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ARTICLE

Does options trading affect audit pricing?

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Abstract

We examine the impact of options trading on audit pricing for a sample of US firms over the period from 2004 to 2021. We find that options trading is significantly and negatively related to audit fees, indicating that firms characterized by higher options trading incur lower audit fees. Auditors spend a lower number of days auditing firms with higher options trading and firms with higher options trading experience lower probabilities of lawsuits, and misstatements, and lower likelihood of material weaknesses and auditor opinion on internal controls. The impact of options trading on audit fees is stronger when the auditor is located further away from the audited firm, for firms with non-specialized auditors, higher information asymmetry problems, poorer earnings and lower governance quality. Overall, our findings underscore the significance of options trading in improving a firm's information environment and reducing litigation risk, resulting in lower audit fees.

KEYWORDS
audit fees, auditor opinion on internal controls, information asymmetry, lawsuits, material weakness, options trading, restatements

1 | INTRODUCTION

The recent spate of corporate scandals and the global financial crisis has led to an increasing emphasis on the role of the auditor and the integrity of financial information. The increasingly important role of auditors has motivated several studies to examine the determinants of audit fees (e.g., see Hay, 2013; Hay et al., 2006; I. Kim et al., 2024; Nekhili et al., 2020; Tan, 2021). The seminal work of Simunic (1980) argues that audit fees are driven by auditors' efforts or the expected losses for auditors. Subsequent work highlights that auditors demand higher fees for those firms with higher informational asymmetries/agency-related conflicts (DeFond, 1992; DeFond & Zhang, 2014; Hope et al., 2017) as they need to input more effort into ensuring that the financial statements do indeed reflect the underlying economic situation of the firm. While several studies have identified various determinants of audit fees, whether and how trading activity in financial markets affects audit fees is relatively less well understood. We fill this void in the current paper by examining the relation between trading activity in the firms' listed stock options and audit fees.

Our analysis of options trading activity is motivated by the tremendous growth of the options market, with the trading volume of options increasing exponentially over the last 20 years from 676 million contracts in 2000 to over 4420 million contracts in 2019 (Blanco & García, 2021). This tremendous growth in options trading has inspired prior research on how options trading affects financial market quality and corporate policies. Such analyses provide important policy implications because, unlike stock listing, options listings are exogenous to firm decisions as the decisions to list options are made by the options exchange and are made within exchanges operating under the jurisdiction of the Securities and Exchange Commission (Blanco & Wehrheim, 2017).

We postulate that firms with higher options trading activity will have lower audit fees. Previous studies argue that options traders improve firms' information environments and enhance market efficiency, as they have a superior ability in interpreting public information as well as in acquiring and conveying private information to investors (e.g., see Blanco & Wehrheim, 2017; H. H. Cao, 1999; J. Cao et al., 2023; Chakravarty et al., 2004; Hong et al., 2023; Hsu et al., 2024; Hu, 2014; Kumar et al., 1998; Pan & Poteshman, 2006; Roll et al., 2009; Ross, 1976; Skinner, 1990). Recent literature shows that options trading disciplines opportunistic reporting behavior, enhances informational efficiency and financial reporting quality (Hao & Li, 2022) and discourages managers from engaging in real activities manipulation (Delshadi et al., 2023). To the extent that options trading leads to a lower likelihood of marginally beating earnings targets and restatements (Hao & Li, 2022), options trading is also related to lower litigation risk for auditors since litigation against auditors is primarily due to overstatements (Carcello & Palmrose, 1994; DeFond et al., 2016). Synthesizing these evidences, we argue that options trading helps improve the information environment and financial reporting quality and lower litigation risk. Auditors' engagement risk will be lower for firms with higher options trading activity and they will need to input less effort in auditing such firms. These arguments lead to our main hypothesis that firms with higher options trading activity will have lower audit fees.

We examine the impact of options trading on audit pricing for a sample of US firms using audit fee and other control variable data from 2004 to 2021 and options trading data from 2003 to 2020. Following Roll et al. (2010), we use the natural logarithm of the ratio of options trading volume to share trading volume (*O/S*) as our main proxy for options trading. We show that firms with higher degrees of options trading incur lower audit fees, *ceteris paribus*. We also conduct several additional tests to mitigate potential endogeneity issues concerning the relation between options trading and audit fees. First, we examine how audit fees change following initial options listings. We focus on options listing events since the decisions to list options are made by the options exchange and are exogenous to firm decisions (Mayhew & Mihov, 2004). Thus, these events represent plausible exogenous shocks to options trading activity. Using difference-in-difference analysis, we document that firms that have options listed for the first time experience a significant decrease in their audit fees after the options listing relative to a matched sample of firms without listed options.

Second, we follow Roll et al. (2009) and conduct an instrumental variables analysis utilizing options open interest and moneyness as instrumental variables. We show that the instrumented options trading is negatively related to audit

fees. We also perform propensity score matching (PSM) in which our treatment firms are those that have high degrees of options trading (above industry medians) in each fiscal year, while our control firms in each fiscal year are otherwise comparable firms with low options trading, and show that treatment firms pay significantly lower audit fees than control firms. We further support the causal inferences using a change analysis and report the negative relation between changes in *O/S* and changes in the natural logarithm of adjusted audit fees (Δ*LNAUDFEEADJ)*. We also conduct several other tests to determine the reliability and robustness of our baseline findings and confirm the validity of our results.

Having robustly established a negative relation between options trading and audit fees, we then examine the underlying channels driving this relation. Auditors consider the integrity of the management when deciding how much effort to exert in auditing (i.e., how many days to audit). By increasing their efforts, auditors can reduce the risk of material misstatements, thereby increasing both audit quality and audit fees (Defond & Zhang, 2014). However, since options trading reduces real activity manipulation (Delshadi et al., 2023; Hao & Li, 2022), we argue that options trading will lead to reductions in auditor effort, which, in turn, reduces audit fees. We use the auditor's report delay used in Jha and Chen (2015), Ettredge et al. (2006) and Knechel and Payne (2001) as a proxy for auditor effort and show that auditors spend a lower number of days, that is, less effort, to audit firms with higher options trading levels. We also find that firms with higher options trading have lower probabilities of lawsuits. Further, we show that firms with higher options trading have a lower likelihood of material weaknesses disclosures and auditor opinions on internal controls.

We also conduct several cross-sectional analyses to further support our main findings. We argue that if options trading reduces audit fees by mitigating information asymmetry/agency problems, the impact of options trading on audit fees should be more pronounced for firms with higher informational asymmetries. Choi et al. (2012) and Jha and Chen (2015) argue that a shorter distance between the auditor and the client reduces the information asymmetry problem. Prior studies also show that firms audited by industry specialist auditors are associated with higher earnings quality (Balsam et al., 2003; Krishnan, 2003; Srinidhi et al., 2014), indicating that they are characterized by having lower information asymmetries (Bhattacharya et al., 2013). Therefore, we predict and find that the impact of options trading on audit fees is more pronounced for firms located further away from the auditor's location and for firms with non-specialist auditors.

We further use the number of analysts following the company and the probability of informed trading (Easley et al., 1998) as proxies for informational asymmetries and find that options trading decreases audit fees in a more pronounced fashion for those firms with lower analysts following and higher probability of informed trading. Given the findings of Bhattacharya et al. (2013) that poor earnings quality is significantly and incrementally associated with higher information asymmetry, we also examine whether the impact of options trading on audit fees differs across firms with differing levels of earnings quality. Using the earnings quality measures developed by Hutton et al. (2009) and Rajgopal and Venkatachalam (2011), we find that the negative relation between audit fees and options trading is more pronounced for firms with poor earnings quality. Overall, these findings indicate the significance of the information environment in moderating the effect of options trading on audit fees.

Corporate governance mechanisms alleviate agency/informational asymmetry problems via various means such as compensation contracts and monitoring (Armstrong et al., 2010). As a consequence, stronger governance mechanisms would be associated with lesser degrees of informational asymmetry (Chung et al., 2010). Extending this argument, we postulate that the benefits of an improved information environment arising from options trading should be most pronounced for firms with weaker governance features. We use board independence, dedicated institutional ownership and the index of takeover susceptibility (Cain et al., 2017) as proxies for governance quality and find that options trading reduces audit fees to a greater extent in firms with weaker governance mechanisms as reflected by lower board independence, fewer dedicated ownerships and higher takeover protection.

Our study contributes to the literature on the determinants of audit fees (see the detailed reviews by Hay, 2013; Hay et al., 2006). Since the seminal work of Simunic (1980), numerous studies have focused on the impact of information quality on audit pricing and found that better information quality is associated with lower audit fees. While the focus of prior work is information quality from ownership concentration (Niemi, 2005), Chief Executive

Officer (CEO) behavioral integrity (Dikolli et al., 2020), corporate culture (H. Chen et al., 2022), employee satisfaction (Huang et al., 2017) and client-firm qualitative disclosure (Abernathy et al., 2019), we instead examine the role of trading in the derivatives market, specifically options trading, as the determinant of audit pricing. Our contribution in this area lies in acknowledging the crucial role played by information originating from options markets in the context of audits. We document how the overall improvement of the information environment resulting from options trading is associated with lower audit pricing. Our findings provide a more comprehensive understanding of the intricate interplay between financial markets and considerations related to audits.

Our study also extends the extant literature on the impact of options trading on decision-making, in general. Prior research emphasizes the importance of stock price informativeness in shaping corporate decisions (Q. Chen et al., 2007; Foucault & Fresard, 2014; Luo, 2005).[1] In this study, we take the improvement in price informativeness that arises with options trading as given and show that the benefit of higher stock price informativeness and a better information (lower agency cost) environment also extends to other market participants such as auditors. In doing so, we complement other recent studies that highlight several benefits of options trading such as higher firm values (Roll et al., 2009); lower costs of capital (Naiker et al., 2013); higher innovation activity (Blanco & Wehrheim, 2017); lower accruals-based earnings management (Hao & Li, 2022); lower real earnings manipulation (Delshadi et al., 2023); and higher managerial learning (Y. Chen et al., 2021).

The remainder of the paper is organized as follows. Section 2 provides a discussion of the related literature and develops our main hypothesis. Section 3 presents the data and research methodology. Section 4 presents and discusses the baseline model results, while Section 5 presents and discusses the empirical analyses that address endogeneity issues and robustness checks. Section 6 examines the role of options trading on auditors' efforts and the probability of misstatements, lawsuits, material weaknesses and auditors' opinions on internal controls as economic channels. Section 7 examines how the distance between the auditor and client firm and specialized versus non-specialized auditors affect the impact of options trading on audit fees. Section 8 discusses the differential impacts of options trading on the audit fee for firms with differing levels of information asymmetry and governance strengths. Section 9 concludes the paper.

2 | HYPOTHESIS DEVELOPMENT

Prior studies (J. R. Francis, 2011; Simunic, 1980; Whisenant et al., 2003) suggest that audit fee is a function of auditor effort, the economic bonding with the client and perceived audit risk. Given that managers are more likely to attempt to disguise firm performance through earnings management in the presence of high information asymmetry (Bhattacharya et al., 2013; Irani & Oesch, 2013), auditors consider higher information asymmetry as an audit risk (Cho et al., 2017). Jha and Chen (2015) conjecture that auditors will determine their effort, and hence fee levels, via an assessment of the managerial integrity within the firm that will depend, in part, upon the degree of informational asymmetry in that firm. Essentially, then, the audit fee will be a positive function of the level of information asymmetry that is inherent within a firm. Previous studies also link information asymmetry to audit fee determinants (e.g., see the number of subsidiaries—Huson & MacKinnon, 2003; auditors' risk—Abbott et al., 2006; and auditor–client relationship—Geiger & Raghunandan, 2002; Solomon et al., 1999).

Given the above discussion on the importance of information quality for auditors, we argue that options trading activity will matter for audit pricing due to the role of options trading in improving market efficiency and the corporate information environment. Options markets are attractive to informed traders because of the higher leverage and lack of short-sale restrictions (Black, 1975). Easley et al. (1998) show that in incomplete markets, options trading contains private information incremental to that available in the equity market. Several subsequent studies document

[1] See Bond et al. (2012) for a review on the real effect of secondary financial market trading.

that options trading improves information efficiency and reduces information asymmetries between insiders and outsiders and that these impacts increase with higher degrees of options trading (e.g., see Blanco & Wehrheim, 2017; H. H. Cao, 1999; Chakravarty et al., 2004; Hu, 2014; Pan & Poteshman, 2006; Roll et al., 2009). Recent work by J. Cao et al. (2023) also shows that options trading volume is linked to increased stock price informativeness as measured by return synchronicity and forecasting efficiency of market valuation.

The improvement in market efficiency and stock price informativeness as a result of options trading should improve financial reporting quality. Hao and Li (2022) argue that options trading can have a dual impact on a financial manager's approach to earnings management. First, by improving price efficiency and mitigating mispricing, active options trading reduces the financial manager's marginal benefit from earnings manipulation. Second, the heightened attention and scrutiny from options traders and other market participants elevate the likelihood of detecting earnings management practices and increase the financial manager's marginal cost of earnings management. This reduction in the manipulation of financial figures alleviates the potential for misrepresentation, consequently lessening the burden on auditors to identify and address deceptive accounting practices. Moreover, given options trading is related to a lower probability of marginally beating earnings forecasts (Hao & Li, 2022), financial performance aligns more closely with market expectations, alleviating pressure on auditors to uncover discrepancies and enhancing the overall predictability of financial outcomes. Additionally, a decrease in the frequency of financial restatements reflects a higher level of reliability in financial reporting, mitigating the likelihood of material misstatements that could pose risks for auditors.

We further argue that options trading may affect audit fees through its impact on the litigation risk faced by the auditors. Litigation risk and reputational concerns are strong motivators for auditors to become fully exercised in their auditing roles (DeAngelo, 1981), along with the professional rules and regulatory requirements that discipline auditors' actions (Caramanis & Lennox, 2008). Auditors use their client information to assess their business risk exposure—reputational damage and litigation risk—and, in turn, set their audit price/negotiate their fee to protect themselves (Barron et al., 2001; Bell et al., 2001; Houston et al., 1999; Lyon & Maher, 2005; Morgan & Stocken, 1998, 2005; Pratt & Stice, 1994; Seetharaman et al., 2002; Simunic & Stein, 1996; Stanley, 2011; Venkataraman et al., 2008).

There has been a significant increase in lawsuits against auditors around the world, which has been manifested in an increase in auditor liability insurance premiums. The lawsuits against auditors increase for non-big audit firms (Palmrose, 1988), firms with financial statement frauds (Bonner et al., 1998) and firms with restatements of financial statements (Carcello & Palmrose, 1994; DeFond et al., 2016; Hennes et al., 2008). Since options trading is related to a lower likelihood of restatements (Hao & Li, 2022) and deters real earnings management activities (Delshadi et al., 2023), the litigation risk will be lower for auditors.

Lawsuits against auditors can also be related to poor stock price performance (Lys & Watts, 1994). In a recent study, Hope et al. (2017) argue that mispriced securities and the consequent convergence to fundamental value can increase the litigation risk for auditors as investors suffering losses from these securities often blame their losses on the auditors. As greater options trading volume implies greater price informativeness (Roll et al., 2009), we postulate that the litigation risk for auditors will be lower for firms with higher options trading activity since the probability of mispriced securities is reduced

Overall, we argue that, due to the role of options trading in reducing information asymmetries, stimulating information production and improving price efficiency and financial reporting quality, the audit risk and litigation risk will be lower for firms with higher options trading activity. These arguments lead to the following hypothesis that underpins our empirical analyses:

Hypothesis 1. Firms with higher options trading activity will have lower audit fees than those firms with lower options trading.

3 | RESEARCH METHODS

3.1 | Data and sample

Our sample includes all publicly listed firms on the US stock exchanges that have options trading data in the Option Metrics database during the period from 2003 to 2020 and audit fee data in the Audit Analytics database during the period from 2004 to 2021. We also obtain data on auditor opinion (*AUOP*), Big 4 auditor (*BIGAUDIT*), financial restatements (*RESTATE*), lawsuit (*LS*), material weaknesses (*MW*) and auditor opinion on internal controls (*DMW*) from the Audit Analytics database. For analyst following and institutional ownership, we obtain the data from the Institutional Brokers' Estimate System (I/B/E/S) and Thomson Reuters Refinitive databases, respectively. We provide the variable definitions and data sources in the Appendix.

We initially identify a sample of firms that have at least 2 years of data from the Compustat database. We then remove firms that do not have options trading data in the Option Metrics database and audit fee data in the Audit Analytics database. Following Barua et al. (2020), we remove firms with total assets of less than $1 million. We also exclude observations from the financial and utility industries based on four-digit standard industrial classification (SIC) codes between 6000 and 6999 and 4000 and 4999, respectively. The final sample comprises 39,388 firm-year observations of 6090 firms.

Barua et al. (2020) show that combining the audit fees of the successor and predecessor in the year of the auditor change mitigates the mismeasurement arising from omitting audit fees of the predecessor in year *t*. Therefore, we have corrected the audit fees measure following the method in eq. (1) in Barua et al. (2020). In line with previous studies (Roll et al., 2010; Chan et al., 2015), we construct our options trading measure (*O/S*) as the natural logarithm of the ratio of options trading volume to stock trading volume. We aggregate daily options trading volume to construct our annual options trading volume of each firm. The daily options trading volume for every firm is determined by multiplying the total number of contracts traded in each option by 100 (as each contract represents 100 shares of stock). We provide the definition and description of other variables in the Appendix.

Table 1 provides the descriptive statistics of our sample. The average of the natural logarithm of the options trading volume to stock trading volume ratio (*O/S*) is −3.29. This statistic is consistent with Johnson and So (2012). The average yearly natural logarithm of the audit fee adjusted for auditor change is 13.77. The average natural logarithm of size (*LNTA*) of the sample firms is 6.33, with an average leverage ratio (*TDRATIO*) of 24% and average profitability (*ROA*) of −2%. Our sample and statistics for audit fees and firm characteristics compare favorably with other recent US studies (e.g., see H. Chen et al., 2022; Costa & Habib, 2023).

3.2 | Baseline model—Options trading and audit fees

We use the following baseline model to examine the impact of options trading on audit fees:

$$\begin{aligned} LNAUDFEEADJ_{i,t} = {} & \alpha + \beta_1 O/S_{i,t-1} + \beta_2 LNTA_{i,t} + \beta_3 LOSS_{i,t} + \beta_4 BUSY_{i,t} + \beta_5 ROA_{i,t} + \beta_6 AUOP_{i,t} + \beta_7 BIGAUDIT_{i,t} \\ & + \beta_8 SQGEOSEG_{i,t} + \beta_9 SQBUSSEG_{i,t} + \beta_{10} FORSALES_{i,t} + \beta_{11} SPECIAL_{i,t} + \beta_{12} TDRATIO_{i,t} \\ & + \beta_{13} DUAUCHANGE_{i,t} + \beta_{14} MB_{i,t} + \beta_{15} LITIGATION_{i,t} + \beta_{16} INHERENT_{i,t} + \beta_{17} DMA_{i,t} + \beta_{18} DSEO_{i,t} \\ & + \beta_{19} LNNONAFEE_{i,t} + \beta_{20} MW_{i,t} + \beta_{21} DMW_{i,t} + \text{YearEffect} + \text{Firmeffect} + \text{Auditoreffect} + \varepsilon_{i,t}. \quad (1) \end{aligned}$$

The dependent variable is the natural logarithm of the adjusted audit fees (*LNAUDFEEADJ*) for firm *i* in year *t*. We follow Barua et al. (2020) to adjust audit fees by combining the audit fees of the successor and predecessor in the year of the auditor change. The main independent variable pertinent to our analyses is the options trading measure

TABLE 1 Descriptive statistics of firm characteristics.

Variable	*N*	Mean	Median	P25	P75	SD
LNAUDFEEADJ	39,388	13.77	13.83	12.88	14.66	1.32
O/S	39,388	−3.29	−3.34	−3.65	−2.99	0.44
LNTA	39,388	6.33	6.37	4.83	7.82	2.20
LNNONAFEE	39,388	8.11	11.21	0.00	12.89	5.82
LOSS	39.388	0.33	0.00	0.00	1.00	0.47
BUSY	39,388	0.83	1.00	1.00	1.00	0.37
ROA	39,388	−0.02	0.03	−0.02	0.07	0.25
AUOP	39,388	0.07	0.00	0.00	0.00	0.25
BIGAUDIT	39,388	0.75	1.00	0.00	1.00	0.43
SQGEOSEG	39,388	1.61	1.41	1.00	2.00	0.64
SQBUSSEG	39,388	2.49	2.45	1.73	3.16	0.85
FORSALES	39,388	0.01	0.00	0.00	0.01	0.01
SPECIAL	39,388	0.67	1.00	0.00	1.00	0.47
TDRATIO	39,388	0.24	0.19	0.02	0.37	0.25
DUAUCHANGE	39,388	0.06	0.00	0.00	0.00	0.24
MB	39,388	1.77	1.49	1.13	2.19	0.80
LITIGATION	39,388	0.32	0.00	0.00	1.00	0.47
INHERENT	39,388	0.25	0.21	0.09	0.36	0.20
DMA	39,388	0.26	0.00	0.00	1.00	0.44
DSEO	39,388	0.07	0.00	0.00	0.00	0.25
MW	39,388	0.09	0.00	0.00	0.00	0.29
DMW	39,388	0.06	0.00	0.00	0.00	0.25

Note: This table reports the descriptive statistics for our sample. We winsorize continuous variables at the 1% and 99% levels. The variables used in this table are the natural logarithm of the adjusted audit fee (*LNAUDFEEADJ*) in year *t*; the natural logarithm of the ratio of options trading volume to stock trading volume in year $t-1$ (*O/S*); the natural logarithm of total assets in year *t* (*LNTA*); the natural logarithm of non-audit fee in year *t* (*LNNONAFEE*); Loss dummy, which equals one if a firm's average ROA during the period $t-1$, *t* and $t+1$ is negative and zero otherwise (*LOSS*); audit period dummy, which equals one for a firm with reporting date in the period Dec–Mar and zero otherwise (*BUSY*); the ratio of net income before extraordinary items to total assets in year *t* (*ROA*); auditor opinion dummy, which equals one if a firm received a modified audit opinion in year *t* and zero otherwise (*AUOP*); Big 4 auditor dummy, which equals one if the firm is audited by Big 4 audit firm in year *t* and zero otherwise (*BIGAUDIT*); the square root of number of geographical segments in year *t* (*SQGEOSEG*); the square root of number of business segments in year *t* (*SQBUSSEG*); the ratio of foreign sales to total sales (*FORSALES*); Special items dummy, which equals one if the firm reports special items in the financial statements in year *t* and zero otherwise (*SPECIAL*); the ratio of total debt to total assets in year *t* (*TDRATIO*); the changes in auditor dummy, which equals one if there is a change in the auditor in the financial year *t* and zero otherwise (*DUAUCHANGE*); the market value of equity to stockholders' equity in year *t* (*MB*); litigation dummy, which equals one if the two-digit standard industrial classification (SIC) code of the firm is from one of the following industries: 28 (chemicals and allied products), 35 (industrial machinery and equipment), 36 (electronic and other electric equipment), 38 (instruments and other related products), 60 (depository institutions), 67 (holding and other investment offices) and 73 (business services) and zero otherwise (*LITIGATION*); the sum of receivables and inventory, scaled by total assets ((*RECT* + *INVT*)/*AT*) in year *t* (*INHERENT*); merger and acquisition activity dummy, which equals one if the firm is engaged in a merger or acquisition in year *t* and zero otherwise (*DMA*); equity issuance dummy, which is equal to one if the number of shares outstanding (*CSHO*) increased by 10% or more in year *t* and zero otherwise (*DSEO*); material weakness dummy, which equals one if the SOX 404(b) internal control opinion discloses a material weakness in year 1 and zero otherwise (*MW*); and audit opinion on internal controls dummy, which equals one if there is a SOX 404(b) audit opinion on internal controls in year *t* and zero otherwise (*DMW*).

O/S in year $t-1$. In line with previous studies (Chan et al., 2015; Roll et al., 2010), we compute *O/S* as the natural logarithm of the ratio of options trading volume to stock trading volume. Consistent with Abott et al. (2017), Costa and Habib (2023) and Dikolli et al. (2020), we use all other control variables in year *t*. In line with previous studies (e.g., see Bryan and Mason 2020; Craswell et al., 1995; Hay et al., 2006; Jha & Chen, 2015; Simunic, 1980; Whisenant et al., 2003), we use several control variables such as the natural logarithm of total assets (*LNTA*), the natural logarithm of non-audit fee (*LNNONAFEE*), loss firms (*LOSS*), audit period (*BUSY*), return on assets (*ROA*), auditor opinion (*AUOP*), Big 4 auditor (*BIGAUDIT*), the square root of geographical segments (*SQGEOSEG*), the square root of business segments (*SQBUSSEG*), the ratio of foreign sales to total sales (*FORSALES*), special items in the financial statements (*SPECIAL*), leverage (*TDRATIO*), the changes in auditor (*DUAUCHANGE*), the market to book ratio (*MB*), litigation (*LITIGATION*), inherent risk (*INHERENT*), equity issuance (*DSEO*), merger and acquisition activity (*DMA*), the internal control opinion discloses a material weakness (*MW*) and audit opinion on internal controls (*DMW*).

We make several predictions as to the directional impacts of the various control variables mentioned above deriving from the extant literature and a priori reasoning. That is, we anticipate larger audit fees for larger, riskier and more complex firms. If a firm employs a Big 4 audit firm and the audit is carried out in a busy period, auditors will demand higher audit fees. Following Numan and Willekens (2012) and Bryan et al. (2018), we control for firms with several segments/subsidiaries in different locations (the square root of geographic segments is used in our model to capture this effect). We predict a positive relation between audit fees and non-audit fees consistent with Simunic (1984) and Palmrose (1986).

Following Srinidhi et al. (2014), we control for the effect of mergers and acquisitions and financing activities. Prior studies show that firms become actively involved in earnings management immediately before equity issuance (Kothari et al., 2015; Rangan, 1998; Teoh et al., 1998) and merger and acquisition activities (Erickson & Wang, 1999). Therefore, auditors have to input greater efforts immediately before such corporate activities and, as a consequence, we would expect that auditors demand higher fees during the announcements of both capital raisings (SEOs hereafter) and mergers and acquisitions (*M&A* hereafter). We control for losses from firm operations since audit fees will be higher where the losses from firm operations are higher. We also expect audit fees to be higher for firms that have special item disclosures in their financial statements. Section 404 of the Sarbanes–Oxley Act requires that listed firms disclose internal control information and that auditors assess the effectiveness of the internal control systems. Since these requirements will necessitate greater audit effort or longer audit times on the part of the auditors, they are likely to generate upward pressure upon audit fees (Raghunandan & Rama, 2006). We also use year-fixed effects to capture the influence of aggregate time-series trends in audit fees; firm-fixed effects to control for time-invariant firm-specific omitted variables bias; and auditor fixed effects to control for time-invariant effects from billing practices specific to audit firms.

4 | EMPIRICAL RESULTS

4.1 | Correlations between our major variables of interest

We examine the correlations between our major variables of interest and present the results in Table 2. We find that the correlation between *O/S* and *LNAUDFEEADJ* is −0.27 (significant at the 1% level). Further, we also find that audit fees (*LNAUDFEEADJ*) are higher for larger firms (*LNTA*), or firms with higher leverage (*TDRATIO*), larger number of geographical segments (*SQGEOSEG*) and business segments (*SQBUSSEG*), higher growth opportunities (*MB*) and firms in litigation industries (*LITIGATION*). In contrast, firms with higher profitability (*ROA*) have lower audit fees. These findings are consistent with prior studies such as Abbott et al. (2017) and Cho et al. (2017).

TABLE 2 Correlation matrix.

	1	2	3	4	5	6	7	8	9	10	11	12
LNAUDFEEADJ (1)	1.00											
O/S (2)	−0.27***	1.00										
LNTA (3)	0.84***	0.45***	1.00									
LNNONAFEE (4)	0.75***	0.37***	0.68***	1.00								
LOSS (5)	0.24***	−0.05**	−0.34***	0.27***	1.00							
BUSY (6)	0.07**	0.13***	0.06*	0.06**	0.04*	1.00						
ROA (7)	−0.17***	0.12***	0.22***	−0.21***	−0.20***	−0.07**	1.00					
AUOP (8)	0.15***	0.18***	0.14***	0.10***	−0.03	0.05*	0.00	1.00				
BIGAUDIT (9)	0.34***	0.23****	0.13***	0.16***	−0.18***	0.03	0.13***	0.01	1.00			
SQGEOSEG (10)	0.15***	0.13***	0.15***	0.15***	−0.02	−0.01	0.07***	0.04*	0.14***	1.00		
SQBUSSEG (11)	0.14***	0.09***	0.17***	0.16***	−0.06**	−0.02	0.11***	−0.07**	0.16***	0.08**	1.00	
FORSALES (12)	0.11***	0.14***	0.07**	−0.06**	−0.12***	−0.06**	−0.11***	−0.13***	−0.11***	−0.16***	−0.18***	1.00
SPECIAL (13)	0.24***	0.23***	0.25***	0.13***	−0.08**	0.02	−0.11***	0.05**	0.16***	0.11***	0.18***	−0.14***
TDRATIO (14)	0.22***	0.18***	0.16***	0.17***	−0.01	0.10***	−0.15***	0.06**	0.11***	−0.13***	−0.13***	−0.05**
DUAUCHANGE (15)	0.04*	0.05**	0.03	−0.03	−0.07**	−0.12***	0.09**	−0.02	0.04*	−0.14***	−0.17***	−0.04*
MB (16)	0.04*	0.08**	0.09**	0.09**	−0.07**	−0.01	0.02	0.03	0.08**	0.12***	0.12***	0.09**
LITIGATION (17)	0.08**	0.05**	−0.17***	0.08**	−0.14***	−0.12***	−0.08**	0.05**	−0.02	0.12***	0.07**	0.16***
INHERENT (18)	0.03	0.20***	0.16***	0.06**	0.09**	−0.15***	0.15***	−0.03	−0.10***	0.21***	0.21***	0.17***
DMA (19)	0.14***	−0.18***	0.10***	−0.18***	0.19***	0.00	0.18***	0.04*	0.24***	0.23***	0.16***	−0.08**
DSEO (20)	0.06**	−0.13***	0.07**	−0.05***	−0.05**	0.04*	−0.07**	0.00	0.05**	−0.03	−0.01	−0.07**
MW (21)	0.12***	−0.10***	0.07**	0.10***	−0.03	0.01	0.03	0.07**	0.02	0.08**	0.06**	−0.06**
DMW (22)	0.04*	−0.07**	0.12***	0.09**	0.12***	0.01	−0.10***	0.01	−0.12***	0.03	0.00	0.11***

(Continues)

TABLE 2 (Continued)

	13	14	15	16	17	18	19	20	21	
SPECIAL (13)	1.00									
TDRATIO (14)	0.16***	1.00								
DUAUCHANGE (15)	0.05**	−0.02	1.00							
MB (16)	0.03	−0.18***	0.00	1.00						
LITIGATION (17)	0.01	−0.14***	0.09**	0.22***	1.00					
INHERENT (18)	0.00	−0.15***	0.09**	−0.07**	−0.04*	1.00				
DMA (19)	0.17***	0.03	−0.05*	0.10**	−0.01	0.01	1.00			
DSEO (20)	0.01	0.06**	−0.03	0.03	0.01	−0.10***	0.10***	1.00		
MW (21)	0.06**	0.02	−0.03	0.01	0.01	0.02	0.05**	−0.01	1.00	
DMW (22)	0.01	0.00	−0.02	−0.02	0.02	0.04*	−0.06**	−0.01	−0.08**	1.00

Note: This table reports the Pearson correlation matrix for the variables used in this study. The variables used in this table are the natural logarithm of the adjusted audit fee (*LNAUDFEEADJ*) in year *t*; the natural logarithm of the ratio of options trading volume to stock trading volume in year $t-1$ (*O/S*); the natural logarithm of total assets in year *t* (*LNTA*); the natural logarithm of non-audit fee in year *t* (*LNNONAFEE*); Loss dummy, which equals one if a firm's average ROA during the period $t-1$, *t* and $t+1$ is negative and zero otherwise (*LOSS*); audit period dummy, which equals one for a firm with reporting date in the period Dec–Mar and zero otherwise (*BUSY*); the ratio of net income before extraordinary items to total assets in year *t* (*ROA*); auditor opinion dummy, which equals one if a firm received a modified audit opinion in year *t* and zero otherwise (*AUOP*); Big 4 auditor dummy, which equals one if the firm is audited by Big 4 audit firm in year *t* and zero otherwise (*BIGAUDIT*); the square root of number of geographical segments in year *t* (*SQGEOSEG*); the square root of number of business segments in year *t* (*SQBUSSEG*); the ratio of foreign sales to total sales (*FORSALES*); Special items dummy, which equals one if the firm reports special items in the financial statements in year *t* and zero otherwise (*SPECIAL*); the ratio of total debt to total assets in year *t* (*TDRATIO*); the changes in auditor dummy, which equals one if there is a change in the auditor in the financial year *t* and zero otherwise (*DUAUCHANGE*); the market value of equity to stockholders' equity in year *t* (*MB*); litigation dummy, which equals one if the two-digit SIC code of the firm is from one of the following industries: 28 (chemicals and allied products), 35 (industrial machinery and equipment), 36 (electronic and other electric equipment), 38 (instruments and other related products), 60 (depository institutions), 67 (holding and other investment offices) and 73 (business services) and zero otherwise (*LITIGATION*); the sum of receivables and inventory, scaled by total assets ((*RECT* + *INVT*)/*AT*) in year *t* (*INHERENT*); merger and acquisition activity dummy, which equals one if the firm is engaged in a merger or acquisition in year *t* and zero otherwise (*DMA*); equity issuance dummy, which equal to one if the number of shares outstanding (*CSHO*) increased by 10% or more in year *t* and zero otherwise (*DSEO*); material weakness dummy, which equals one if the SOX 404(b) internal control opinion discloses a material weakness in year 1 and zero otherwise (*MW*); and audit opinion on internal controls dummy, which equals one if there is a SOX 404(b) audit opinion on internal controls in year *t* and zero otherwise (*DMW*).
The 1%, 5% and 10% significance level are denoted by ***, ** and *, respectively.

4.2 | Baseline results—Options trading and audit fees

We report our baseline results on the impact of options trading on adjusted audit fees in Table 3. We present two models, one without control variables (Model 1) and the other with control variables (Model 2). We document a significantly negative relation between options trading measure (*O/S*) and the audit fee, controlling (without controlling for) the various variables that determine the audit fee, as well as year, firm and auditor fixed effects. These findings indicate that auditors charge lower audit fees for firms with higher options trading. In terms of economic significance, the coefficient of our options trading measure *O/S* is −0.1841 in Model 2 of Table 3, which indicates that a 1% increase in options trading reduces audit fees by 0.18%.

Given that we have corrected for the measurement errors in the audit fee when there is a change in auditor, we find that the estimated coefficient of the variable *DUAUCHANGE* is insignificant confirming the findings of Barua et al. (2020). The estimated coefficients of material weaknesses (*MW*) and auditors' opinion on internal controls (*DMW*) are significantly positive, consistent with Munsif et al. (2011) and Bryan et al. (2018). The estimated coefficient on the size (*LNTA)* variable has the expected positive sign and is statistically significant at the 1% level, indicating that larger firms pay higher audit fees. The estimated coefficient of *ROA* is significantly negative, suggesting that auditors charge higher audit fees for firms with lower returns on assets. The estimated coefficients on the geographical segments (*SQGEOSEG*) and business segments (*SQBUSSEG*) have the expected positive sign and are statistically significant at least at the 1% level. These results are consistent with prior studies' findings that audit work in well-diversified firms is somewhat more complex (e.g., see Bryan et al., 2018; Collier & Gregory, 1996; Langendijk, 1997), resulting in higher audit fees for these firms. The estimated coefficient on the Special (*SPECIAL*) variable is positive and statistically significant, indicating that the existence of special items requires increased audit effort and hence higher audit fees. The estimated coefficient of *LNNONAFEE* is significantly positive, consistent with Simunic (1984) and Palmrose (1986). These findings suggest that auditors exert greater effort and charge higher audit fees when scrutinizing the financial statements of clients with higher non-audit fees.

5 | ENDOGENEITY ISSUES AND ROBUSTNESS CHECKS

In this section, we address potential endogeneity concerns regarding the relation between options trading and audit fees. First, we employ a difference-in-differences regression approach by examining how audit fees change following an initial options listing relative to comparable firms without listed options. Second, we perform an instrumental variable regression analysis using options open interest and moneyness as two exogenous instrumental variables for options trading measure (Roll et al., 2009). Third, we perform PSM analysis in which our treatment firms are those that have high options trading, while our control firms are otherwise comparable firms with low options trading. Fourth, we present the results of the change analysis. Finally, we perform several tests to ensure the robustness of our findings.

5.1 | Difference in difference analysis

We corroborate our main findings of a negative relation between options trading and audit fees by examining how audit fees change following options listings. We focus on options listing events as these events improve the overall market information environment (Hu, 2018). The options listing decisions are also made by exchanges (Mayhew & Mihov, 2004) and thus these events represent a plausible exogenous shock to options trading activity. We employ a difference-in-differences regression approach similar to that of Naiker et al. (2013) on a matched sample to investigate how audit fees change following an option listing relative to the changes in audit fees for firms without listed options. First, we identify firms (treatment firms) that had options created and listed by the exchange for the first time during

TABLE 3 The impact of options trading on audit fees.

	(1)	(2)
O/S	−0.3573	−0.1841
	(−16.52)***	(−10.68)***
LNTA		0.2417
		(26.46)***
LNNONAFEE		0.0237
		(23.02)***
LOSS		0.0056
		(0.65)
BUSY		0.1123
		(2.74)***
ROA		−0.0347
		(−1.87)*
AUOP		0.0318
		(1.12)
BIGAUDIT		0.2308
		(0.87)
SQGEOSEG		0.045
		(3.19)***
SQBUSSEG		0.0438
		(4.80)***
FORSALES		−0.3693
		(−0.74)
SPECIAL		0.0107
		(1.84)*
TDRATIO		0.0036
		(0.14)
DUAUCHANGE		−0.0784
		(−0.26)
MB		0.0055
		(0.85)
LITIGATION		0.0085
		(0.52)
INHERENT		0.2545
		(5.21)***
DMA		−0.0046
		(−0.67)
DSEO		0.0226
		(2.43)**
MW		0.0821
		(9.84)***

(Continues)

TABLE 3 (Continued)

	(1)	(2)
DMW		0.1583
		(10.25)***
Constant	9.935	11.0676
	(111.12)***	(39.53)***
Year, firm and auditor fixed effects	Yes	Yes
R^2	0.9312	0.9413
F-stats	180.30	113.85
Sample	39,388	39,388

Note: This table presents the regression results on the impact of options trading on audit fees using the following equation:

$$\begin{aligned} LNAUDFEEADJ_{i,t} = {} & \alpha + \beta_1 O/S_{i,t-1} + \beta_2 LNTA_{i,t} + \beta_3 LOSS_{i,t} + \beta_4 BUSY_{i,t} + \beta_5 ROA_{i,t} + \beta_6 AUOP_{i,t} + \beta_7 BIGAUDIT_{i,t} \\ & + \beta_8 SQGEOSEG_{i,t} + \beta_9 SQBUSSEG_{i,t} + \beta_{10} FORSALES_{i,t} + \beta_{11} SPECIAL_{i,t} + \beta_{12} TDRATIO_{i,t} \\ & + \beta_{13} DUAUCHANGE_{i,t} + \beta_{14} MB_{i,t} + \beta_{15} LITIGATION_{i,t} + \beta_{16} INHERENT_{i,t} + \beta_{17} DMA_{i,t} + \beta_{18} DSEO_{i,t} \\ & + \beta_{19} LNNONAFEE_{i,t} + \beta_{20} MW_{i,t} + \beta_{21} DMW_{i,t} + \text{Year Effect} + \text{Firm effect} + \text{Auditor effect} + \varepsilon_{i,t}. \end{aligned}$$

The dependent variable is the natural logarithm of the adjusted audit fee (*LNAUDFEEADJ*) in year *t*. Independent variables are the natural logarithm of the ratio of options trading volume to stock trading volume in year $t-1$ (*O/S*); the natural logarithm of total assets in year *t* (*LNTA*); the natural logarithm of non-audit fee in year *t* (*LNNONAFEE*); Loss dummy, which equals one if a firm's average ROA during the period $t-1$, *t* and $t+1$ is negative and zero otherwise (*LOSS*); audit period dummy, which equals one for a firm with reporting date in the period Dec–Mar and zero otherwise (*BUSY*); the ratio of net income before extraordinary items to total assets in year *t* (*ROA*); auditor opinion dummy, which equals one if a firm received a modified audit opinion in year *t* and zero otherwise (*AUOP*); Big 4 auditor dummy, which equals one if the firm is audited by Big 4 audit firm in year *t* and zero otherwise (*BIGAUDIT*); the square root of number of geographical segments in year *t* (*SQGEOSEG*); the square root of number of business segments in year *t* (*SQBUSSEG*); the ratio of foreign sales to total sales (*FORSALES*); Special items dummy, which equals one if the firm reports special items in the financial statements in year *t* and zero otherwise (*SPECIAL*); the ratio of total debt to total assets in year *t* (*TDRATIO*); the changes in auditor dummy, which equals one if there is a change in the auditor in the financial year *t* and zero otherwise (*DUAUCHANGE*); the market value of equity to stockholders' equity in year *t* (*MB*); litigation dummy, which equals one if the two-digit SIC code of the firm is from one of the following industries: 28 (chemicals and allied products), 35 (industrial machinery and equipment), 36 (electronic and other electric equipment), 38 (instruments and other related products), 60 (depository institutions), 67 (holding and other investment offices) and 73 (business services) and zero otherwise (*LITIGATION*); the sum of receivables and inventory, scaled by total assets ((*RECT* + *INVT*)/*AT*) in year *t* (*INHERENT*); merger and acquisition activity dummy, which equals one if the firm is engaged in a merger or acquisition in year *t* and zero otherwise (*DMA*); equity issuance dummy, which equal to one if the number of shares outstanding (*CSHO*) increased by 10% or more in year *t* and zero otherwise (*DSEO*); material weakness dummy, which equals one if the SOX 404(b) internal control opinion discloses a material weakness in year 1 and zero otherwise (*MW*); and audit opinion on internal controls dummy, which equals one if there is a SOX 404(b) audit opinion on internal controls in year *t* and zero otherwise (*DMW*). We cluster the standard error at the firm level. We winsorize continuous variables at the 1% and 99% levels. We report *t*-statistics in parentheses.

The symbols ***, ** and * denote significance levels at the 1%, 5% and 10% levels, respectively.

our sample period for which audit fee data are available for 3 years before and 3 years after the options listing event. Second, we identify other firms with audit data available for a similar 6-year period but without listed options. Third, we rank firms with listed options and those without options listing based on financial year data prior to the sample firms' options listing year, using all of the control variables included in the baseline model. Fourth, we compute the absolute difference in ranks between each firm with an options listing and all possible firms without an options listing for each firm characteristic. Finally, we select the matching firm without listed options as the one with the smallest sum of absolute rank differences.

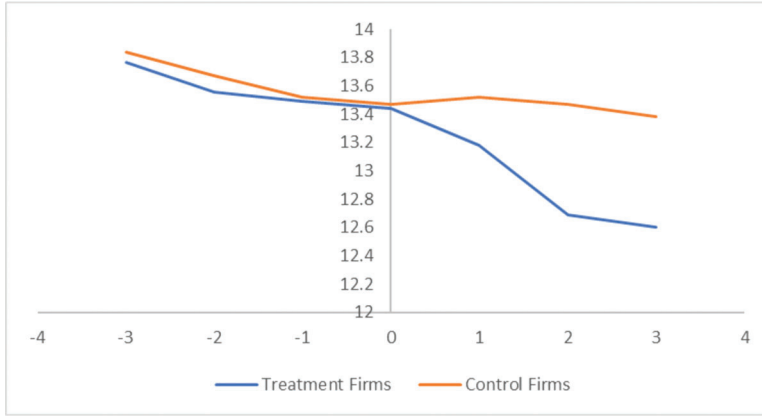

FIGURE 1 Audit fees of the treatment and control firms around options listing events (based on Control Group 1).

We use two groups of matching (control) firms. In the first group (Group 1), we use the firms that do not have options over the 6-year period surrounding the options listing events. In the second group (Group 2), we use all the firms that never have options over our entire sample period. We have 596 sample firms with an option listing and a corresponding number of control firms without an option listing in Group 1. We have 484 sample firms with an option listing and a corresponding number of control firms without an option listing in Group 2.

We run a regression of the audit fee for the 6-year period (3 years before and 3 years after the options listing year of sample firms) for the treatment and control firms against a listed options indicator (*DOPTINILIST*), a post-options-listing year indicator (*DPOSTYR*), a variable capturing the interaction effect of *DOPTINILIST* with *DPOSTYR* and the control variables used in our baseline model and present the results in panel A of Table 4. We present the results with year, firm and auditor fixed effects in Models 1 and 3 and report the results with year, industry and auditor fixed effects in Models 2 and 4, utilizing control Groups 1 and 2, respectively. Given that the value of *DOPTINILIST* is one for each treatment firm and zero for each control firm, the coefficient does not appear for the variable *DOPTINILIST* in Models 1 and 3 with year, firm and auditor fixed effects. We find that the estimated coefficient on the interaction variable *DOPTINILIST*DPOSTYR* is negative and significant at the 1% level in all models. This finding indicates a reduction in audit fees for firms with options listing in the post-listing period, relative to control firms.

One of the conditions for the difference-in-difference (DiD) analysis is the parallel trend assumption that requires any trends in the outcome variables (audit fees in our case) for the treatment and control groups to be the same prior to the treatment (Roberts & Whited, 2013). We test for this assumption in two ways. First, in Figures 1 and 2, we plot the audit fees for the treatment and control firms in the years surrounding options listing events. We observe little difference in the audit fees for treatment and control firms before the options listing year. The significant difference in the audit fees for treatment versus control firms is mostly noticeable following the options listing events. Second, we provide the descriptive statistics for our treatment firms that had an option listing for the first time in our sample period and the two groups of matched control firms without an option listing in panel B of Table 4. We do not find any difference between the treatment and control firms in terms of audit fees and other control variables in our baseline regression before the options listing.[2]

Overall, the findings in Table 4 and Figures 1 and 2 indicate that firms that have options listed for the first time experience lower audit fees subsequent to initial options listing relative to comparable firms not experiencing options listing events. There are no significant differences in audit fees between firms with options and matched firms without

[2] We also obtain similar results when we extend the sample period for analysis of options listing to an 8-year period, consisting of 4 years prior to, and 4 years following options listing events.

TABLE 4 Difference-in-differences regression analysis.

Panel A—DIFF in DIFF analysis				
	Based on Control Group 1		Based on Control Group 2	
	(1)	(2)	(3)	(4)
DOPTINILIST		−0.0327		−0.0316
		(1.14)		(−1.08)
DPOSTYR	−0.0186	−0.0378	−0.0174	−0.0339
	(−0.19)	(−0.87)	(−0.14)	(−0.73)
DOPTINILIST DPOSTYR*	−0.0229	−0.0544	−0.0215	−0.0531
	(−2.54)**	(−4.71)***	(−2.42)**	(−4.58)**
LNTA	0.2123	0.3213	0.2064	0.3105
	(20.06)***	(34.92)***	(19.61)***	(34.48)***
LNNONAFEE	0.0145	0.0653	0.0138	0.0642
	(9.94)***	(14.37)***	(9.65)***	(14.03)***
LOSS	0.0375	0.0596	0.0358	0.0572
	(3.28)***	(5.41)***	(3.04)***	(5.15)***
BUSY	0.0873	0.1919	0.0787	0.1844
	(1.76)*	(3.89)*	(1.67)*	(3.82)*
ROA	−0.0194	−0.0705	−0.0204	−0.0726
	(−1.06)	(−4.15)***	(−1.14)	(−4.23)***
AUOP	0.0698	0.0925	0.0691	0.0917
	(4.27)***	(6.93)***	(4.12)***	(6.86)***
BIGAUDIT	0.2698	0.3311	0.2651	0.3266
	(2.63)**	(4.45)***	(2.47)**	(4.34)**
SQGEOSEG	0.0227	0.0439	0.0224	0.0434
	(2.33)**	(3.76)***	(2.28)**	(3.67)***
SQBUSSEG	0.0054	0.0199	0.0052	0.0187
	(0.14)	(1.73)*	(0.08)	(1.66)
FORSALES	0.0306	0.0515	0.0301	0.0513
	(1.28)	(1.85)*	(1.23)	(1.78)*
SPECIAL	0.0076	0.0362	0.0084	0.0386
	(1.38)	(2.71)***	(1.49)	(2.84)***
TDRATIO	0.0599	0.0923	0.0506	0.0928
	(3.83)***	(5.91)***	(3.61)***	(5.74)***
DUAUCHANGE	−0.0485	−0.0602	−0.0462	−0.0582
	(−0.27)	(−0.69)	(−0.13)	(−0.57)
MB	0.0131	0.0452	0.0126	0.0435
	(3.83)***	(6.97)***	(3.78)***	(6.91)***
LITIGATION	0.0402	0.0514	0.0394	0.0519
	(3.34)***	(4.42)***	(3.18)***	(4.33)****
INHERENT	0.1768	0.2844	0.1652	0.2728
	(2.48)**	(4.52)***	(2.37)**	(4.43)***

(Continues)

TABLE 4 (Continued)

Panel A—DIFF in DIFF analysis				
	Based on Control Group 1		Based on Control Group 2	
	(1)	(2)	(3)	(4)
DMA	−0.0098	−0.0383	−0.0086	−0.0388
	(−1.14)	(−3.04)***	(−1.10)	(−3.09)***
DSEO	0.0163	0.0671	0.0157	0.0665
	(1.69)*	(4.73)***	(1.55)	(4.63)***
MW	0.0071	0.0264	0.0074	0.0273
	(0.49)	(2.38)**	(0.52)	(2.59)**
DMW	0.1152	0.1206	0.1137	0.1181
	(6.73)***	(7.03)***	(6.69)***	(6.95)***
Constant	7.6325	5.9656	7.6786	5.0137
	(26.07)***	(17.24)***	(26.72)***	(17.89)***
Year, firm and auditor fixed effects	Yes	No	Yes	No
Year, industry and auditor fixed effects	No	Yes	No	Yes
R^2	0.9432	0.8376	0.9431	0.8373
F-stats	69.69	412.64	58.75	397.37
Sample	7152	7152	5808	5808

Panel B—Descriptive statistics: Treatment and control firms							
		Treatment and control firms Group 1			Treatment and control firms Group 2		
		Treatment	Control	U-test	Treatment	Control	U-test
LNTA	Mean	5.48	5.26		5.32	5.30	
	Median	5.34	5.29	[0.99]	5.18	5.09	[1.12]
LOSS	Mean	0.23	0.26		0.24	0.26	
	Median	0.00	0.00	[1.15]	0.00	0.00	[0.73]
BUSY	Mean	0.81	0.73		0.74	0.71	
	Median	0.93	0.92	[0.87]	0.92	0.90	[0.94]
ROA	Mean (%)	1.44	1.37		1.43	1.39	
	Median (%)	1.21	1.18	[0.78]	1.29	1.27	[0.80]
AUOP	Mean	0.03	0.04		0.04	0.05	
	Median	0.00	0.00	[1.42]	0.00	0.00	[1.35]
BIGAUDIT	Mean	0.83	0.77		0.77	0.76	
	Median	0.81	0.80	[1.11]	0.81	0.79	[1.07]
SQGEOSEG	Mean	1.14	1.09		1.10	1.07	
	Median	1.07	1.05	[0.98]	1.04	1.02	[1. 19]
SQBUSSEG	Mean	2.07	2.04		2.05	2.04	
	Median	1.90	1.89	[1.23]	1.87	1.84	[1.27]
FORSALES	Mean	0.02	0.03		0.02	0.04	
	Median	0.00	0.00	[0.78]	0.00	0.00	[0.90]

(Continues)

TABLE 4 (Continued)

Panel B—Descriptive statistics: Treatment and control firms							
		Treatment and control firms Group 1			Treatment and control firms Group 2		
		Treatment	Control	U-test	Treatment	Control	U-test
SPECIAL	Mean	0.45	0.44		0.50	0.46	
	Median	0.94	0.92	[1.12]	0.94	0.91	[1.17]
TDRATIO	Mean	0.17	0.19		0.15	0.17	
	Median	0.09	0.11	[0.78]	0.10	0.12	[0.92]
DUAUCHANGE	Mean	0.05	0.03		0.04	0.03	
	Median	0.00	0.00	[0.56]	0.00	0.00	[0.73]
MB	Mean	1.43	1.41		1.30	1.26	
	Median	1.21	1.18	[0.76]	1.21	1.17	[0.73]
LITIGATION	Mean	0.25	0.28		0.29	0.30	
	Median	0.00	0.00	[0.59]	0.00	0.00	[0.81]
INHERENT	Mean	0.14	0.21		0.19	0.25	
	Median	0.17	0.19	[0.67]	0.16	0.17	[0.73]
DMA	Mean	0.22	0.27		0.23	0.26	
	Median	0.00	0.00	[1.10]	0.00	0.00	[1.19]
DSEO	Mean	0.06	0.04		0.06	0.05	
	Median	0.00	0.00	[0.78]	0.00	0.00	[0.83]
MW	Mean	0.03	0.04		0.04	0.06	
	Median	0.06	0.05	[0.79]	0.04	0.03	[0.67]
DMW	Mean	0.01	0.02		0.02	0.03	
	Median	0.00	0.00	[0.63]	0.00	0.00	[0.70]
LNAUDFEEADJ	Mean	13.52	13.55		13.56	13.58	
	Median	12.82	13.01	[1.31]	12.65	12.81	[1.37]
Sample		3576	3576		2904	2904	

Note: Panel A of this table presents the regression results on the impact of options listing for the first time for a firm on audit fees, using the difference-in-difference analysis. The sample for this analysis is based on a 6-year period, consisting of 3 before and 3 after options listing events. We use two groups of control firms. In the first group (Group 1), we use the firms that do not have options over the 6-year period surrounding the options listing events. In the second group (Group 2), we use all the firms that never had options over our entire sample period. We report the results with year, firm and auditor fixed effects in Models 1 and 3, and the results with year, industry and auditor fixed effects in Models 2 and 4 utilizing control Groups 1 and 2, respectively. The dependent variable is the natural logarithm of the adjusted audit fee in year *t* (*LNAUDFEEADJ*). Independent variables are *DOPTINILIST*, which takes a value of one for firms with options listed for the first time during the sample period and zero for the firms without listed options; *DPOSTYR*, which takes a value of unity during the post-options-listing years for the firms with listed options and the corresponding years for the matched firms without listed options and zero for the pre-options-listing years for both sub samples; the natural logarithm of total assets in year *t* (*LNTA*); the natural logarithm of non-audit fee in year *t* (*LNNONAFEE*); Loss dummy, which equals one if a firm's average ROA during the period $t-1$, *t* and $t+1$ is negative and zero otherwise (*LOSS*); audit period dummy, which equals one for a firm with reporting date in the period Dec–Mar and zero otherwise (*BUSY*); the ratio of net income before extraordinary items to total assets in year *t* (*ROA*); auditor opinion dummy, which equals one if a firm received a modified audit opinion in year *t* and zero otherwise (*AUOP*); Big 4 auditor dummy, which equals one if the firm is audited by Big 4 audit firm in year *t* and zero otherwise (*BIGAUDIT*); the square root of number of geographical segments in year *t* (*SQGEOSEG*); the square root of number of business segments in year *t* (*SQBUSSEG*); the ratio of foreign sales to total sales (*FORSALES*); Special items dummy, which equals one if the firm reports special items

(Continues)

TABLE 4 (Continued)

in the financial statements in year *t* and zero otherwise (*SPECIAL*); the ratio of total debt to total assets in year *t* (*TDRATIO*); the changes in auditor dummy, which equals one if there is a change in the auditor in the financial year *t* and zero otherwise (*DUAUCHANGE*); the market value of equity to stockholders' equity in year *t* (*MB*); litigation dummy, which equals one if the two-digit SIC code of the firm is from one of the following industries: 28 (chemicals and allied products), 35 (industrial machinery and equipment), 36 (electronic and other electric equipment), 38 (instruments and other related products), 60 (depository institutions), 67 (holding and other investment offices) and 73 (business services) and zero otherwise (*LITIGATION*); the sum of receivables and inventory, scaled by total assets ((*RECT* + *INVT*)/*AT*) in year *t* (*INHERENT*); merger and acquisition activity dummy, which equals one if the firm is engaged in a merger or acquisition in year *t* and zero otherwise (*DMA*); equity issuance dummy, which equal to one if the number of shares outstanding (CSHO) increased by 10% or more in year *t* and zero otherwise (*DSEO*); material weakness dummy, which equals one if the SOX 404(b) internal control opinion discloses a material weakness in year 1 and zero otherwise (*MW*); and audit opinion on internal controls dummy, which equals one if there is a SOX 404(b) audit opinion on internal controls in year *t* and zero otherwise (*DMW*). We cluster the standard error at the firm level and include year, firm and auditor fixed effects in the regression. We winsorize continuous variables at the 1% and 99% levels. We cluster the standard error at the firm level and report *t*-statistics in parentheses. Panel B of this table presents the descriptive statistics for the difference between treatment firms and Control Group 1 and treatment firms and Control Group 2. We present the Mann–Whitney U-test statistics in square brackets.

The symbols ***, ** and * denote significance levels at the 1%, 5% and 10% levels, respectively.

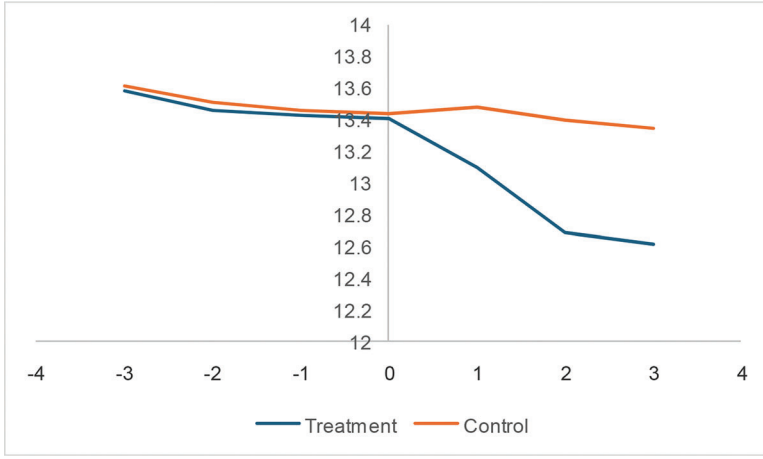

FIGURE 2 Audit fees of the treatment and control firms around options listing events (based on Control Group 2).

listed options during the pre-options listing period. These results further support our arguments that options trading does play a key role in the determination of the audit fee.

5.2 | Instrumental variable regression analysis

We also adopt an instrumental variable regression approach to further address the endogeneity issue between options trading and audit fees. Following Roll et al. (2009), we consider the natural logarithm of open interest in the stock's listed options (*LNOPINTEREST*) and the natural logarithm of "moneyness" (*LNMONEYNESS*) as two plausible exogenous instrumental variables in performing the instrumental variable regression. The open interest in the stock's listed options variable is measured as the average of daily open interest across all options of a stock during the particular year. We measure *MONEYNESS* as the annual average of the daily average of absolute deviation of the exercise price of each traded option from the closing price of the underlying stock.

A good instrument is a variable that satisfies the relevance and exclusion conditions (Roberts & Whited, 2013). Regarding the relevance condition, Roll et al. (2009) argue that moneyness should be related to options trading activity given that informed traders would prefer out-of-the-money (OTM) options because they offer greater leverage while uninformed traders would prefer in-the-money (ITM) options to avoid a risky position. Volatility traders would also avoid OTM options or deep ITM options as the vegas of these options are close to zero. Options trading activity should also be higher when open interest is higher (i.e., there are more open positions in call and put contracts). As such, one would expect that moneyness and open interest will be related to options trading activity. For the exclusion conditions, there is no reason to believe that moneyness or open interest will be related to audit fees in any intrinsic way except through the effect of options trading on audit fees. Therefore, choosing *LNOPINTEREST* and *LNMONEYNESS* as instruments fulfills the relevance and exclusion conditions for identification tests.

In the first stage, we regress our options trading measure (*O/S*) as a function of *LNOPINTEREST* and *LNMONEYNESS* with all control variables used in Model 2 of Table 3 and present the results in panel A of Table 5. We find that *LNOPINTEREST* and *LNMONEYNESS* are significantly and positively related to *O/S*. The *F*-statistics are significant at the 1% level, rejecting the null hypothesis that all coefficients in our first-stage model are zero. Our first-stage *F*-statistics are also much larger than 10, which is the value suggested by Staiger and Stock (1997) for a strong instrument in a two-stage least-squares (2SLS) setting.

In the second stage of regressions, we examine the impact of predicted options trading on the audit fee model and present the results in panel B of Table 5. We find that the predicted options trading measure is significantly and negatively related to audit fees at the 1% level. We conduct several post-estimation tests to check the validity and strength of our instruments. The *Durbin-Wu-Hausman* test statistics are significant at the 1% level in Panel B, suggesting that the options trading variable have endogenous relations with the audit fee, supporting the use of an instrumental variable approach. Our model is not under-identified as suggested by the significant Anderson canonical correlation test statistics at the 1% level. The Cragg–Donald Wald *F*- statistic further shows that the instruments used in the first stage are valid instruments, under the Stock and Yogo (2005) critical values. We also perform the over-identifying restrictions test using the Sargan $\chi 2$ statistics. We find that the Sargan test statistic is insignificant. Thus, we conclude that our instruments are valid, and our model is specified correctly.

5.3 | PSM analysis

We further use PSM analysis to examine whether firms with higher options trading activity would have lower audit fees. This approach helps to mitigate potential selection bias issues that may arise from firm characteristics (e.g., Rosenbaum & Rubin, 1983). Specifically, we compare the audit fees of firms with a higher level of options trading with the audit fees of firms with a lower level of options trading, but which are otherwise comparable. We use Fama and French's 12 industry classifications and employ the annual industry median for the options trading measure as the cut-off value and define firms with high (low) options trading activity as those with above- (below-) median options trading. Firms with high options trading activity are our treatment firms, whereas firms with low options trading activity are our control firms. For each fiscal year, we match our treatment firms with high options trading levels to control firms with low options trading levels based on one-to-one nearest neighbor matching with replacement using our control variables presented in Table 6. We compare the characteristics of firms with high options trading (treatment firms) and those with low options trading (control firms) and show that the mean values of these control variables are similar across treatment and control firms in panel A of Table 6. The audit fees for treatment firms are smaller than those for control firms. We present the regression result using our matched sample in panel B of Table 6. Similar to the analysis in Table 3 using the full sample, the results for the matched sample show that *O/S* has a significantly negative relationship with audit fees. Overall the findings in Table 6 alleviate concerns that selection bias could affect our findings of a negative relation between options trading and audit fees.

TABLE 5 Endogeneity—Predicted options trading and audit fees.

	Panel A – First stage	Panel B—Second stage
LNOPINTEREST	0.0673	
	(18.63)***	
LNMONEYNESS	0.0102	
	(2.78)***	
EXPOPTRAD		−0.0745
		(−3.12)***
Constant	−2.4419	10.0544
	(−14.73)***	(10.25)***
All controls	Yes	Yes
Year, firm and auditor fixed effects	Yes	Yes
R^2	0.8466	0.9284
F-stats	264.96	89.34
Sample	39,388	39,388
Durbin–Wu–Hausman χ^2	48.38	
Under identification test (Anderson—Lagrange Multiplier (LM) statistic):	873.95	
Weak identification test: (Cragg–Donald Wald *F*-statistic)	1287.94	
Overidentification test Sargan (1958) χ^2	27.60	
p-value for Sargan test	0.5986	

Note: This table presents the results addressing endogeneity in the relation between options trading and audit fees using two-stage least squares. Panel A presents the first stage, with the dependent variable being the natural logarithm of the ratio of options trading volume to stock trading volume in year $t-1$ (*O/S*). Instruments are the natural logarithm of open interest in year $t-1$ (*LNOPINTEREST*) and the natural logarithm of moneyness in year $t-1$ (*LNMONEYNESS*). Panel B presents the results on the impact of predicted options trading (*EXPOPTRAD*) on the natural logarithm of the adjusted audit fee in year t (*LNAUDFEEADJ*) as the dependent variable. Control variables are measured in year $t-1$ for first stage and year t in the second stage. We use the following control variables: the natural logarithm of total assets in year t (*LNTA*); the natural logarithm of non-audit fee in year t (*LNNONAFEE*); Loss dummy, which equals one if a firm's average ROA during the period $t-1$, t and $t+1$, is negative and zero otherwise (*LOSS*); audit period dummy, which equals one for a firm with reporting date in the period Dec–Mar and zero otherwise (*BUSY*); the ratio of net income before extraordinary items to total assets in year t (*ROA*); auditor opinion dummy, which equals one if a firm received a modified audit opinion in year t and zero otherwise (*AUOP*); Big 4 auditor dummy, which equals one if the firm is audited by Big 4 audit firm in year t and zero otherwise (*BIGAUDIT*); the square root of number of geographical segments in year t (*SQGEOSEG*); the square root of number of business segments in year t (*SQBUSSEG*); the ratio of foreign sales to total sales (*FORSALES*); Special items dummy, which equals one if the firm reports special items in the financial statements in year t and zero otherwise (*SPECIAL*); the ratio of total debt to total assets in year t (*TDRATIO*); the changes in auditor dummy, which equals one if there is a change in the auditor in the financial year t and zero otherwise (*DUAUCHANGE*); the market value of equity to stockholders' equity in year t (*MB*); litigation dummy, which equals one if the two-digit SIC code of the firm is from one of the following industries: 28 (chemicals and allied products), 35 (industrial machinery and equipment), 36 (electronic and other electric equipment), 38 (instruments and other related products), 60 (depository institutions), 67 (holding and other investment offices) and 73 (business services) and zero otherwise (*LITIGATION*); the sum of receivables and inventory, scaled by total assets ((*RECT* + *INVT*)/*AT*) in year t (*INHERENT*); merger and acquisition activity dummy, which equals one if the firm is engaged in a merger or acquisition in year t and zero otherwise (*DMA*); equity issuance dummy, which equal to one if the number of shares outstanding (*CSHO*) increased by 10% or more in year t and zero otherwise (*DSEO*); material weakness dummy, which equals one if the SOX 404(b) internal control opinion discloses a material weakness in year 1 and zero otherwise (*MW*); and audit opinion on internal controls dummy, which equals one if there is a SOX 404(b) audit opinion on internal controls in year t and zero otherwise (*DMW*). We cluster the standard error at the firm level and include year, firm and auditor fixed effects in the regression. We report *t*-statistics in parentheses. We winsorize continuous variables at the 1% and 99% levels.

The symbols ***, ** and * denote significance levels at the 1%, 5% and 10% levels, respectively.

TABLE 6 Propensity score matching (PSM) analysis.

Panel A: PSM			
	Treatment	**Control**	***t*-test**
LNAUDFEEADJ	11.56	12.97	2.69**
LNTA	6.82	6.39	0.98
LNNONAFEE	8.31	8.86	1.12
LOSS	0.41	0.44	1.19
BUSY	0.96	0.97	0.62
ROA	−0.03	−0.07	1.14
AUOP	0.04	0.06	0.82
BIGAUDIT	0.82	0.80	1.04
SQGEOSEG	1.76	1.67	1.18
SQBUSSEG	2.79	2.28	0.88
FORSALES	0.01	0.01	1.43
SPECIAL	0.77	0.72	1.29
TDRATIO	0.27	0.25	0.44
DUAUCHANGE	0.05	0.07	1.22
MB	1.93	1.88	0.66
LITIGATION	0.05	0.07	0.19
INHERENT	0.24	0.25	0.28
DMA	0.19	0.17	1.12
DSEO	0.08	0.07	0.44
MW	0.02	0.03	1.07
DMW	0.14	0.16	1.12
Panel B: PSM regression			
O/S			−0.1159
			(−5.83)***
Constant			10.5638
			(14.69)***
All controls			Yes
Year, firm and auditor fixed effects			Yes
R^2			0.9259
F-stats			75.93
Sample			9874

Note: Panel A shows the average treatment effects obtained from PSM. Our treatment group comprises firms with high options trading activity, defined as those exceeding the annual Fama and French's 12-industry classification median, whereas firms with low options trading activity are our control firms. Panel B presents the results based on PSM regression. We winsorize continuous variables at the 1% and 99% levels. The variables used in this table are the natural logarithm of the adjusted audit fee (*LNAUDFEEADJ*) in year *t*, the natural logarithm of the ratio of options trading volume to stock trading volume in year $t-1$ (*O/S*), the natural logarithm of total assets in year *t* (*LNTA*); the natural logarithm of non-audit fee in year *t* (*LNNONAFEE*); Loss dummy, which equals one if a firm's average ROA during the period $t-1$, *t* and $t+1$ is negative and zero otherwise (*LOSS*); audit period dummy, which equals one for a firm with reporting date in the period Dec–Mar and zero otherwise (*BUSY*); the ratio of net income before extraordinary items to total assets in year *t* (*ROA*); auditor opinion dummy, which equals one if a firm received a modified audit opinion in year *t* and zero otherwise (*AUOP*); Big 4 auditor dummy, which equals one if the firm

(Continues)

TABLE 6 (Continued)

is audited by Big 4 audit firm in year *t* and zero otherwise (*BIGAUDIT*); the square root of number of geographical segments in year *t* (*SQGEOSEG*); the square root of number of business segments in year *t* (*SQBUSSEG*); the ratio of foreign sales to total sales (*FORSALES*); Special items dummy, which equals one if the firm reports special items in the financial statements in year *t* and zero otherwise (*SPECIAL*); the ratio of total debt to total assets in year *t* (*TDRATIO*); the changes in auditor dummy, which equals one if there is a change in the auditor in the financial year *t* and zero otherwise (*DUAUCHANGE*); the market value of equity to stockholders' equity in year *t* (*MB*); litigation dummy, which equals one if the two-digit SIC code of the firm is from one of the following industries: 28 (chemicals and allied products), 35 (industrial machinery and equipment), 36 (electronic and other electric equipment), 38 (instruments and other related products), 60 (depository institutions), 67 (holding and other investment offices) and 73 (business services) and zero otherwise (*LITIGATION*); the sum of receivables and inventory, scaled by total assets ((*RECT* + *INVT*)/*AT*) in year *t* (*INHERENT*); merger and acquisition activity dummy, which equals one if the firm is engaged in a merger or acquisition in year *t* and zero otherwise (*DMA*); equity issuance dummy, which equal to one if the number of shares outstanding (*CSHO*) increased by 10% or more in year *t* and zero otherwise (*DSEO*); material weakness dummy, which equals one if the SOX 404(b) internal control opinion discloses a material weakness in year 1 and zero otherwise (*MW*); and audit opinion on internal controls dummy, which equals one if there is a SOX 404(b) audit opinion on internal controls in year *t* and zero otherwise (*DMW*). We cluster the standard error at the firm level and include year, firm and auditor fixed effects in the regression. We report *t*-statistics in parentheses.
The symbols ***, ** and * denote significance levels at the 1%, 5% and 10% levels, respectively.

5.4 | Change analysis

To further alleviate the endogeneity concern, we conduct a change-in-variable analysis and investigate the relation between the change in options trading intensity and the change in audit pricing. In the change analysis, cross-sectional variation in firms is differenced away, which allows us to focus on the time-series variation. As a result, the change analysis mitigates the omitted variable biases to the extent that such omitted variables change slowly over time (S. Chen et al., 2011).

We use the following equation to conduct the change-in-variable test:

$$\Delta LNAUDFEEADJ_{i,t} = \alpha + \beta_1 \Delta O/S_{i,t-1} + \beta_2 \Delta controls_{i,t} + \varepsilon_{i,t}. \quad (2)$$

The dependent variable is $\Delta LNAUDFEEADJ$, which is the change in the logarithmic value of the adjusted audit fee from year $t-1$ to year t. Our main independent variable is changes in options trading (ΔO/S) from year $t-2$ to year $t-1$. We also include changes in all control variables in the baseline model as additional variables. As we can see in the results in Table 7, we find a significantly negative relationship between ΔO/S and $\Delta LNAUDFEEADJ$. These results are consistent with our baseline results reported in Table 3. The finding also highlights that the relation between options trading and audit fees is not simply due to cross-sectional variations, and time-series changes in options trading are also related to changes in audit fees.

5.5 | Robustness analysis

We perform additional tests to ensure the robustness of our findings. First, given that the size of the firm alone generally accounts for a large proportion of the variation in audit fee (see Hay et al., 2006), and options trading measure (*O/S*) are highly correlated with the firm size as we demonstrate in Table 2, a potential concern regarding our main result is that the inclusion of the options trading variable in the audit fee model is likely to moderate what is otherwise just a firm size effect on fees. To address this concern, we use *AFEEADJTA* (adjusted audit fee*100 divided by total assets) as the dependent variable and run the baseline model. We present the results in panel A of Table 8. We find that the options trading measure is significantly and negatively related to *AFEEADJTA*. This finding emphasizes the result that firms with higher levels of options trading do incur lower audit fees.

TABLE 7 Change analysis.

	ΔLNAUDFEEADJ	*ΔLNAUDFEEADJ*
ΔO/S	−0.1047	−0.0959
	(−8.13)***	(−7.50)***
Constant	9.5376	11.4496
	(57.48)***	(34.49)***
Changes in all controls	No	Yes
Year, firm and auditor fixed effects	Yes	Yes
R^2	0.9373	0.9466
F-stats	89.53	72.33
Sample	27,864	27,864

Note: This table presents the regression results on the impact of changes in options trading on changes in audit fees. The dependent variable is *ΔLNAUDFEEADJ*, which is the change in the logarithmic value of the adjusted audit fee. Our main independent variable is changes in options trading (ΔO/S). We also include changes in all control variables in the baseline model as additional variables. We calculate the changes in the following control variables: the natural logarithm of total assets in year *t* (*LNTA*); the natural logarithm of non-audit fee in year *t* (*LNNONAFEE*); Loss dummy, which equals one if a firm's average ROA during the period *t* − 1, *t* and *t* + 1 is negative and zero otherwise (*LOSS*); audit period dummy, which equals one for a firm with reporting date in the period Dec–Mar and zero otherwise (*BUSY*); the ratio of net income before extraordinary items to total assets in year *t* (*ROA*); auditor opinion dummy, which equals one if a firm received a modified audit opinion in year *t* and zero otherwise (*AUOP*); Big 4 auditor dummy, which equals one if the firm is audited by Big 4 audit firm in year *t* and zero otherwise (*BIGAUDIT*); the square root of number of geographical segments in year *t* (*SQGEOSEG*); the square root of number of business segments in year *t* (*SQBUSSEG*); the ratio of foreign sales to total sales (*FORSALES*); Special items dummy, which equals one if the firm reports special items in the financial statements in year *t* and zero otherwise (*SPECIAL*); the ratio of total debt to total assets in year *t* (*TDRATIO*); the changes in auditor dummy, which equals one if there is a change in the auditor in the financial year *t* and zero otherwise (*DUAUCHANGE*); the market value of equity to stockholders' equity in year *t* (*MB*); litigation dummy, which equals one if the two-digit SIC code of the firm is from one of the following industries: 28 (chemicals and allied products), 35 (industrial machinery and equipment), 36 (electronic and other electric equipment), 38 (instruments and other related products), 60 (depository institutions), 67 (holding and other investment offices) and 73 (business services) and zero otherwise (*LITIGATION*); the sum of receivables and inventory, scaled by total assets ((*RECT* + *INVT*)/*AT*) in year *t* (*INHERENT*); merger and acquisition activity dummy, which equals one if the firm is engaged in a merger or acquisition in year *t* and zero otherwise (*DMA*); equity issuance dummy, which equals one if the number of shares outstanding (*CSHO*) increased by 10% or more in year *t* and zero otherwise (*DSEO*); material weakness dummy, which equals one if the SOX 404(b) internal control opinion discloses a material weakness in year 1 and zero otherwise (*MW*); and audit opinion on internal controls dummy, which equals one if there is a SOX 404(b) audit opinion on internal controls in year *t* and zero otherwise (*DMW*). We cluster the standard errors at the firm level and winsorize continuous variables at the 1% and 99% levels. We report *t*-statistics in parentheses. The symbol *** denotes the significance level at the 1% level.

Hay (2013) suggests the inclusion of city effects in the analysis, citing the association between the presence in large, expensive cities and fluctuations in audit fees. Furthermore, it is recommended to incorporate audit firm and audit office fixed effects to address time-invariant influences stemming from distinctive billing practices within individual audit firms and offices. As the second robustness check, we also include another set of fixed effects for the city where the auditor is located. The results in panel B of Table 8 show that including the city of the auditor fixed effects, together with fixed effects for year, firm and auditor, does not change our finding. We employ adjusted audit fees as our primary measure, following the measure outlined by Barua et al. (2020) in the baseline setting. As the third robustness check, we examine the impact of options trading on unadjusted audit fees. Despite this variation in measurement, our results consistently uphold the observed negative relationship between options trading and audit fees. However, the estimated coefficient of *DUAUCHANGE* is significantly positive. We present the results in panel C of Table 8.

Auditors would set the fee based on the effort they expect to put in. Options trading improves the information environment, which may reduce auditors' effort. Therefore, in the final robustness check, we control for auditors' effort

TABLE 8 Robustness checks.

	Panel A	Panel B	Panel C	Panel D
O/S	−0.0858	−0.1833	−0.2395	−0.1495
	(−7.15)***	(−10.16)***	(−12.49)***	(−5.86)***
LNAUDDELAY				0.3732
				(8.69)***
DAUCHANGE			0.3183	
			(2.73)***	
Constant	0.4796	10.8449	12.8216	9.5647
	(24.72)***	(42.71)***	(41.62)***	(16.63)***
All controls	Yes	Yes	Yes	Yes
Year, firm and auditor fixed effects	Yes	Yes	Yes	Yes
City of the auditor fixed effects	No	Yes	No	No
R^2	0.8897	0.9320	0.9419	0.9486
F-stats	86.74	76.68	115.78	45.32
Sample	39,388	29,240	39,388	39,388

Note: This table reports the results on the robustness checks using alternative model specifications. Panel A presents the results on the effect of options trading on *AFEEADJTA* controlling for baseline controls and year, firm and auditor fixed effects. We measure *AFEEADJTA* as adjusted Audit fee*100 divided by total assets at the balance sheet date in year *t*. Panel B reports the results on the effect of options trading on *LNAUDFEEADJ* controlling for baseline controls and year, firm, auditor and city of the auditor fixed effects. Panel C presents the regression results on the impact of options trading on unadjusted audit fees, which is the logarithmic value of the unadjusted audit fee. Panel D presents the regression results on the impact of options trading on audit fees controlling for auditors' efforts *(LNAUDDELAY)*. We use the following control variables: the natural logarithm of total assets in year *t* (*LNTA*); the natural logarithm of non-audit fee in year *t* (*LNNONAFEE*); Loss dummy, which equals one if a firm's average ROA during the period *t* − 1, *t* and *t* + 1 is negative and zero otherwise (*LOSS*); audit period dummy, which equals one for a firm with reporting date in the period Dec–Mar and zero otherwise (*BUSY*); the ratio of net income before extraordinary items to total assets in year *t* (*ROA*); auditor opinion dummy, which equals one if a firm received a modified audit opinion in year *t* and zero otherwise (*AUOP*); Big 4 auditor dummy, which equals one if the firm is audited by Big 4 audit firm in year *t* and zero otherwise (*BIGAUDIT*); the square root of number of geographical segments in year *t* (*SQGEOSEG*); the square root of number of business segments in year *t* (*SQBUSSEG*); the ratio of foreign sales to total sales (*FORSALES*); Special items dummy, which equals one if the firm reports special items in the financial statements in year *t* and zero otherwise (*SPECIAL*); the ratio of total debt to total assets in year *t* (*TDRATIO*); the changes in auditor dummy, which equals one if there is a change in the auditor in the financial year *t* and zero otherwise (*DUAUCHANGE*); the market value of equity to stockholders' equity in year *t* (*MB*); litigation dummy, which equals one if the two-digit SIC code of the firm is from one of the following industries: 28 (chemicals and allied products), 35 (industrial machinery and equipment), 36 (electronic and other electric equipment), 38 (instruments and other related products), 60 (depository institutions), 67 (holding and other investment offices) and 73 (business services) and zero otherwise (*LITIGATION*); the sum of receivables and inventory, scaled by total assets ((*RECT* + *INVT*)/*AT*) in year *t* (*INHERENT*); merger and acquisition activity dummy, which equals one if the firm is engaged in a merger or acquisition in year *t* and zero otherwise (*DMA*); equity issuance dummy, which equals one if the number of shares outstanding (*CSHO*) increased by 10% or more in year *t* and zero otherwise (*DSEO*); material weakness dummy, which equals one if the SOX 404(b) internal control opinion discloses a material weakness in year 1 and zero otherwise (*MW*); and audit opinion on internal controls dummy, which equals one if there is a SOX 404(b) audit opinion on internal controls in year *t* and zero otherwise (*DMW*). We cluster the standard errors at the firm level and winsorize continuous variables at the 1% and 99% levels. We report *t*-statistics in parentheses.

The symbols ***, ** and * denote significance levels at the 1%, 5% and 10% levels, respectively.

using the natural logarithm of audit delay (*LNAUDDELAY*) as a proxy for auditors' efforts to examine whether options trading influences audit fees beyond that are influenced by audit effort. We measure audit delay as the number of days between the auditor's signature date and the date of the fiscal year-end. We present the results in panel D of Table 8.[3] We find that the estimated coefficient on the audit delay (*LNAUDDELAY*) is significantly positive, while the estimated coefficient on options trading (*O/S*) is significantly negative, indicating that auditors who input more effort in the audit process charge higher audit fees, while firms with higher options trading pay lower audit fees. Our baseline results hold controlling for auditors' efforts.

6 | ECONOMIC CHANNELS

In this section, we examine the underlying channels driving the negative relation between options trading and audit fees. Simunic (1980) and Bronson et al. (2017) argue that audit fees are driven by audit work/effort or expected losses for auditors. As options markets improve informational efficiency, firms with higher options trading will be likely to have a lower probability of misstatements and lawsuits as a result of the mitigated information asymmetries, and, hence, auditors will charge lower fees. We therefore investigate whether options trading reduces audit fees via its impact on misstatements, lawsuits and auditor efforts. Since higher options trading leads to reductions in real activity manipulation (Delshadi et al., 2023), improvements in management knowledge (Y. Chen et al., 2021) and efficient allocation of corporate resources (Anagnostopoulou et al., 2023; Blanco & Wehrheim, 2017), we predict that firms with higher options trading will have lower-levels of reported material weaknesses and auditor opinions on internal controls. As such, we also examine the impact of options trading on material weaknesses and auditor opinions on internal controls.

6.1 | Options trading and restatements

In this section, we investigate the effect of options trading on the probability of restatement. Prior research posits that high-quality information reduces information asymmetries in the stock market (Bhushan, 1989; Diamond, 1985; Verrecchia, 1982). Kim and Verrecchia (1994, 1997) conjecture that restatements are considered as low-quality information because investors believe that past and future accounting information is of low quality and is not reliable. Cao et al. (2012) find that companies with higher reputations produce higher-quality financial reports, and these companies with higher reputations are less likely to misstate their financial statements. Further, Chen et al. (2014) find that firms with material restatements experience a decrease in the credibility of accounting earnings and an increase in information asymmetry after restatement announcements. Literature on options trading shows that it enhances informational efficiency and increases the earnings quality by reducing accruals-based earnings management (Hao & Li, 2022) and real earnings manipulation (Delshadi et al., 2023). Synthesizing all these considerations, we predict that firms with higher options trading will have a lower likelihood of restatements.

Following Michelon et al. (2019) and DeFond and Lennox (2017), we define a restatement as occurring when a firm restates the financial statement of its financial report. We collect financial restatement data from the Audit Analytics database and construct a dummy variable, restatement ($RESTATE_{i,t}$), which equals one when a firm restates its financial statement in a given year and zero otherwise. We conduct the following probit regression to examine the relation between *O/S* and restatement.

$$RESTATE_{i,t} = \alpha + \beta_1 O/S_{i,t-1} + \beta_2 CONTROLS_{i,t} + \text{YearFE} + \text{IndustryFE} + \text{AuditorFE} + \varepsilon_{i,t}. \quad (3)$$

[3] We use the logarithm of number of days between the signature date of the audit opinion and the date of fiscal year-end as a proxy for auditors' effort.

Our dependent variable is the probability of restatement (*RESTATE*). We use all the control variables we used in the baseline model in Equation (1) and cluster the standard errors at the firm level.[4] We present the results of our test in Model 1 of panel A in Table 9. We find that the *O/S* measure is negatively related to the probability of a financial restatement. To obtain more insight into the economic significance of our results, we rely on the marginal effects. In terms of economic significance, in Model 1, we find that a one standard deviation increase in *O/S* is associated with a reduction of 2.45 percentage points in the probability of misstatements. These findings suggest that options trading reduces the probability of misstatements, a key determinant of litigation risk for auditors.

6.2 | Options trading and lawsuits

In this section, we test the relation between options trading and lawsuits. Prior studies show that restatements of audited financial statements are the key driver for lawsuits against auditors (Hennes et al., 2008; Lennox & Li, 2014; Palmrose & Scholz, 2004). Given that higher options trading results in higher firm values (Roll et al., 2009), lower accruals-based earnings management (Hao & Li, 2022), lower real earnings manipulation (Delshadi et al., 2023) and higher managerial learning (Y. Chen et al., 2021), we argue that higher options trading decreases the likelihood of lawsuits on auditors.

To capture the client risk that auditors face, following Jha and Chen (2015), we define lawsuits (*LS*) as a binary variable that takes the value of one if, in any given year, a lawsuit is initiated and zero otherwise. A lawsuit is defined based on one of the following Audit Analytics categories: Accounting and Auditing Enforcement Release (category 54), Accounting Malpractice (category 2) and Financial Reporting (Category 48). Jha and Chen (2015) assert that the *LS* variable is a comprehensive measure of the client risk that auditors face because it captures both the financial reporting risk and the client business risk. We conduct the following probit regression to examine the relation between O/S and lawsuits.

$$LS_{i,t} = \alpha + \beta_1 O/S_{i,t-1} + \beta_2 CONTROLS_{i,t} + \text{YearFE} + \text{IndustryFE} + \text{AuditorFE} + \varepsilon_{i,t}. \quad (4)$$

Our dependent variable is the probability of lawsuits (*LS*). We use all the control variables in the baseline model in Equation (1), with the standard errors clustered at the firm level. We present the results of the probit regression results in Model 2 of panel A in Table 9. We find that *O/S* is negatively and significantly related to the likelihood of a lawsuit at the 1% level, indicating that options trading has a significantly negative impact on the probability of lawsuits, which, in turn, reduces the audit fees charged by auditors. That is, the lower probability of lawsuits for firms with higher options trading provides a plausible explanation for the lower audit fees in firms with higher options trading previously reported. In terms of economic significance, the marginal effect reported in Model 2 suggests that a one standard deviation increase in *O/S* is associated with a reduction of 1.24 percentage points in the probability of lawsuits.

As a robustness check, we also examine how the impact of options trading on audit fees differs between firms belonging to "litigation-prone industries" (*HLITIGATION*) and "other industries" (*LLITIGATION*). If options trading reduces audit fees through the lower likelihood of lawsuits for firms with higher options trading, we should observe a stronger effect of options trading on audit fees for firms operating in "litigation-prone industries." We present the results in Table IA2 of the Internet Appendix. We find that the impact of options trading on the audit fee is, indeed, more pronounced for firms in litigation-prone industries. Overall, then, we provide further supportive evidence that the litigation risk provides additional insights into the effect of options trading upon audit fees.

[4] We thank the reviewer for suggesting us to use the probit model. We use industry rather than firm fixed effects for the probit models to mitigate the finite sample bias in discrete choice models (Greene, 2004). We obtained similar results in Table IA1 when we use the linear probability model instead of the probit model.

TABLE 9 The impact of options trading on audit outcome.

Panel A—The impact of options trading on restatements and lawsuits		
	(1)	**(2)**
	RESTATE	***LS***
O/S	−0.2756	−0.3834
	(−7.61)***	(−5.02)***
	[−0.0556]***	[−0.0281]***
All controls	Yes	Yes
Year, industry and auditor fixed effects	Yes	Yes
Pseudo R^2	0.0298	0.0644
Sample	39,381	14,464
Panel B -The impact of options trading on material weaknesses (*MW*) and auditor opinion on internal controls (*DMW*)		
	(1)	**(2)**
	MW	***DMW***
O/S	−0.8481	−0.2928
	(−16.58)***	(−5.71)***
	[−0.0656]***	[−0.0237]***
All controls	Yes	Yes
Year, industry and auditor fixed effects	Yes	Yes
Pseudo R^2	0.2535	0.0979
Sample	29,187	29,214

Note: Panel A of this table presents the probit regression results on the impact of options trading on the probability of restatements (*RESTATE*) and on the probability of lawsuits (*LS*). Panel B shows the probit regression results for the impact of options trading on the probability of material weakness (*MW*) and auditor opinion on internal controls (*DMW*). We use the following control variables: the natural logarithm of total assets in year *t* (*LNTA*); the natural logarithm of non-audit fee in year *t* (*LNNONAFEE*); Loss dummy, which equals one if a firm's average ROA during the period *t* − 1, *t* and *t* + 1 is negative and zero otherwise (*LOSS*); audit period dummy, which equals one for a firm with reporting date in the period Dec–Mar and zero otherwise (*BUSY*); the ratio of net income before extraordinary items to total assets in year *t* (*ROA*); auditor opinion dummy, which equals one if a firm received a modified audit opinion in year *t* and zero otherwise (*AUOP*); Big 4 auditor dummy, which equals one if the firm is audited by Big 4 audit firm in year *t* and zero otherwise (*BIGAUDIT*); the square root of number of geographical segments in year *t* (*SQGEOSEG*); the square root of number of business segments in year *t* (*SQBUSSEG*); the ratio of foreign sales to total sales (*FORSALES*); Special items dummy, which equals one if the firm reports special items in the financial statements in year *t* and zero otherwise (*SPECIAL*); the ratio of total debt to total assets in year *t* (*TDRATIO*); the changes in auditor dummy, which equals one if there is a change in the auditor in the financial year *t* and zero otherwise (*DUAUCHANGE*); the market value of equity to stockholders' equity in year *t* (*MB*); litigation dummy, which equals one if the two-digit SIC code of the firm is from one of the following industries: 28 (chemicals and allied products), 35 (industrial machinery and equipment), 36 (electronic and other electric equipment), 38 (instruments and other related products), 60 (depository institutions), 67 (holding and other investment offices) and 73 (business services) and zero otherwise (*LITIGATION*); the sum of receivables and inventory, scaled by total assets ((*RECT* + *INVT*)/*AT*) in year *t* (*INHERENT*); merger and acquisition activity dummy, which equals one if the firm is engaged in a merger or acquisition in year *t* and zero otherwise (*DMA*); equity issuance dummy, which equal to one if the number of shares outstanding (CSHO) increased by 10% or more in year *t* and zero otherwise (*DSEO*); material weakness dummy, which equals one if the SOX 404(b) internal control opinion discloses a material weakness in year 1 and zero otherwise (*MW*); and audit opinion on internal controls dummy, which equals one if there is a SOX 404(b) audit opinion on internal controls in year *t* and zero otherwise (*DMW*). We cluster the standard errors at the firm level and winsorize continuous variables at the 1% and 99% levels. We report *t*-statistics in parentheses and marginal effects in square brackets.
The symbols ***, ** and * denote significance levels at the 1%, 5% and 10% levels, respectively.

6.3 | Options trading, material weaknesses and auditors' opinions on internal control

In this section, we examine the impact of options trading on material weaknesses and auditors' opinions on internal controls. Previous studies (Barua et al., 2020; Bryan et al., 2018) have emphasized the role of material weaknesses (*MW*) and auditors' opinions on internal controls (*DMW*) in examining the determinants of audit fees via the information environment channel. Easley and O'Hara (2004) report that the presence of low financial reporting quality could lead to an increase in information asymmetry between firm insiders and outsiders. Recently, Lobo et al. (2020) argue firms with material weaknesses have lower financial reporting precision and this lower reporting precision (a) increases divergence of investor opinion with regard to firm valuation and (b) facilitates managers' withholding of negative information, which increases the information asymmetry between managers and outside investors. Recent literature shows that options trading improves underlying stock price informativeness and information acquisition by both options and stock investors (J. Cao et al., 2023) and reduces accruals-based earnings management (Hao & Li, 2022) and real earnings manipulation (Delshadi et al., 2023). Given that options trading is associated with a higher-quality information environment and lower earnings management, we argue that higher options trading decreases the likelihood of material weaknesses (*MW*) and auditors' opinions on internal controls (*DMW*).

We conduct the following probit regression to examine the relation between *O/S* and material weaknesses (*MW*).

$$MW_{i,t} = \alpha + \beta_1 O/S_{i,t-1} + \beta_2 CONTROLS_{i,t} + \text{YearFE} + \text{IndustryFE} + \text{AuditorFE} + \varepsilon_{i,t}. \quad (5)$$

Our dependent variable is the probability of material weakness (*MW*). We use all the control variables we used in the baseline model in Equation (1) and cluster the standard errors at the firm level. We present the results of the probit regression results on the relation between *O/S* and material weaknesses in Model 1 of panel B in Table 9. We find that options trading measure is negatively associated with material weaknesses, indicating that firms with higher options trading are less likely to have reported material weaknesses. In terms of economic significance, in Model 1 of panel B in Table 9, we find that a one standard deviation increase in *O/S* will produce a 2.89 percentage points reduction in the probability of material weaknesses.

We examine the relation between *O/S* and auditors' opinions on internal controls (*DMW*) utilizing the following probit regression equation.

$$DMW_{i,t} = \alpha + \beta_1 O/S_{i,t-1} + \beta_2 CONTROLS_{i,t} + \text{YearFE} + \text{IndustryFE} + \text{AuditorFE} + \varepsilon_{i,t}. \quad (6)$$

Our dependent variable is the probability of auditors' opinion on internal controls (*DMW*). We use all the control variables we used in the baseline model in Equation (1). The results, presented in panel B of Table 9, reveal a consistent negative relationship between options trading (*O/S*) and the likelihood of auditors expressing opinions on internal controls. This significant result suggests that a higher prevalence of options trading is associated with a diminished likelihood of auditors providing opinions on the effectiveness of internal controls. In terms of economic significance, in Model 2 of panel B in Table 9, we find that a one standard deviation increase in *O/S* will produce a 1.04 percentage points reduction in the probability of auditors' opinion of internal controls.

6.4 | Options trading and auditor effort

Jha and Chen (2015) argue that auditors consider the integrity of the management when deciding how much effort to exert in auditing a particular firm. In this section, we directly examine the impact of options trading on auditor efforts. We argue that if options trading reduces informational asymmetry problems for auditors, there will be a negative relation between options trading activity and the number of days to audit. Following Jha and Chen (2015), we measure the

number of days to complete an audit as the number of days between the auditor's signature date and the date of the fiscal year-end.

We conduct the following ordinary least squares (OLS) regression to examine the relation between *O/S* and auditors' efforts (*LNAUDDELAY*).

$$LNAUDDELAY_{i,t} = \alpha + \beta_1 O/S_{i,t-1} + \beta_2 CONTROLS_{i,t} + \text{YearFE} + \text{FirmFE} + \text{AuditorFE} + \varepsilon_{i,t}. \quad (7)$$

We use two proxies for auditors' efforts. Following Jha and Chen (2015), we use the logarithm of the number of days to audit (*LNAUDDELAY*) as the first measure of auditors' effort. Following Rice and Weber (2012), we use audit fees scaled by the square root of total assets (*AFEEADJ/SQRTTA*) as our second measure of auditors' effort. We use all the control variables we used in the baseline model in Equation (1) and cluster the standard errors at the firm level.

We present the results of the OLS regression on the relation between *O/S* and auditors' effort in Models 1 and 2 of Table 10 using *LNAUDDELAY* and *AFEEADJ/SQRTTA*, respectively, as proxies for auditors' effort. We show that the options trading measure is significantly and negatively related to *LNAUDDELAY* and *AFEEADJ/SQRTTA* in Models 1 and 2, respectively. These findings indicate that auditors spend less effort in those firms with higher options trading. The lower levels of auditor effort for firms with higher options trading provide a plausible explanation for the negative impact of options trading on audit fees reported earlier.

7 | AUDITOR FEATURES, OPTIONS TRADING AND AUDIT FEES

In this section, we investigate how the impact of options trading on audit fees varies depending on the distance between the auditor and client firm and between specialist and non-specialized auditors. Prior research shows that firms employing industry specialist auditors are associated with higher earnings quality (Balsam et al., 2003; Krishnan, 2003). Further, Choi et al. (2012) and Jha and Chen (2015) argue that a shorter distance between the auditor and the client reduces the information asymmetry problem. We predict that the negative effects of options trading on audit fees will be more pronounced for firms located at further distances from the auditor and in the case of non-specialist auditors.

7.1 | Auditor–client distance

We investigate in this section the moderating effect of the geographic proximity between auditor and client impacts on the relation between options trading and audit fees. Choi et al. (2012) document that auditors residing closer to their clients (local auditors) have informational advantages that help them constrain opportunistic earnings management and improve audit quality. If options trading affects audit fees because of its role in alleviating information asymmetry problems, we argue that the effect of options trading on audit fees should be stronger for auditors residing further away from the firms.

We estimate the geographic distance between the cities where the auditor's practicing office and the client's headquarters are located. Similar to Choi et al. (2012) and Jha and Chen (2015), we classify the firms into two groups: local auditor (*SDISTANCE*) and non-local auditor (*LDISTANCE*), with the *SDISTANCE* groups comprising firms located within a 100-km radius or in the same metropolitan statistical area (MSA) where the firm's auditor is located and the *LDISTANCE* groups consisting of firms that are neither within a 100-km radius nor in the same MSA. We examine how the distance between the auditor location and firm headquarters affects the relation between options trading and audit fees by utilizing a dummy variable that reflects a long distance from the auditor's office to the firm (*LDISTANCE*) and interaction variable *LDISTANCE*O/S* in addition to *O/S* and other control variables. We present the results in panel A of Table 11. We find that the estimated coefficient of the interaction variable *LDISTANCE*O/S* is significantly negative,

TABLE 10 The impact of options trading on auditors' efforts.

	LNAUDDELAY	*AFEEADJ/SQRTTA*
O/S	−0.0762	−0.0624
	(−7.78)***	(−6.82)***
Constant	4.0067	1.2488
	(26.39)***	(14.97)***
All controls	Yes	Yes
Year, firm and auditor fixed effects	Yes	Yes
R^2	0.6278	0.8378
F-stats	134.76	47.52
Sample	39,388	39,388

Note: This table presents the regression results on the impact of options trading on auditor effort. We use two measures of auditors' efforts: the natural logarithm of the number of days between the signature date of the audit opinion and the date of fiscal year-end (*LNAUDDELAY*) and the adjusted audit fees scaled by square root of total assets (*AFEEADJ/SQRTTA*). We use the following control variables: the natural logarithm of total assets in year *t* (*LNTA*); the natural logarithm of non-audit fee in year *t* (*LNNONAFEE*); Loss dummy, which equals one if a firm's average ROA during the period $t-1$, t and $t+1$ is negative and zero otherwise (*LOSS*); audit period dummy, which equals one for a firm with reporting date in the period Dec–Mar and zero otherwise (*BUSY*); the ratio of net income before extraordinary items to total assets in year *t* (*ROA*); auditor opinion dummy, which equals one if a firm received a modified audit opinion in year *t* and zero otherwise (*AUOP*); Big 4 auditor dummy, which equals one if the firm is audited by Big 4 audit firm in year *t* and zero otherwise (*BIGAUDIT*); the square root of number of geographical segments in year *t* (*SQGEOSEG*); the square root of number of business segments in year *t* (*SQBUSSEG*); the ratio of foreign sales to total sales (*FORSALES*); Special items dummy, which equals one if the firm reports special items in the financial statements in year *t* and zero otherwise (*SPECIAL*); the ratio of total debt to total assets in year *t* (*TDRATIO*); the changes in auditor dummy, which equals one if there is a change in the auditor in the financial year *t* and zero otherwise (*DUAUCHANGE*); the market value of equity to stockholders' equity in year *t* (*MB*); litigation dummy, which equals one if the two-digit SIC code of the firm is from one of the following industries: 28 (chemicals and allied products), 35 (industrial machinery and equipment), 36 (electronic and other electric equipment), 38 (instruments and other related products), 60 (depository institutions), 67 (holding and other investment offices) and 73 (business services) and zero otherwise (*LITIGATION*); the sum of receivables and inventory, scaled by total assets ((*RECT* + *INVT*)/*AT*) in year *t* (*INHERENT*); merger and acquisition activity dummy, which equals one if the firm is engaged in a merger or acquisition in year *t* and zero otherwise (*DMA*); equity issuance dummy, which equal to one if the number of shares outstanding (*CSHO*) increased by 10% or more in year *t* and zero otherwise (*DSEO*); material weakness dummy, which equals one if the SOX 404(b) internal control opinion discloses a material weakness in year 1 and zero otherwise (*MW*); and audit opinion on internal controls dummy, which equals one if there is a SOX 404(b) audit opinion on internal controls in year *t* and zero otherwise (*DMW*). We cluster the standard error at the firm level and include year, firm and auditor fixed effects in the regression. We report *t*-statistics in parentheses. We winsorize continuous variables at the 1% and 99% levels.
The symbols ***, ** and * denote significance levels at the 1%, 5% and 10% levels, respectively.

indicating that the impact of options trading on audit fees is stronger when the auditor is located further away from the audited firm.

7.2 | Auditor specialization

Audit firms that specialize in specific industries build an expertise in these specific areas and put greater efforts into building reputations of good quality and through such efforts they can use this knowledge gleaned to provide more effective audits. Prior research shows that firms employing industry specialist auditors are associated with higher earnings quality (Balsam et al., 2003; Krishnan, 2003). Srinidhi et al. (2014) find that strongly governed family firms are more likely to choose specialist auditors and exhibit higher earnings quality than non-family firms. Given

TABLE 11 Distance to the firm and Industry specialist auditors.

	Panel A	Panel B
O/S	−0.1154	−0.1123
	(−3.72)***	(−3.24)***
LDISTANCE	0.1051	
	(1.04)	
LDISTANCE O/S*	−0.0775	
	(−2.68)**	
NONSPECIALIST		0.0789
		(0.73)
NONSPECIALIST O/S*		−0.0829
		(−3.89)***
Constant	10.4094	10.1904
	(57.34)***	(36.00)***
All controls	Yes	Yes
Year, firm and auditor fixed effects	Yes	Yes
R^2	0.9220	0.9213
F-stats	87.42	147.52
Sample	22,888	27,264

Note: Panel A of this table reports the impacts of the distance of the audit office from firm's headquarters on the relation between options trading and audit fees. We use *O/S*, a dummy variable for long distance from the auditor's office to the firm (*LDISTANCE*) and interaction variable *LDISTANCE*O/S* as key independent variables while including other baseline control variables. Panel B of this table reports the impacts of specialized versus non-specialized auditors on the relation between options trading and audit fees. We use *O/S*, a dummy variable non-specialist auditor (*NON-SPECIALIST*) and interaction variable *NON-SPECIALIST*O/S* as key independent variables while including other baseline control variables. We use the following control variables: the natural logarithm of total assets in year *t* (*LNTA*); the natural logarithm of non-audit fee in year *t* (*LNNONAFEE*); Loss dummy, which equals one if a firm's average ROA during the period $t-1$, t and $t+1$ is negative and zero otherwise (*LOSS*); audit period dummy, which equals one for a firm with reporting date in the period Dec–Mar and zero otherwise (*BUSY*); the ratio of net income before extraordinary items to total assets in year *t* (*ROA*); auditor opinion dummy, which equals one if a firm received a modified audit opinion in year *t* and zero otherwise (*AUOP*); Big 4 auditor dummy, which equals one if the firm is audited by Big 4 audit firm in year *t* and zero otherwise (*BIGAUDIT*); the square root of number of geographical segments in year *t* (*SQGEOSEG*); the square root of number of business segments in year *t* (*SQBUSSEG*); the ratio of foreign sales to total sales (*FORSALES*); Special items dummy, which equals one if the firm reports special items in the financial statements in year *t* and zero otherwise (*SPECIAL*); the ratio of total debt to total assets in year *t* (*TDRATIO*); the changes in auditor dummy, which equals one if there is a change in the auditor in the financial year *t* and zero otherwise (*DUAUCHANGE*); the market value of equity to stockholders' equity in year *t* (*MB*); litigation dummy, which equals one if the two-digit SIC code of the firm is from one of the following industries: 28 (chemicals and allied products), 35 (industrial machinery and equipment), 36 (electronic and other electric equipment), 38 (instruments and other related products), 60 (depository institutions), 67 (holding and other investment offices) and 73 (business services) and zero otherwise (*LITIGATION*); the sum of receivables and inventory, scaled by total assets ((*RECT* + *INVT*)/*AT*) in year *t* (*INHERENT*); merger and acquisition activity dummy, which equals one if the firm is engaged in a merger or acquisition in year *t* and zero otherwise (*DMA*); equity issuance dummy, which equal to one if the number of shares outstanding (CSHO) increased by 10% or more in year *t* and zero otherwise (*DSEO*); material weakness dummy, which equals one if the SOX 404(b) internal control opinion discloses a material weakness in year 1 and zero otherwise (*MW*); and audit opinion on internal controls dummy, which equals one if there is a SOX 404(b) audit opinion on internal controls in year *t* and zero otherwise (*DMW*). We cluster the standard error at the firm level and include year, firm and auditor fixed effects in the regression. We report *t*-statistics in parentheses. We winsorize continuous variables at the 1% and 99% levels. The symbols ***, ** and * denote significance levels at the 1%, 5% and 10% levels, respectively.

TABLE 12 Information environment, options trading and audit fees.

	ANALYSTS	*PIN*	*OPACITY*	*RajgopalDD*
O/S	−0.0797	−0.1014	−0.1312	−0.1278
	(−1.99)**	(−2.72)***	(−4.25)***	(−4.18)***
LANALYSTS	0.0733			
	(1.07)			
LANALYSTS O/S*	−0.0639			
	(−2.82)***			
HPIN		0.0324		
		(1.40)		
HPIN O/S*		−0.1044		
		(−3.48)***		
HOPACITY			0.0177	
			(1.48)	
HOPACITY O/S*			−0.0329	
			(−1.76)*	
HRajgopalDD				0.0171
				(1.22)
HRajgopalDD O/S*				−0.0540
				(−2.31)**
Constant	10.0959	10.6423	10.5715	10.4531
	(36.02)***	(32.37)***	(57.96)***	(70.88)***
All controls	Yes	Yes	Yes	Yes
Year, firm and auditor fixed effects	Yes	Yes	Yes	Yes
R^2	0.9397	0.9239	0.9247	0.9237
F-stats	111.64	58.68	78.93	87.48
Sample	39,388	12,783	24,994	23,843

Note: This table reports the impact of the degree of information asymmetry on the options trading-audit fees relation. For each fiscal year and using median values, we assign firms into the high information asymmetry group if they have lower analysts following (*LANALYSTS*), higher probability of informed trading (*HPIN*), higher opacity (*HOPACITY*) and higher Rajgopal et al. (2011) *DD* measure (*HRajgopalDD*). We use *O/S*, a dummy variable for the high information asymmetry group, their interactions and the following control variables: the natural logarithm of total assets in year *t* (*LNTA*); the natural logarithm of non-audit fee in year *t* (*LNNONAFEE*); Loss dummy, which equals one if a firm's average ROA during the period $t-1$, t and $t+1$ is negative and zero otherwise (*LOSS*); audit period dummy, which equals one for a firm with reporting date in the period Dec–Mar and zero otherwise (*BUSY*); the ratio of net income before extraordinary items to total assets in year *t* (*ROA*); auditor opinion dummy, which equals one if a firm received a modified audit opinion in year *t* and zero otherwise (*AUOP*); Big 4 auditor dummy, which equals one if the firm is audited by Big 4 audit firm in year *t* and zero otherwise (*BIGAUDIT*); the square root of number of geographical segments in year *t* (*SQGEOSEG*); the square root of number of business segments in year *t* (*SQBUSSEG*); the ratio of foreign sales to total sales (*FORSALES*); Special items dummy, which equals one if the firm reports special items in the financial statements in year *t* and zero otherwise (*SPECIAL*); the ratio of total debt to total assets in year *t* (*TDRATIO*); the changes in auditor dummy, which equals one if there is a change in the auditor in the financial year *t* and zero otherwise (*DUAUCHANGE*); the market value of equity to stockholders' equity in year *t* (*MB*); litigation dummy, which equals one if the two-digit SIC code of the firm is from one of the following industries: 28 (chemicals and allied products), 35 (industrial machinery and equipment), 36 (electronic and other electric equipment), 38 (instruments and other related products), 60 (depository institutions), 67 (HOLDING and other investment offices) and 73 (Business services) and zero otherwise (*LITIGATION*); the sum of receivables and inventory, scaled by total assets ((*RECT* + *INVT*)/*AT*) in year *t* (*INHERENT*); merger and acquisition activity dummy, which equals one if the firm is engaged in a merger or acquisition in year *t* and zero otherwise (*DMA*); equity issuance dummy, which

(Continues)

TABLE 12 (Continued)

equal to one if the number of shares outstanding (*CSHO*) increased by 10% or more in year *t* and zero otherwise (*DSEO*); material weakness dummy, which equals one if the SOX 404(b) internal control opinion discloses a material weakness in year 1 and zero otherwise (*MW*); and audit opinion on internal controls dummy, which equals one if there is a SOX 404(b) audit opinion on internal controls in year *t* and zero otherwise (*DMW*). We cluster the standard error at the firm level and winsorize continuous variables at the 1% and 99% levels. We report *t*-statistics in parentheses.
The symbols ***, ** and * denote significance levels at the 1%, 5% and 10% levels, respectively.

that firms with industry specialist auditors have better information environments with higher earnings quality than non-specialist auditors, we argue that the effect of options trading on audit fees will be stronger for firms with non-specialist auditors. In line with Stein (2019), we calculate the audit fee revenue generated by an audit office in a two-digit SIC industry relative to the total fee revenue generated by that office for each year. Then, we create a dummy variable for a non-specialist auditor (*NON-SPECIALIST*), which takes a value of one if an audit firm does not have the largest or second largest market share in a year in a two-digit industry and zero otherwise.

We examine whether the impact of options trading on audit fees is stronger for firms with non-specialist auditors by utilizing a dummy variable *NON-SPECIALIST* and an interaction variable *NON-SPECIALIST* O/S* in addition to *O/S* and other control variables. We present the results in panel B of Table 11. We find that the estimated coefficients of *NON-SPECIALIST* O/S* are significantly negative. This finding indicates that the impact of options trading on audit fees is more pronounced for firms with non-specialized auditors.

8 | FURTHER CROSS-SECTIONAL ANALYSES

Since informational asymmetries are central to our arguments and hypotheses for the effects of options trading upon the audit fee, we provide further cross-sectional analyses on the relation between options trading and audit fees based on firms with differing levels of their information environment, earnings quality and governance quality.

8.1 | Information environment and earnings quality

We examine the effect of the information environment and earnings quality on the association between options trading and audit fees. Previous studies (e.g., see Daley et al., 1995) argue that lower levels of accounting transparency are likely to increase information asymmetry which, in turn, results in both increased complexity and risk related to the audit process. Bhattacharya et al. (2013) find that poor earnings quality is significantly and incrementally associated with higher information asymmetry. In addition, Cho et al. (2017) find a negative relation between accruals quality and audit hours/fees, indicating that auditors increase their audit efforts by modifying audit procedures in such cases, thereby leading to higher fees. If a client's financial reports are misstated, auditors face significant reputational and litigation costs as we argued previously, and, therefore, they increase audit effort and the risk premium that they charge for firms with poor earnings quality and higher information asymmetries (Hennes et al., 2013; Hribar et al., 2014). The above discussion suggests that the impact of options trading on the audit fee will be more pronounced among firms with lower earnings quality or a poorer information environment since the benefits of improvements in the information environment by options trading will be higher in such cases.

We use the number of analysts following the stock (*ANALYSTS)* and the probability of informed trading (*PIN*) developed by Easley et al. (1998) as proxies for the information asymmetry level. We measure earnings quality using the Hutton et al. (2009) opacity measure of earnings management (*OPACITY*) and the Rajgopal et al. (2011) *DD* measure (*RajgopalDD*), based on an approach proposed by Dechow and Dichev (2002) and J. Francis et al. (2005). We partition our sample based on the yearly median values of *ANALYSTS*, *PIN*, *OPAQUE* and *RajgopalDD*. We use *LANALYSTS* and

TABLE 13 Corporate governance and the impact of options trading on audit fees.

	BIND	*IODED*	*TOIND*
O/S	−0.1053	−0.1019	−0.0376
	(−2.17)**	(−2.04)**	(−1.26)
LBIND	0.0204		
	(1.45)		
*LBIND*O/S*	−0.0673		
	(−2.55)**		
LIODED		0.0199	
		(1.01)	
*LIODED*O/S*		−0.0557	
		(−2.88)***	
LTOIND			0.0143
			(0.43)
*LTOIND*O/S*			0.0365
			(−4.39)***
Constant	10.4344	10.252	11.6483
	(28.35)***	(36.93)***	(67.4)***
All controls	Yes	Yes	Yes
Year, firm and auditor fixed effects	Yes	Yes	Yes
R^2	0.9371	0.9398	0.9267
F-stats	47.52	58.94	74.93
Sample	12,051	29,054	19,759

Note: This table reports the results on the impacts of the strength of the governance structure on the relation between options trading and audit fees. We use *O/S*, a dummy variable for lower governance, and the interaction variable between lower governance dummy and *O/S* and other controls in the regressions. Our proxies for lower governance are lower board independence (*LBIND*), lower dedicated ownership (*LIODED*) and lower takeover index (*LTOIND*). For each fiscal year, we assign firms to the low governance group based on the median value of each of the governance measures. We use the following control variables: the natural logarithm of total assets in year *t* (*LNTA*); the natural logarithm of non-audit fee in year *t* (*LNNONAFEE*); Loss dummy, which equals one if a firm's average ROA during the period $t-1$, t and $t+1$ is negative and zero otherwise (*LOSS*); audit period dummy, which equals one for a firm with reporting date in the period Dec–Mar and zero otherwise (*BUSY*); the ratio of net income before extraordinary items to total assets in year *t* (*ROA*); auditor opinion dummy, which equals one if a firm received a modified audit opinion in year *t* and zero otherwise (*AUOP*); Big 4 auditor dummy, which equals one if the firm is audited by Big 4 audit firm in year *t* and zero otherwise (*BIGAUDIT*); the square root of number of geographical segments in year *t* (*SQGEOSEG*); the square root of number of business segments in year *t* (*SQBUSSEG*); the ratio of foreign sales to total sales (*FORSALES*); Special items dummy, which equals one if the firm reports special items in the financial statements in year *t* and zero otherwise (*SPECIAL*); the ratio of total debt to total assets in year *t* (*TDRATIO*); the changes in auditor dummy, which equals one if there is a change in the auditor in the financial year *t* and zero otherwise (*DUAUCHANGE*); the market value of equity to stockholders' equity in year *t* (*MB*); litigation dummy, which equals one if the two-digit SIC code of the firm is from one of the following industries: 28 (chemicals and allied products), 35 (industrial machinery and equipment), 36 (electronic and other electric equipment), 38 (instruments and other related products), 60 (depository institutions), 67 (holding and other investment offices) and 73 (business services) and zero otherwise (*LITIGATION*); the sum of receivables and inventory, scaled by total assets ((*RECT* + *INVT*)/*AT*) in year *t* (*INHERENT*); merger and acquisition activity dummy, which equals one if the firm is engaged in a merger or acquisition in year *t* and zero otherwise (*DMA*); equity issuance dummy, which equal to one if the number of shares outstanding (*CSHO*) increased by 10% or more in year *t* and zero otherwise (*DSEO*); material weakness dummy, which equals one if the SOX 404(b) internal control opinion discloses a material weakness in year 1 and zero otherwise (*MW*); and audit opinion on internal controls dummy, which equals one if there is a SOX 404(b) audit opinion on internal controls in year *t* and zero otherwise (*DMW*). We cluster the standard error at the firm level and include year, firm and auditor fixed effects in the regression. We report *t*-statistics in parentheses. We winsorize continuous variables at the 1% and 99% levels. The symbols ***, ** and * denote significance levels at the 1%, 5% and 10% levels, respectively.

HPIN as proxies for higher information asymmetry levels. *LANALYSTS* is a dummy variable that takes the value of one if *ANALYSTS* is equal to or less than its median value of each year and zero otherwise. *HPIN* is a dummy variable that takes the value of one if *PIN* is greater than its median value of each year and zero otherwise. We use *HOPACITY* and *HRajgopalDD* as proxies for lower earnings quality levels. *HOPACITY* is a dummy variable that takes the value of one if *OPACITY* is greater than its median value of each year and zero otherwise. *HRajgopalDD* is a dummy variable that takes the value of one if *RajgopalDD* is greater than its median value of each year and zero otherwise. For our analyses, we augment our baseline regression model with each of the proxies for information asymmetry level and earnings quality measures and the interaction of these measures with *O/S*.

We present the results in Table 12. Consistent with the main results in Table 3, we find that the *O/S* measure is negatively related to audit fees. More importantly, we observe negative and significant coefficients for the interaction terms: *LANALYSTS* * *O/S*, *HPIN* * *O/S*, *HOPACITY* * *O/S* and *HRajgopalDD* * *O/S*. These results suggest that the effect of *O/S* on audit fees is stronger for firms with a poorer information environment, as characterized by having lower analyst following (*LANALYSTS*), higher probability of informed trading (*HPIN*), higher opacity (*HOPACITY*) and higher Rajgopal et al. (2011)'s *DD* measure (*HRajgopalDD*).

8.2 | Agency costs, monitoring and information asymmetry

Strong corporate governance mechanisms can mitigate agency problems or reduce information asymmetries through utilizing independent boards of directors and by providing share-based compensation packages to managers (Shleifer & Vishny, 1997). In contrast, weak corporate governance leads to serious agency conflicts and informational asymmetries between shareholders and managers (Armstrong et al., 2010). We argue therefore that the negative relation between options trading and audit fees will be more pronounced for firms with weaker internal and external governance mechanisms. We use the proportion of independent directors (*BIND*) following Rosenstein and Wyatt (1990) and Ryan and Wiggins (2004), dedicated institutional ownership (*IODED*) following Bushee (1998) and Hartzell and Starks (2003) and the index of takeover susceptibility (*TOIND*) following Cain et al. (2017) as our measures for the strength of internal and external governance mechanisms. Firms with lower board independence, lower dedicated institutional ownership and lower takeover susceptibility are those with weaker internal and external governance mechanisms.

We divided our sample based on the yearly median values of *BIND*, *IODED* and *TOIND*. *LBIND* is a dummy variable that takes the value of one if *BIND* is equal to or less than its median value of each year and zero otherwise. *LIODED* is a dummy variable that takes the value of one if *IODED* is equal to or less than its median value of each year and zero otherwise. *LTOIND* is a dummy variable that takes the value of one if *TOIND* is equal to or less than its median value of each year and zero otherwise. To examine the moderating effect of governance mechanisms on the relation between options trading and audit fees, we augment our baseline regression model with each of our proxies of governance measures and the interaction of these measures with *O/S*. We present the results in Table 13. We find that *O/S* exerts a larger effect on audit fees for firms with lower dedicated institutional ownership (*LIODED*), weaker board independence (*LBIND*) and lower takeover susceptibility or higher takeover protection (*LTOIND*). These findings indicate that the effect of options trading on audit fees is more pronounced among firms with lower governance mechanisms.

9 | CONCLUSION

We examine the role of options trading on audit fees. We provide evidence to indicate that options trading does have a significant and negative effect on audit fees. Our findings are robust when we address potential endogeneity issues related to options trading using several methods, including DiD analysis based on options listing events, instrumental variable regression analysis, PSM analysis and change analysis. We further show that there are lower probabilities of

lawsuits and misstatements for firms with higher options trading. Auditors also spend a lower number of days on the audit of firms with higher levels of options trading.

In further tests, we find that the relation between options trading and audit fees is stronger when auditors are subject to higher information asymmetry problems, such as when auditors are located further away from the clients or are less specialized in the client's industry. We also investigate how the negative relation between options trading and the audit fee differs across different firm information environments. We find that the negative relation between options trading and the audit fee is more pronounced for firms with higher levels of information asymmetry and lower earnings quality. We also document that the negative relation between options trading and audit fees is stronger for firms with poor governance mechanisms.

Our study sheds light on the considerable influence of options trading on the information environment surrounding a firm. Our findings underscore the relevance of options trading for key stakeholders, notably auditors. The observed relationship between options trading and lower audit fees suggests a nuanced interplay between financial market activities and the costs associated with ensuring financial transparency and accountability. This perspective enhances our comprehension of the intricate relationships between market dynamics, information quality and the financial considerations involved in audit services.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from a number of third-party providers that are cited in the paper. Restrictions apply to the availability of these data as they require a paid subscription.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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APPENDIX: VARIABLE DEFINITIONS

Variable name	Definition	Source
Measures related to options trading		
DOPTINILIST	A dummy variable that equals one for firms with options listed the first time during our sample period and zero otherwise	Option Metrics
DPOSTYR	A dummy variable that equals one in the post-options-listing years for the firms with listed options and the corresponding matched firms without listed options and zero for the pre-options-listing years of these firms	
O/S	The natural logarithm of the ratio of options trading volume to stock trading volume	Option Metrics
LNMONEYNESS	Logarithm of *MONEYNESS*	Option Metrics
LNOPINTEREST	Logarithm of *OPEN INTEREST*	Option Metrics
MONEYNESS	The annual average of the daily average of absolute deviation of the exercise price of each traded option from the closing price of the underlying stock	Option Metrics
OPEN INTEREST	The average of daily open interest across all options of a stock	Option Metrics
Measures related to audit		
AUDFEEADJ	Adjusted audit fee in dollars at the balance sheet date in year *t*. Following Barua et al. (2020), we corrected audit fees during the year of auditor changes	Audit Analytics
AFEEADJTA	Adjusted audit fee*100 divided by the total assets at the balance sheet date in year *t*	Audit Analytics
AFEEADJ/SQRTTA	Adjusted audit fees scaled by square root of total assets (*AFEEADJ/SQRTTA*) as a measure of audit effort (Rice & Weber, 2012)	Audit Analytics
AUDIT DELAY	Number of days between the signature date of the audit opinion and the date of fiscal year-end	Audit Analytics
AUOP	A dummy variable that equals one if a firm received a modified audit opinion in year *t* and zero otherwise	Audit Analytics
BIGAUDIT	A dummy variable that equals one for a Big 4 audit firm and zero for other firms in year *t*	Audit Analytics
DMW	Dummy variable that equals one if there is a SOX 404(b) audit opinion on internal controls in year *t* and zero otherwise	Audit Analytics
DUAUCHANGE	A dummy variable that equals one if there is a change in the auditor in the financial year *t* and zero otherwise	Audit Analytics
LNAUDDELAY	Natural logarithm of the number of days between the signature date of the audit opinion and the date of fiscal year-end	Audit Analytics
LNAUDFEE	Natural logarithm of audit fee at the balance sheet date in year *t*	Audit Analytics
LNAUDFEEADJ	Natural logarithm of adjusted audit fee at the balance sheet date in year *t*	Audit Analytics
LNNONAFEE	Natural logarithm of non-audit fee at the balance sheet date in year *t*	Audit Analytics
LS	A dummy variable that measures the probability of lawsuits. It equals one if there is a lawsuit in the financial year *t* and zero otherwise. A lawsuit is defined based on one of the following Audit Analytics categories: Accounting and Auditing Enforcement Release (category 54), Accounting Malpractice (category 2) and Financial Reporting (Category 48)	Audit Analytics

(Continues)

Variable name	Definition	Source
MW	A dummy variable that equals one if the SOX 404(b) internal control opinion discloses a material weakness in year *t* and zero otherwise	Audit Analytics
NON-SPECIALIST	A dummy variable that takes a value of one if an audit firm does not have the largest or second largest market share in a year in a two-digit industry and zero otherwise	Audit Analytics
RESTATE	A dummy variable, restatement ($RESTATE_{i,t}$), which equals one when a firm restates its financial statement in a given year and zero otherwise	Audit Analytics
Other control variables		
All controls	All the control variables are used in Model 2 of Table 3	
ANALYSTS	Monthly average of the number of analysts following a firm over a 12-month period in the financial year *t*	I/B/E/S
BIND	The percentage of independent directors on the board in year $t-1$. We first use the BoardEX database to obtain this variable. We extract data for firm years with missing values from the institutional shareholder services (ISS) database	BoardEx/ISS
BUSSEG	The number of business segments in year *t*	Compustat
BUSY	A dummy variable that equals one for a firm with reporting date in the period Dec–Mar in year *t* and zero otherwise	Compustat
DMA	A dummy variable that equals one if the firm is engaged in a merger or acquisition and zero otherwise in year *t*	Compustat
DSEO	*DSEO* is equal to one if the number of shares outstanding (*CSHO*) increased by 10% or more and zero otherwise in year *t*	Compustat
FORSALES	Foreign sales scaled by total sales in year *t*	Compustat
HLITIGATION	This dummy variable takes the value of one if the firm is in the high litigation industries and zero otherwise. Following Hogan and Jeter (1999), we define the dummy variable *HLITIGATION* as being equal to 1 if the two-digit SIC code of the firm is from one of the following industries: 28 (chemicals and allied products),35 (industrial machinery and equipment), 36 (electronic and other electric equipment), 38 (instruments and other related products), 60 (depository institutions), 67 (holding and other investment offices) and 73 (business services) and zero otherwise	Compustat
HOPACITY	A dummy variable that takes the value of one if *OPACITY* is greater than its median value of each year and zero otherwise	Compustat
HPIN	A dummy variable that takes the value of one if PIN is greater than its median value of each year and zero otherwise	Stephen Brown's website
HRajgopalDD	A dummy variable that takes the value of one if *RajgopalDD* is greater than its median value of each year and zero otherwise	Compustat
IODED	Percentage of dedicated institutional ownership in year *t*. We calculate the yearly percentages of shares outstanding held by dedicated institutional investors, taking the average over the four quarters of the firm's financial year *t* using data from the Thomson Reuters Institutional Holdings (13F) database. Our classification of dedicated institutions is based on Bushee (1998)	13F
INHERENT	This is the sum of receivables and inventory, scaled by total assets ((*RECT* + *INVT*)/*AT*) in year *t*	Compustat
LANALYSTS	A dummy variable that takes the value of one if *ANALYSTS* is equal to or less than its median value of each year and zero otherwise	I/B/E/S

(Continues)

Variable name	Definition	Source
LBIND	A dummy variable that takes the value of one if BIND is equal to or less than its median value of each year and zero otherwise	BoardEx/ISS
LIODED	A dummy variable that takes the value of one if *IODED* is equal to or less than its median value of each year and zero otherwise	
LITIGATION	Following Hogan and Jeter (1999), we define the dummy variable *LITIGATION* as being equal to one if the two-digit SIC code of the firm is from one of the following industries: 28 (chemicals and allied products), 35 (industrial machinery and equipment), 36 (electronic and other electric equipment), 38 (instruments and other related products), 60 (depository institutions), 67 (holding and other investment offices) and 73 (business services) and zero otherwise	Compustat
LNTA	Natural logarithm of total assets in year *t*	Compustat
LOSS	A dummy variable that equals one for a firm's average ROA during the period $t-1$, t and $t+1$ is negative and zero otherwise	Compustat
LTOIND	Dummy variable that takes the value of one if *TOIND* is equal to or less than its median value of each year and zero otherwise	Compustat
MB	Market value of equity (*CSHO* PRCC_F*) divided by the stockholders' equity in year *t*	Compustat
OPACITY	The moving sum of the absolute value of discretionary accruals over the 3 years from $t-1$ to $t-3$, where discretionary accruals are calculated based on the modified Jones model (Dechow et al., 1995)	Compustat
PIN	Probability of insider trading (*PIN*), obtained from http://scholar.rhsmith.umd.edu/sbrown/pin-data	Stephen Brown's website
RajgobalDD	It is a measure of earnings quality. It is calculated as the standard deviation of firm residuals, over the period $t-4$ to t using eq. 1(a) in Rajgopal and Venkatachalam (2011)	
ROA	The ratio of net income before extraordinary items to total assets (*IB/AT*) in year *t*	Compustat
GEOSEG	The number of geographic segments in year *t*	Compustat
SPECIAL	Special items dummy that equals one if the firm reports special items in the financial statements in year *t* (Compustat SPI) and zero otherwise	Compustat
SQBUSSEG	The square root of the number of business segments in year *t*	Compustat
SQGEOSEG	The square root of the number of geographic segments in year *t*	Compustat
TA	Total assets at the balance sheet date in year *t*	Compustat
TDRATIO	The ratio of total debt to total assets in year *t*. Total debt = Long term debt + Debt in current liabilities in year *t*	Compustat
TOIND	The takeover index in year *t*, obtained from Cain et al. (2017)	Cain et al. (2017)