

The moderating impact of the audit committee on the relationship between audit quality and market reactions in South Africa

Moderating
impact of the
audit
committee

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Abstract

Purpose – This paper aims to examine whether the audit committee moderates the relationship between audit quality and market reactions.

Design/methodology/approach – Using fixed effects and the GMM model for robustness, the study used 472 publicly listed firms on South Africa's Johannesburg stock exchange spanning a period of six years from 2014 to 2019.

Findings – Results obtained show that audit quality impacts market reactions through share price and adjusted market returns. And, that the audit committee moderates the relationship between audit quality and market reactions in South Africa's publicly listed firms. An effective audit committee is expected to play a crucial role in overseeing the audit process, ensuring the independence of auditors and promoting transparency and accountability which in turn impacts asset prices.

Research limitations/implications – The study implies that governments and regulatory bodies in other developing economies could strengthen regulations about companies' Acts, how firms regulate themselves and more so audit committees. Firms can also strive to make sure that audit committees are staffed with experts to promote higher audit quality and investor attention to get access to the much-alluded capital.

Originality/value – To the best of the authors' knowledge, the study adds value by being the first to explore the subject matter of the importance of audit committees in defining audit quality and market reactions in publicly listed firms. The research adds to the body of knowledge on corporate governance and audit quality. It provides a case study specific to the South African context, contributing to the global literature on these topics.

Keywords South Africa, Audit committee, Audit quality, Market reactions

Paper type Research paper

Introduction

Several studies have depicted how audit quality impacts stock markets (Mansur *et al.*, 2020; Afifa *et al.*, 2020; Brown and Popova, 2019) but no study as of yet has considered what moderates the relationship between audit quality and the market reactions. Audit committees are expected to play a crucial role in overseeing the financial reporting process,

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ensuring the integrity of the audit and enhancing corporate governance. Do investor expectations play a role in the performance and structure of audit committees? Do stock markets value governance and financial transparency? Does this translate to the moderation effect of audit committees on the relationship between audit quality and market reactions?

The audit committee is part of the requirement spelled out in the corporate governance code (Salehi and Alinya, 2017) as it is important in furthering the protection of stakeholders from the selfishness of managers/directors. Audit committee members that have personal ties impair members' objectivity (Jeffrey *et al.*, 2022a). So, it is important to make sure that audit committee members do not have personal ties. One way of doing so is by changing audit committee membership every now and then starting with the chairman who is different every time as required by the companies Act stipulation.

Audit committee affect firm performance (Al-Mamun *et al.*, 2014), and investment decisions (Jeffrey *et al.*, 2022b) of investors when they find out about the composition of the audit committee. For this reason, many audit committees have a composition of financial experts and other directors.

Audit quality impacts market reactions because it provides a level of assurance that the financial statements accurately reflect the financial position of the company (Hoti *et al.*, 2012). Auditors are hired to ensure that companies provide accurate financial information to investors and other stakeholders (Krishnan and Zhang, 2019). Audits have become increasingly important in recent years due to regulations such as Sarbanes–Oxley and the increasing use of electronic information by companies.

An audit is an independent review of a company's internal controls and financial reporting processes, which helps ensure that internal controls are functioning correctly and that financial reports are accurate (Pham *et al.*, 2020).

South Africa has got the second largest, the most technologically advanced, most diversified and the most industrialized economy in Africa. The South African economy is also classified as Upper middle-income economy with a GDP of US\$419.95bn as of 2021-year end.

The economy of South Africa is primarily driven by the tertiary sector which accounted for 65% to the national GDP as of 2021. The tertiary sector in South Africa involves retail and wholesale, transportation, telecommunications, financials, energy, transportation, fisheries, mining, vehicle assembly and manufacturing, tourism, food processing, real estate, textile and clothing, agriculture and tourism. Manufacturing accords 15% to the GDP and agriculture and the informal sector accord 2.8% and 8% to the GDP of South African economy.

South Africa is one country in Africa that has a robust legal structure with several regulatory bodies that were set to help in ease of doing business, conducting business and firm activities such as companies Act of 2008 (Amon *et al.*, 2022).

The study used fixed effects regression model to explore the moderating impact of audit committee on the relationship between audit quality and market reactions and later used GMM regression model to run robustness checks. The use of GMM regression model was done to make sure that the results were coherent.

Results from the regression analysis show that audit committee moderates the relationship between audit quality and market reactions. With audit quality indicators of audit opinion, industry specialization and discretionary accruals being statistically significant before the introduction of audit committee in the equation. Audit quality indicators became strongly significant with the introduction of audit committee in the equation signifying that audit committee moderates the audit quality and market reactions relationship. Some control variables were also statistically significant to market reactions.

The study has several contributions which have been identified. (1) Audit committees play a pivotal role in overseeing the financial reporting process and ensuring the integrity of the audit. By moderating the impact, they can potentially enhance or mitigate the effects of audit quality on market reactions. The study sheds light on how the effectiveness of audit committees can shape investor perceptions and market responses. (2) The study suggests that having a strong and active audit committee is important for ensuring that reports are accurate and reliable. This helps restore confidence in the public and investors/shareholders about the financial health of a firm. Audit committees are very important and essential. Therefore, the study emphasizes the importance of audit committees to a firm and public. (3) Essentially, this research might contribute to our understanding of corporate governance mechanisms and how they interact with other factors to influence market outcomes. Improved insights into these relationships can inform regulatory practices, corporate policies and academic research in the field.

To the best of the authors' knowledge, this study is the first to explore the moderating impact of audit committee on the relationship between audit quality and market reactions, thus, underscoring the significance of this research. The study has an implication that governments and regulatory bodies in other developing economies could strengthen regulations pertaining to companies Acts and how firms regulate themselves and more so audit committees. Firms can also strive to make sure that audit committees are staffed with experts to promote higher audit quality and investor attention to get access to the much-alluded capital.

The rest of the paper is organized such that review of literature, methods and modelling, results and discussions and conclusion sections follow in that order.

Review of literature

Audit quality

Audit quality refers to the chance that the auditor discovers a breach and reports it (Tepalagul and Lin, 2015). Audit quality plays a primary role in assuring all stakeholders that the financial records as presented by a firm do contain accurate information which thing safeguards the interests of shareholders/owners, investors, markets and the general public. Generally speaking, audit quality is significant in assurances of quality of financial reporting information (Clinch *et al.*, 2012).

Audit quality has been and is always critical and its indicators have been under intense scrutiny (Martin, 2013; Harris and Williams, 2020) from users of financial statements, regulators, investors, issuers and other stakeholders have called for publicly available audit quality indicators. A common ground in this work is the reasoning that audit quality indicators benefit users of financial statements, issuers and auditors by providing audit quality indicators which improves transparency of audit processes and audit firms. The improved transparency is expected to further market participants and their ability to assess audit quality, audit firms and greater incentive by audit firms to upgrade audit quality (Martin, 2013).

Audit quality indicators can also be used by regulators in their quality assessment process to let setters of standards know of deficiencies and challenges in current approaches of audit that are brought to light by observing audit quality indicators over time (Martin, 2013).

Audit quality indicators defer in accordance to the party requiring them for example, the audit committee refer audit quality to industry specialization (the big4 or non-big4) while investors rely on output measures to measure audit quality since they do not have access to engagement details of the auditor (Martin, 2013).

PCAOB went ahead to state that other users of audit quality indicators include business press, academicians, general public and the company management. Other literature also include investors as another user of audit quality indicators (Chi *et al.*, 2009; Brown and Popova, 2019; Afifa *et al.*, 2020) with indicators such as earnings quality (Dechow *et al.*, 2010), audit opinion (going concern; Hoti *et al.*, 2012) and discretionary accruals (Brown and Popova, 2019) among others.

An audit quality framework when used appropriately has merits to the general public and other stakeholders as it gives information about audit firms with intentions of having a market which is more vibrant with supplying quality audit services and better help investors in evaluating audit quality connected with current and previous financial statements (Brown *et al.*, 2016).

Audit quality indicators which do rely on auditor skills, expertise, experience and internal control issues timely reporting are seen to have a higher possession of effectiveness in audit quality evaluation (Harris and Williams, 2020). Thus, we see literatures promoting big4 as industry specialists and having better quality audits than non-big4.

Audit quality has a significant relationship with auditor independence (Mohamed and Habib, 2013a; Tepalagul and Lin, 2015) when auditor independence is proxy by auditor tenure (Carey *et al.*, 2014). This is so because auditor tenure is a threat to auditor independence and as such once an auditor lacks independence, his/her ethical stance is put under check and develop familiarity with the client firm which will have a significant impact on audit quality (Sari *et al.*, 2019) as lack of auditor independence reduces audit quality (Tepalagul and Lin, 2015).

The 2002 Sarbanes–Oxley Act was introduced after the Andersen saga to help promote auditor independence with a perception that auditor independence will improve audit quality. The Act asks for a one year cooling off period from previous audit engagements before being re-appointed (Tepalagul and Lin, 2015). Auditor rotation is expected to overcome the problem of auditor independence (Mohamed and Habib, 2013b), hence, improving audit quality.

Literature shows that audit quality begins declining in the third year following the appointment (Brooks and Johnston, 2012) as audit tenure nears the end. Thus, explaining why audit tenure is significant in impacting audit quality. As audit tenure nears end, auditor independence comes into question as it looks to breed familiarity between the client firm and the auditor. This creates conflict between auditors and ethical issues/threats to independence which ultimately impacts audit quality (Carey *et al.*, 2014). Therefore, auditor tenure affects auditor independence (Garcia-Blandon and Argiles, 2015; Siregar *et al.*, 2012) which in turn affects audit quality.

Audit quality also impacts mandatory auditor rotation (Chi *et al.*, 2009; Mohamed and Habib, 2013a; Arthur *et al.*, 2017; Sari *et al.*, 2019; Mohamed and Habib, 2013b; Lennox *et al.*, 2014) (Velte and Stiglbauer, 2012) as it is perceived that a new auditor comes with fresh eyes and new view of the auditing strategy and process at the client firm with professional scepticism which the predecessor may have lacked. Serving at one client firm for a long term creates auditing inertia which affects audit quality as the auditor loses the eyes, morale and professional scepticism of observing inaccurate financial statements and misstatements (Carey *et al.*, 2014).

Audit quality is improved by mandatory auditor rotation especially where the incoming auditor and the audit firm are both industry specialists (Arthur *et al.*, 2017). Industry specialist refers to the big audit firms since they have the professional skilled labor, expertise, experience and finances needed to carry out the audit process.

Audit committee

Companies Act 2013 Section 117 stipulates that an audit committee should compose of at least three director's majority of whom should be non-executive directors. Majority of these directors on the audit committee must be persons capable of reading financial statements (Albring *et al.*, 2014; Alzeban, 2020) as part of their roles is to evaluate the auditor's report, financial statements and valuation of assets.

Because of the audit committee's roles of recommending of the appointment, pay package and appointment terms of an auditor, and reviewing and monitoring independence of auditors and their performance plus effectiveness of the process of audit, it connects them to the quality of audit produced (Albring *et al.*, 2014).

Audit committees' responsibility of dealing with auditing issues in a firm links them to the quality of audits produced and seen in a firm. Although the audit committee legal expertise and gender diversity has no significant effect on audit quality (Alhababsah and Yekini, 2021), Audit committees associated with a bigger number of financial expertise is linked with higher audit quality (Ghafran and O'Sullivan, 2017).

One of the issues that bring about lower audit quality is earnings management. Audit committees share responsibility in stopping earnings management just as much as the auditors themselves. Audit quality, which is the result of audit engagement negates earnings management in such a way that high quality audits constrain client firms from engaging in earnings management. Audit committees perform internal audit work which external auditors usually rely on first when engaging in auditing services with a client firm.

Earnings management is a dubious scheme where managers hoodwink investors and other shareholders about the financial health of a firm (Miko and Kamardin, 2015). Once detected and found out, they result into lower audit quality opinion issued by external auditors. Therefore, audit committees and quality audits are needed to be in place to safeguard against earnings management (Miko and Kamardin, 2015). This will result into a higher audit quality report issued and the assurance it carries to investors and the public.

Because of the importance of audit committee to a firm, investors and the public pay attention to its composition and are more disposed to invest in firms with audit committees with a greater composition of industry expertise (financial and accounting) than those without such a composition (Jeffrey *et al.*, 2022a). Investors also feel the same way about composition of audit committees with personal ties as they see them not being independent with a view that audit committee members are impaired because of the personal ties (Jeffrey *et al.*, 2022a).

Market reactions

Market reactions refer to the way a stock market reacts to movements in asset prices. We use two measures of market reactions in our study, namely, (1) share price and (2) adjusted market returns.

A share price is the value of an asset at a given point in time (Affa *et al.*, 2020). Stock price alternation is negative and immediate reverse in the market prospectus of the company's shares (David *et al.*, 2018). Stocks fluctuate for two major reasons, accounting information and management actions (Khajavi and Zare, 2016). Management actions such as manipulating earnings, and hiding bad news until it 'is impossible to hide all lead to stock price reactions that could be drastic like stocks crashing (Kim *et al.*, 2015). We used the firm financial year-end share price at the date when the financial records were released by the firm.

Adjusted market returns (Ferguson *et al.*, 2018) are computed over 250-day estimation window ending 10 days prior to the event window (the day audit reports are released to the

public) with returns on the All Ordinaries Index that proxies for market returns. Market adjusted return model is used to calculate abnormal returns (Stephen, 1980; Mushtaq and Sajid, 2018).

Since audit committees are responsible for recommending and appointment of external auditors, carry out internal audit which external auditors may rely on during the auditing engagement, and have an impact on stock markets and investor perceptions and judgement (Jeffrey *et al.*, 2022a; Singhvi *et al.*, 2013), we have reason to hypothesize that the relationship between audit quality and market reactions is moderated by the audit committee of publicly listed firms in Africa's growing economies.

We assume that the close relationship between quality of audit and market reaction can be moderated by the audit committee in a number of ways. Firstly, enhanced oversight. Audit committees are typically composed of independent directors with financial expertise. Their primary responsibility is to oversee the financial reporting process, including the work of external auditors. This enhanced oversight is believed to contribute to better audit quality. Secondly, they can determine whether or not an auditor's fees are excessive based on the quality of their work. Finally, if necessary, they can fire an auditor if they discover major problems during their review process. These actions can have an impact on stock markets through how investors and shareholders choose to react to such information. So, the hypothesis suggests that when audit committees are actively involved, independent and effective in their oversight, they can moderate or influence the relationship between audit quality and market reactions. Essentially, they act as a safeguard to ensure that audit quality translates into positive market perceptions and reactions.

This led us to hypothesize that:

- H1. Audit quality is statistically significant to market reactions.
- H2. The relationship between audit quality and market reactions is moderated by the audit committee.

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Methods and modeling

This study was conducted on publicly listed firms of South Africa because of audit rules and other regulations being more stringent in South Africa than anywhere else in Africa. The data set was compiled by adding data from secondary sources, firm level data was extracted from individual firm annual integrated reports from 2014 to 2019 by the researcher.

The study uses public listed firms' data listed on the above countries data stream from 2014 to 2019. The reason for choosing this study period is because it coincides with the time frame when the new companies act of 2008 came out. The study excludes firms with fewer observations and firms with missing data are also excluded from the study. The study has 1,776 observations from 472 South African firms.

We used the usage of fixed effects regression model to run the test result of the study after describing the data and running multi-collinearity tests. To make our results coherent, we ran robustness checks first using adjusted market returns to proxy market reactions using GMM regression model and the results were presented under additional analysis.

Table 1 shows the variable definitions and acronyms.

Majority of the firms sampled belonged to the mining sector, followed by wine, beverage and consumer goods, manufacturing, financials, transportation, oil and gas, real estate and telecommunication firms as depicted in Table 2.

Variables	Definition	Short form
<i>Independent variable</i>		
Discretionary accruals	Discretionary accruals following De Angelo model uses last year's total accruals divided by last year's total assets as a measure of non-discretionary accruals	Disc
Industry specialist	Referring to expertise of an audit firm in terms of size. i.e. Big4 vs Not-big 4	IS
<i>Dependent variable</i>		
Share price	The value of an asset at a given point in time (Afifa <i>et al.</i> , 2020)	SP
Adjusted market returns	Adjusted market returns (Ferguson <i>et al.</i> , 2018) are computed over 250- day estimation window ending ten days prior to the event window (the day audit reports are released to the public) with returns on the All ordinaries index that proxies for market returns	Admkt
<i>Moderating variable</i>		
Audit committee	Is part of the requirement spelled out in the corporate governance code (Salehi and Alimya, 2017)	AC
<i>Control variables</i>		
Assets/firm size	Assets refer to a resource owned by a firm as a result of past events from which future economic benefits are expected to flow to the firm (IASB)	Assets
Operating income	residual income after deducting a firm's operating expenses and tax	OY
Market to book ratio	market value of a firm stock divided by the book value for every share	MBR
Return on assets	a metric used to compute the efficiency of a firm and how managers use the existing assets to generate wealth for the owners/shareholders	ROA
Leverage	refers to the sum of short-term and long-term debt divided by total assets	LEV

Source: Authors' own work

Moderating
impact of the
audit
committee

Table 1.
Variable definition
and acronyms

Independent variable

Widyarningsih *et al.* (2019) and Imegi and Oladutire (2018) define audit quality as a possibility where an auditor will find and report material misstatements in the financial statements of a client. It a two-fold definition implying a joint probability that an auditor will (1) identify fraud in a client's accounting and financial systems, and (2) report that fraud.

Audit quality following Sari *et al.* (2019) and Friedrich and Pappert (2020) have several measures such as industry specialist and discretionary accrual among others (Harris and Williams, 2020). We use discretionary accruals (Bartov *et al.*, 2000; Acar and Coskun, 2020) as they are able to divide accruals into discretionary and non-discretionary components which makes it possible to detect earnings management.

Discretionary accruals following De Angelo model uses last year's total accruals divided by last year's total assets as a measure of non-discretionary accruals. Then the discretionary accrual part is the difference between total accruals of the event year scaled back by the total assets and non-discretionary accruals (Bartov *et al.*, 2000).

Industry specialization refers to the specialists in audit industry mainly the big4 (Harris and Williams, 2020; Martin, 2013). The big4 audit firms are deemed to have the expertise, technical know-how, professionals and other skills which can enable them work thoroughly well in Auditing and, thus, they are assumed to produce high-quality audits when compared to the non-big4 due to the non-big4 being small in size with little of the advantages of a big scale that the big4 enjoy.

Thus, for this study, we used the binary system by assigning 1 where the audit firm belongs to the big4 and 0 if the audit firm belonged to the non-big4.

For this study, we used audit quality indicators of discretionary accruals following De Angelo model, audit opinion and big 4 as proxies for audit quality.

The use of discretionary accruals and industry specialization as audit quality indicators is rooted in the premise that certain financial reporting choices and audit firm characteristics are associated with the likelihood of high-quality audits. Monitoring discretionary accruals helps assess the potential for earnings management, while industry specialization reflects the auditor's ability to understand and address industry-specific risks. These indicators contribute to a broader assessment of audit quality and help stakeholders evaluate the reliability of financial statements.

Dependent variable

Market reactions refer to the way a stock market reacts with movements in asset prices. We use adjusted market returns as proxy for market reactions.

Table 2.
Firm specialization
and contribution to
the sample

Industry	No. of firms	%
Mining	90	19.1
Wine, beverage and consumer goods	61	12.9
Manufacturing	88	18.6
Real estate	38	8.1
Oil and natural gas	45	9.4
Transportation	50	11
Telecommunications	20	4
Financials	80	16.9
<i>Total</i>	<i>472</i>	<i>100</i>

Source: Authors' own work

Adjusted market returns (Ferguson *et al.*, 2018) are computed over 250-day estimation window ending 10 days prior to the event window (the day audit reports are released to the public) with returns on the All Ordinaries Index that proxies for market returns. Market adjusted return model is used to calculate abnormal returns (Stephen, 1980; Mushtaq and Sajid, 2018).

Being error-proof and avoidance of extra computations linked with the estimation of security of security betas is the best merit of the usage of this model over other models (Mushtaq and Sajid, 2018). This model makes usage of CAPM assumption that the expected return and market return are equal, i.e:

$$R_{it} = R_{mt} \quad (1)$$

We calculated the abnormal returns following this equation:

$$AR_{it} = R_{it} - (\alpha_i + \beta_i * R_{mt}) \quad (2)$$

where AR_{it} stands for stock I abnormal return at time t , R_{it} is the stock I actual return at time t and $(\alpha_i + \beta_i * R_{mt})$ is the normal or expected return of stock I at time t , and α and β are set to 0 and 1, respectively.

We calculate the abnormal return mean value as:

$$AAR_t = (1/N)\Sigma AR_{it} \quad (3)$$

and the cumulative abnormal returns are computed as:

$$CAR_i = \Sigma AR_{it} \quad (4)$$

We used the significance test to explore the effect of the event (Stephen, 1980; Mushtaq and Sajid, 2018) using this equations to check for significance:

$$t - stat = AAR_t * (N^{0.5}/SD_t)(AR) \quad (5)$$

$$t - stat = CAAR_t * (N^{0.5}/SD_t)(AR) \quad (6)$$

A value greater than 1.96 is interpreted as being positively significant and a value less than -1.96 is seen as negatively significant.

Moderating variable

The moderating variable is audit committee. Companies Act 2013 section 117 stipulates that an audit committee should compose of at least three director's majority of whom should be non-executive directors. Majority of these directors on the audit committee must be persons capable of reading financial statements (Albring *et al.*, 2014; Alzeban, 2020) as part of their roles is to evaluate the auditor's report, financial statements and valuation of assets.

An audit committee is a subgroup within an organization's board of directors, typically composed of independent and non-executive members. Its primary responsibility is to oversee and monitor the financial reporting and disclosure process. This includes reviewing the financial statements, ensuring compliance with accounting standards and regulatory requirements and assessing the effectiveness of the internal control systems.

The study used a moderator–mediator testing approach (Baron and Kenny, 1986) to test the moderating impact of audit committee on the relationship between audit quality and market reactions. Baron and Kenny (1986) state that with moderation, the regression of the moderator and the explanatory variable should be established first. The explanatory variable must show that it statistically and significantly explains the moderator variable. Then, the regression of the explained variable on the explanatory variable should be established as well. The independent variable must be statistically and significantly related to the dependent variable. Lastly, the regression of the dependent variable on both the moderator variable and independent variable must be established. If both the moderator and independent variables are statistically significant, and the coefficient on the independent variable is dampened because of the moderator, it can then be concluded that the moderator drives the relationship between the independent and dependent variables.

Modelling

In examining the statistical significance that audit quality exerts on market reactions, we used the following equation;

$$Mkt = \alpha + \beta_1 Xaq + \beta_2 Xassts + \beta_3 Xmbr + \beta_4 Xlev + \beta_5 Xoy + \beta_6 Xroa + \beta_7 Xbod + \varepsilon \dots \quad (7)$$

Where Mkt stands for market reactions, α represents the constant, $\beta\beta\beta\beta\beta\beta$ are parameters representing coefficients of regression, Xaq represents audit quality, $Xassts$ represents assets, $Xlev$ represents leverage, $Xmbr$ represents market to book ratio, Xoy representing operating income, $Xroa$ represents return on assets, $Xbod$ represents board of directors and finally, ε represents the error term.

To examine the moderating impact of audit committee on the relationship between audit quality and market reactions, the researchers use the following equations:

$$Mkt = \alpha + \beta_1 Xaq + \beta_2 Xassts + \beta_3 Xmbr + \beta_4 Xlev + \beta_5 Xoy + \beta_6 Xroa + \beta_7 Xbod + \varepsilon \quad (8)$$

$$Mkt = \alpha + \beta_1 Xac + \beta_2 Xassts + \beta_3 Xmbr + \beta_4 Xlev + \beta_5 Xoy + \beta_6 Xroa + \beta_7 Xbod + \varepsilon \quad (9)$$

$$Mkt = \alpha + \beta_1 Xaq + \beta_2 Xac + \beta_3 X(aq * ac) + \beta_4 Xassts + \beta_5 Xmbr + \beta_6 Xlev + \beta_7 Xoy + \beta_8 Xroa + \beta_9 Xbod + \varepsilon \dots \quad (10)$$

Where Mkt stands for market reactions, α represents the constant, $\beta\beta\beta\beta\beta\beta$ are parameters representing coefficients of regression, Xaq represents audit quality, Xac represents audit committee, $X(aq*ac)$ stands for the moderating influence, $Xassts$ represents assets, $Xlev$ represents leverage, $Xmbr$ represents market to book ratio, Xoy representing operating income, $Xroa$ represents return on assets, $Xbod$ represents board of directors and finally, ε represents the error term.

Control variables identified and their measurement

In exploring the moderating impact of audit committee on the relationship between audit quality on market reactions under the study, other variables explaining the dependent variable have been identified by reviewing literature and included in the model specified and

used. Company specific variables, including Size, operating income, return on assets and leverage have been included in the regression models.

Operating income refers to residual income after deducting a firm's operating expenses and tax. It tells of the operational status of a firm in question and the financial health of a firm and could be a good measure to check and see if a firm has a going concern issue in the next 12 months. And it is one of the metrics looked at during the auditing process (Lee, 2022; Hossain *et al.*, 2014). We converted the operating income of the country under study to dollars in regards to the year of occurrence of the same operating income.

Assets refers to a resource owned by a firm as a result of past events from which future economic benefits are expected to flow to the firm (IASB). Assets do provide information about the size of a firm, its leverage and return on assets and the financial health of a firm (Ferragina and Iandolo, 2022). This was illustrated in Italy during the COVID-19 pandemic period as firm's economic and financial status (Ferragina and Iandolo, 2022). We can deduce that the size of a firm's (assets) affects investor decisions regarding whether to invest in a firm or not as it affects other evaluation metrics such as return on assets, Leverage, Capital used to mention but a few.

We used the firm value of assets as found in integrated annual reports of each firm for each other and to make their usage coherent, we converted the asset values to dollar terms during each firm year end.

Leverage refers to the sum of short-term and long-term debt divided by total assets. It is an evaluation metric that shows how much debt is covered by the existing assets owned by the firm and it is useful in informing investors about the going concern of a firm. Usually, a highly geared firm is considered too risky for investment. While a very low gearing ratio may signify the company is not using its assets wisely and needs to strike a balance or reach the optimal leverage (Ramalho, 2022; Amon *et al.*, 2022).

The leverage was calculated by dividing firm assets by firm liabilities for each year of the study and for each firm as presented in the annual reports and, thus, the figures drawn showed the leverage position of each firm for each year from 2008 to 2019.

Market-to-book ratio refers to a ratio that helps firms determine if its book values are comparable to the market price of its stock. It is a financial evaluation ratio used to measure a firm's current market value in relation to its book value. The ratio is important to investors as it helps them assert the real value of the firm by comparing the firm book value to its market value.

A high market-to-book ratio may imply that the market values a firm's assets cheaply and the reverse is true also. This implies that the market-to-book ratio has a significant impact on firm performance and value. A high valuation of a firm may be attributed to profitability and cost efficiency or an increase in net interest margin (Mathieu Simoens, 2021). In the same study, they found out that US firms had a lower market-to-book ratio and a high valuation of the firms as compared to the European counterparts.

Market-to-book ratio not only helps in valuation of a firm's equity by investors and scholars but also helps in discern impalpable information at a corporate footing with advantageous selection emerging among low and small market-to-book firms (Rachel *et al.*, 2021). This can imply that market-to-book ratio contains information such as managerial risk preferences which can be useful in evaluating a firm by investors and purchasing the firm assets. We expect market-to-book ratio to impact market reactions in South.

Market-to-book ratio was calculated as market value of a firm stock divided by the book value for every share. All prices are in Dollar terms to remain coherent with the study.

Return on assets refers to the residue of net income divided by total assets. With an aim of showing value created for shareholders and how the assets assigned to a firm were able to

generate wealth. Return on assets is computed by dividing revenue generated by the assets of the firm. With a high return on asset figure meaning the firm generated value for its shareholders.

Other tests

We carried out moderation test to ensure that the Audit committee moderates the relationship between audit quality and market reactions and we obtained results of 0.0040 as reported in [Appendix 1](#).

[Appendix 3](#) shows how we came to choose the fixed effect regression model as our choice model for the first regression order

Results and discussions

Descriptive statistics

The data used for the study used publicly listed firms in both South Africa. Only firms that had data available for the study period were selected. Other firms that did not have the data and did not fit our study were dropped from the sample. The final sample consists of 246 firms after removing firms that do not fit the study period or those which lack the data thereof. And, thus, the firm observations during the same period totalled 1,776 observations.

The data came from South Africa due to availability of data spanning the study period as presented in [Table 3](#).

[Table 3](#) depicts descriptive statistics of the variables under study with results depicting. That industry specialization which is an indicator of audit quality has a mean value of 0.7367 signifying that 74% of the audit firms that carried out auditing on the sampled publicly listed firms in South Africa are the big4 audit firms since the big4 are assumed to have experience, expertise and the workforce that is necessary to carry out audit engagements effectively and in a manner that promotes ethics amongst auditors.

Audit committee has a mean value of 0.9993. Which could be interpreted to mean that almost 100% of publicly listed firms on Johannesburg stock exchange had an audit committee comprised of majority financial experts. This is good as the companies Act of 2008 in South Africa require such a move for audit committees.

Adjusted market returns has a mean value of 0.1029 and a standard deviation value of 0.7581. This could be interpreted as meaning that adjusted market returns occurred 10% of times in publicly listed firms in South Africa. Adjusted market returns is one of the proxies for market reactions. The nearer to zero the values of mean and standard deviation are, the more confident one gets in the normality of data used.

Variable	N	Mean	SD	Maximum	Minimum
IS	1,428	0.7367	0.4406	1	0
Disc	1,428	1.1301	7.9986	162.75	0
Admkt	1,428	0.1029	0.7581	5.8927	-2.3010
SP	1,428	1.5378	0.6278	5.4997	-0.7959
AC	1,428	0.9993	0.0265	1	0

Table 3.
Descriptive statistics
of audit quality,
market reactions and
audit committee

Notes: With IS representing industry specialization; Disc representing discretionary accruals; Admkt representing adjusted market returns; SP representing share and AC representing audit committee
Source: Authors' own work

Multi-collinearity test

To explore the relationship between the variables under study, the researcher ran a multiple linear regression analysis with various indicators of audit quality and market reactions, including control variables. In the multiple regression analysis, the variables that predict should be orthogonal in nature, and a significant relationship amongst the control variables may hamper the estimation of a real link between the primary independent and dependent variables. Thus, the study used pairwise correlation coefficient and variance influence factor (VIF) values to examine multicollinearity among the variables. The results are presented in [Table 3](#).

[Table 4](#) presents the multi-collinearity test results of the researchers dependent and independent variables using pairwise correlation matrix and VIF. The highest correlation is 0.3552 and is between audit opinion and integrated reporting, and is way below the tolerable value and the usual standard 0.7 ([Verbeek, 2008](#); [Afifa et al., 2020](#)). Also, a higher value of VIF of more than 10, or the tolerance value (1/VIF) which is less than 0.1 implies the existence of the problem of multicollinearity ([Leech et al., 2005](#)). The tolerance values are all more than 0.1 and the VIF values are all less than 10 in [Table 3](#), seeming to suggest that there were no issues of multicollinearity between the variables under study. Thus, the multicollinearity assumption is not violated as depicted in [Table 3](#).

Variables	AO	IS	DA	SP	AMR	VIF	1/VIF
AC * AQ	1.0000					1.21	0.8283
IS	0.0252	1.0000				1.08	0.9274
DA	0.0285	-0.1240	1.0000			1.03	0.9705
AMR	-0.0269	0.1459	-0.0795	-0.0340	1.0000	1.05	0.9562
AO = audit opinion; IS = industry specialization; DA = discretionary accruals; SP = share price						Mean VIF	1.09

Table 4.
Multi-collinearity
results

Source: Authors' own work

Variables	Share price	Admkt
IS	0.218** (1.0665)	0.221*** (3.0460)
Disc	0.0114** (2.0358)	0.00619* (2.0248)
Assets	-3.75e-10 (5.62e-10)	-1.19e-09** (3.89e-10)
MBR	-0.01691 (0.1569)	0.0131*** (2.0393)
LEV	-0.0616** (3.00232)	-0.1984 (0.0161)
OY	3.38e-09 (4.39e-09)	5.56e-09 (3.04e-09)
ROA	-0.2379** (3.0138)	0.0334*** (3.1955)
BOD	1.259*** (2.230)	0.0565 (0.159)
_cons	0.552* (3.217)	0.0631** (4.150)
N	1,427	1,427
R-sq	0.15	0.162

Table 5.
Audit quality is
statistically
significant to market
reactions

Notes: Standard errors in parentheses; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Admkt stands for adjusted market returns, IS means industry specialization, Disc means discretionary accrual, OY means operating income, MBR means market-to-book ratio, ROA means the return on assets and _cons stand for constant

Source: Authors' own work

Baseline estimates

Results from Table 5 depict that when share price at the end of a financial year is used to proxy market reactions, audit quality proxies are statistically significant with audit opinion being positive and statistically significant at 99% confidence interval, industry specialization is also positive and statistically significant at 95% confidence interval and discretionary accruals are also positive and statistically significant at 95% confidence interval. Control variables are also statistically significant to market reactions with leverage being statistically significant at 95% confidence interval, return on assets' statistical significance is at 95%, board of directors' statistical significance is at 99% confidence interval and the constants are also statistically significant at 90% confidence interval.

Using adjusted market returns as an alternative to market reactions, audit opinion is statistically significant at 95% confidence rate, industry specialization is positive and statistically significant at 99% confidence interval, discretionary accruals as a proxy for audit quality is also statistically significant at 90% confidence interval. Turning to control variables, return on assets is statistically significant at 99% confidence interval, assets are also statistically significant at 95% confidence interval and the constants are also statistically significant at 95% confidence rate.

Results from Table 6 show the results of audit committee moderation effect on the relationship between audit quality and market reactions in South Africa. The audit quality indicators of industry specialization, audit opinion and discretionary accruals are all positive and statistically significant to market reactions and audit quality becomes very significant when audit committee comes into play.

Discussions

Audit quality is the most important factor affecting a company's market reaction. An audit is a comprehensive assessment of the financial statements of a company and an opinion on whether they are presented fairly, in all material respects. When an auditor issues an

Variables	Admkt	Admkt	Admkt
IS	0.221* (1.4460)		0.221*** (1.4460)
Disc	0.3619* (1.6248)		0.3698*** (2.3314)
OY	5.56e-09 (3.04e-09)	5.00e-09 (3.07e-09)	5.56e-09 (3.04e-09)
Assets	-1.19e-09** (3.89e-10)	-1.23e-09** (3.93e-10)	-1.19e-09** (3.89e-10)
MBR	0.0131*** (4.2393)	0.0140*** (1.1398)	0.0131*** (2.4394)
LEV	-0.9984 (0.2161)	-0.2171 (0.1162)	-0.9980 (0.1161)
ROA	0.0334*** (1.2955)	0.0300** (2.1962)	0.0335*** (1.1956)
lod	0.0565 (0.159)	0.0965 (0.151)	0.0566 (0.159)
AC		0.476** (0.750)	0.425 (0.742)
ACAQ			0.00619* (0.00248)
_cons	0.0631*** (1.150)	0.437*** (2.765)	0.362*** (1.757)
N	1,427	1,427	1,427
R-sq	0.178	0.186	0.177

Table 6. Audit committee moderates audit quality and market reactions relationship

Notes: Standard errors in parentheses; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. With Admkt standing for adjusted market returns, IS meaning industry specialization; AO meaning audit opinion; Disc meaning discretionary accrual; all measures of audit quality. OY means operating income; MBR means market-to-book ratio; ROA means the return on assets; AC stands for audit committee; ACAQ stands for the moderation variable(x \times M) and _cons stands for constant

Source: Authors' own work

unqualified opinion, it means that they have found no material misstatements in the financial statements. When an auditor issues a qualified opinion, it means that they have identified some material misstatements but also that these do not affect the overall fairness of the financial statements.

Investors rely heavily on audited financial statements to make investment decisions (Lin *et al.*, 2009). This is because investors and markets trust the auditor's findings and have trust in the independence of auditors to issue correct audit reports. Audit quality will have an impact on market reactions as investors and markets will read the information coming from auditors as information pertaining to the financial health of a firm (Lin *et al.*, 2009).

This will affect the market reactions negatively or positively depending on the perceived audit quality being either poor or good. Audit quality entails firm's specific information in firms share price thus the market reactions to audit quality (Almaharmeh *et al.*, 2021).

Audit quality is an important factor in market reactions. Investors respond to audit quality by adjusting their investments based on how poorly or well a company's financials have been audited (J. O. Brown and Popova, 2019).

Audit quality is determined by several different factors. Auditors must be able to determine whether the financial statements provided by companies are accurate, and they must also be able to provide information about the company's internal controls and procedures. If the auditor finds problems with any part of those assessments, it can lead investors to change their behaviour towards the company.

Audit quality does affect market reactions (Almaharmeh *et al.*, 2021; Hoti *et al.*, 2012) because audit quality shows the health and going concern of the firm in question. Investors are rational people who base their decisions on what they perceive to be going on and their decisions are usually based on signals coming from firms (Augustine O Okolie, 2014). Audit quality is very important for investors. It is often the primary source of information about a company's financial health, and investors rely on audits to provide them with a view of the company's financials that can be used to make investment decisions.

Firms with higher/better audit quality are more synchronous to markets than firms with lower audit quality (Pham *et al.*, 2020). Augustine O Okolie (2014) found out that audit quality has an impact on market stock prices just like in our study. This is so because a high-quality audit sends signals to the markets that the financial information coming from the firm is reliable. Investors will tend to punish firms with lower audit quality by not purchasing their assets (Augustine O Okolie, 2014) as they deem the firm to be financially unreliable.

Audit quality was found to have statistical significant impact on stock returns movement in Vietnam suggesting that firms with higher audit quality are more concomitant with stock markets (Pham *et al.*, 2020). The assumption behind the results like many other literatures (David *et al.*, 2018; Almaharmeh *et al.*, 2021) seem to indicate that investors/shareholders are up-to-date with information coming from the firms and trust auditors to safeguard their interests. The investors like any other rational thinking person will choose to invest/purchase assets from firms with higher audit qualities (Lin *et al.*, 2009).

The audit committee moderates the relationship between audit quality and market reactions. Investors react to audit committee by reacting to the company's financial information. If the company has a weak auditing process, investors will be wary of investing in the company. They will see that as a sign that there is something wrong with the company since they are not willing to subject themselves to an audit. The audit committee is responsible for ensuring that their auditors have integrity and are doing their jobs correctly. Audit committee members are responsible for a company's financial reporting and the audits that confirm their accuracy. In addition to making sure that the company's financial

statements are accurate, audit committee members must also ensure that all related processes follow accounting standards and ethical practices.

Audit committees are typically comprised of three to five members who have significant experience in finance and accounting. They may be required to meet with senior management to discuss quarterly performance reports, including those related to earnings releases, internal controls and risk management.

The role of the audit committee in moderating this relationship comes from their ability to ensure that the auditors perform their jobs in accordance with professional standards. They do this by reviewing the company's internal controls and monitoring how they are applied, ensuring that audits are conducted in a manner consistent with industry standards, ensuring that there is adequate disclosure of financial information and ensuring that the auditors are independent from management.

Investors react to audit committee actions by evaluating whether or not they believe these actions will help them make more informed decisions about their investments. If investors feel confident that an audit committee has taken proper measures to ensure quality control over financial statements, then they will be more likely to invest in companies with strong audit committees. Audit committee member expertise can promote higher financial reporting quality (Jeffrey *et al.*, 2022a) which is loosely translated to higher quality audits and seems attractive to investors.

The audit committee moderates the relationship between audit quality and market reactions by overseeing the work of external auditors, reviewing their findings and making sure that auditors are sufficiently independent. The audit committee also monitors internal controls over financial reporting and ensures that there is strong communication within the organization about financial reporting.

A study on the UK firms found out that audit committees have a profound effect on audit quality (Wu *et al.*, 2014). Where, firms with audit committee characteristics like composition had a sway on auditors issuing report specifically going concern report which is modified before failure. This coincides with our study where we found that audit committee has an influence on audit quality. However, in a study conducted in Jordan, it was found out that audit committee composition, specifically legal and gender diversity have no significant impact on audit quality (Alhababsah and Yekini, 2021). This could downplay the relationship between audit committee and audit quality in Jordan's setting. Our study focused on financial expertise composition though.

Firms that are identified with internal control weakness are usually ones with poor audit committee composition (Zhang *et al.*, 2007). The internal control weakness in turn translates to poorer audit quality and subsequently investors figure out that all is not well in a firm, thus, lower market reactions like in our study. In the same line, investors react positively or negatively depending on the composition of audit committees (Jeffrey *et al.*, 2022a). This compared to our study is consistent with the view that audit committee influences market reactions in South African publicly listed firms.

The theoretical implication of the findings reveal that audit committees play a huge role in the financial health of a firm (Salloum *et al.*, 2014). Audit committees help to prevent financial distress especially in the meeting frequency as a frequently meeting audit committee helps to deter financial distress (Salloum *et al.*, 2014). This is bound to improve audit quality and market reactions as investors favour firms that are economically sound. The way investors get this information is through signalling theory. The information released by firms says a lot about it and its operation. Thus, the study supports signalling theory as a medium that binds firms and stock markets. The audit committee acts as a

mediator, aligning the interests of shareholders (principals) with those of management (agents).

Additional analysis

To make our study coherent, we carried out robustness checks for mandatory auditor rotation impact on audit quality in South Africa using GMM model and discretionary accruals as a proxy for audit quality.

Following bond 2001, to decide on whether system GMM or difference GMM is better suited for the study, we first computed the variables using pooled OLS then used fixed effects model, and later used one-step and two-step difference GMM model and the results are presented in [Appendix 2](#). Because the results as presented in [Appendix 2](#) of one-step and two-step difference GMM coefficients being close or below the fixed effects regression coefficients, it suggested that the results are downward biased because of weak instrumentation and system GMM is preferred just like bond 2001.

The researcher used a one-step system GMM to estimate the study as presented in [Table 7](#) to ascertain the moderating impact of audit committee on the relationship between audit quality and market reactions after carrying out tests in depicted in [Table A1](#) in [Appendix 2](#).

The table depict the results of robustness test using one step GMM regression model. The variables lag share price and lag adjusted market returns are statistically significant. Audi quality indicators of audit opinion, industry specialization and discretionary accruals are statistically significant but become strongly significant when audit committee is introduced into the equation. This can be taken to signify that audit committee moderates the relationship between audit quality and market reactions.

The audit committee moderates the relationship between audit quality and market reactions by ensuring that the audit process is both thorough and efficient. To meet these responsibilities, audit committees must oversee the audit process carefully. They should monitor when audits are being conducted, how they are being conducted, who is conducting them and what kind of results they produce. Audit committees should also make sure that auditors have access to all necessary information to perform their jobs effectively.

When an audit is done properly, it can have a positive impact on the market reaction to the company's stock price. A good audit means that investors know they can trust the numbers in the financial statement, and this can lead to increased confidence in management's ability to continue delivering on its stated goals. Audit quality improves market reactions by increasing investor confidence. Audit quality is the extent to which an audit is conducted in accordance with professional standards and principles, as evidenced by the auditor's report. Investors will be more likely to invest in a company that undergoes a thorough audit, because they know that the company has been assessed by a qualified expert and has passed the audit. This can lead to better returns on investment and greater market confidence overall.

The study contributes to the understanding of how audit committees act as intermediaries in reducing information asymmetry between management and investors. By moderating the audit quality-market reactions relationship, they signal to the market about the reliability of financial information.

Conclusion

The study was conducted to explore the moderating impact of audit committee on the relationship between audit quality and market reactions in South Africa's publicly listed firms. The study spanned a period of six years starting from 2014 to 2019. Audit quality was proxy by audit opinion, industry specialization and discretionary accruals while market

Variables	Admkt	Admkt	Admkt
OY	-2.5719 (2.9019)	5.8521 (3.9421)	4.7521 (2.6419)
ASSTS	2.9321 (1.7420)	-1.2521 (6.4122)	-1.6720 (2.8020)
MBR	2.2813 (3.5213)	5.6515 (1.2914)	1.1313 (3.2313)
LEV	-2.0313 (2.1713)	-3.6616 (1.1815)	-2.3813 (1.6113)
ROA	8.8215 (1.5812)	2.8914 (2.4014)	-2.1011 (1.1611)
bod	9.9711 (6.6211)	1.1013 (2.4113)	-4.9911 (8.4111)
IS	8.6411* (9.0411)		4.5711** (6.3511)
y1	5.8812 (1.3411)	1.0813 (2.6213)	-1.0412 (1.2311)
y2	-1.6511 (2.5511)	-5.3014 (2.1813)	-1.2911 (1.6311)
y3	0 (.)	0 (.)	0 (.)
y4	-8.4012 (1.3911)	7.2414 (3.1013)	1.1511 (1.7411)
y5	-8.6212 (1.6111)	-3.1913 (3.3913)	1.2511 (1.8211)
y6	-8.8512 (1.7311)	-4.5213 (3.3213)	5.9812 (2.1711)
AC		-5.4311 (5.5311)	-5.4310 (6.5110)
Disc	6.6713* (4.1212)		3.0712** (5.3612)
AC*	0.0768** (2.413)		0.043* (1.564)
Lag admkt	-1.000*** (1.7911)	-1.000*** (4.3713)	-1.000*** (2.8211)
_cons	1.000*** (3.5411)	1.000*** (5.5311)	1.000*** (6.4310)
No of obs	1,427	1,427	1,427
Year dummies	Yes	Yes	Yes
F-stats	13.2	13	10
Groups/instruments	119/24	119/24	119/24
AR(2)	0.111	0.507	0.389
Hansen stat	0.411	0.452	0.443

Notes: Where Admkt is adjusted market returns, lag Admkt is lag of adjusted market returns, IS is industry specialization; Disc is discretionary accruals (Disc, audit opinion and IS are audit quality proxies); OY is operating income, MBR is a market-to-book ratio; AC is audit committee; ACAQ is the multiple of audit quality and audit committee and ROA is the return on assets. Standard errors in parentheses * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$ and are based on white heteroscedasticity consistent std errors. p -Values reported for AR(2) and Hansen statistics

Source: Authors' own work

Table 7.
The audit committee moderates audit quality and market reactions relationship

reactions were proxy by share price and adjusted market returns. Other control variables were introduced in the equation to help in explaining the dependent variable. Results obtained depict that audit committee moderates the relationship between audit quality and market reactions as the audit quality indicators become more statistically significant when audit committee is introduced in the equation.

This carries an implication that governments and regulatory bodies in other developing economies could strengthen regulations pertaining to companies Acts and how firms regulate themselves and more so audit committees. Firms can also strive to make sure that audit committees are staffed with experts to promote higher audit quality and investor attention to get access to the much-alluded capital. The study also encourages smaller audit firms to up their game with expertise and workforce to get better clientele. The study supports signalling and information asymmetry theories as investors use and perceive information coming from firms as an indication of the actual happenings in the firm and, thus, base their investment decisions on such. We suggest future research into international perspectives on how cultural and institutional differences influence the effectiveness of audit committees in different countries. Do audit committees in diverse cultural settings play a similar moderating role, or are there variations in their impact on audit quality and market reactions?.

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Appendix 1

Test for moderation interaction

$$F(1, 1423) = 11.01.$$

$$\text{Prob} > \chi^2 = 0.0040.$$

Appendix 2

Table A1 shows the results of why we chose system GMM regression model.

Regression model	Coefficients
OLS	2.75812
Fixed effects	1.056218
One-step difference GMM	-1.5471
Two-step GMM	-1.9641

Source: Authors' own work

Table A1.
Showing lag
coefficients for
lagged dependent
variable, hence,
choosing system
GMM

Appendix 3

Table A2 shows the results between using OLS, Fe and random effects regression models.

Variables	OLS Share price	FE Share price	RE Share price
IS	0.274*** (1.7663)	0.235*** (1.0697)	0.237*** (1.1666)
Disc	-0.0109** (1.9362)	0.0128* (1.0233)	0.1790** (2.0231)
OY	3.50e-09 (4.43e-09)	5.92e-10 (2.47e-09)	6.77e-10 (2.45e-09)
Assets	-3.53e-10 (5.68e-10)	-2.46e-10 (3.13e-10)	-2.46e-10 (3.12e-10)
MBR	-0.0657 (0.0575)	-0.0177 (0.0275)	-0.0188 (0.0275)
LEV	-0.00594* (1.0234)	-0.0669 (0.0156)	-0.000877 (0.0154)
ROA	-0.0378** (0.0140)	0.00529 (0.0834)	0.00397 (0.0827)
_cons	1.582*** (1.110)	2.007*** (1.0798)	1.985*** (1.120)
N	1427	1427	1427
R-sq	0.187	0.180	0.21

Notes: Standard errors in parentheses * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. IS represents industry specialization; Disc represents discretionary accruals; OY represents operating income; MBR represents market-to-book ratio; Lev represents leverage; ROA represents return on assets and OLS, FE and RE represent ordinary least squares, fixed effects and random effects, respectively

Source: Authors' own work

Table A2.
Results of OLS, fixed
effects and random
effects

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