Corporate Innovation and Audit Fees

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ABSTRACT
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. We find that a client firm's strategic emphasis on corporate innovations may require more significant audit effort, while the efficiency of the firm's innovation can attenuate the demand for heightened external auditor's audit effort related to the firm's risky and innovative activities. Findings suggest that the external auditor does not always discourage corporate innovation as the efficiency of a firm's innovation may lower the client business risk perceived by an auditor.

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1. INTRODUCTION

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 for two reasons: complexity and uncertainty. First, accounting for corporate innovation is complicated with research and development arrangements (FASB ASC 730) and fair value measurement (FASB ASC 350). Auditors not only need to verify the fair value of the corporate innovation such as patent 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, leading to higher business risk. Prior literature suggests that a firm's high innovation activities are related to the firm's greater risk and uncertainty, such as increased volatility of future earnings (Kothari, Laguerre, & Leonse, 2002) and lower financial reporting quality (Lobo, Xie, & Zhang, 2018). According to Auditing Standards (PCAOB AS 2110 and AICPA AU-C 320), auditors gather the evidence to see if the client firm identifies its business risk and prepares processes to mitigate the risk. In this regard, auditors need to identify the business risk anticipated from unsuccessful corporate innovation, i.e., future deterioration of a client firm's economic condition, and assess the risk of material misstatements related to the corporate innovation. Moreover, corporate innovation requires extensive professional judgment. Partner, senior manager, and sometimes industry specialists are involved in the audit to confirm the reasonableness of the assumptions and the transactions (Godfrey & Hamilton, 2005).

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 increased audit risk, requiring more competent auditors and greater audit effort (Bentley, Omer, & Sharp, 2013; Godfrey & Hamilton, 2005; Johnstone, 2000; Lobo, Xie, & Zhang, 2018; Stanley, 2011). 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, Hsu, & Li, 2013). Higher efficiency in a firm's innovative effort can signal its managerial ability, affecting financial reporting quality and auditor's risk assessment (Demerjian, Lev, Lewis, & McVay, 2013; Krishnan & 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 audit effort level. We are motivated to study the relationship 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, Harvey, & Rajgopal, 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, Hermanson, Houston, & Peters, 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 & Hope, 2018). However, a firm's track record in converting R&D expenditure into valuable knowledge assets might relieve an auditor's concern for the client's business risk attributable to risky R&D investments.

Similarly, Krishnan and Wang (2015) suggest that an auditor perceives a lower audit risk from a firm with greater managerial ability, manifested by lower audit fees and a lower likelihood of issuing going-concern opinions. Furthermore, a client firm's high innovation efficiency may enable the firm to have greater bargaining power in negotiating the audit scope and fees with its external auditor. 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 perceived by its incumbent auditor.

In our empirical investigation, we treat R&D expenditure as an input measure and the patent granted/cited as an output measure of a firm's innovative effort (Gunny & Zhang, 2014; Koh & Reeb, 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 a 20% annual depreciation assumption (See Appendix for details). As an alternative measure, we use the patents' forward citation instead 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, Newton, & Thompson, 2013; Hackenbrack & 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 granted 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 increased audit risk, requiring greater audit effort. In contrast, a client firm's innovation efficiency has a mitigating role in business risk. Our results are robust through the tests using a matched sample, a three-stage least squares regression to mitigate the endogeneity concerns. 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 on the high 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 contributes 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, Singh, & Zaldokas, 2017), banking-sector distress (Nanda & Nicholas, 2014), the threat of hostile takeovers (Atanassov, 2013), and accounting conservatism (Chang, Hillary, Kang, & Zhang, 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 to increase 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, Newton, & Thompson, 2013; Godfrey & Hamilton, 2005). However, we also provide evidence suggesting that the efficiency of a firm's innovative effort can attenuate the demand for increased 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. 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. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

The economic theory of endogenous growth suggests that technological innovation is an "engine of growth" (Grossman & 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, Ciftci, & Cready, 2012; Chan, Lakonishok, & Sougiannis, 2001; Eberhart, Maxell, & Siddique, 2004; Lev & Sougiannis, 1996). Recently, considerable literature has investigated several factors affecting corporate innovation, including corporate taxes (Mukherjee, Singh, & Zaldokas, 2017), CEO's risk-taking attitude (Sunder, Sunder, & Zhang, 2017), banking development (Amore, Schneider, & Zaldokas, 2013), strong corporate governance (Atanassov, 2013), and accounting conservatism (Chang, Hillary, Kang, & Zhang, 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 & 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, Newton, & Thompson, 2013; Bentley-Goode, Newton, & Thompson, 2017; Chen, Eshleman, & Soileau, 2017).

2.1 Innovative Effort and Audit Effort

While a firm's innovative effort is considered 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, Laguerre, & Leone, 2002). Moreover, because managers have significant discretion to invest in R&D projects, R&D investment tends to create an agency problem heightening the need for specialist auditors (Godfrey & Hamilton, 2005). Compared to the intensity of a firm's R&D expenditure, the patents granted and cited are deemed less noisy and more reliable because they are outputs of successful R&D investments (Gunny & Zhang, 2014; Hall, Jaffe, & Trajtenberg, 2005; Lin, Lee, & Hung, 2006). Brown and Kimbrough (2011) suggest that patents provide 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, Hsu, & Li, 2013, 2013). Lobo et al. (2018) suggest that firms' innovation activity is negatively related to financial reporting quality because of high information asymmetry and the possibility of earnings management. Therefore, both R&D expenditure and the patents can signal the complexity and uncertainty of a client's prospects related to its innovative strategy and lead to higher audit fees to compensate for increased 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 patents granted (cited) is positively associated with audit fees.

2.2 Innovation Efficiency and Audit Effort

Despite both larger R&D expenditure and more patents granted 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 higher efficiency as a factor in lowering audit risk and, accordingly, reduce the audit effort (Krishnan & Wang, 2014). Similarly, we expect that higher efficiency in obtaining patents reflects the firm's greater ability to implement its innovative strategies, reducing the need for audit effort. Besides, client firms' high innovation efficiency may enable the firms to have more bargaining power in negotiating audit fees with their auditors by asserting that high innovation efficiency reduces the audit risk and audit effort concerning the client firms' innovation activities. Previous studies suggest that client firms' high bargaining power works negatively on audit fees (Casterella, Francis, Lewis, & Walker, 2004; Huang, Liu, Raghunandan, & Rama, 2007; Asthana & Boone, 2012). Thus, we conjecture that client firms' high innovation efficiency will negatively work on audit fees. 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

First, we obtain the patent data from the United States Patent and Trademark Office (USPTO) compiled by Kogan et al. (2017).[1] The patent dataset provides information about the annual patent number and the patent citation for the years ending 2010. Our sample period covers the fiscal years from 2000 to 2010 at the intersection of patent data and audit fee data. Due to the availability of audit fee data, our sample period begins in the year 2000. The patent dataset is matched with COMPUSTAT to generate our initial sample. After removing utilities and financial industries from our initial sample, we obtain 55,906 firm-year observations for the fiscal years between 2000 to 2010 without missing information for our variables calculation. To control the small-size-firm effect, we remove penny stocks and small firms with a share price of less than US$1 or total assets less than US$100 million. Further, we restrict our sample to the firms with audit fees (AUDIT_FEES) higher than US$10,000. 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 contains 11,646 observations from 2,051 unique firms. Our sample selection procedure is summarized in Table 1. Sample distribution by industry illustrated in Table 2 shows that more than half of the sample firms belong to the industries of business equipment (40%) and manufacturing (22%).

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Table 1. 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 with the minimum audit fees of US$10,000	(17,561)
Total observations	11,646

Table 2. Sample distribution by industry

Industry	**Description**	**Obs.**	**Percent**
Business equipment	Computers, software, and electronic equipment	4,603	39
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

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. When R&D expense information is missing, we replace the missing value with zero.

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:

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

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.[2]

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:

$$lnAUDITFEE = \beta_0 + \beta_1 R\&D + \beta_2 lnPATENT\ (or\ lnCITE) + \beta_3 IE\_PATENT\ (or\ IE\_CITE) + \beta_4 ROA + \beta_5 Size + \beta_6 Leverage + \beta_7 MB + \beta_8 Quick\ Ratio + \beta_9 Inherent + \beta_{10} Loss + \beta_{11} ICMW + \beta_{12} BIG4 + \beta_{13} New\ Auditor + \beta_{14} FOROPS + \beta_{15} AUD\_LAG + \beta_{16} N\_SEG + \beta_{17} Expert + \beta_{18} Busy + \sum\beta Year + \sum\beta Industry + \varepsilon \quad (2)$$

The dependent variable is the natural log of audit fees. Our variables of interest 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 fee would be positively associated with the proxies for innovative effort, *R&D*, and *lnPATENT*. In addition, to the extent that a firm's high innovation efficiency mitigates the embedded risk and uncertainty 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. (2006), our control variables include several client attributes, such as client size, profitability, audit complexity, and the client's inherent and control risks. 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 (*Quick Ratio*), and a dichotomous variable showing a loss year (*Loss*). While the coefficients of *ROA* and *Quick Ratio* are expected to be negative, indicating that higher profitability signals the client's lower 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*), market- to-book ratio (*MB*), and the existence of foreign operation (*FOROPS*), the number of business segments (*N_SEG*), all 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 auditor attributes, we add Big-4 auditing firms (*BIG4*), auditor change (*New Auditor*), and auditor's expertise (*Expert*). 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*. Godfrey and Hamilton (2005) argue that more R&D intensive firms demand top-tier, specialist auditors for more rigorous external verification, which would lead to paying higher audit fees. Therefore, we control specialist auditors' potential influence on audit fees by using the auditor's market shares as a proxy for auditor expertise (Godfrey & Hamilton, 2005). We control for the delay of the audit report (*AUD_LAG*) because Knechel and Payne (2001) suggest that audit lags may signal the problems during the audit or the complexity of financial reports, which is expected to be positively associated with audit fees. Following Hay et al. (2006), we control for a busy season (*Busy*) because the calendar year-end is the most popular fiscal year-end among firms resulting in more demand for external auditors in January and February and high audit fees accordingly. A detailed description of the variables is presented in Appendix 1.

4. EMPIRICAL RESULTS

4.1 Descriptive Statistics

Table 3 shows descriptive statistics. The mean (median) value of the audit fees is $2.9 million ($1.1 million), and the mean (median) value of the log of audit fees is 14.038 (13.959), which is comparable to previous studies (e.g., Bentley, Newton, & Thompson, 2013; Krishnan & Wang, 2015; Stanley, 2011). Our sample firms have 44 patents, with 59 citations on average. The mean value of R&D intensity is 5.8% of market capitalization, and the mean value of patent counts after log transformation was 1.581. Since we exclude small firms from our sample, the average size of logged total assets (6.895) is slightly higher than that of other studies. Consistent with prior literature, our sample demonstrates the dominance of Big-4 auditors (89.2%). 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 2.907, a quick ratio of 2.603, 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 occurs in 13.0% and 5.3% of our sample, respectively. About 46% of the sample firms report foreign exchange income/loss reflecting their foreign operations, and 69.3% of the sample firms have the calendar year-end as the fiscal year-end.

Table 4 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.

Table 3. Descriptive statistics for included variables

Variable	*N*	Mean	Std.Dev.	25%	Median	75%
AUDITFEE	11,646	2,925,492	5,859,745	537,200	1,154,000	2,719,160
PATENT	11,646	44.232	222.939	0.000	2.000	13.000
CITE	11,646	58.715	163.089	0.000	4.000	27.906
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
Busy	11,646	0.693	0.461	0.000	1.000	1.000

Note: Variables are as defined in Appendix 1. To control for the small-size-firm effect, we restricted our sample to the firm's audit fees (AUDIT_FEES) higher than US$10,000; and total assets (AT) at least US$100 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 4. 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	21
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**	**0.05**
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**	**-0.01**
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**	**-0.03**
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**	**-0.03**
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	-0.02
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	-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**	**-0.04**
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**	**0.05**
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**	**0.09**
10	*MB*	**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	**0.04**
11	*Quick Ratio*	**-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**	**-0.02**
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**	**-0.09**
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**	**0.03**
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**	0.00
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**	**0.02**
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**	0.02
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**	0.01
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**	**0.02**
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**	-0.01
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**		**0.06**
21	*Busy*	**0.05**	**-0.03**	**-0.02**	**-0.02**	**-0.04**	**-0.04**	**-0.03**	**0.05**	**0.10**	**0.04**	**-0.06**	**-0.09**	**0.03**	0.00	**0.02**	0.02	0.01	0.01	**-0.03**	**0.04**	

Notes: All variables are as defined in Appendix 1. The values in boldface indicate a significance level of less than 5%.

4.2 Test of Hypotheses

Table 5 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 an adjusted R^2 of about 0.81. 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. That suggests our input and output measures may capture different dimensions of a firm's innovative effort, thereby significantly influencing audit fees independent from each other. Control variables are significantly loaded in the expected direction, except for *LOSS*. We also find the consistent result from using the citation count (*lnCITE*) as an alternative output measure of innovative effort in 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.

To test H2, we extend our models in Models 1 and 2 to Models 3 and 4, respectively (see Table 5) and include a measure of innovation efficiency based on patent count (*IE_PATENT*) and patent citation (*IE_CITE*). Because the existence of innovation effort is the precondition of observing the innovation efficiency, we follow this step-wise approach in our test of H2. 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 innovation efficiency as a factor mitigating the inherent risk and uncertainty embedded in the firm's innovative effort.

Our findings also show economic significance. In Model 3, for instance, the coefficient of 0.505 for *R&D* implies that one standard deviation increase in R&D intensity would increase audit fees by 3.86%. Similarly, the coefficient of 0.047 for *lnPATENT* represents that a one standard deviation increase in the log of the number of patents obtained in a given year is associated with 8.55% higher audit fees. Meanwhile, one standard deviation increase in *IE_PATENT* is associated with 4.68% lower audit fees, suggesting a significant attenuation of client business risk arising from risky, innovative investments.[3,4]

Because our innovation efficiency measures are measured using both input- and output-based innovation effort measures, there can be structural multicollinearity between the effort and efficiency variables. To alleviate the multicollinearity concern, we check variance inflation factors (VIF) of our variables of interest and find that all VIF values are far below 10.[5]

Table 5. The effect of corporate innovation on audit fees

	(1) *lnAUDITFEE*	(2) *lnAUDITFEE*	(3) *lnAUDITFEE*	(4) *lnAUDITFEE*
R&D	0.623***	0.628***	0.505***	0.524***
	(4.86)	(4.94)	(3.95)	(4.12)
lnPATENT	0.027***		0.047***	
	(3.40)		(5.14)	
lnCITE		0.023***		0.037***
		(3.52)		(5.03)
IE_PATENT			-0.285***	
			(-4.41)	
IE_CITE				-0.093***
				(-4.29)
ROA	-0.245***	-0.244***	-0.253***	-0.249***
	(-3.52)	(-3.50)	(-3.64)	(-3.59)
Size	0.520***	0.521***	0.508***	0.511***
	(54.18)	(55.75)	(49.82)	(51.78)
Leverage	0.107*	0.108*	0.117*	0.113*
	(1.78)	(1.80)	(1.96)	(1.89)
MB	0.003	0.003	0.003	0.003
	(1.60)	(1.57)	(1.34)	(1.40)
Quick Ratio	-0.043***	-0.043***	-0.042***	-0.042***
	(-10.75)	(-10.76)	(-10.69)	(-10.71)
Inherent	0.776***	0.782***	0.776***	0.782***
	(8.13)	(8.18)	(8.16)	(8.22)
Loss	0.026	0.026	0.023	0.025
	(1.26)	(1.27)	(1.14)	(1.22)
ICMW	0.450***	0.449***	0.453***	0.452***
	(13.62)	(13.58)	(13.71)	(13.71)
Big4	0.073**	0.072**	0.070**	0.070**
	(2.07)	(2.04)	(2.01)	(2.01)
NewAuditor	-0.127***	-0.126***	-0.123***	-0.123***
	(-5.05)	(-5.03)	(-4.90)	(-4.88)
FOROPS	0.037*	0.037*	0.038*	0.038*
	(1.86)	(1.86)	(1.92)	(1.91)
AUD_LAG	0.120***	0.121***	0.124***	0.125***
	(4.41)	(4.45)	(4.57)	(4.61)
N_SEG	0.011***	0.011***	0.011***	0.011***
	(7.70)	(7.75)	(7.65)	(7.68)
EXPERT	0.431***	0.431***	0.428***	0.429***
	(4.39)	(4.40)	(4.39)	(4.39)
Busy	0.060**	0.059*	0.061**	0.062**
	(2.58)	(2.57)	(2.65)	(2.68)
Constant	8.503***	8.486***	8.590***	8.557***
	(63.37)	(63.60)	(63.04)	(63.42)
Industry/Year Fixed Effects	Yes	Yes	Yes	Yes
# of obs.	11,647	11,647	11,647	11,647

Adj.R-Sq	0.813	0.813	0.814	0.814

Note: 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 robust standard errors clustered by firm. Variables are defined in Appendix 1. 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.

4.3 Matched Sample Approach

While we are using the reported R&D expense and the patent granted by USPTO in a given year to measure the magnitude of a firm's innovative activities, Koh and Reeb (2015) report that about 10% of firms not reporting R&D expenses in their financial statements in fact file and receive patents. If so, the firms not reporting any R&D expenses may not necessarily be valid control firms against the firms reporting zero or positive R&D expenses but just a mismeasurement of their innovative activities. Further, Koh and Reeb (2015) add that the exogenous auditor change is associated with a higher likelihood of reporting R&D expenses in the firm's financial statements, suggesting the role of auditor's scrutiny on the nondisclosure of R&D expenses. Given that we replace the missing R&D expenses with zero, the potential measurement error can affect our results. To mitigate this concern, we construct a matched sample based on the R&D disclosure decision model that incorporates various audit risk factors affecting the level of auditor's scrutiny by running a logit model as follows:

$$R\&D\_Missing = \gamma_0 + \gamma_1 ROA + \gamma_2 Size + \gamma_3 Leverage + \gamma_4 MB + \gamma_5 Quick\ Ratio + \gamma_6 Inherent + \gamma_7 Loss + \Sigma\ Industry + \varepsilon. \quad (3)$$

R&D missing is an indicator variable that is set to 1 if a firm doesn't report R&D expense in a given year and 0 otherwise. Appendix 1 shows the results of the logit regression. We match the treatment sample and control sample based on propensity score matching obtained from the logit model above. Table 6 presents the results of using a matched sample. In the restrictive Models 1 and 2, the coefficients of both input- and output-based measures of innovative effort, R&D intensity, and the number of patents are positively associated with audit fees at the 1% significance level. After fully specifying our model with the measures of innovation efficiency, we also find that in Models 3 and 4, innovative effort variables are positively related to audit fees, and innovation efficiency measures are negatively associated with audit fees. That is consistent with our findings from our audit fee test summarized in Table 5.

Table 6. Matched sample analysis

	(1) *lnAUDITFEE*	(2) *lnAUDITFEE*	(3) *lnAUDITFEE*	(4) *lnAUDITFEE*
R&D	1.165***	1.141***	1.144***	1.107***
	(6.40)	(6.31)	(6.27)	(6.10)
lnPATENT	0.090***		0.099***	
	(8.77)		(8.49)	
lnCITE		0.075***		0.084***
		(9.19)		(9.08)
IE_PATENT			-0.153**	
			(-2.06)	
IE_CITE				-0.071**
				(-2.87)

ROA	-0.110	-0.107	-0.111	-0.110
	(-1.44)	(-1.39)	(-1.46)	(-1.42)
Size	0.500***	0.502***	0.498***	0.500***
	(46.81)	(47.73)	(45.88)	(46.67)
Leverage	0.163***	0.164***	0.165***	0.166***
	(2.76)	(2.77)	(2.80)	(2.81)
MB	0.002	0.002	0.002	0.002
	(0.87)	(0.80)	(0.85)	(0.80)
Quick Ratio	-0.035***	-0.036***	-0.035***	-0.035***
	(-7.28)	(-7.34)	(-7.29)	(-7.32)
Inherent	0.594***	0.601***	0.595***	0.603***
	(8.22)	(8.33)	(8.24)	(8.34)
Loss	0.121***	0.122***	0.121***	0.121***
	(5.64)	(5.64)	(5.60)	(5.60)
ICMW	0.386***	0.385***	0.386***	0.385***
	(10.62)	(10.59)	(10.60)	(10.60)
Big4	0.171***	0.171***	0.171***	0.171***
	(5.88)	(5.86)	(5.88)	(5.87)
NewAuditor	-0.135***	-0.135***	-0.135***	-0.134***
	(-6.36)	(-6.34)	(-6.33)	(-6.29)
FOROPS	0.099***	0.098***	0.100***	0.098***
	(4.38)	(4.31)	(4.39)	(4.33)
AUD_LAG	0.148***	0.151***	0.148***	0.152***
	(5.42)	(5.52)	(5.43)	(5.56)
N_SEG	0.014***	0.014***	0.014***	0.014***
	(9.86)	(9.90)	(9.89)	(9.93)
EXPERT	0.351***	0.351***	0.352***	0.351***
	(4.46)	(4.45)	(4.47)	(4.47)
Busy	0.061**	0.061**	0.062**	0.062**
	(2.47)	(2.49)	(2.50)	(2.52)
Constant	8.221***	8.196***	8.232***	8.206***
	(59.86)	(59.95)	(59.75)	(59.88)
Industry/Year Fixed Effects	Yes	Yes	Yes	Yes
N	10,966	10,966	10,966	10,966
adj. R-sq	0.766	0.766	0.766	0.766

Note: 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:

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

The dependent variable is the natural log of the annual audit fee (*lnAUDITFEE*). t-statistics in parentheses are calculated using robust standard errors clustered by firm. Variables are defined in Appendix 1. 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.

4.4 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, Byard, Kite, & Riedl, 2002; Barth, Kasznik, & McNichols, 2001; Palmon & Yezegel, 2012). In essence, analysts identify 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 (Irani & Oesch, 2016; Yu, 2008). In line with analysts' external monitoring role, PCAOB Auditing Standard No. 2110 requires an auditor to consider client-related information in analysts' reports to understand better 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 7 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. However, we do not find a significant association between our patent-based measures of innovative effort and *Anal.Cov.*, although we find the negative coefficients on the interaction variables between innovation efficiency measures and analyst coverage. We conjecture that this difference 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.

Table 7. Interaction effect with analyst coverage on audit fees

	(1) *lnAUDITFEE*	(2) *lnAUDITFEE*	(3) *lnAUDITFEE*	(4) *lnAUDITFEE*
R&D	1.275***	1.269***	1.201***	1.212***
	(6.31)	(6.30)	(6.04)	(6.06)
Anal.Cov.	0.004	0.004	0.007	0.007
	(0.70)	(0.70)	(1.11)	(1.09)
R&D × Anal.Cov.	-0.157***	-0.154***	-0.166***	-0.165***
	(-4.27)	(-4.18)	(-4.56)	(-4.55)
lnPATENT	0.013		0.032**	
	(0.96)		(2.13)	
lnPATENT × Anal.Cov.	0.003		0.002	
	(1.46)		(1.22)	
lnCITE		0.013		0.025*
		(1.14)		(1.99)

lnCITE × Anal.Cov.		0.002		0.002
		(1.16)		(1.20)
IE_PATENT			-0.147	
			(-1.32)	
IE_PATENT × Anal.Cov.			-0.020	
			(-0.99)	
IE_CITE				-0.034
				(-0.90)
IE_CITE × Anal.Cov.				-0.010
				(-1.52)
ROA	-0.239**	-0.237**	-0.244***	-0.241**
	(-3.24)	(-3.20)	(-3.31)	(-3.27)
Size	0.519***	0.521***	0.508***	0.511***
	(48.22)	(49.51)	(43.96)	(46.00)
Leverage	0.137**	0.138**	0.147**	0.143**
	(2.15)	(2.15)	(2.30)	(2.24)
MB	0.003	0.003	0.002	0.002
	(1.13)	(1.16)	(0.87)	(0.94)
Quick Ratio	-0.041***	-0.041***	-0.040***	-0.040***
	(-9.88)	(-9.88)	(-9.87)	(-9.87)
Inherent	0.820***	0.825***	0.822***	0.829***
	(8.24)	(8.29)	(8.28)	(8.32)
Loss	0.024	0.025	0.023	0.024
	(1.14)	(1.16)	(1.08)	(1.14)
ICMW	0.413***	0.413***	0.417***	0.417***
	(11.40)	(11.39)	(11.52)	(11.55)
Big4	0.026	0.025	0.026	0.026
	(0.73)	(0.68)	(0.72)	(0.73)
NewAuditor	-0.136***	-0.136***	-0.133***	-0.133***
	(-4.93)	(-4.92)	(-4.80)	(-4.81)
FOROPS	0.046**	0.045**	0.047**	0.046**
	(2.23)	(2.20)	(2.28)	(2.26)
AUD_LAG	0.130***	0.130***	0.133***	0.133***
	(4.76)	(4.74)	(4.89)	(4.88)
N_SEG	0.009***	0.009***	0.009***	0.009***
	(6.53)	(6.59)	(6.49)	(6.51)
EXPERT	0.421***	0.422***	0.419***	0.421***
	(4.23)	(4.23)	(4.23)	(4.25)
Busy	0.069***	0.069***	0.070***	0.070***
	(2.86)	(2.86)	(2.87)	(2.90)
Constant	8.473***	8.455***	8.542***	8.514***
	(60.94)	(60.99)	(60.29)	(60.70)
Industry/Year Fixed Effects	Yes	Yes	Yes	Yes
N	10,004	10,004	10,004	10,004
adj. R-sq	0.823	0.822	0.823	0.823

Note: This table presents an 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 Appendix 1. 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.

5. CONCLUSIONS

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 an 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 audit 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 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. To the best of our knowledge, our study is the first to examine the effect of a firm's innovation efficiency on audit pricing. We expect our study contributes to further understanding of a firm's innovation efforts and auditors' responses to those efforts. Although we conduct a battery of robust tests to mitigate the possible endogeneity problem, we cannot rule out the possibility that some unobserved factors may affect our results due to the limitation of robust tests. We expect that future studies will find more evidence to enhance our understanding of the implication of a firm's innovation and audit activities.

ENDNOTE

[1] 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.
[2] Following Hall *et al*. (2005) and Kogan *et al*. (2017), we use the forward citation measure as ∑(1+Ci/Avg. Ci) where Avg. Ci is the average number of forward citations obtained by the patents that were granted in the same year as patent i to address truncation problems. Also, the measure has been deflated by total book assets to mitigate the size effect.
[3] In table 5 model 3, one standard deviation increases in *R&D* (0.075 from Table 3) with everything else being equal leads 0.037875 (coefficient of *R&D*×one standard deviation of *R&D*=0.505×0.075) in *ΔlnAUDITFEE*. *ΔlnAUDITFEE* equals to $lnAUDITFEE_2$-$lnAUDITFEE_1$=ln ($AUDITFEE_2$/$AUDITFEE_1$)=0.037875, therefore, $AUDITFEE_2/AUDITFEE_1=e^{0.037875}=1.0386$. That is 3.86% increase in audit fees.
[4] As in endnote 3, one standard deviation increases in *lnPATENT* (1.746 from Table 3) with everything else being equal leads 0.082062 (coefficient of *lnPATENT*×one standard deviation of *lnPATENT*=0.047×1.746) in *ΔlnAUDITFEE*. Therefore, $AUDITFEE_2/AUDITFEE_1=e^{0.082062}=1.0855$. That is an 8.55% increase in audit fees.
[5] We appreciate the anonymous reviewers' comment on this issue.

Appendix 1. Variable definitions

Variable	**Description (Compustat mnemonic in brackets)**
Dependent Variable	
lnAUDITFEE	Natural log of total audit fee of the year (AUDIT_FEES in Audit Analytics database).
Test Variables	
R&D	R&D expense deflated by market capitalization (XRD/(CSHO×PRCC_F)).
lnPATENT	Natural log of the number of patents obtained.
lnCITE	Natural log of the number of patent citations.
R&D Capital	$R\&D_{t-2}+0.8*R\&D_{t-3}+0.6*R\&D_{t-4}+0.4*R\&D_{t-5}+0.2*R\&D_{t-6}$.
IE_PATENT	Number of patents obtained deflated by *R&D Capital*.
IE_CITE	Number of patent citations deflated by *R&D Capital*.
Anal. Cov.	Analyst coverage as calculated by the decile rank of analysts following by year.
Control Variables	
ROA	Income before extraordinary items divided by prior year's total assets (IB/AT)
Size	The natural logarithm of total assets (AT).
Leverage	Long-term debt divided by total assets (DLTT/AT).
MB	Market-to-book ratio measured as market capitalization divided by the book value of equity ((CSHO×PRCC_F)/CEQ).
Quick Ratio	Ratio of current assets minus inventories to current liabilities ((ACT–INVT)/LCT).
Inherent	Inventory and receivables divided by total assets ((INVT+REC)/AT).
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 the auditor's opinion on the 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.
FOROPS	Equal to one if a firm reports foreign exchange income, zero otherwise (1 if FCA is not missing, 0 otherwise).
AUD_LAG	Natural log of the number of days between the fiscal year-end and the auditor's signature date.
N_SEG	Number of business segments
Expert	Ratio of aggregate audit fees paid by an auditor's all clients in an industry (two-digit SIC) to the total audit fees paid by all firms in the industry.
Busy	Equal to one if a firm's fiscal year ends in December, zero otherwise.

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

Appendix 2. Selection Model for Reporting R&D Expenditure

	R&D_Missing
ROA	1.178***
	(7.17)
Size	-0.237***
	(-18.41)
Leverage	1.785***
	(18.22)
MB	-0.044***
	(-8.29)
Quick Ratio	-0.059***
	(-5.98)
Inherent	1.216***
	(9.64)
Loss	-0.160***
	(-3.13)
Constant	-8.046
	(-0.02)
Industry/Year Fixed Effects	Yes
# of obs.	24,690
Pseudo R-Sq	0.290

Note: This table presents logit regression results for a client's propensity to report R&D expenditure estimated for PSM procedure used in the tests reported in Table 6. The dependent variable is an indicator variable that is set to 1 if a firm doesn't report R&D expense in a given year and 0 otherwise. Variables are defined in Appendix 1. 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.

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