurtosis, 0.4508 and 2.3287, imply that the data for the variable is not normally distributed, as the data is positively skewed and exhibits peakedness.

Table 4 revealed that the average Audit Committee Size (ACSZ) of the sampled listed oil and gas firms during the period was 4 members (from the mean value of 04.1731) with a standard deviation of 0.5109, indicating that the data deviates from the mean value by 0.5109. The minimum ACSZ was 4 members, and the maximum was 6 members. The range of ACSZ composition signifies that sample oil and gas firms are well-composed in line with the CAMA 2020 and Nigerian Corporate Governance Code's (NCGC, 2018) minimum requirements for audit committee membership of five for every public company. On the other hand, there are listed companies that failed to implement the minimum ACSZ of five members. The coefficients of Skewness and Kurtosis, 2.8898 and 10.033, imply that the data for the variable is not normally distributed, as the data is positively skewed and exhibits peakedness.

The table also indicated that the average Total Assets-Firm Size (FSZ), which is the natural logarithm, is 18.692. The standard deviation of 1.0801 suggests the level of dispersion in the total assets among the sampled firms. The reason behind this could not be far from the fact that the study covers different firms with different asset bases. The FSZ recorded a minimum value of 16 and a maximum value of 20. The coefficients of Skewness of -0.5269 and Kurtosis of 2.5145 imply that the data for the FSZ is not normally distributed, because the data is negatively skewed and has a high value of Kurtosis of the data.

The analysis of the descriptive statistics revealed that the data for the variables of the study did not follow the normal distribution assumption of parametric analysis. However, to determine the statistical evidence with regards to the data normality, the study employed the Shapiro-Wilk Test for normal data. The results of the test are presented in Table 5.

Table 5: Data Normality Test

Variables	W	V	Z	Prob>Z	N
FRQ	0.9957	0.353	-2.314	0.9897	104
BSZE	0.9469	4.524	3.355	0.0004	104
BIND	0.8299	14.513	5.947	0.0000	104
BACT	0.9883	1.001	0.003	0.4989	104
BIEX	0.9384	5.253	3.688	0.0001	104
ACSZ	0.9697	2.586	2.113	0.0173	104
FSZ	0.9689	2.646	2.163	0.0153	104

Source: Results Output from STATA

The Shapiro-Wilk test is a useful tool for testing normality. The null hypothesis principle is used in the Shapiro-Wilk (W) test for normal data; under the principle, the Null hypothesis that 'the data is normally distributed' is tested. Table 5 indicates that data from all the variables of the study are not normally distributed because the P-values are significant at a 1% and 5% level of significance (p-values of 0.0000, 0.0004, 0.0001, 0.0153, and 0.0173), except the FRQ and BACT, which are not statistically significant at all levels of significance (p-value of 0.9897 and 0.4989). Therefore, the null hypothesis (that the data is normally distributed) is rejected for BSZE, BIND, BIEX, ACSZ, and FSZ, while not rejected for the FRQ and BACT. This may lead to problems in some regression, hence the need for a generalized regression model.

Correlation Analysis

Table 6 shows the correlation coefficients between the dependent and the independent variables. The asterisk beside the correlation coefficient shows the coefficient's significance level. The correlation indicates the direction of the relationships as well as the strength of the relationship. Values of the correlation coefficient range from -1 to 1. The sign of the correlation coefficient indicates the direction of the relationship (positive or negative), and the absolute value of the correlation coefficient indicates the strength, with larger values indicating stronger relationships

Table 6: Correlation Matrix

Variable	FRQ	BSZE	BIND	BACT	BIEX	ACSZ	FSZ
FRQ	1.0000						
BSZE	0.2390**	1.0000					
BIND	-0.1505	0.0555	1.0000				
BACT	0.1989**	0.0387	-0.2762	1.0000			
BIEX	-0.7208***	-0.4702	0.0379	-0.1953	1.0000		
ACSZ	-0.5736***	-0.1217	-0.2836	-0.0368	0.3032	1.0000	
FSZ	-0.1712*	0.0140	-0.2768	0.0557	0.1401	-0.0281	1.0000

*Significant at 10%; **Significant at 5%; ***Significant at 1%;

Source: Results Output from STATA

The correlation results in Table 6 show that there is a significant positive relationship between board of directors size (BSZE) and Discretionary Accruals, the measure of Financial Reporting Quality (FRQ) of listed oil and gas firms in Nigeria, with a correlation coefficient of 0.2390, and the relationship is statistically significant at a 5% level of significance. That is, an increase in the membership of the board of listed oil and gas firms in Nigeria is related to an improvement in the discretionary accruals. The results in Table 4.3 show that there is a negative relationship between board independence (BIND) and discretionary accruals, which implies a positive Financial Reporting Quality (FRQ) of listed oil and gas firms in Nigeria, from the correlation coefficient of -0.1505, but the relationship is not statistically significant at all levels of significance. That is, an increase in membership of the board of directors by independent non-executive directors of listed oil and gas firms in Nigeria is related to an improvement in the FRQ.

Table 6 shows that there is a significant positive relationship between board of directors activities (BACT) and Discretionary Accruals, the measure of Financial Reporting Quality of listed oil and gas firms in Nigeria, with a correlation coefficient of 0.1989, and the relationship is statistically significant at a 5% level of significance. That is, an increase in activities (meetings) of the board of listed oil and gas firms in Nigeria is related to an improvement in the discretionary accruals, low FRQ. The results in Table 6 show that there is a significant negative relationship between board industry expertise (BIEX) and discretionary accruals, which implies a positive relation with Financial Reporting Quality (FRQ) of listed oil and gas firms in Nigeria, from the correlation coefficient of -0.7208, and the relationship is statistically significant at 1% level of significance. That is, an increase in membership of the board of directors by independent non-executive directors of listed oil and gas firms in Nigeria is related to an improvement in the FRQ. -0.1712

The correlation results in Table 6 show that there is a significant negative relationship between audit committee size (ACSZ) and discretionary accruals, which implies a positive relation with Financial Reporting Quality (FRQ) of listed oil and gas firms in Nigeria, from the correlation coefficient of -0.5736, and the relationship is statistically significant at 1% level of significance. That is, an increase in the membership of the audit committee listed oil and gas firms in Nigeria by one member is related to an improvement in the FRQ. The correlation results also reveal that there is a significant negative relationship between firm size (FSZ) and discretionary accruals, which implies a positive relation with Financial Reporting Quality of listed oil and gas firms in Nigeria, from the correlation coefficient of -0.1712, and the relationship is statistically significant at 5% level of significance. That is, an increase in the asset size of listed oil and gas firms in Nigeria by N1 is related to an improvement in the FRQ.

The correlation results among the independent variables confirm the absence of perfect relationships. Because no correlation coefficient is greater than 0.80 as it might be a sign of multicollinearity (Gujarati 2003; Hair et al., 2006). Hence, there is an absence of multicollinearity among the independent variables of the study.

Regression Diagnostic Tests

Consistent with the classical regression assumptions, the study conducted some robustness tests to ensure the validity and reliability of all the statistical inferences as well as the findings of the study. The tests include Data Normality (Table 5), Heteroscedasticity, Multicollinearity, Model Specification Test, and the Model fit test. When these assumptions are not met, the estimators are biased and cannot be used to draw any inference.

Table 7: Regression-Diagnostic Summary

Variables	Coefficient	Prob- Value
Hettest: Chi2	0.0000	0.9829
Mean VIF	1.30	
RAMSEY Test- Omitted Variable	1.29	0.2830
LINKTEST: _hat sq	-0.4629	0.0920

Hausman Test: Chi2	3.84	0.6983
Random Effect LM Test: Chibar2	0.78	0.1880
R Squared (Adjusted)	0.7463	
F-Statistic (Wald Chi2)	51.49	0.0000

Source: Results Output from STATA (Appendix)

To ensure the reliability of the results, the models of the study were subjected to robustness checks, given the panel nature of the data and the need to validate classical regression assumptions. One of the key assumptions of the classical regression model is homoskedasticity, which requires that the variance of the error terms remains constant across observations. The Breusch–Pagan/Cook–Weisberg heteroskedasticity test was conducted and yielded a Chi-square coefficient of 0.0000 with a probability value of 0.9829. Since the p-value is not statistically significant at the 5% level, the null hypothesis of homoskedasticity could not be rejected. This confirms the absence of heteroskedasticity in the model, implying that the variance of the error term is constant.

The study also tested for multicollinearity, as explanatory variables are not expected to be perfectly correlated. The Variance Inflation Factor (VIF) was computed, and the results revealed a mean VIF of 1.30, which is well below the conventional threshold of 10 that signals multicollinearity. This indicates that the independent variables in the model are not highly correlated and that the estimates obtained are reliable and not distorted by redundant explanatory power.

Furthermore, the model was assessed for specification errors, which can occur when relevant variables are omitted or irrelevant ones are included. The Ramsey RESET test, which checks for omitted variables using higher-order fitted values of the dependent variable, produced a Chi-square statistic of 1.29 with a probability value of 0.2830. This non-significant result suggests that the model is correctly specified and does not suffer from functional form misspecification. Similarly, the Linktest, which generates predicted values (_hat) and their squares (_hatsq), showed that while _hat was significant, _hatsq was not (p-value = 0.092). This outcome further confirms that the model is well-specified, with no evidence of missing important variables.

To determine the appropriate estimation technique for the panel data, the Hausman specification test and the Breusch–Pagan Lagrangean Multiplier (LM) test for random effects were conducted. The Hausman test reported a Chi-square value of 3.84 with a p-value of 0.6983, indicating that the null hypothesis favoring the random-effects model could not be rejected. However, the Breusch–Pagan LM test yielded a Chibar2 statistic of 0.78 with a p-value of 0.1880, suggesting no significant difference across the cross-sectional units. This outcome implies that the pooled Ordinary Least Squares (OLS) regression model provides more robust and efficient estimates for the study.

Finally, the overall fitness of the model was assessed. The adjusted R-squared (Adj. R^2) value of 0.7463 indicates that approximately 74.63% of the variation in financial reporting quality (proxied by discretionary accruals) of the sampled oil and gas firms is explained by the independent variables. In addition, the F-statistic of 51.49, significant at the 1% level (p-value = 0.0000), confirms the joint significance of the explanatory variables. These results demonstrate that the model is well-fitted, robust, and suitable for hypothesis testing.

Regression Analysis and Hypothesis Testing

The results are presented in Table 4.5.

Tables 8: OLS Regression Coefficients

Variables	**Coefficient**	**t-value (z-value)**	**Prob- Value**
BSZE	-0.2938	-1.12	0.256
BIND	-0.3132	-5.66	0.000

BACT	-0.0136	-0.10	0.918
BIEX	-0.0969	-8.98	0.000
ACSZ	-0.0566	-9.13	0.000
FSZ	-0.0377	-3.67	0.000
Constant_	0.4998	2.52	0.013

Source: Results Output from STATA (Appendix)

The regression results presented in Table 8 show that board size has a negative but statistically insignificant effect on discretionary accruals, a proxy for earnings management, with a coefficient of –0.2938 (p = 0.265). This implies that while an increase in board size marginally reduces earnings management and enhances financial reporting quality (FRQ), the effect is not statistically meaningful. Thus, the study fails to reject the first null hypothesis (H01), suggesting that board size does not significantly influence FRQ among Nigerian oil and gas firms.

In contrast, board independence demonstrates a significant negative relationship with discretionary accruals, with a coefficient of –0.3132 (p = 0.000). This finding supports the second hypothesis (H02) and implies that adding independent directors to the board reduces earnings manipulation and strengthens reporting quality. This result is consistent with agency theory, which argues that independent directors provide effective monitoring by curbing managerial opportunism.

Board activity, proxied by meeting frequency, also shows a negative but insignificant relationship with discretionary accruals (–0.0136; p = 0.918). Although the direction suggests that more meetings may reduce earnings management, the absence of statistical significance indicates that frequency alone does not guarantee effective oversight. This outcome supports the third null hypothesis (H03), implying that the number of board meetings, in isolation, does not materially affect FRQ.

Board industry expertise, however, reveals a significant negative effect on discretionary accruals, with a coefficient of –0.0969 (p = 0.000). This confirms the fourth hypothesis (H04) and indicates that the inclusion of directors with industry-specific knowledge improves FRQ by reducing the scope for earnings manipulation. This finding highlights the value of specialized human capital on boards, particularly in technically complex sectors such as oil and gas.

The results also reveal that audit committee size significantly reduces discretionary accruals, with a coefficient of –0.0566 (p = 0.000). This finding leads to the rejection of the fifth null hypothesis (H05), confirming that larger audit committees enhance FRQ. The implication is that a sufficiently resourced audit committee strengthens oversight and reduces the likelihood of opportunistic reporting practices.

Finally, firm size exhibits a significant negative effect on discretionary accruals (–0.0377; p = 0.013). Larger firms, therefore, are associated with higher-quality financial reporting, likely due to greater scrutiny from regulators, auditors, and market participants, as well as the presence of more formalized control structures.

Taken together, the findings suggest that while overall board size and board meeting frequency do not significantly shape FRQ, independence, industry expertise, audit committee size, and firm size all play critical roles in reducing earnings management in Nigerian oil and gas firms. This pattern is theoretically coherent: independence aligns with agency-theoretic monitoring predictions, industry expertise reflects resource-dependence benefits, audit committee size enhances oversight capacity, and firm size reflects external scrutiny effects. Conversely, the null results for board size and meeting frequency underscore the importance of board composition and process quality rather than mere numbers.

These findings broadly align with the mixed evidence reported in prior studies and map coherently onto the theoretical perspectives underpinning this research. The significant negative association between board independence and earnings management is consistent with agency theory (Jensen & Meckling, 1976; Fama &

Jensen, 1983), which posits that independent directors enhance monitoring and constrain managerial opportunism. The positive role of board industry expertise echoes resource dependence theory (Pfeffer & Salancik, 1978), highlighting how directors with specialized knowledge and networks reduce informational asymmetry and improve oversight in technically complex industries such as oil and gas. Similarly, the significant effect of audit committee size reinforces the agency-based view that stronger, better-resourced committees provide more effective monitoring, while also reflecting stewardship theory in their supportive advisory role. The significant role of firm size resonates with both agency and stakeholder perspectives, as larger firms face stronger external scrutiny from regulators, analysts, and communities, thereby fostering transparency and high-quality reporting. Conversely, the lack of significance for board size and meeting frequency confirms the argument in the governance literature that mere numerical strength or frequency of meetings does not ensure effectiveness, unless complemented by independence, expertise, and robust processes (Xie, Davidson & DaDalt, 2003; Vafeas, 1999). Taken together, the results emphasize that in Nigerian oil and gas firms, it is not the quantity of directors or meetings but the quality, independence, expertise, and committee structures that most strongly determine financial reporting quality.

CONCLUSION AND RECOMMENDATION

Based on the findings, the study concludes after controlling for firm size that monitoring quality is composition-driven, as improvements in FRQ are most strongly associated with the independence of directors, the presence of industry/financial expertise on the board, and the capacity of the audit committee. These attributes enhance directors' ability and willingness to challenge high-judgment estimates, strengthen engagement with internal and external auditors, and reduce managerial discretion over accruals.

The study also concludes that structural headcount and meeting tallies are insufficient, as the insignificance of overall board size and meeting frequency indicates that headcount quotas and raw activity counts are weak proxies for effective oversight when considered in isolation. Without the right mix of independence and expertise, and without process quality, increases in board seats or meetings do not translate into better FRQ. Moreover, the study thinks that Scale and systems matter, as the negative association between firm size and discretionary accruals suggests that larger issuers benefit from stronger information environments, greater external scrutiny, and more formalized internal controls, which, in this context, dominate any complexity-driven latitude for accrual manipulation. Collectively, the evidence supports a governance paradigm that emphasizes who serves on the board and audit committee and how oversight is executed, rather than reliance on blunt structural metrics.

This study recommends that regulators such as NGX Regulation, SEC Nigeria, and FRCN strengthen governance codes by prioritizing independence and expertise in boards and audit committees. A clear majority of members should be independent, with annual independence attestations and disclosure of directors' skills and expertise mapped to key accounting judgments. Audit committee requirements should emphasize capacity and effectiveness, focusing on independence, financial expertise, and sector knowledge, with outcome-oriented disclosures on how challenges and control issues are addressed.

For boards and their committees, independence should be embedded in nomination policies through strict conflict-of-interest checks, tenure refresh practices, and rotation of committee membership. Boards should actively recruit industry and financial experts, provide continuous professional development, and organize deep-dive sessions on complex reporting issues. Process quality should be prioritized over formal metrics by ensuring timely materials, documenting challenges, engaging with auditors and risk managers, and tracking adjustments from audit reviews. Audit committees should be right-sized according to reporting complexity, with clear accountability for implementing audit findings. Collectively, these measures will strengthen oversight, reduce earnings management, and improve the quality of financial reporting in Nigerian oil and gas firms.

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APPENDICES

```
. xtset id year, yearly
       panel variable:  id (strongly balanced)
        time variable:  year, 2012 to 2024
                delta:  1 year
```

```
. sum frq bsze bind bact biex acsz fsz, detail
```

frq

	Percentiles	Smallest		
1%	.63	.57		
5%	.69	.63		
10%	.82	.63	Obs	104
25%	.915	.69	Sum of Wgt.	104
50%	1.07		Mean	1.064615
		Largest	Std. Dev.	.207022
75%	1.2	1.45		
90%	1.33	1.52	Variance	.0428581
95%	1.33	1.52	Skewness	-.130505
99%	1.52	1.52	Kurtosis	2.634007

bsze

	Percentiles	Smallest		
1%	10	10		
5%	10	10		
10%	10	10	Obs	104
25%	11	10	Sum of Wgt.	104
50%	13		Mean	13.20192
		Largest	Std. Dev.	2.035509
75%	15	16		
90%	16	16	Variance	4.143297
95%	16	16	Skewness	-.1161083
99%	16	16	Kurtosis	1.719686

bind

	Percentiles	Smallest		
1%	.3333333	.3333333		
5%	.3333333	.3333333		
10%	.3333333	.3333333	Obs	104
25%	.5333334	.3333333	Sum of Wgt.	104
50%	.5833333		Mean	.5742514
		Largest	Std. Dev.	.1060138
75%	.6666667	.7		
90%	.6923077	.7142857	Variance	.0112389
95%	.7	.7272727	Skewness	-.917116
99%	.7272727	.8	Kurtosis	3.491851

bact

	Percentiles	Smallest		
1%	3	3		
5%	4	3		
10%	4	3	Obs	104
25%	4	3	Sum of Wgt.	104
50%	4		Mean	3.990385
		Largest	Std. Dev.	.2954408
75%	4	4		
90%	4	4	Variance	.0872853
95%	4	5	Skewness	1.989702
99%	5	6	Kurtosis	27.27453

biex

Percentiles		Smallest		
1%	.13	.13		
5%	.13	.13		
10%	.13	.13	Obs	104
25%	.14	.13	Sum of Wgt.	104
50%	.19		Mean	.185
		Largest	Std. Dev.	.0450458
75%	.21	.27		
90%	.25	.27	Variance	.0020291
95%	.27	.29	Skewness	.4508387
99%	.29	.29	Kurtosis	2.328673

acsz

Percentiles		Smallest		
1%	4	4		
5%	4	4		
10%	4	4	Obs	104
25%	4	4	Sum of Wgt.	104
50%	4		Mean	4.173077
		Largest	Std. Dev.	.5108969
75%	4	6		
90%	5	6	Variance	.2610157
95%	6	6	Skewness	2.889843
99%	6	6	Kurtosis	10.03297

fsz

Percentiles		Smallest		
1%	16	16		
5%	17	16		
10%	17	16	Obs	104
25%	18	17	Sum of Wgt.	104
50%	19		Mean	18.69231
		Largest	Std. Dev.	1.080066
75%	20	20		
90%	20	20	Variance	1.166542
95%	20	20	Skewness	-.5269833
99%	20	20	Kurtosis	2.514462

```
. swilk frq bsze bind bact biex acsz fsz
```

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
frq	104	0.99586	0.353	-2.314	0.98968
bsze	104	0.94698	4.524	3.355	0.00040
bind	104	0.82990	14.513	5.947	0.00000
bact	104	0.98826	1.001	0.003	0.49888
biex	104	0.93843	5.253	3.688	0.00011
acsz	104	0.96968	2.586	2.113	0.01732
fsz	104	0.96899	2.646	2.163	0.01526

```
. reg tac rev_rec ppe roa
```

Source	SS	df	MS	Number of obs	=	104
				F(3, 100)	=	4.41
Model	.516153375	3	.172051125	Prob > F	=	0.0059
Residual	3.89823124	100	.038982312	R-squared	=	0.1169
				Adj R-squared	=	0.0904
Total	4.41438462	103	.042858103	Root MSE	=	.19744

tac	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rev_rec	.072974	.0581158	1.26	0.212	-.0423262	.1882741
ppe	-.1387491	.0488971	-2.84	0.006	-.2357596	-.0417387
roa	.1861245	.0917027	2.03	0.045	.004189	.3680601
_cons	.9666588	.0838297	11.53	0.000	.8003431	1.132974

```
. hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of tac

         chi2(1)      =     1.51
         Prob > chi2  =   0.2185
```

```
. vif
```

Variable	VIF	1/VIF
ppe	1.05	0.954094
roa	1.04	0.965599
rev_rec	1.02	0.983242
Mean VIF	1.03	

```
. linktest
```

Source	SS	df	MS	Number of obs	=	104
				F(2, 101)	=	6.73
Model	.519194432	2	.259597216	Prob > F	=	0.0018
Residual	3.89519018	101	.038566239	R-squared	=	0.1176
				Adj R-squared	=	0.1001
Total	4.41438462	103	.042858103	Root MSE	=	.19638

tac	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_hat	1.53756	1.933773	0.80	0.428	-2.298526	5.373645
_hatsq	-.2898285	1.032137	-0.28	0.779	-2.33731	1.757653
_cons	-.2423626	.9110435	-0.27	0.791	-2.049628	1.564903

```
. xtreg tac rev_rec ppe roa, fe

Fixed-effects (within) regression               Number of obs      =       104
Group variable: id                              Number of groups   =         8

R-sq:                                           Obs per group:
     within  = 0.1186                                         min =        13
     between = 0.1203                                         avg =      13.0
     overall = 0.1164                                         max =        13

                                                F(3,93)            =      4.17
corr(u_i, Xb)  = -0.0822                        Prob > F           =    0.0081

------------------------------------------------------------------------------
         tac |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     rev_rec |   .0923918   .0644241     1.43   0.155    -.0355418    .2203253
         ppe |  -.1445529   .0501626    -2.88   0.005    -.2441658   -.0449399
         roa |   .2058434   .1524183     1.35   0.180    -.0968291    .5085158
       _cons |   .9393426   .1144915     8.20   0.000     .7119852     1.1667
-------------+----------------------------------------------------------------
     sigma_u |  .08992105
     sigma_e |  .18460976
         rho |  .19175847   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(7, 93) = 3.05                     Prob > F = 0.0061

. est store fixed

. xtreg tac rev_rec ppe roa, re

Random-effects GLS regression                   Number of obs      =       104
Group variable: id                              Number of groups   =         8

R-sq:                                           Obs per group:
     within  = 0.1186                                         min =        13
     between = 0.1203                                         avg =      13.0
     overall = 0.1167                                         max =        13

                                                Wald chi2(3)       =     13.38
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0039

------------------------------------------------------------------------------
         tac |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     rev_rec |   .0873354   .0608983     1.43   0.152    -.0320231    .2066938
         ppe |   -.143088   .0480109    -2.98   0.003    -.2371877   -.0489884
         roa |   .1981549   .1252186     1.58   0.114    -.0472691    .4435789
       _cons |   .9480234   .1059591     8.95   0.000     .7403474    1.155699
-------------+----------------------------------------------------------------
     sigma_u |   .1054223
     sigma_e |  .18460976
         rho |  .24591112   (fraction of variance due to u_i)
------------------------------------------------------------------------------

. est store random
```

```
. hausman fixed random
```

	Coefficients (b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
rev_rec	.0923918	.0873354	.0050564	.0210207
ppe	-.1445529	-.143088	-.0014648	.014534
roa	.2058434	.1981549	.0076885	.0869001

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 0.07
Prob>chi2 = 0.9948

```
. xttest0
```

Breusch and Pagan Lagrangian multiplier test for random effects

tac[id,t] = Xb + u[id] + e[id,t]

Estimated results:

	Var	sd = sqrt(Var)
tac	.0428581	.207022
e	.0340808	.1846098
u	.0111139	.1054223

Test: Var(u) = 0
chibar2(01) = 8.69
Prob > chibar2 = 0.0016

```
. xtreg tac rev_rec ppe roa, re

Random-effects GLS regression                   Number of obs      =       104
Group variable: id                              Number of groups   =         8

R-sq:                                           Obs per group:
     within  = 0.1186                                         min =        13
     between = 0.1203                                         avg =      13.0
     overall = 0.1167                                         max =        13

                                                Wald chi2(3)       =     13.38
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0039
```

tac	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
rev_rec	.0873354	.0608983	1.43	0.152	-.0320231	.2066938
ppe	-.143088	.0480109	-2.98	0.003	-.2371877	-.0489884
roa	.1981549	.1252186	1.58	0.114	-.0472691	.4435789
_cons	.9480234	.1059591	8.95	0.000	.7403474	1.155699
sigma_u	.1054223					
sigma_e	.18460976					
rho	.24591112	(fraction of variance due to u_i)				

```
. predict dacc
(option xb assumed; fitted values)
```

```
. pwcorr frq bsze bind bact biex acsz fsz, star (0.05) sig
```

	frq	bsze	bind	bact	biex	acsz	fsz
frq	1.0000						
bsze	0.2390*	1.0000					
	0.0145						
bind	-0.1505	0.0555	1.0000				
	0.1273	0.5755					
bact	0.1989*	0.0387	-0.2762*	1.0000			
	0.0429	0.6966	0.0045				
biex	-0.7208*	-0.4702*	0.0379	-0.1953*	1.0000		
	0.0000	0.0000	0.7027	0.0470			
acsz	-0.5736*	-0.1217	-0.2836*	-0.0368	0.3032*	1.0000	
	0.0000	0.2184	0.0035	0.7110	0.0018		
fsz	-0.1712	0.0140	-0.2768*	0.0557	0.1401	-0.0281	1.0000
	0.0823	0.8881	0.0045	0.5746	0.1561	0.7768	

```
. reg frq bsze bind bact biex acsz fsz
```

Source	SS	df	MS	Number of obs	=	104
				F(6, 97)	=	51.49
Model	3.35951158	6	.559918596	Prob > F	=	0.0000
Residual	1.05487304	97	.01087498	R-squared	=	0.7610
				Adj R-squared	=	0.7463
Total	4.41438462	103	.042858103	Root MSE	=	.10428

frq	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
bsze	-.2938628	.2622047	-1.12	0.265	-.8142665	.2265409
bind	-.3132691	.0553784	-5.66	0.000	-.4231799	-.2033584
bact	-.0136625	.1331174	-0.10	0.918	-.2778637	.2505387
biex	-.0969408	.0107903	-8.98	0.000	-.1183565	-.0755251
acsz	-.0566101	.0062008	-9.13	0.000	-.068917	-.0443031
fsz	-.0377108	.0102795	-3.67	0.000	-.0581127	-.0173088
_cons	.4998314	.1984953	2.52	0.013	.1058732	.8937896

```
. hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of frq

         chi2(1)      =     0.00
         Prob > chi2  =   0.9829

. vif
```

Variable	VIF	1/VIF
biex	1.56	0.640806
bind	1.35	0.738655
bsze	1.32	0.756835
acsz	1.27	0.786675
fsz	1.17	0.856538
bact	1.13	0.884384
Mean VIF	1.30	

```
. ovtest

Ramsey RESET test using powers of the fitted values of frq
       Ho:  model has no omitted variables
                   F(3, 94) =      1.29
                   Prob > F =      0.2830



. linktest
```

Source	SS	df	MS	Number of obs	=	104
				F(2, 101)	=	166.87
Model	3.38881535	2	1.69440768	Prob > F	=	0.0000
Residual	1.02556926	101	.010154151	R-squared	=	0.7677
				Adj R-squared	=	0.7631
Total	4.41438462	103	.042858103	Root MSE	=	.10077

frq	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_hat	2.001942	.5923542	3.38	0.001	.8268703	3.177013
_hatsq	-.4628791	.2724758	-1.70	0.092	-1.003398	.0776396
_cons	-.5271004	.3159066	-1.67	0.098	-1.153774	.0995735

```
. xtreg frq bsze bind bact biex acsz fsz, fe

Fixed-effects (within) regression               Number of obs      =       104
Group variable: id                              Number of groups   =         8

R-sq:                                           Obs per group:
     within  = 0.7525                                         min =        13
     between = 0.7006                                         avg =      13.0
     overall = 0.7389                                         max =        13

                                                F(6,90)            =     45.61
corr(u_i, Xb)  = -0.1407                        Prob > F           =    0.0000
```

frq	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
bsze	.1048139	.3106631	0.34	0.737	-.5123725	.7220003
bind	-.2832516	.0836269	-3.39	0.001	-.4493909	-.1171122
bact	.0906644	.1370073	0.66	0.510	-.1815246	.3628534
biex	-.0820233	.0143531	-5.71	0.000	-.1105382	-.0535085
acsz	-.0674778	.0076334	-8.84	0.000	-.082643	-.0523127
fsz	-.0253381	.0126438	-2.00	0.048	-.0504572	-.000219
_cons	.0830715	.2810164	0.30	0.768	-.4752166	.6413596
sigma_u	.05423732					
sigma_e	.09944343					
rho	.22926972	(fraction of variance due to u_i)				

```
F test that all u_i=0: F(7, 90) = 2.38                     Prob > F = 0.0279

. est store fixed
```

```
. xtreg frq bsze bind bact biex acsz fsz, re

Random-effects GLS regression                   Number of obs     =       104
Group variable: id                              Number of groups  =         8

R-sq:                                           Obs per group:
     within  = 0.7504                                         min =        13
     between = 0.7735                                         avg =      13.0
     overall = 0.7530                                         max =        13

                                                Wald chi2(6)      =    292.55
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =    0.0000

------------------------------------------------------------------------------
         frq |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        bsze |  -.0491597   .2861283    -0.17   0.864    -.6099609    .5116415
        bind |   -.296436   .0671147    -4.42   0.000    -.4279784   -.1648937
        bact |   .0569352   .1327769     0.43   0.668    -.2033027     .317173
        biex |  -.0884031   .0125556    -7.04   0.000    -.1130115   -.0637946
        acsz |  -.0628528   .0068701    -9.15   0.000     -.076318   -.0493877
         fsz |   -.030026   .0112617    -2.67   0.008    -.0520986   -.0079535
       _cons |   .2461562    .240744     1.02   0.307    -.2256934    .7180059
-------------+----------------------------------------------------------------
     sigma_u |   .04888027
     sigma_e |   .09944343
         rho |   .19459412   (fraction of variance due to u_i)
------------------------------------------------------------------------------

. est store random

. hausman fixed random

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |    fixed       random       Difference          S.E.
-------------+----------------------------------------------------------------
        bsze |   .1048139   -.0491597        .1539736        .1210046
        bind |  -.2832516    -.296436        .0131845        .0498906
        bact |   .0906644    .0569352        .0337293        .0337834
        biex |  -.0820233   -.0884031        .0063797        .0069547
        acsz |  -.0674778   -.0628528        -.004625        .0033273
         fsz |  -.0253381    -.030026        .0046879         .005748
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        3.84
                Prob>chi2 =      0.6983


. xttest0

Breusch and Pagan Lagrangian multiplier test for random effects

        frq[id,t] = Xb + u[id] + e[id,t]

        Estimated results:
                     |       Var     sd = sqrt(Var)
             ---------+-----------------------------
                 frq |    .0428581        .207022
                   e |     .009889       .0994434
                   u |    .0023893       .0488803

        Test:   Var(u) = 0
                                chibar2(01) =     0.78
                            Prob > chibar2 =   0.1880
```