






“Competition and efficiency in an oligopolistic audit market: Evidence from the Nigerian banking industry”

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COMPETITION AND EFFICIENCY IN AN OLIGOPOLISTIC AUDIT MARKET: EVIDENCE FROM THE NIGERIAN BANKING INDUSTRY

Abstract

Economic theory posits that competition drives efficiency; the extent to which this is true in an oligopolistic audit market poses an empirical challenge. Furthermore, studies have postulated that both traditional and modern industrial organization theories are relevant for analyzing market competition. Therefore, this study investigated the effects of static and dynamic audit market competition on audit efficiency in the Nigerian banking industry. Secondary data were obtained from the audited annual financial statements of 12 banks from 2006 to 2020. The study adopted a 2-stage regression model; in the first stage, the audit efficiency scores were derived from an output-based, variable-return-to-scale version of data envelopment analysis (DEA) comprising audit report lag and audit fees as audit input variables and audit quality as the audit output variable. The efficiency scores were regressed on audit market competition and some control variables in the second stage via the bootstrapped truncated regression technique to analyze the effect of competition on efficiency in the audit market. The results showed a positive association between static competition and audit efficiency (50.57, $p = 0.014$). Because high concentration implied low competition, this finding implied that efficiency was impaired because of a lack of significant competition. The results also showed a positive and significant association between dynamic competition and efficiency, which implied that dynamic competition enhanced efficiency (0.21, $p = 0.000$) in the audit market. The study concluded that static competition impairs efficiency, while dynamic competition ensures efficiency in the Nigerian banking industry.

Keywords

industrial organization theories, bootstrapped truncated regression, market shares, Nigerian banks

JEL Classification

C24, G14, G21, L13

INTRODUCTION

Regulators and other stakeholders in the auditing profession have consistently expressed concerns about the nature of competition and rivalry, which can negatively impact market behavior (Kend et al., 2014; Pan et al., 2022). Justifiably, this concern is rooted in traditional industrial organization theory, which contends that many participants with similar characteristics are sufficient to prevent anti-competitive behavior in the market. The theory advocates the use of a concentration ratio to measure competition and argues that a high concentration implies a low level of competition. Despite this concern by stakeholders, studies analyzing the association between audit market competition and audit efficiency remain scarce (see Mohammad Rezaei & Mohd-Saleh, 2018). Pan et al. (2022) posit that the effect of audit market competition on audit outcome (including audit efficiency) is not always clear, despite the economic theory's assertion that competition can promote efficiency. Therefore, the auditing profession must understand how competition impacts efficiency in the audit market (Chou et al., 2021).

However, some emerging studies motivated by the new industrial organization theory argue that concentration ratios are inadequate indicators of the intensity of competition and that an industry can be both concentrated and competitive at the same time as long as the market has at least two suppliers (Gerakos & Syverson, 2015). Furthermore, there is evidence in the literature pointing to an ambiguous association between concentration and competition (Dedman & Lennox, 2009; DeFond & Zhang, 2014). The new industrial organization theory also posits that audit market competition should be measured using dynamic indices (e.g., Van Raak et al., 2020).

Therefore, it has become imperative for the audit profession to understand the effect of audit market competition (using static and dynamic measures) on audit efficiency. Based on the previous premise, this study makes an incremental contribution to audit market competition-audit efficiency studies by simultaneously using static and dynamic measures of audit market competition, which may result in more realistic and objective findings. The study also employs data envelopment analysis (DEA), a frontier efficiency technique, to model audit efficiency using audit report lag (ARL) and audit fees as input variables and audit quality as an output variable.

This study is situated within the Nigerian banking industry. The industry has faced many challenges, including financial scandals, collusion, inefficiency and poor corporate governance structure. One of the factors that have continuously characterised the industry is the structure of the audit market and poor audit quality allegations. The audit market can be regarded as an oligopolistic market; as of 1st January 2022, the industry is 100 per cent audited by the Big 4 firms because of the belief that these firms provide high-quality services and possess specialised skills.

1. LITERATURE REVIEW

The theoretical and empirical literature on the association between audit market competition and audit efficiency is limited and inconclusive. The theoretical framework relevant to audit market competition-audit efficiency studies is discussed within the context of ‘*competition-efficiency*’ and ‘*competition-inefficiency*’ theories. On the one hand, the ‘*competition-efficiency*’ theory posits a positive association between competition and efficiency, such that an increase in competition brings about an increase in efficiency. This position is derived from Demsetz’s (1973) efficient-structure paradigm, which documents that competition drives efficiency. On the other hand, the ‘*competition-inefficiency*’ theory posits a negative association between competition and efficiency, implying that intense competition can impair efficiency. This theory also aligns with the quiet life hypothesis, which documents a negative association between competition and efficiency; firms with greater market power in the concentrated industry enjoy monopoly rents with no incentive to be efficient.

The results of the few empirical studies on the subject have been mixed and inconclusive. Pearson

and Trompeter (1994) investigated the effect of competition on audit efficiency. The study selected 140 life and health insurance companies and 101 property and casualty insurance companies in the United States of America. The audit market competition was measured using a concentration ratio, while audit efficiency was measured using audit fees. The findings indicated a negative association between concentration and audit fees, signifying that an increase in competition is not associated with lower audit fees. Broye and Weill (2008) examined the effect of competition (using a concentration ratio) on cost efficiency in the French audit market between 1999 and 2003. Cost efficiency was measured using the frontier efficiency technique, while competition was measured using the Rosse-Panzar model. The main findings showed that concentration impacted cost efficiency negatively.

Evans and Schwartz (2014) examined the effect of competition on audit efficiency using data of auditors’ clients in the USA between 2000 and 2010. The market competition was measured using a concentration ratio, while audit efficiency was measured using audit fees. The results

found no significant association between concentration and audit fees. Mohammad Rezaei and Mohd-Saleh (2018) investigated the effect of audit market competition on audit efficiency in firms listed on the Tehran Stock Exchange between 1999 and 2010. The study used a dummy variable and a concentration ratio as proxies for audit market structure and audit report lag as a proxy for audit efficiency. The results showed that competition drives higher audit efficiency (shorter audit report lag). Azizkhani et al. (2022) examined the effect of audit market competition (using concentration ratio) on audit fees in a sample of listed firms in the Iranian audit market. The model was analyzed using ordinary least squares and logit regression models. The results showed that higher (lower) levels of audit market structure are associated with lower (higher) audit fees.

The results of prior studies are similar to that of the Nigerian banking industry, where the audit market is wholly oligopolistic in nature because, as of January 1, 2022, the industry is 100 per cent audited by the four big international auditing firms comprising PricewaterhouseCoopers, Deloitte, KPMG, and Ernst & Young (Big 4).

A review of these studies shows two important gaps. First, most empirical studies have been underpinned by the traditional industrial organization theory's structure-conduct-performance (SCP) paradigm, which recommends that concentration is inversely related to competition (Bain, 1951). In prior studies (e.g., Bylykbashi et al., 2021; Choi et al., 2020; Davies & Geroski, 1997), the static concentration ratios have been criticized for

- (i) being noisy in capturing the level of competition;
- (ii) showing little change over time; and
- (iii) concealing the dynamics associated with variability in market shares, especially in concentrated markets.

However, studies have continued to use concentration ratios despite their shortcomings as proxies for competition. The new industrial or-

ganization theory promotes the use of dynamic competition measures in preference to the static approach because the dynamic measures more accurately reflect the level of competition (Hymer & Pashigian, 1962). Furthermore, the new industrial organization theory emphasizes the instability of market shares as an appropriate reflection of market competition dynamics (Caves & Porter, 1978). Market share mobility metrics such as the client mobility indices, the proportion of clients switching auditors, leader dethronement, the 'difference in market share of an incumbent auditor with that of the dominant auditor,' the 'distance in market share between an incumbent auditor and its nearest competitor,' and audit firm entry and exit are some of the examples of dynamic indices of audit market competition (Baldwin & Gorecki, 1989; Buijink et al., 1998; Choi et al., 2020; Chu et al., 2018; Dekeyser et al., 2016; Numan & Willekens, 2012; van Raak et al., 2020).

Second, while some studies use either ARL or audit fees as a proxy for audit efficiency, other studies use audit hours because of a lack of data from audit firms, particularly in developing economies (e.g., Mali & Lim, 2021). However, audit fees and ARL have been criticized for their biased coverage of audit efficiency (Xiao et al., 2020). According to Hollingshead (1996), audit efficiency is the ability to complete an audit task in less time, and it is based on the effort exerted (input) to achieve audit quality (output). Some studies (e.g., Knechel et al., 2009) apply efficiency frontier techniques to measure audit efficiency because efficiency is the relationship between input and output. These studies adopt the input minimizing audit efficiency technique in terms of minimizing input for a constant level of audit quality (e.g., O'Keefe et al., 1994). In contrast to a constant level of audit quality, new studies have found heterogeneity in audit quality within the same audit firm (Aobdia et al., 2019).

These empirical studies measure audit market competition using static concentration ratios and proxy audit efficiency with ARL or audit fees. This study differs from prior literature by

- (i) measuring audit market competition using static and dynamic measures; and

(ii) measuring audit efficiency using the frontier technique of DEA.

Therefore, this study aims to determine whether audit efficiency is a function of static or dynamic competition. Thus, the study's hypotheses in the null form are as follows:

H_1 : Audit market competition (measured by static concentration ratio) impairs audit efficiency.

H_2 : Audit market competition (measured by dynamic competition ratio) impairs audit efficiency.

2. METHODOLOGY

2.1. Research design, data and sample description

The study adopts a longitudinal research design comprising data at both time and cross-sectional levels. Though there are 23 commercial banks (deposit money banks) operating in Nigeria, 14 banks are publicly quoted on the Nigerian Exchange Group (NGX), while the remaining nine banks are privately held. The sample comprises a publicly available annual panel data set of 12 listed deposit money banks on the NGX between 2006 and 2020 (see Table 1). We select 2006 as the first year to control the impact of corporate governance codes for banks that became operational in 2006. The data at 1 and 99 per cent at the upper and lower tails were winsorized to reduce the effect of outliers which may bias the results. The sample is limited to a single industry (banking sector) to ensure uniformity and limit bias.

Table 1. Sample selection

Sample selection	Number
Total population	23
(-) Privately owned banks	(9)
(-) Banks reporting in currency other than Nigerian currency (Naira)	(1)
(-) Banks that are taken over during the period under study	(1)
Study sample	12

2.2. Model specification and measurement of variables

The econometric model for the study is as follows:

$$\begin{aligned}
 EFF_{it} = & \beta_0 + \beta_1 CONC_{it} + \beta_2 MOB_{it} + \\
 & + \beta_3 DIST_{it} + \beta_4 DIFF_{it} + \beta_5 SPEC_{it} + \\
 & + \beta_6 JOINT_{it} + \beta_7 TEN_{it} + \beta_8 BUSY_{it} + \\
 & + \beta_9 AUDSW_{it} + \beta_{10} CAGE_{it} + \beta_{11} CSIZ_{it} + \\
 & + \beta_{12} CIMP_{it} + e_{it},
 \end{aligned}
 \tag{1}$$

where *EFF* represents audit efficiency, *CONC* represents market concentration. *MOB* represents market share mobility, *DIST* and *DIFF* represent competition proxies of Numan and Willeken (2012) and Chu et al. (2018), respectively. *SPEC* represents audit market specialization, *JOINT* represents joint audit, *TEN* represents auditor's tenure, and *BUSY* represents the audit's busy season. Finally, *CAGE* represents the client's age, *CSIZ* represents the client's size, and *CIMP* represents the client's importance.

Drawing from both the theoretical and empirical literature, the dependent, test and control variables for this study are described as follows:

2.2.1. Dependent variable (EFF)

Following the model of O'Keefe et al. (1994) that links audit effort (input) to achieve the desirable but unobservable assurance (output), the study defines input as the cost of effort and output as the level of assurance. In this regard, audit effort is measured using audit report lag and audit fees, while the desirable level of assurance is measured using audit quality (Knechel & Sharma, 2012). The choice of the variables (input and output) is based on the premise that higher audit quality incrementally reduces audit fees and audit report lag. Thus, efficiency is conceptualized as accomplishing higher audit quality with minimal effort (Hollingshead, 1996; DeFond & Zhang, 2014). Therefore, the study adopts an output-oriented, variable return-to-scale version of data envelopment analysis (DEA) to generate efficiency scores (Chang et al., 2018). The output orientation is adopted based on the heterogeneity of audit quality (Aobdia et al., 2019). In summary, inputs are audit fee and audit report lag, while the output is audit quality.

In line with some empirical studies (e.g., Ayoola, 2022), the model for deriving audit quality is the non-discretionary constituent of loan loss provision stated as follows:

$$LLP_{it} = \beta_0 + \beta_1 NL + \beta_2 NPL_{it} + \beta_3 \Delta TOTLOAN_{it} + e_{it}, \quad (2)$$

where *LLP* denotes total loan loss provision for banks divided by loan at the opening year; *NPL* is the non-performing loan at the opening year divided by loan at the opening year; ΔNPL is the change in non-performing loan divided by loan at the beginning of the year; $\Delta TOTLOAN$ is the change in total loan divided by loan at the beginning of the year; and e_{it} is the residual term, which functions as the discretionary *LLP* in estimating earnings management. This error term (residual), which functions as a measure for accrual earnings management, is multiplied by -1 . Thus, higher values indicate higher audit quality. After that, the audit quality variable is normalized to avoid a negative efficiency score that may bias the results (Baduneko & Tauchmann, 2019).

2.2.2. Test variables (CONC, MOB, DIST, DIFF)

The variables of interest are static and dynamic measures of competition. The static measure is the concentration ratio (CONC) which is measured as the Herfindahl-Hirschman Index (hhi) of market shares based on audit fees (Averhals et al., 2020) with a value between '0' and '1', where '0' means minimal concentration and '1' means a single firm controls the market.

Three dynamic measures of competition are considered in the study. The first measure is market share mobility (MOB), which is measured using the market share instability index of Hymer and Pashigian (1962), defined as the sum of the year-on-year fluctuations in market shares (using audit fees) of all competitors in an industry. The second proxy for measuring dynamic competition is the Numan and Willekens (2012) method, which measures competition as the "distance between an incumbent auditor's market share and its nearest/closest competitor" based on audit fees (DIST). The third measure is the Chu et al. (2018) indices that measure competition as the

"difference between an incumbent auditor's market share and the dominant competitor" based on audit fees (DIFF).

2.2.3. Control variables

Following prior studies (e.g., Asthana et al., 2019; Hallman et al., 2018), this study controls both auditee's and audit firm characteristics. The auditee-related characteristics included in the model are auditee size (CSIZ), auditee age (CAGE), and auditee importance (CIMP). The audit firm characteristics included in the model are audit industry specialization (SPEC), joint audit (JOINT), audit tenure (TEN); busy accounting season (BUSY); and auditor switch (AUDSW). We expect that SPEC, JOINT, TEN, and CIMP should all have a positive association with audit efficiency, while BUSY, AUDSW, CSIZ, and CAGE should have a negative association with audit efficiency. The a priori expectation is that competition (static and dynamic) impairs audit efficiency in the Nigerian banking industry.

3. RESULTS

3.1. Diagnostic results

The descriptive statistics (Table 2) show that concentration (CONC) has a low mean score of 8%. Market share mobility (MOB) also has a mean score of 12.5%, suggesting a less vigorous competitive process occurring among market participants. Auditor switch (AUDSW) has a mean of 13.1%, consistent with a less aggressive audit market. An auditee with international operations (CIMP) has a mean of about 67%, indicating that many auditees have international operations. The Pearson correlation matrix tests the possibility of collinearity among the independent variables. The results show that all coefficients do not exceed the threshold of 0.70. This test is complemented by the variance inflation factor (VIF) analysis, and none of the independent variables exceeds the threshold of 5. The four proxies of competition (CONC, MOB, DIST, and DIFF) are introduced simultaneously into the regression model for two reasons. First, there is a negative correlation between the static concentration ratio (CONC) and two dynamic competition ratios (MOB, DIFF); this is justified on the ground that

Table 2. Descriptive statistics

Variables	N	Mean	SD	Min	Medium	Max
CONC	174	0.0837	0.0002	0.0834	0.0837	0.0839
MOB	174	0.1246	0.4666	-2.9507	0.11122	1.9297
DIST	176	0.0825	0.1134	-0.1653	0.0461	0.3416
DIFF	176	0.1083	0.1211	0	0.0604	0.4266
SPEC	174	0.3631	0.4823	0	0	1
AUDSW	180	0.1310	0.3384	0	0	1
TEN	180	4.1018	2.4901	1	4	10
JOINT	180	0.1131	0.3177	0	0	1
BUSY	180	0.7840	0.4128	0	1	1
CAGE	180	3.4521	0.7936	0	3.3322	4.8283
CSIZ	180	20.0607	2.0485	12.7405	20.5587	22.5076
CIMP	180	0.6667	0.4728	0	1	1

Table 3. Correlation analysis

Variables	1	2	3	4	5	6	7	8	9	10	11	12
CONC (1)	1.00	-	-	-	-	-	-	-	-	-	-	-
MOB (2)	-0.22	1.00	-	-	-	-	-	-	-	-	-	-
DIST (3)	0.02	-0.04	1.00	-	-	-	-	-	-	-	-	-
DIFF (4)	-0.05	-0.12	-0.52	1.00	-	-	-	-	-	-	-	-
SPEC (5)	-0.04	0.10	0.31	-0.68	1.00	-	-	-	-	-	-	-
AUDSW (6)	-0.16	-0.17	-0.01	0.19	-0.04	1.00	-	-	-	-	-	-
TEN (7)	0.55	-0.08	0.03	-0.03	-0.07	-0.34	1.00	-	-	-	-	-
JOINT (8)	-0.13	0.13	-0.31	0.37	-0.27	0.14	-0.06	1.00	-	-	-	-
BUSY (9)	0.57	-0.25	0.14	0.13	0.00	0.02	0.44	-0.09	1.00	-	-	-
CAGE (10)	0.17	-0.12	0.07	-0.10	0.05	0.00	0.14	0.03	0.10	1.00	-	-
CSIZE (11)	0.18	0.01	-0.16	0.00	0.08	0.03	0.14	0.11	0.14	0.27	1.00	-
CIMP (12)	0.00	0.00	0.17	-0.35	0.17	0.05	-0.02	0.13	-0.06	0.37	0.59	1.00

while market concentration is a market-wide ratio, dynamic competition ratio is a firm-specific competitive positioning ratio (Zhang et al., 2019). A positive correlation exists between static concentration ratio (CONC) and one dynamic competition ratio (DIST). This position justifies the claim that the association between competition and concentration is ambiguous. Second, there is a moderate significant correlation ($r = 0.524$) between two dynamic competition ratios (DIST & DIFF). Finally, the model incorporates four proxies of audit market competition due to their low correlation (0.02-0.52) with one another.

3.2. Regression results

The regression results of estimating Eq. (1) using the bootstrapped truncated regression mod-

el are shown in Table 4 Col (1). The results show that the audit market competition, measured by static concentration ratio (CONC), exhibited a positive and significant relationship with audit efficiency (50.57, $p = 0.014$). The results also show that, as measured by a dynamic proxy (DIFF), audit market competition demonstrated a positive and significant association with audit efficiency (0.21, $p = 0.000$). The sensitivity analyses (columns 2-5) showed similar results to the primary findings. On auditee-specific control variables, CSIZ, CAGE and CIMP are significantly related; while CIMP has a positive association with efficiency, CAGE and CSIZ have a negative association with efficiency. Similarly, specific control variables in audit firms, that is, AUDSW, JOINT and BUSY, are negatively related to efficiency.

Table 4. Regression results

Dependent variable	EFF	EFF	EFF	EFF	ARL
	Col (1)	Col (2)	Col (3)	Col (4)	Col (5)
CONC	50.574** (2.45)	421.458*** (2.92)	50.291** (2.35)	39.183** (2.12)	-387.969** (-2.32)
MOB	-0.007 (-0.91)	-0.053 (-1.01)	-0.007 (-0.87)	-0.011 (-1.68)	-0.040 (-0.60)
DIST	0.023 (0.56)	0.151 (0.56)	0.023 (0.591)	0.051* (1.89)	-0.285 (-0.73)
DIFF	0.209*** (3.57)	1.600*** (3.19)	0.209*** (3.41)	0.110*** (3.06)	-1.694** (-2.47)
SPEC	0.003 (0.31)	0.031 (0.37)	0.004 (0.30)	0.021** (2.19)	-0.080 (-0.45)
AUDSW	-0.023** (-2.06)	-0.162* (-1.76)	-0.023 (-1.97)	0.002 (0.18)	0.128* (1.68)
TEN	0.002 (0.84)	0.013 (0.92)	0.002 (0.78)	0.001 (0.97)	-0.024 (-1.05)
JOINT	-0.030** (-2.46)	-0.232** (-2.17)	-0.030** (-2.34)	-0.018 (-1.17)	0.524* (1.65)
BUSY	-0.052*** (-3.44)	-0.408*** (-2.89)	-0.052*** (3.29)	-0.054** (-2.19)	0.099 (0.67)
CAGE	-0.011** (-2.54)	-0.080** (-2.05)	-0.012** (-2.46)	-0.002 (-0.35)	-0.044 (-0.32)
CSIZ	-0.018*** (-6.83)	-0.165*** (-5.49)	-0.018*** (-6.61)	-0.017*** (-5.06)	0.057* (1.74)
CIMP	0.049*** (3.90)	0.396*** (3.38)	0.049*** (3.73)	0.036** (2.39)	-0.533** (-2.19)
N	180	180	180	180	180
Wald Chi	100.56	99.89	92.45	130.15	30.97
Prob. > Chi	0.000	0.000	0.000	0.000	0.000

Note: The dependent variable is audit efficiency measured as EFF and ARL. 'EFF' is audit efficiency using frontier data envelopment analysis technique, where input variables comprise audit report lag and audit fees, while the output variable is the audit quality. 'ARL' is audit report lag. Column (1) presents the result of a bootstrapped truncated regression model, column (2) presents the result of the fractional regression model, column (3) presents the result of random effect regression, while column (4) presents the result of Arellano-Bover/Blundell-Bond, dynamic panel data model. Column (5) presents the result of random effect regression, where the dependent variable is audit report lag. The z-statistics are shown in parentheses, while ***, **, and * reflect the significance level at 1, 5, and 10%, respectively.

4. DISCUSSION

The study investigates the effect of audit market competition on audit efficiency in the context of the Nigerian banking industry. The study applies a 2-stage regression model where an output-based, variable return-to-scale version of the DEA technique in the first stage, is applied to generate efficiency scores. In the second stage, the bootstrapped truncated regression model is applied to determine the effect of audit market competition on audit efficiency. The bootstrapped truncated regression model is applied using the 'sirmarwilson' command (Badunenko & Tauchmann, 2019). All analyses are performed using STATA version 16.1, and a 5% significance level is adopted. The study results are reported in Table 4, where column (1) reflects the main analysis results

and columns (2-5) represent further robustness analyses to validate the main results.

Table 4 column (1) presents the regression results of estimating eq. (1) using the bootstrapped truncated regression model. The findings show that two test variables (CONC and DIFF) are significantly related to efficiency, while the others (MOB and DIST) are insignificantly related to efficiency. According to Zhang et al. (2019), the significance of DIFF over DIST supports the argument of Chu et al. (2018) that competition (measured as the "difference between an incumbent auditor's market share and the dominant competitor") is a better measure than Numan and Willekens's (2012) proxy for competition (defined as the "distance between an incumbent auditor's market share and its nearest/closest competitor").

The finding shows that the coefficient of concentration (CONC) is positively and significantly related to efficiency (50.57, $p = 0.014$). This finding is interpreted as a negative relationship between audit market competition and audit efficiency because a positive static concentration value implies negative and low competition (Weiss, 1989). This finding aligns with the assumption that efficiency may be impaired because of a lack of significant competition where an audit market is concentrated with similarly large audit firms (Broye & Weill, 2008). This finding also aligns with the competition-inefficiency hypothesis that posits a negative relationship between competition and efficiency. Thus, based on this result, which shows that competition, as measured by the static concentration ratio, impairs audit efficiency, the first hypothesis (*H1*) is accepted. However, studies have shown that concentration ratios cannot capture competition among market participants as it implies that all audit firms face the same level of competition, which may be incorrect (Dedman & Lennox, 2009). Concentration ratios (as measured by HHI) indicate the collective market power (i.e., a market-wide measure) of all audit firms but cannot discriminate the relative competitive positioning of each audit firm in the market (Zhang et al., 2019).

The coefficient of dynamic competition (DIFF) is positive and significant (0.21, $p = 0.000$). The result indicates that dynamic competition leads to efficiency. This position aligns with previous studies that argue that competition among auditors can result in efficiency (e.g., Asthana et al., 2019; Hallman et al., 2018). Competition can spur audit firms to innovate, use sophisticated managerial and technical skills, and adopt the latest technologies to improve efficiency. The use of Chu et al.'s (2018) measure of competition shows that audit market competition is audit firm-specific and not uniform to all audit firms (Zhang et al., 2019). This result supports the competition-efficiency hypothesis and rejects the second hypothesis (*H2*), which states that audit market competition (as measured by dynamic ratio) impairs efficiency.

On auditee-specific control variables, CSIZ, CAGE and CIMP are significantly related; while CIMP is positively associated with efficiency, CAGE and CSIZ are negatively associated with efficiency. The negative relationship between an auditee's

size and efficiency may be explained by the fact that large auditees, through their strong bargaining power, may exert enormous pressure on audit firms, which can affect the efficiency of the audit firm. Similarly, specific control variables in audit firms, AUDSW, JOINT and BUSY, are negatively related to efficiency. The negative relationship between auditor switch and efficiency is explained by the continuing threat of auditor substitution, which may negatively impact auditor's efficiency. The negative relationship between joint audit and efficiency implies that joint audit impedes efficiency in concentrated markets (Broye & Weill, 2008). The negative relationship between the busy accounting period and efficiency is explained by the fact that auditors suffer capacity constraints when clients' fiscal year-end cluster together, resulting in inefficiency (Hallman et al., 2018). The insignificant effect of audit market specialization (special) did not come as a surprise because competitive exploitation pales to insignificance in a concentrated audit market with few similar-sized large audit firms (Zhang et al., 2019).

4.1. Sensitivity analyses

4.1.1. Alternative analytical techniques

The study applies two additional analytical techniques to validate the results. First, the fractional regression model is employed on the premise that DEA efficiency results from a fractional logit process rather than a truncated process (McDonald, 2009). The results, as shown in Table 4, column (2), are substantially the same as the results of the bootstrapped truncated regression model. Second, the random effect regression model based on the analysis of the Hausman test is also applied, and the result, as shown in column (3) of Table 4, is the same. A fractional regression model is applied using the 'fracglm' command (Williams, 2010), while the random effect regression model is applied using the STATA commands ('xtreg' and 're', respectively) (StataCorp, 2019).

4.1.2. Endogeneity concerns

The study examines the plausibility of endogeneity using the Arellano-Bover/Blundell-Bond technique. The concern for endogeneity is based on the premise that auditees' preferences and characteristics may

reflect competition, in addition to the fact that auditees typically appoint auditors according to perceived audit quality (Pan et al., 2022). The Arellano-Bover/Blundell-Bond technique is applied using the STATA command ('xtdpdsys') (StataCorp, 2019). Table 4, column (4), reports the dynamic regression results, similar to the main results.

4.1.3. *Alternative measure of audit efficiency*

The study uses ARL, commonly used in literature, as a proxy for audit efficiency to ensure the robustness of the results. The empirical results in Table 4, column (5), show that three variables (CONC, DIFF, and CIMP) are significant. The coefficient of concentration (CONC) is negative and significant (-387.969 , $p = 0.021$). This finding shows that high concentration (less competition) leads to audit firms' complacency and inefficiency because auditees have a small number of audit firms avail-

able to them. The coefficient of dynamic competition (DIFF) is negative and significant (-1.694 , $p = 0.013$). This finding shows that dynamic competition enhances audit efficiency (shorter ARL). This result aligns with the main results, where audit efficiency is determined through the frontier technique of data envelopment analysis.

The coefficient of client importance (CIMP) is negative and significantly related to audit efficiency (measured by audit report lag). This association is justified on the ground that banks with international operations may have stronger accounting systems and internal controls in line with international best practices, which may be considered reliable by the audit firm, thereby reducing audit report lag. Additionally, the banks may be subject to both internal and external pressure from local and international investors and regulatory agencies to release their audited annual reports.

CONCLUSION

This study investigates the effect of audit market competition on audit efficiency in Nigeria from 2006 to 2020. It uses static and dynamic measures to measure audit market competition and DEA to measure audit efficiency. The study uses a 2-stage bootstrapped truncated regression model. In the first stage, audit efficiency scores are derived from DEA analysis under the variable return to scale, while in the second stage, the audit efficiency scores are regressed on the test and control variables using the bootstrapped truncated regression technique. The main empirical findings reveal that competition (measured by the static concentration ratio) impairs efficiency, and competition (measured by the dynamic ratio) drives efficiency in the audit market. The results of the study are understood to allay regulators' concerns that concentration does not constrain firm-specific dynamic competition among the Big 4. Therefore, regulators should not continue to take measures that could adversely affect the audit market in the name of engendering competition.

AUTHOR CONTRIBUTIONS

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