Audit fees and corporate innovation: Auditors' response to corporate innovation

Kim, Hyung-Tae and Lee, Seungwon and Park, Sung-Jin and Lee, Brandon

California State University, Fresno, Penn State University Harrisburg, Indiana University South Bend, Indiana University Northwest

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Audit Fees and Corporate Innovation

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Abstract
Purpose - Investigates the extent to which a client's innovative effort affects the level of audit effort and whether the innovative-effort efficiency can attenuate the demand for greater audit effort associated with a client's risky research-and-development (R&D) investments.
Design/methodology/approach - We treat R&D expenditure as an input measure and the patent obtained/cited in a given year as an output measure of a firm's innovative effort. We estimate innovation efficiency as the number of patents granted to a firm in a given year, scaled by its R&D capital. As a proxy for audit effort, we use audit fees. Combining firm-year observations for fiscal years 2000 to 2010 from Compustat, patent data from the United States Patent and Trademark Office, and Audit Analytics provided a sample of 11,646 observations from 2,051 unique firms.
Findings - Results confirm that a client firm's strategic emphasis on corporate innovations may require greater audit effort. However, we find evidence that the efficiency of a firm's innovative effort can attenuate the demand for heightened audit effort against risky innovative efforts, implying that the external auditor's role is not necessarily detrimental to corporate innovation, which suggests that the efficiency of a firm's innovation effort lowers the client business risk perceived by an auditor related to corporate innovation.
Originality/value - Contributes to a stream of literature identifying facilitators and impediments to corporate innovation. Our findings also complement an emerging body of literature on the effect of a firm's business strategies on the auditor's decision. Prior studies have not considered the input–output conversion of a firm's R&D expenditure as something that the firm values. By using the number of patents obtained and cited as an output measure of a firm's innovative effort, we extend understanding of the influence of a firm's business strategies on the level of audit effort.

Keywords: Corporate innovation, Auditors, Research and development, Risk management

Paper type: Research paper

1. Introduction

In this paper, we investigate the extent to which a client's innovative effort affects the level of audit effort and whether the innovative-effort efficiency can attenuate the demand for greater audit effort associated with a client's risky research-and-development (R&D) investments (Holmstrom, 1989). We define innovative effort as a firm's strategic emphasis on corporate innovation that incorporates the conversion of R&D expenditure into knowledge assets such as patents.

Corporate innovation is closely related to auditor's risk of material misstatements and the audit risk for two reasons: complexity and uncertainty. First, the accounting for corporate innovation is complex with research and development arrangements (FASB ASC 730) and fair value measurement (FASB ASC 350). The auditor not only needs to verify the fair value of the corporate innovation, such as patents, initially, but also is mandated to perform impairment test subsequently (PCAOB AS 2502, AICPA AU 328). Second, while corporate innovation is a source of a firm's competitiveness in the product market, a strategic emphasis on innovation and product differentiation may entail greater uncertainty and a more unstable information environment, thereby leading to higher business risk. According to Auditing Standards (AS 2110 and AU-C 320), the auditor gathers the evidence to see if the company identifies its business risk and prepares processes to mitigate the risk. In regards this, the auditor needs to identify the business risk anticipated from unsuccessful corporate innovation, i.e. future deterioration of a client firm's economic condition, and assess risk of material misstatements related to the corporate innovation. Moreover, the corporate innovation requires extensive professional judgment, partner, senior manager, and/or specialists are involved in the auditing to confirm the reasonableness of the assumptions and the fairness of the transactions.

To the extent that an auditor recognizes the complexity and uncertainty, an increased risk of material misstatements arising from the firm's innovative effort can be perceived as an increased audit risk, requiring more competent auditors and greater audit effort (Bentley *et al.*, 2013; Godfrey and Hamilton, 2005; Johnstone, 2000; Stanley, 2011; Lobo *et al.* 2018). However, a firm's greater ability to innovate, as demonstrated by a track record of successful R&D investments, can mitigate the business risk and increase firm value (Hirshleifer *et al.*, 2013). Higher efficiency in a firm's innovative effort can signal its managerial ability, which affects financial reporting quality and auditor's risk assessment (Demerjian *et al.*, 2013; Krishnan and Wang, 2015). Nevertheless, prior studies on the auditor's response to a client's innovative effort have focused primarily on the intensity of a firm's R&D expenditure and often failed to consider the innovation efficiency that can attenuate the uncertainty arising from risky R&D investments. To better understand an auditor's response to corporate innovation, we investigate whether a firm's innovative effort and innovation efficiency collectively affect the level of audit effort. We are motivated to study the relation between corporate innovation and the level of audit effort because an external auditor's strict monitoring of long-term investments for corporate innovation may inadvertently lead to managers' myopic decision-making (Graham *et al.*, 2005). From an auditor's perspective, a client firm's innovative effort may be linked to the risk of performance deterioration attributable to unsuccessful R&D investments and the threat of real earnings management due to its discretionary nature (Commerford *et al.*, 2016; Roychowdhury, 2006). More conservative auditors may, therefore, increase their audit effort and restrict managers' options in meeting short-term performance targets, which, unintentionally, impedes the client firm's innovative effort (Chy and Hope, 2018). However, a firm's past ability in converting R&D expenditure into valuable knowledge assets can assuage an auditor's concern for the client business risk attributable to risky R&D investments. Similarly, Krishnan and Wang (2015) suggested that an auditor perceives a lower audit risk from a firm with greater managerial ability, which is manifested by lower audit fees and a lower likelihood of issuing going-concern opinions. Considering these collectively, we conjecture that, while a firm's innovative effort demands heightened audit effort to mitigate greater client business risk, higher innovation efficiency would decrease the risk of material misstatements.

In our empirical investigation, we treat R&D expenditure as an input measure and the patent obtained/cited in a given year as an output measure of a firm's innovative effort (Gunny and Zhang, 2014; Koh and Reel, 2015). Following Hirshleifer *et al.* (2013), we estimate innovation efficiency as the number of patents granted to a firm in a given year, scaled by its R&D capital, measured as the past five years' R&D expenditure, with 20% annual depreciation. As an alternative measure, we use the patents' forward citation in lieu of the number of patents granted and re-estimated a firm's innovation efficiency. As a proxy for audit effort, we use audit fees, consistent with prior literature (e.g. Bentley *et al.*, 2013; Hackenbrack and Knechel, 1997).

Using 11,646 firm-year observations from 2000 and 2010, we find that both measures of a firm's innovative effort − R&D intensity and patent counts − are positively associated with audit fees. Our findings also indicate that high innovation efficiency, measured by the number of patents obtained or forward citation, scaled by R&D capital, is negatively associated with audit fees. Collectively, our results suggest that a firm's innovation activities are perceived by auditors as an increased audit risk, requiring greater audit effort, whereas a firm's innovation efficiency has a mitigating role on business risk. Our results are found to be robust through tests using a matched sample, by industry and size, and a two-stage least squares regression using industry peers' patenting activity as the instrumental variable. In addition, we find that the positive relationship between R&D intensity and audit fees is attenuated by high analyst coverage, suggesting that the information intermediary role of analysts may have a similar positive effect of the risk-mitigation role played by innovation efficiency related to higher uncertainty arising from a firm's innovative effort. However, the risk-mitigation effect of analyst coverage is not observed for firms with high patent activity or high innovation efficiency, indicating that the relevance of analysts' information role is limited to the audit pricing of R&D intensity.

Our study makes two important contributions. First, we contribute to a stream of literature identifying facilitators and impediments to corporate innovation. Prior studies have identified several obstacles to corporate innovation, including corporate taxes (Mukherjee *et al.*, 2017), banking-sector distress (Nanda and Nicholas, 2014), the threat of hostile takeovers (Atanassov, 2013), and accounting conservatism (Chang *et al.*, 2015). While Chy and Hope (2018) find that conservative auditors' scrutiny of a firm's financial reporting may impede corporate innovation by inducing managers' myopic decisions, it is not known whether the auditor's inclination for heightened audit effort is tempered by the client firm's innovation efficiency. Our results corroborate that a client firm's strategic emphasis on corporate innovations may require greater audit effort to provide reasonable assurance in its financial reporting (Bentley *et al.*, 2013; Godfrey and Hamilton, 2005). However, we also provide evidence suggesting that the efficiency of a firm's innovative effort can attenuate the demand for heightened audit effort against risky innovative efforts. This implies that the role of the external auditor is not necessarily detrimental to corporate innovation. Rather, our findings suggest that the efficiency of a firm's innovation effort lowers the client business risk perceived by an auditor related to corporate innovation. Second, our findings complement an emerging literature on the effect of a firm's business strategies on the auditor's decision. Although prior studies, using Miles and Snow's (1978) typology of business strategies, have included the intensity of R&D expenditure as a component of a firm's business strategy (e.g. Bentley *et al.*, 2013; Bentley-Goode *et al.*, 2017; Chen *et al.*, 2017), they have not considered the input–output conversion of a firm's R&D expenditure as something that the firm values. By using the number of patents obtained as an output measure of a firm's innovative effort, we extend the findings of Bentley *et al.* (2013) on the influence of a firm's business strategies on the level of audit effort.

The paper proceeds as follows. Section 2 presents a literature review and develops hypotheses. Section 3 describes the data and empirical models used in our study. Section 4 reports the empirical results, which is followed by concluding remarks in section 5.

2. Related literature and hypotheses development

The economic theory of endogenous growth suggests that technological innovation is an "engine of growth" (Grossman and Helpman, 1994). According to Accenture's (2016) survey of corporate executives, more than 80% of executives believe that their firms' long-term strategies are highly dependent on corporate innovation. In line with this strategic importance given to corporate innovation, a large body of accounting and finance literature has documented that corporate innovative activities, such as R&D, are associated with future sales growth and profitability improvement, thereby leading to an increase in firm value (e.g. Ali *et al.*, 2012; Chan *et al.*, 2001; Eberhart *et al.*, 2004;. Lev and Sougiannis, 1996). Recently, considerable literature has investigated several factors affecting corporate innovation, including corporate taxes (Mukherjee *et al.*, 2017), CEO's personal risk-taking attitude (Sunder *et al.*, 2017), banking development (Amore *et al.*, 2013), strong corporate governance (Atanassov, 2013), and accounting conservatism (Chang *et al.*, 2015).

In addition to these external constraints, the extent of a firm's innovative effort is shaped by its competitive strategy, balancing exploitation of existing knowledge and more radical exploration/innovation (Benner and Tushman, 2003). Prior studies have suggested that auditors respond to their client's business strategy by adjusting the level of audit effort or the likelihood of issuing control weakness or going-concern opinions (Bentley *et al.*, 2013; Bentley-Goode *et al.*, 2017; Chen *et al.*, 2017).

2.1 Client's business strategy and audit effort

For the planning of an audit engagement, audit standards require that an auditor obtain sufficient understanding of a client's business, environment, and its strategies that may affect the risk of material misstatement (American Institute of Certified Public Accountants (AICPA), 2006) [1]. Miles and Snow (1978) categorize four distinct business strategies to respond to changing competitive environment: prospectors; defenders; analyzers; and reactors. Prospectors are firms that remain as pioneers in product and market developments and intend to maintain their competitive position by pursuing aggressive corporate innovation. By contrast, defenders commit little toward corporate innovation and product development. Rather, they compete based on the price or quality of their products. Analyzers follow an intermediate strategy between prospector and defender, whereas reactors do not have a coherent competitive strategy but provide impromptu responses to external forces (Hambrick, 1983).

Following Miles and Snow's (1978) typology, Bentley *et al.* (2013) develop a measure capturing the inclination of a firm's business strategy toward that of prospector and find that the firms are inclined to follow a prospector strategy showed a higher likelihood of financial misreporting (such as SEC's AAER enforcement, shareholder lawsuits, or financial restatements) and auditors correspondingly exert greater audit effort and charge higher audit fees to compensate for higher auditor business risk arising from the client's business strategy. In addition, it has been documented that the innovation-oriented prospector strategy is associated with a higher likelihood of disclosing internal control material weakness (ICMW) and issuing a going-concern opinion (Bentley-Goode *et al.*, 2017; Chen *et al.*, 2017). Taken together, the empirical evidence suggests that an auditor who perceives higher risk in a client following an innovative prospector strategy exerts greater audit effort and charges higher audit fees (Bell *et al.*, 2008; Bentley *et al.*, 2013).

2.2 Innovative effort and audit effort

Business strategies embody a firm's reliance on technological innovation to remain competitive in the market. For instance, a firm following a prospector strategy strives to develop innovative products and promote new markets whereas those following a defender strategy focus on production efficiency and cost minimization as a source of competitiveness (Bentley *et al.*, 2013; Miles and Snow, 1978). Notably, a key functional attribute differentiating the prospector strategy from other business strategies is the commitment to corporate innovation and technological leadership (Hambrick *et al.*, 1983).

While a firm's innovative effort is regarded as a source of future sales growth and profitability improvement, R&D is a risky investment by nature and accompanied by greater uncertainty regarding its success and the firm's future profitability (Kothari *et al.*, 2002). Compared to the intensity of a firm's R&D expenditure, the patents obtained and cited are deemed less noisy and more reliable because they are outputs of successful R&D investments (Gunny and Zheng, 2014; Hall *et al.*, 2005; Lin *et al.*, 2006). Brown and Kimbrough (2011) suggest that patents provide a legal protection for R&D activities, resulting in a more positive effect on future earnings than R&D expenditure. Nevertheless, both R&D expenditure and the patents incorporate a client firm's business risk arising from its innovative strategy. Although patents are intellectual properties providing an exclusive right to the patented technologies, information about the patented technologies is costly to process and the likelihood of its commercialization is difficult to assess (Hirshleifer *et al.*, 2013). Therefore, both R&D expenditure and the patents can signal the uncertainty of a client's future prospects related to its innovative strategy and lead to higher audit fees to compensate for heightened audit effort.

To test this conjecture on the relation between innovative effort and audit fees, we propose our first hypothesis as follows:

H1a: A firm's R&D intensity is positively associated with audit fees.

H1b: The number of patent obtained (cited) by a firm is positively associated with audit fees.

2.3 Innovation efficiency and audit effort

Despite both larger R&D expenditure and more patents obtained requiring greater audit effort, higher efficiency in converting R&D expenditure into patents would assuage the uncertainty embedded in a firm's innovative effort. Hirshleifer *et al.* (2013) document that innovation efficiency, measured by the ratio of the number of patents to R&D capital, is positively associated with future returns, suggesting incremental information benefits from innovation efficiency.

Regarding the information role of an organization's operational efficiency, Demerjian *et al.* (2013) show that higher efficiency attributable to a firm's top management team in converting production inputs (e.g. cost of goods sold, net PP&E, and R&D expenditure) into a firm's sales revenue is positively associated with earnings quality. To the extent that superior managers' greater knowledge and better judgments enable higher efficiency in revenue generation, an auditor may perceive the higher efficiency as a factor lowering audit risk and accordingly reduce the audit effort (Krishnan and Wang, 2014). Similarly, we expect that higher efficiency in obtaining patents reflects the firm's greater ability in implementing its innovative strategies, thereby reducing the need for audit effort. To test this conjecture, we propose our second hypothesis as follows:

H2: Innovation efficiency is negatively associated with audit fees.

3. Data and empirical model

3.1 Sample

We construct our initial sample of firm-year observations using Compustat for fiscal years between 2000 to 2010. After removing utilities and financial industries from our initial sample, we obtain 55,906 firm-year observations without missing information for our variables calculation. We remove penny stocks and small firms with a share price of less than US$1 or total assets less than US$100 million. We add the patent data from the United States Patent and Trademark Office (USPTO) compiled by Kogan *et al.* (2017) [2]. The patent dataset provides information about the annual patent number and patent citation. For our sample period, the patent dataset includes 16,046 firm-year observations. We then merge our dataset, using Audit Analytics, to collect audit engagement information such as audit fees and auditor attributes. After deleting the observations with missing values, our final sample containes 11,646 observations from 2,051 unique firms. Our sample selection procedure is summarized in Tables I. Sample distribution by industry illustrated in Table II shows that more than half of the sample firms belong to the industries of business equipment (40%) and manufacturing (22%).

<INSERT TABLES I and II>

3.2 Measurement of corporate innovation

Following prior literature on corporate innovation, we use two proxies for a firm's innovative effort: R&D intensity; and the patents granted. As an input measure of innovative effort, we use R&D intensity (R&D), where R&D expense is scaled by market capitalization. As an output measure of innovative effort, we use the natural log of the number of patents granted in a given year.

Similar to Hirshleifer *et al.* (2013), we define innovation efficiency (IE) as the number of patents granted, scaled by R&D capital, where R&D capital is calculated as the five-year cumulative R&D expenses, assuming a 20% depreciation rate, as follows:

$$\textit{Innovation Efficiency (IE)} = \textit{Patent count}_t / (R\&D_{t-2} + 0.8*R\&D_{t-3} + 0.6*R\&D_{t-4} + 0.4*R\&D_{t-5} + 0.2*R\&D_{t-6}) \quad (1)$$

Since the number of patents does not incorporate the full extent of innovative effort and the size of the R&D projects, we also use the patents' adjusted forward citation number as the numerator in the equation (1). This measure represents the input–output conversion efficiency between our two proxies for innovative effort, assuming that more recent R&D expenditure contributes to the current generation of knowledge assets more directly.

3.3 Empirical model

Hay *et al.* (2006) conclude that most audit-fee models in the extant literature consider client attributes (such as size, complexity, inherent risk, profitability, internal control, and leverage) and auditor attributes (such as auditor quality and auditor tenure). Building on Hay *et al.*'s (2006) framework, we construct the following regression model with our measures of corporate innovation, innovative effort (R&D intensity and the number of patents granted), and innovation efficiency:

$$lnAUDITFEE = \beta_0 + \beta_1 R\&D + \beta_2 lnPATENT \text{ (or } lnCITE) + \beta_3 IE\_PATENT \text{ (or } IE\_CITE) + \beta_4 ROA + \beta_5 SIZE + \beta_6 Leverage + \beta_7 M/B + \beta_8 QUICKRATIO + \beta_9 INHERENT + \beta_{10} LOSS + \beta_{11} ICMW + \beta_{12} BIG4 + \beta_{13} New\ Auditor + \sum\beta Year + \sum\beta Industry + \varepsilon \quad (2)$$

The dependent variable is the natural log of audit fees. Our variables of interests are R&D intensity (*R&D*), the number of patents granted (*lnPATENT*), and innovation efficiency (*IE*). To the extent that a client firm's innovative effort entails an increase in its business risk, we conjecture that audit fees would be positively associated with the proxies for innovative effort, *R&D* and *lnPATENT*. In addition, to the extent that a firm's higher innovation efficiency reflects greater managerial ability, mitigating the embedded risk of innovative effort, we conjecture that an auditor may assess the client business risk lower, leading to a negative association between the proxies for *IE* and audit fees.

Following Hay *et al.* (2016), our control variables include several client attributes, such as client size, profitability, audit complexity, and the inherent and control risks of the client. Our proxy for client size is the total assets (*SIZE*), which is expected to be positively associated with audit fees. For profitability, we control for return on assets (*ROA*), quick ratio (*QUICKRATIO*), and a dichotomous variable showing a loss year (*LOSS*). While the coefficients of *ROA* and *QUICKRATIO* are expected to be negative, indicating that higher profitability signals lower client's business risk, *Loss* is expected to have a positive coefficient. Variables that represent audit complexity include the ratio of inventory and receivable to total assets (*INHERENT*) and market-to-book ratio (*M/B*), both of which are expected to be positively associated with audit fees. To the extent that a higher risk of financial distress increases audit risk, we expect to see a positive coefficient for leverage (*Leverage*). As Raghunandan and Rama (2006) document, the existence of internal control material weak (*ICMW)* is expected to be positively associated with audit fees. To control for auditor attributes, we add an indicator variable representing Big-4 auditing firms (*BIG4*) and a dichotomous variable indicating an auditor change (*New Auditor*). As Carson *et al.* (2012) illustrate, we expect an audit-fee premium for Big-4 auditors and, accordingly, a positive coefficient for *BIG4*. Consistent with the practice of fee discounting on initial audit engagements (i.e. "lowballing"), we expect to see a negative coefficient for *New Auditor*. A detailed description of the variables is presented in the Appendix.

4. Empirical results

4.1 Descriptive statistics

Table III shows the descriptive statistics. The mean value of the log of audit fees is 14.035 (equivalent to about US$1.25 million), which is comparable to previous studies (e.g. Bentley *et al.*, 2013; Krishnan and Wang, 2015; Stanley, 2011). The mean value of R&D intensity is 5.8% of market capitalization and the mean value of patent counts after log transformation was 1.579 (equivalent to about 4.85 patents). The two innovation-efficiency measures show that, on average, one patent (one citation) required US$11 million (US$4.65 million) cumulative R&D investments over the five years, after amortizing the investment by 20% per year. Since we exclude small firms from our sample, the average size of logged total assets (6.894) is slightly higher than that of other studies. Consistent with prior literature, our sample demonstrate the dominance of Big-4 auditors (89.3%). In addition, the average firm in our sample shows an average return on assets of 2.1%, leverage of 0.154, a market-to-book ratio of 2.911, a quick ratio of 2.600, and a ratio of inventory and accounting receivable to total assets of 0.251. Auditor change and auditor's disclosure of internal control material weakness occurrs in 13.0% and 5.3% of out sample, respectively.

<INSERT TABLE III>

Table IV presents the Pearson and Spearman correlations among our variables. Notably, our two output measures of innovative effort (*lnPATENT* and *lnCITE*) are highly correlated to each other, whereas their correlation with an input measure (*R&D*) has a lower magnitude, which suggests that our input and output measures of innovative effort may capture different dimensions of a firm's innovative effort. By construction, our two measure of innovation efficiency (*IE_PATENT* and *IE_CITE*) are positively correlated with patent counts and negatively correlated with R&D investments.

<INSERT TABLE IV>

4.2 Test of hypotheses

Table V shows the main testing results. Across all models, our proxies for a firm's innovative effort are positively related to audit fees. All models are significant at $p<0.01$, with adjusted R^2 of about 0.80. As a baseline, we first estimate restrictive models of audit fees using only our proxies for innovative effort. When the patent count (*lnPATENT*) is used as an output measure of innovative effort in addition to R&D intensity (*R&D*) as an input measure in Model 1, we find that both variables have a positive and significant coefficient at the 1% significance level, suggesting that our input and output measures may capture different dimensions of a firm's innovative effort, thereby leading to a significant influence on audit fees independent from each other. Control variables are significant at the 1% level in the expected direction, except for *Leverage* and *M/B* (though *Leverage* was significant at 10% level). We also find the consistent result from using the citation count (*lnCITE*) as an alternative output measure of innovative effort in the Model 2. These results are consistent with our prediction that auditors tend to charge higher audit fees for the clients engaging more in innovative activities. Therefore, both *H1a* and *H1b* are supported.

<INSERT TABLE V>

To test H2, we extend our models in Models 1 and 2 to Models 3 and 4 respectively (see Table V) and include a measure of innovation efficiency based on patent count (*IE_PATENT*) and patent citation (*IE_CITE*). In Model 3, when innovation efficiency is measured by the ratio between the number of patents and R&D capital, the coefficient of *IE_PATENT* is negatively significant at the 1% level while the coefficients of our innovative effort measures remain positive. In Model 4, when innovation efficiency is measured by the ratio between patent citation and R&D capital, we also find that the coefficient of *IE_CITE* is negatively significant at the 1% level, lending support to *H2*. The findings imply that an auditor may assess a client's business risk as low and reduce the audit effort when a client firm demonstrates higher efficiency in converting risky R&D investments into patents that are legally protected knowledge assets. This suggests that an auditor may perceive a client firm's greater managerial ability regarding corporate innovation as a factor mitigating the innate risk embedded in the firm's innovative effort.

Our findings also show economic significance. In Model 3, for instance, the coefficients of 0.558 for *R&D* and 0.045 for *lnPATENT* imply that one standard deviation increase in R&D intensity and the number of patents obtained in a given year would increase audit fees by 3.5% and 6.5%, respectively, equivalent to US$43,111 and $80,845 fee increases at the mean of our sample [3]. Meanwhile, one standard deviation increase in *IE_PATENT* is associated with 4% lower audit fees, or US$49,150 fee reduction at the mean, illustrating a significant attenuation of client business risk arising from risky innovative investments.

4.3 Matched sample approach

Early literature on innovation has argued that the intensity of a firm's innovative activities is affected by the firm size and industry-level innovative effort (e.g. Audretsch and Acs, 1991; Cohen and Klepper, 1992). In particular, Bound *et al.* (1984) reported that patenting activities are concentrated in industries, including chemical, drugs, computer equipment, and communications. To the extent that the influence of firm size and industry-level factors is not fully controlled in our models, the uneven distribution of innovative activities across firms may cause a bias in the results. To corroborate our findings, we conduct a matched sample analysis by separating our sample into high and innovation efficiency sub-samples, based on annual industry median and then matching based on the asset size and industry. Table VI presents the results from using a matched sample. In the restrictive Models 1 and 2, our input-based measure of innovative effort, R&D intensity, is positively associated with audit fees at the 1% significance level, though patent-based output measures became insignificant at the conventional significance level. However, after fully specifying our model with the measures of innovation efficiency, we find in Models 3 and 4 that both innovative effort variables are positively related to audit fees and innovation efficiency measures are negatively associated with audit fees, consistent with our findings from our audit fee test summarized in Table V.

<INSERT TABLE VI>

4.4 Endogeneity

Even though we control for various audit risk factors affecting audit pricing to identify the influence of corporate innovation on audit fees, we cannot rule out that the relationship between audit fees and a firm's innovative effort could be driven by correlated omitted factors. To alleviate this potential endogeneity issue, we use a two-stage least squares (2SLS) regression model.

In the first stage, we regress R&D intensity (*R&D*) and the number of patents granted (*lnPATENT*) on the control variables representing various audit risk factors and adopt the industry mean of the number of patents granted as our instrumental variable. As Larcker and Rusticus (2010) emphasize, the validity of our 2SLS results relies on the use of an appropriate instrumental variable correlated with our endogenous variables of corporate innovation but uncorrelated with the error in our audit fee model. We define two-digit SIC (*SIC2*) as the boundary of an industry and used the industry mean of patents granted as our instrumental variable in the first-stage regression model. The industry mean of patents granted is highly correlated with a firm's R&D intensity and the number of patents granted but not related to residuals of pre-instrumented audit fee regressions. This rejects the conventional weak instrument tests and meets the exclusion criterion.

In the second stage, we regress audit fees on the fitted value from the first-stage regression and other control variables that are used in the main testing model from Table V. Table VII presents the results. Columns 1 and 2 show the result of first-stage regression. The coefficients for the industry mean of patents granted are positive and statistically significant, supporting that the industry peers' patenting activities are correlated with our endogenous corporate innovation variables. Columns 3 and 4 show the results from the second-stage regression. Consistent with our main testing results, the coefficients on the instrumental variables for R&D intensity and patents granted are positive and statistically significant. Taken together, these results support our prediction that a firm's innovative effort has a positive effect on audit efforts.

<INSERT TABLE VII>

4.5 Additional test

Research has suggested that firms with higher R&D intensity and intangible assets tend to have more analyst coverage and greater value relevance of recommendations (Barron *et al.*, 2002; Barth *et al.*, 2001; Palmon and Yezegel, 2012). In essence, analysts contribute to identifying the value of the firms with high intangible assets by lowering information asymmetry and relating firms' innovation efforts with future value creation. This external monitoring of security analysts can also affect a firm's accruals management and real activities manipulation decisions (Yu, 2008; Irani and Oesch, 2016). In line with the notion of external monitoring role of analysts, PCAOB Auditing Standard No. 2110 requires an auditor to consider client-related information in analysts' reports to better understand the client's business (PCAOB, 2010). As such, we supplement our examination on auditor response to corporate innovation by assessing the moderating effect of analysts' external monitoring on the relationship between innovation and audit fees.

To the extent that analysts' external monitoring enriches a firm's information environment and thereby assists an auditor's assessment of client business risk, we conjecture that analysts' monitoring would attenuate the auditor's risk pricing of a client's innovative activities. To test this moderating effect, we adopt the number of analysts following as our proxy for the analysts' monitoring and interact it with our variables of interest, representing both innovative effort and innovation efficiency. Specifically, we use decile ranks of analyst coverage, denoted by *Anal.Cov.*, with the ranking, performed by year. Table VIII presents the results of estimating the same audit models we use above, augmented by *Anal.Cov.* and its interactions. As we predict, we find significantly negative coefficients for the interaction variables between analyst coverage and R&D intensity (*R&D* × *Anal.Cov.*) across all models. This finding suggests that an auditor may perceive that the uncertainties in the client firm's future economic condition arising from risky innovative effort can be mitigated by analysts' external monitoring, which discourages extreme risk-taking by the firm. Notably, we fail to find a significant association between our patent-based measures of innovative effort and *Anal.Cov*. We conjecture that this inconsistency with our prediction may occur because the auditor's response to the information role of analysts following is concentrated on its audit pricing of an input measure of innovative effort rather than more observable output measures such as patent counts.

5. Conclusion

Motivated by the growing importance of technological innovation in management practice and research, we explore the auditor's response to corporate innovation by examining the relationship among a firm's innovative effort, innovation efficiency, and audit fees. Our findings lead us to argue that auditors tend to charge higher audit fees for the clients with higher innovative activities, proxied by R&D intensity and the number of patents granted. The results suggest that auditors are more likely to perceive a firm's innovative activities as client business risks that require more audit efforts, thereby leading to higher audit fees being charged. We also find that auditors charged lower audit fees when client firms show greater innovation efficiency, measured by the number of patents granted (and forward citation), scaled by the capitalized R&D expenditures. This finding indicates that auditors tend to consider the efficiency of a firm's innovation activities as a risk-mitigating factor that they may lower the demand for audit efforts. Overall, our findings suggest that, while an auditor would respond to a client's risky investments to innovative activities by increasing the audit effort, the client's innovation efficiency may temper the auditor's response to innovative effort by signaling the client's greater risk-management ability in converting R&D expenditure into the creation of valuable knowledge assets.

As an extension to our main tests, we test the effect of analyst coverage and firms' innovation activities on audits fees to assess what effect the information environment has on auditors in evaluating client firms' innovation activities. The findings indicate that an enhanced information environment, proxied by high analyst coverage, for client firms with high R&D intensity plays a positive role in reducing audit fees, suggesting that auditors view analyst coverage as a risk-mitigating factor for a client's business risk attributable to its corporate innovation. Further, the insignificant effect of analyst coverage and innovation efficiency on audit fees suggests that the risk-mitigating effect of innovation efficiency on audit fees is more pronounced in a high-information-asymmetry environment.

Notes

1. AU Section 314.29 states that "The auditor should obtain an understanding of the entity's objectives and strategies, and related business risks that may result in material misstatement of the financial statements. … the entity's management or those charged with governance define objectives, which are the overall plans for the entity. Strategies are the operational approaches by which management intends to achieve its

objectives." Currently, the same requirement is stipulated in PCAOB Audit Standard 2110: Identifying and Assessing Risks of Material Misstatement (PCAOB, 2010).

2. We use patent data provided by Noah Stoffman covering all patents granted by USPTO until 2010. The dataset is available at https://iu.app.box.com/patents .
3. Since *R&D* and *lnPATENT* are measured by different units (i.e., dollar versus count), we first calculate their standardized coefficients by multiplying OLS coefficients by standard deviation of the predictors and divide them by the standard deviation of outcome variable, *lnAUDITFEE*. Our calibration of the economic significance is performed by multiplying the standardized coefficients to the mean of unlogged audit fees representing the impact of one standard deviation change of the predictors on the audit fees in U.S. dollar.

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Appendix

Variable definitions.

Variable	Description (Compustat mnemonic in brackets)
lnAUDITFEE	Natural log of total audit fee of the year (AUDIT_FEES in Audit Analytics database).
R&D	R&D expense deflated by market capitalization.
lnPATENT	Natural log of the number of patents obtained.
lnCITE	Natural log of the number of patent citation.
IE_PATENT	Number of patents obtained deflated by R&D capital where R&D capital is calculated as $R\&D_{t-2}+0.8*R\&D_{t-3}+0.6*R\&D_{t-4}+0.4*R\&D_{t-5}+0.2*R\&D_{t-6}$.
IE_CITE	Number of patent citations deflated by R&D capital.
SIZE	The natural logarithm of total assets (AT).
ROA	Income before extraordinary items (IB) divided by prior year's total assets (AT)
Leverage	Long-term debt divided by total assets (DLTT/AT).
M/B	Market-to-book ratio measured as market capitalization (CSHO*PRCC_F) divided by the book value of equity (CEQ).
Inherent	Inventory and receivables divided by total assets ((INVT+REC)/AT).
QuickRatio	Ratio of current assets minus inventories to current liabilities ((ACT–INVT)/LCT).
LOSS	Equal to one if a firm reports negative income before extraordinary items, zero otherwise (1 if IB<0, 0 otherwise).
ICMW	Equal to one if auditor's opinion on firm's internal control is weak and zero otherwise.
BIG4	Equal to one if a firm uses Big 4/5/6/8 auditors, zero otherwise (1 if AU is 1 to 8, 0 otherwise).
New Auditor	Equal to one if a firm has an auditor tenure of two or fewer years, zero otherwise.
Anal. Cov.	Analyst coverage as calculated by the decile rank of analysts following by year.

Note: All continuous variables are winsorized by each year for top and bottom 1%.

Table I. Sample selection.

	Obs.
Compustat data for years between 2000 and 2010 without missing information	55,906
LESS: small firms with a share price of less than US$1 or total assets less than US$100 million	(26,699)
LESS: missing values after merging with Audit Analytics	(17,561)
Total observations	11,646

Table II. Sample distribution by industry.

Industry	Description	Obs.	Percent
Business equipment	Computers, software, and electronic equipment	4,603	40
Manufacturing	Machinery, trucks, planes, office furniture, paper, commercial printing	2,561	22
Healthcare	Healthcare, medical equipment, and drugs	1,838	16
Chemical	Chemicals and allied products	667	6
Consumer durables	Cars, TVs, furniture, household appliances	569	5
Consumer non-durables	Food, tobacco, textiles, apparel, leather, toys	460	4
Other	Mines, construction, building materials, transportation, hotels	457	4
Energy	Oil, gas, and coal extraction and products	259	2
Wholesale	Retail, repair, and other services	232	2
Total		11,646	100

Table III. Descriptive statistics for included variables.

Variable	*N*	Mean	Std.	0.250	Median	0.750
lnAUDITFEE	11,646	14.038	1.211	13.194	13.959	14.816
R&D	11,646	0.058	0.075	0.013	0.033	0.072
lnPATENT	11,646	1.581	1.746	0.000	1.099	2.639
lnCITE	11,646	1.979	2.048	0.000	1.609	3.364
IE_PATENT	11,646	0.090	0.168	0.000	0.026	0.108
IE_CITE	11,646	0.214	0.459	0.000	0.051	0.222
ROA	11,646	0.021	0.153	-0.014	0.045	0.094
SIZE	11,646	6.895	1.669	5.540	6.585	7.920
Leverage	11,646	0.154	0.176	0.000	0.107	0.248
M/B	11,646	2.907	3.444	1.410	2.238	3.628
QUICKRATIO	11,646	2.603	2.689	1.119	1.694	2.981
INHERENT	11,646	0.251	0.142	0.144	0.242	0.338
LOSS	11,646	0.288	0.453	0.000	0.000	1.000
ICMW	11,646	0.053	0.224	0.000	0.000	0.000
BIG4	11,646	0.892	0.310	1.000	1.000	1.000
New Auditor	11,646	0.130	0.337	0.000	0.000	0.000
FOROPS	11,646	0.464	0.499	0.000	0.000	1.000
AUD_LAG	11,646	4.056	0.435	3.871	4.094	4.304
N_SEG	11,646	16.260	8.934	9.000	15.000	22.000
EXPERT	11,646	0.232	0.118	0.162	0.221	0.302

Notes: Variables are as defined in the Appendix. To control for the small-size-firm effect, we restricted our sample to: firm's audit fees (AUDIT_FEES) higher than US$10,000; total assets (AT) at least US$100 million; and stockholders' equity (SET) at least US$1 million. To control for the penny stock, we restricted our sample to firms with a stock price at fiscal year end (PRCC_F) of at least $1. Firm-years not reporting any R&D expense (XRD) were treated as zero.

Table IV. Correlations: Pearson (Spearman) correlations above (below) the diagonal.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	*lnAUDITFEE*		**-0.08**	**0.42**	**0.38**	**-0.05**	**-0.08**	**0.17**	**0.80**	**0.12**	**0.03**	**-0.39**	**0.05**	**-0.19**	**0.08**	**0.22**	**-0.14**	**0.22**	**0.14**	**0.46**	**0.25**
2	*R&D*	**-0.10**		**0.14**	**0.15**	**-0.05**	**-0.04**	**-0.42**	**-0.17**	**0.05**	**-0.18**	**0.08**	**-0.09**	**0.42**	**0.03**	0.02	**0.00**	**0.03**	**0.05**	**-0.10**	**-0.04**
3	*lnPATENT*	**0.32**	**0.25**		**0.98**	**0.42**	**0.36**	**0.03**	**0.51**	0.00	**0.08**	**-0.03**	**-0.09**	**-0.04**	**-0.06**	**0.15**	**-0.10**	**0.08**	**-0.17**	**0.25**	**0.14**
4	*lnCITE*	**0.30**	**0.25**	**0.99**		**0.44**	**0.42**	**0.02**	**0.46**	**-0.02**	**0.09**	-0.01	**-0.11**	**-0.02**	**-0.05**	**0.15**	**-0.10**	**0.07**	**-0.18**	**0.22**	**0.13**
5	*IE_PATENT*	**0.07**	**0.13**	**0.85**	**0.84**		**0.88**	0.00	-0.01	**-0.02**	-0.01	**0.06**	**0.05**	-0.01	0.00	**-0.02**	0.01	0.00	**-0.07**	**0.03**	-0.01
6	*IE_CITE*	**0.07**	**0.15**	**0.84**	**0.86**	**0.98**		0.00	**-0.04**	**-0.05**	0.01	**0.09**	0.01	0.00	0.01	-0.02	0.02	-0.01	**-0.06**	-0.01	-0.01
7	*ROA*	**0.16**	**-0.46**	**0.03**	**0.03**	-0.01	-0.01		**0.22**	**-0.15**	**0.14**	**-0.14**	**0.18**	**-0.69**	**-0.05**	0.01	**-0.02**	**0.07**	**-0.06**	**0.18**	**0.03**
8	*SIZE*	**0.76**	**-0.22**	**0.39**	**0.37**	**0.12**	**0.11**	**0.23**		**0.17**	**0.07**	**-0.30**	**-0.07**	**-0.25**	**-0.08**	**0.24**	**-0.12**	**0.14**	**-0.11**	**0.46**	**0.29**
9	*Leverage*	**0.24**	**-0.10**	**0.04**	0.01	-0.01	**-0.03**	**-0.13**	**0.35**		**-0.02**	**-0.15**	**-0.05**	**0.11**	**-0.03**	**0.08**	**-0.03**	**-0.02**	-0.01	**0.05**	**0.07**
10	*M/B*	**0.09**	**-0.26**	**0.15**	**0.16**	**0.07**	**0.08**	**0.39**	**0.13**	**-0.03**		**0.02**	**-0.09**	**-0.11**	**-0.02**	**0.04**	**-0.04**	**-0.04**	**-0.10**	**-0.05**	0.01
11	*QUICKRATIO*	**-0.41**	**0.20**	**0.02**	**0.04**	**0.09**	**0.11**	**-0.02**	**-0.39**	**-0.38**	**0.05**		**-0.40**	**0.15**	**-0.02**	**-0.02**	0.00	**-0.14**	**-0.05**	**-0.28**	**-0.11**
12	*INHERENT*	**0.07**	**-0.12**	**-0.08**	**-0.10**	0.00	**-0.03**	**0.15**	**-0.03**	**0.05**	**-0.11**	**-0.36**		**-0.17**	0.01	**-0.11**	**0.02**	**0.10**	**0.03**	**0.20**	**-0.04**
13	*LOSS*	**-0.20**	**0.40**	-0.02	-0.01	0.00	0.01	**-0.78**	**-0.26**	**0.04**	**-0.22**	**0.10**	**-0.19**		**0.08**	**-0.04**	**0.02**	**-0.05**	**0.08**	**-0.18**	**-0.06**
14	*ICMW*	**0.09**	**0.05**	**-0.06**	**-0.05**	**-0.03**	**-0.03**	**-0.09**	**-0.08**	**-0.04**	**-0.02**	-0.02	0.00	**0.08**		**-0.06**	**0.05**	**0.04**	**0.25**	**-0.03**	**-0.05**
15	*BIG4*	**0.22**	**0.02**	**0.15**	**0.15**	**0.07**	**0.07**	**0.02**	**0.26**	**0.09**	**0.08**	**-0.04**	**-0.09**	**-0.04**	**-0.06**		**-0.20**	**0.04**	**-0.05**	**0.09**	**0.54**
16	*New Auditor*	**-0.14**	0.00	**-0.10**	**-0.10**	**-0.05**	**-0.05**	**-0.03**	**-0.13**	**-0.04**	**-0.06**	0.01	0.01	**0.02**	**0.05**	**-0.20**		**0.02**	**0.07**	**-0.02**	**-0.16**
17	*FOROPS*	**0.22**	**0.05**	**0.06**	**0.06**	0.02	0.01	**0.04**	**0.14**	0.01	**-0.06**	**-0.09**	**0.11**	**-0.05**	**0.04**	**0.04**	**0.02**		**0.14**	**0.20**	**0.04**
18	*AUD_LAG*	**0.06**	**0.05**	**-0.20**	**-0.19**	**-0.14**	**-0.14**	**-0.13**	**-0.22**	**-0.06**	**-0.16**	0.00	0.01	**0.12**	**0.25**	**-0.09**	**0.07**	**0.12**		-0.02	**-0.07**
19	*N_SEG*	**0.44**	**-0.11**	**0.20**	**0.18**	**0.10**	**0.08**	**0.15**	**0.45**	**0.16**	**-0.04**	**-0.29**	**0.24**	**-0.19**	**-0.03**	**0.09**	**-0.03**	**0.21**	**-0.06**		**0.16**
20	*EXPERT*	**0.24**	**-0.03**	**0.13**	**0.13**	**0.06**	**0.06**	**0.03**	**0.26**	**0.07**	**0.03**	**-0.10**	**-0.03**	**-0.05**	**-0.05**	**0.49**	**-0.15**	**0.05**	**-0.07**	**0.15**	

Notes: All variables are as defined in the Appendix. The values in boldface indicate a significance level of less than 5%.

Table V. The effect of corporate innovation on audit fees.

	(1) AFEE	(2) AFEE	(3) AFEE	(4) AFEE
R&D	0.625***	0.630***	0.509***	0.528***
	(4.87)	(4.94)	(3.98)	(4.15)
lnPATENT	0.0266**		0.0454***	
	(3.29)		(5.00)	
lnCITE		0.0225***		0.0361***
		(3.42)		(4.89)
IE_PATENT			-0.281***	
			(-4.32)	
IE_CITE				-0.0903***
				(-4.14)
ROA	-0.246***	-0.245***	-0.254***	-0.250***
	(-3.54)	(-3.52)	(-3.66)	(-3.60)
Size	0.520***	0.521***	0.509***	0.512***
	(54.06)	(55.62)	(49.80)	(51.74)
Leverage	0.113	0.114	0.123*	0.119*
	(1.86)	(1.88)	(2.04)	(1.97)
MB	0.00378	0.00372	0.0032	0.00334
	(1.73)	(1.70)	(1.47)	(1.53)
Quick Ratio	-0.0434***	-0.0434***	-0.0428***	-0.0428***
	(-10.85)	(-10.86)	(-10.79)	(-10.80)
Inherent	0.754***	0.760***	0.754***	0.760***
	(7.86)	(7.91)	(7.89)	(7.94)
Loss	0.0267	0.0269	0.0242	0.0258
	(1.30)	(1.31)	(1.18)	(1.26)
ICMW	0.450***	0.449***	0.453***	0.453***
	(13.73)	(13.70)	(13.82)	(13.82)
Big4	0.0729*	0.0717*	0.0703*	0.0703*
	(2.07)	(2.03)	(2.01)	(2.01)
NewAuditor	-0.124***	-0.124***	-0.121***	-0.120***
	(-4.95)	(-4.93)	(-4.80)	(-4.78)
FOROPS	0.0376	0.0375	0.0387	0.0384
	(1.90)	(1.89)	(1.96)	(1.94)
AUD_LAG	0.122***	0.123***	0.126***	0.127***
	(4.49)	(4.54)	(4.66)	(4.69)
N_SEG	0.0106***	0.0107***	0.0105***	0.0106***
	(7.66)	(7.71)	(7.61)	(7.64)
EXPERT	0.441***	0.441***	0.439***	0.440***
	(4.48)	(4.49)	(4.48)	(4.49)
Constant	8.545***	8.528***	8.631***	8.598***
	(64.75)	(65.03)	(64.42)	(64.83)
Industry/Year Fixed Effects	Yes	Yes	Yes	Yes
N	11,646	11,646	11,646	11,646
adj. R-sq	0.812	0.812	0.813	0.813

Notes: This table presents the OLS regressions of audit fees on corporate innovations. The dependent variable is a natural log of annual audit fees (*lnAUDITFEE*). t-statistics in parentheses are calculated using standard errors clustered by firm. Variables are defined in the Appendix. Industry fixed effect is based on the Fama–French 48 industry classification. *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively, using a two-sided t-test.

Table VI. Matched sample analysis.

	(1) AFEE	(2) AFEE	(3) AFEE	(4) AFEE
R&D	1.160***	1.135***	1.140***	1.103***
	(-6.41)	(6.32)	(6.28)	(6.11)
lnPATENT	0.0886***		0.0971***	
	(8.60)		(8.31)	
lnCITE		0.0738***		0.0826***
		(9.03)		(8.93)
IE_PATENT			-0.148*	
			(-1.99)	
IE_CITE				-0.0691**
				(-2.79)
ROA	-0.109	-0.107	-0.111	-0.109
	(-1.43)	(-1.38)	(-1.45)	(-1.41)
Size	0.502***	0.503***	0.500***	0.501***
	(46.83)	(47.72)	(45.92)	(46.69)
Leverage	0.171**	0.172**	0.173**	0.174**
	(2.88)	(2.89)	(2.92)	(2.93)
MB	0.00262	0.00243	0.00258	0.00243
	(0.95)	(0.88)	(0.93)	(0.88)
Quick Ratio	-0.0348***	-0.0350***	-0.0347***	-0.0348***
	(-7.13)	(-7.19)	(-7.13)	(-7.17)
Inherent	0.596***	0.603***	0.597***	0.605***
	(8.22)	(8.33)	(8.24)	(8.34)
Loss	0.123***	0.124***	0.123***	0.123***
	(5.75)	(5.75)	(5.72)	(5.72)
ICMW	0.385***	0.384***	0.385***	0.384***
	(10.66)	(10.64)	(10.65)	(10.64)
Big4	0.172***	0.171***	0.172***	0.171***
	(5.91)	(5.89)	(5.92)	(5.90)
NewAuditor	-0.135***	-0.134***	-0.134***	-0.133***
	(-6.33)	(-6.31)	(-6.31)	(-6.26)
FOROPS	0.0981***	0.0966***	0.0984***	0.0970***
	(4.33)	(4.26)	(4.34)	(4.28)
AUD_LAG	0.151***	0.154***	0.152***	0.155***
	(5.51)	(5.61)	(5.52)	(5.65)
N_SEG	0.0143***	0.0143***	0.0143***	0.0144***
	(9.81)	(9.85)	(9.84)	(9.87)
EXPERT	0.351***	0.351***	0.352***	0.351***
	(4.44)	(4.43)	(4.45)	(4.44)
Constant	8.246***	8.221***	8.256***	8.231***
	(60.87)	(60.99)	(60.74)	(60.90)
Industry/Year Fixed Effects	Yes	Yes	Yes	Yes
N	10,966	10,966	10,966	10,966
adj. R-sq	0.765	0.765	0.765	0.766

Notes: This table presents OLS regression results for the propensity-score matched sample based on a client's propensity to report R&D expenditure. Specifically, we estimate the following Logit model by year to estimate the propensity:

$$RnD\_Missing = \gamma_0 + \gamma_1 ROA + \gamma_2 Size + \gamma_3 Leverage + \gamma_4 MB + \gamma_5 QuickRatio + \gamma_6 Inherent + \gamma_7 Loss + \Sigma\ Industry + \varepsilon.$$

The dependent variable is the natural log of the annual audit fee (*lnAUDITFEE*). t-statistics in parentheses are calculated using standard errors clustered by firm. Variables are defined in the Appendix. Industry fixed effect is based on the Fama–French 48 industry classification. *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively, using a two-sided t-test.

Table VII. Three-stage least squares regression.

	AFEE	*lnPATENT*	*R&D*
AFEE		0.075**	0.015***
		(2.00)	(11.31)
R&D	3.236***	17.219***	
	(11.57)	(30.36)	
lnPATENT	0.047***		
	(3.81)		
ROA	0.285***	1.251***	-0.113***
	(4.73)	(9.06)	(-20.35)
Size	0.522***	0.595***	-0.012***
	(58.48)	(25.68)	(-13.91)
Leverage	-0.137***	-0.968***	0.010***
	(-3.69)	(-12.01)	(2.81)
MB	0.011***	0.067***	-0.002***
	(5.38)	(15.60)	(-13.58)
Quick Ratio	-0.056***	0.082***	0.000
	(-20.20)	(13.07)	(1.62)
Inherent	0.304***	0.466***	-0.031***
	(6.22)	(4.15)	(-6.13)
Loss	-0.122***	-0.363***	0.036***
	(-6.02)	(-7.75)	(19.31)
ICMW	0.520***	0.018	
	(19.36)	(0.28)	
Big4	0.102***		
	(4.47)		
NewAuditor	-0.196***		
	(-11.09)		
FOROPS	0.088***	-0.069**	0.006***
	(7.04)	(-2.41)	(4.77)
AUD_LAG	0.536***	-0.556***	
	(35.33)	(-15.22)	
N_SEG	0.010***	0.008***	0.000**
	(12.39)	(4.35)	(-2.17)
EXPERT	0.104*		
	(1.74)		
R&D_Missing		-0.380***	
		(-4.86)	
IND_PATENT			0.000***
			(14.95)
Constant	7.781***	-2.693***	-0.081***
	(99.18)	(-7.95)	(-5.69)
Industry/Year Fixed Effects	YES	YES	YES
N	11,593	11,593	11,593
R-sq	0.714	0.171	0.247
Chi^2	31,424.47	6,711.08	4,040.45

Notes: This table presents the 3SLS regression results from estimating a system of equations having *AFEE*, *LnPATENT,* and *R&D* as endogenous variables. Auditor's attributes (*Big4, NewAuditor*, and *EXPERT*) are used as instruments for *AFEE*. Indicator variable for missing R&D expenditure (*R&D_Missing*) is used as an instrument for *LnPATENT*. Industry average number of patents (*IND_PATENT*) is used as an instrument for *R&D*. z-statistics are presented in parentheses. Variables are defined in the Appendix. Industry fixed effect is based on the Fama–French 48 industry classification. *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively, using a two-sided t-test.

Table VIII. Interaction effect with analyst coverage on audit fee.

	(1) AFEE	(2) AFEE	(3) AFEE	(4) AFEE
R&D	1.261***	1.255***	1.189***	1.202***
	(6.26)	(6.25)	(5.99)	(6.03)
Anal.Cov.	0.004	0.004	0.006	0.006
	(0.68)	(0.69)	(1.09)	(1.07)
R&D × *Anal.Cov.*	-0.153***	-0.149***	-0.162***	-0.161***
	(-4.17)	(-4.07)	(-4.46)	(-4.44)
lnPATENT	0.012		0.030*	
	(0.84)		(1.97)	
lnPATENT × *Anal.Cov.*	0.003		0.003	
	(1.55)		(1.33)	
lnCITE		0.012		0.023
		(1.04)		(1.82)
lnCITE x Anal.Cov.		0.002		0.002
		(1.22)		(1.32)
IE_PATENT			-0.14	
			(-1.24)	
IE_PATENT x Anal.Cov.			-0.021	
			(-1.03)	
IE_CITE				-0.028
				(-0.70)
IE_CITE x Anal.Cov.				-0.011
				(-1.64)
ROA	-0.242**	-0.240**	-0.247***	-0.244**
	(-3.27)	(-3.23)	(-3.33)	(-3.29)
Size	0.519***	0.521***	0.509***	0.512***
	(48.11)	(49.39)	(43.92)	(45.95)
Leverage	0.145*	0.146*	0.155*	0.152*
	(2.25)	(2.26)	(2.40)	(2.35)
MB	0.00297	0.00302	0.00236	0.00254
	(1.29)	(1.32)	(1.03)	(1.11)
Quick Ratio	-0.0413***	-0.0413***	-0.0408***	-0.0406***
	(-9.94)	(-9.94)	(-9.93)	(-9.92)
Inherent	0.799***	0.804***	0.801***	0.807***
	(7.99)	(8.04)	(8.02)	(8.07)
Loss	0.0253	0.0257	0.024	0.0253
	(1.19)	(1.21)	(1.13)	(1.19)
ICMW	0.414***	0.414***	0.418***	0.418***
	(11.56)	(11.55)	(11.68)	(11.71)
Big4	0.0267	0.0251	0.0263	0.0269
	(0.74)	(0.69)	(0.73)	(0.74)
NewAuditor	-0.133***	-0.133***	-0.130***	-0.130***
	(-4.82)	(-4.81)	(-4.69)	(-4.71)
FOROPS	0.0473*	0.0467*	0.0482*	0.0479*
	(2.30)	(2.27)	(2.35)	(2.33)
AUD_LAG	0.134***	0.133***	0.136***	0.136***

	(4.87)	(4.85)	(5.00)	(4.99)
N_SEG	0.00929***	0.00936***	0.00918***	0.00922***
	(6.49)	(6.55)	(6.45)	(6.47)
EXPERT	0.434***	0.435***	0.433***	0.435***
	(4.34)	(4.34)	(4.34)	(4.36)
Constant	8.520***	8.503***	8.589***	8.560***
	(62.30)	(62.38)	(61.67)	(62.08)
Industry/Year Fixed Effects	Yes	Yes	Yes	Yes
N	10,004	10,004	10,004	10,004
adj. R-sq	0.822	0.822	0.823	0.823

Notes: This table presents OLS regression of audit fees on the interaction effect between corporate innovation and analyst coverage. The dependent variable was a natural log of audit fees (*lnAUDITFEE*). Analyst coverage (*Anal.Cov.*) is defined as the decile rank of the number of analysts following. t-statistics in parentheses are calculated using standard errors clustered by firm. Variables are defined in the Appendix. Industry fixed effect is based on the Fama–French 48 industry classification. *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively, using a two-sided t-test.