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RESEARCH AND DEVELOPMENT INTENSITY AND AUDIT FEES

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ABSTRACT

This study provides evidence on whether audit fees vary in response to the intensity of research and development (R&D) expenditure and whether some other factors, such as expert auditor, may moderate the relationship between R&D intensity and audit fees. Our evidence indicates that there is a positive relationship between R&D intensity and audit fees and hiring an industry specialist auditor may attenuate the relationship. Our findings sugge*st that auditors charge a premium for heightened audit risk and increased audit efforts related to R&D intensity.

1. INTRODUCTION

Prior literature identifies two factors that interact to influence an auditor's pricing decision (Bell et al., 2001): first, the risk profile of an audit client that impacts auditor's assessment of client-specific business risk. High client-specific business risk may heighten the litigation risk and/or loss of reputation from bankruptcies or undetected misreported accounting numbers. In return, auditors charge risk premium to compensate for future litigation risk; second, the extent of audit coverage and/or the amount of audit effort may vary across different audit clients, which influence auditors' pricing decision. In this paper, we explore whether research and development (R&D) intensity is related to audit fees and whether hiring an industry specialist auditor may impact the relationship.

The relationship between R&D intensity and audit fees is based on the argument that higher R&D intensity can increase both audit risk and audit effort and thus auditors charge more accordingly.

Higher R&D intensity can lead to higher audit risk for the following reasons. First, R&D investments have some unique characteristics (Holmstrom, 1989): long-term in nature, uncertain in result, risky in terms of failure likelihood, and idiosyncrasy. R&D expenditure, unlike other corporate investments, creates tremendous amount of information asymmetry problem. Managers can continuously monitor the progress of the R&D investments while investors only get an aggregate value of the R&D investments.

To the extent that higher information asymmetry may lead to higher likelihood of earnings management and asset embezzlement (Frankel and Li, 2004; Froot et. al 1993; Tsui et al. 2001), auditors may ask for a price premium to compensate for heightened risk of litigation as the exposure of the earnings management and asset embezzlement may result in shareholder litigations against auditors. Second, the results of the R&D investments are highly unpredictable, which increases the overall firm risk and the variance of the future cash flows. Shi (2003) suggests that the increased overall firm risk and the variance of the future cash flows arising from high R&D intensity will increase the probability of debt default and the bankruptcy risk of a firm. Debt default, business failure and bankruptcy risk will also trigger shareholder litigation against managers and auditors for financial losses incurred by the business failure. Simunic(1980) indicates that auditors take into consideration the probability of business failure and bankruptcy risk into pricing decision and ask for fee premium to compensate for the litigation risk and loss of reputation if the risk of business failure is high. Thus, high R&D intensity may increase the risk of business failure and auditors will raise audit fee if the R&D intensity is high.

R&D intensity can also increase the audit scope and audit effort. R&D investments are firm specific and idiosyncratic as each R&D project is unique (Himmelberg and Petersen, 1994). The uniqueness of R&D investments increases the difficulty of valuation of those investments and the measurement of the R&D investments is generally unreliable. Auditors must exert additional effort to verify the accounting measurement and valuation.

The above arguments imply that higher R&D intensity increases information asymmetry, earnings management risk, overall firm risk, the risk of debt default and business failure, and ultimately, the risk of litigation against auditors. The idiosyncrasy of R&D investments also increases the difficulty of valuation and the unreliability of accounting measurement of those investments demand an expanded audit scope and audit efforts. Therefore, we hypothesize a positive relationship between R&D intensity and audit fees.

To address our research questions, we utilize a sample of audit fees from the database of Audit Analystics from the fiscal year 2000 to fiscal year 2012. We obtain accounting data from the database of Compustat and exclude foreign firms (ADRs) and firms in regulated industries. Following prior research (Godfrey and Hamilton, 2005), we define R&D intensity as all non-missing values of R&D expenditure in Compustat scaled by total assets. Our empirical finding corroborates our prediction. We document that as R&D intensity is higher, audit fees tend to increase too.

The extent to which R&D intensity can impact auditor’s pricing decision is likely to be conditioned on a number of factors including internal and external monitoring mechanisms, such as auditor type. We next examine whether high-quality auditors, or industry specialist auditors, may attenuate the higher audit fees due to higher audit risk and audit efforts related to R&D intensity.

Industry specialist auditors, or industry specialists, are known to invest heavily in sophisticated auditing technologies and accrue significant amount of experience of using such technologies in practice.

Prior audit fee research argues that high-quality audit firms, such as industry specialist auditors, are more likely to detect accounting fraud, enhance a firm's information environment by reducing information asymmetry and is an additional control mechanism to relieve agency cost (Francis, Maydew, and Sparks 1999; Francis and Wilson 1988;). Empirical evidence confirms that industry specialists can relieve client's concern of earnings management, asset embezzlement, and provide high-quality audits (Johnson and Lys 1990; DeFond 1992). For example, DeAngelo (1981) argues that industry specialists have a higher likelihood to detect accounting problems and are more incentivized to do so than low-quality auditors. More recently, Godfrey and Hamilton (2005) suggest that firms with higher agency costs proxied by R&D intensity are more likely to hire high-quality auditors to improve the accuracy of the financial reports, reduce information asymmetry and constrain managerial opportunism. We thus hypothesize that audit fee premium arising from the litigation risk related to R&D intensity can be reduced if industry specialist auditors are hired. In other words, high quality audits may significantly reduce audit risk and attenuate the positive relationship between audit fees and R&D intensity.

Consistent with prior research (Godfrey and Hamilton, 2005), we use the city level expertise of auditors as our proxy for industry specialist auditors and interact this proxy with R&D intensity as the primary independent variable in the multiple regression models. Our empirical finding supports our hypothesis. The interactive variable is significantly negative in the audit fee regression, suggesting the risk premium arising from high R&D intensity is reduced if a high-quality auditor is hired.

Our research contributes to the audit fee research literature as our paper identifies an important determinant to audit fees. Our research contributes to the research of R&D intensity. Our research indicates that high R&D intensity, although enhance firm value, has unintended burden on firms.

2. METHODOLOGY

2.1 Proxies of R&D Intensity

The R&D expenditure variable in COMPUSTAT has a lot of missing values. Following prior research (Godfrey and Hamilton, 2005),we use all non-missing values of R&D expenditure, and scale this variable with the total assets as our primary R&D intensity proxy. This definition of R&D intensity may relieve the doubt that our results are driven by the missing values. Alternatively, similar results are found if we replace the missing values of the R&D expenditure with zeros.

2.2 Sample Selection

Our sample is the overlap of the audit fee data from Audit Analytics dababase and the financial statement data from Compustat database from the fiscal year 2000 to fiscal year 2012. Observations are removed from the sample if there are duplicate audit fees entries in Audit Analytics, if they are foreign firms (ADRs), or if there is not enough financial statement information to calculate the R&D intensity and other control variables, or if they are from regulated industries (SIC 4000-4999) or financial industries(SIC6000-6999).

To mitigate the effect of potential outliers, all continuous variables are winsorized at the 1 percent and 99 percent levels before analysis[1]. The final sample size is 23,439 firm-year observations from 3,979 firms.

2.3 Regression Model

To test the association between our proxies of R&D intensity, and fees paid to auditors, we estimate the following regression model based on audit fee models, consistent with prior research (Abott et.al, 2003):

$$LAUDIT_t = b0 + b1*RD\_INTENSITY_t + b2*LOGAT_t + b3*BM_t + b4*BUSY_t + b5*ROA_t$$
$$+ b6*QUICK_t + b7*LEVERAGE_t + b8*LOSS_t + b9*INVREC_t$$
$$+ b10*SPITEM_t + b11*BIGN_t + b12*NSEG_t + b13*FOPS_t$$
$$+ b14*GCM_t + b15*REPORT\_LAG_t + b16*EXPERT_t + b17TENURE_t + e_t.$$

A detailed description of variable definitions is listed in Appendix 1.

The dependent variable (*LAUDIT*) is the natural log of fees (in 000s) paid to auditors for audit services[2]. *RD_INTENSITY* is the independent variable, calculated as was described above. If the R&D intensity is a risk factor to which the external auditor sensitive, then we expect b_1 will be positive and significant. The common determinants of audit fees model include audit client size, complexity, financial health, and auditor characteristics. The auditee's size is measured by the natural log of its total assets. We control for client complexity by including the number of consolidated segments (*NSEG*) and if the company has foreign operation (*FOPS*). *INV_REC* measures the proportion of total assets in inventory and accounts receivable. *LEVERAGE* is used to measure the client's business risk related to their financial structure and the debt level. *BM*, the book to market ratio, is used to control the client growth opportunities. *ROA*, the return on assets and *LOSS*, the net income direction dummy, are used to control the audit client financial health. *GCM*, is a dummy variable that deonotes if the client has received a qualified opinion from their auditor. *REPORT_LAG* is the variable ofthe audit report lag. the city level audit expert (*EXPERT*)[3],the number of years for any auditor serving her specific client[4](*TENURE*), and BIGN, a dummy variable to indicate if the auditor is one of big 5 auditors[5], are used here to control the possible auditor characteristics in the regression.

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[1]Our results remain unchanged if unwinsorized or winsorized at top and bottom 5% data are used in the regression.

[2] To be consistent with Abbot et. al. (2003), Fields et. al. (2004), Mayhew and Wilikins (2003), and other prior studies, the natural log of audit fees in thousands of dollars is used as dependent variables in this study.

[3]Industry audit expert or Industry specialist auditor is defined on city (or the metropolitan statistical areas) level following Reichelt and Wang (2009). Similar results are found if we use both national and city level audit expert as control variable in our regression model.

[4] Instead of using the continuous tenure measurements, when we use another dummy variable *TENURE2*(= 1 when *TENURE* is larger than or equal 3, = 0 otherwise) to replace the *TENURE* variable, our results hold.

[5]*BigN* auditors are defined as: Deloitte, PwC, Ernst & Young, KPMG and Arthur Andersen in this study.

To study the moderating effect of auditor expertise on the R&D audit risk, an interaction term of the city level industry specialist (*EXPERT*) and R&D intensity (*RD_INTENSITY*) is added to our main regression. If hiring the industry specialist auditors can mitigate the audit risk associated with R&D intensity, then we expect the coefficient on this interaction term will be negative significant.

3. RESULTS

3.1 Descriptive and Univariate Results

Panel A of Appendix 2 provides descriptive statistics for the sample. The mean audit fees are 1,416 thousand dollars, which is a lot larger than the median audit fees of 473 thousand dollars. Consistent with prior literature, after the log transformation, the difference between the mean and median of *LAUDIT* is small.

Panel B of Appendix 2 exhibits the correlation matrix for the variables in the regressions. In line with prior studies, the *LAUDIT* is positively correlated with *SIZE*. The *RD_INTENSITY* are correlated with natural log of audit fees negatively. The negative coefficient correlation suggests a negative relationship between R&D intensity and audit fees, on the surface. We control other factors that may impact the relationship in multiple regression. Although the correlation coefficients between some variables are larger than 0.50, the VIF scores are less than 6 in our regressions. Therefore, multicolinearity does not seem an issue here.

3.2 Multivariate Results

Appendix 3 reports the multivariate regression results of our primary regressions. Following Krishnan et. al. (2013)_, our regressions models are estimated with the standard errors clustered by firms to correct for time-series dependence of audit fee data. Year and industry fixed effects are controlled by dummy variables[6]. The regressions have a high R-square value (0.85), which confirms the high explanatory power of the audit fee model in prior literature. All control variables are in the expected direction as in prior literature (Hay et al. 2006). The coefficient of *RD_INTENSITY* is significantly positive (p=0.00). This result supports our risk hypothesis on R&D expenditure.

In addition, Appendix 4 reports results of the moderating effect of audit expertise on the riskiness of R&D expenditure. The coefficient of the interaction term of audit expertise and *RD_INTENSITY* is significantly negative (p = 0.00). This result is in line with our hypothesis that audit expertise may mitigate the audit risk associated with RD activities.

3.3 Sensitivity Analysis

Additional tests are conducted to determine if our results are sensitive to the specification of the audit fee model. Using alternative definitions of *RD_INTENSITY*, such as R&D expenditure scaled by firm total sales revenue, the regressions yield similar results. Since R&D expenditure is associated with intangible assets development, we also include intangible asset ratio (intangible assets scaled by total assets) as an sensitivity test. Our

[6] The unreported regression results with no clustering standard errors are similar with the reported.

result does not change. In addition, our results hold when we include performance matched discretionary accruals (Kothari 2005) as additional control variable in our regression. Lastly, similar results are also found in both pre-SOX and post-SOX subsamples (using year = 2002 as cut off), or both pre-crisis and post-crisis subsamples (using year = 2008 as cut off).

5. CONCLUSION

We provide evidence on whether audit fees vary in response to the intensity of research and development (R&D) expenditure and whether some other factors, such as high-quality auditors, may moderate the relationship between R&D intensity and audit fees. Our evidence indicates that there is a positive relationship between R&D intensity and audit fees and hiring an industry specialist auditor may attenuate the relationship. Our findings suggest that auditors charge a premium for heightened audit risk and increased audit efforts related to R&D intensity. We contribute to both the research of determinants to audit fees and the literature of R&D intensity.

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Appendix 1
Variable Definitions

Dependent Variables

AUDFEE	=	audit fees in thousand dollars;
LAUDIT	=	log of audit fees in thousand dollars;

Experimental Variables

RD_INTENSITY	=	research and development expenditure scaled total assets;

Control Variables

ASSET	=	total assets in millions of dollars;
LOGAT	=	natural log of total assets;
BM	=	book-to-market ratio;
BUSY	=	1 if fiscal year end is December, and 0 otherwise;
ROA	=	income before extraordinary items deflated by total assets;
QUICK	=	current assets divided by current liabilities;
LEVERAGE	=	total debts deflated by total assets;
LOSS	=	1 if the firm report loss for current year, and 0 otherwise;
INV_REC	=	sum of inventories and receivables, divided by total assets;
SPITEM	=	1 if the firm reports a special item, and 0 otherwise;
BIGN	=	1 if the firm is audited by a big 5 audit firm, and 0 otherwise;
NSEG	=	the number of business segments;
FOPS	=	1 if firm has a foreign operation, and 0 otherwise;
GCM	=	1 if firm receives a going concern opinion, and 0 otherwise;
REPORT_LAG	=	time in days from fiscal year end to the audit report date;
EXPERT	=	1 if an auditor is City (MSA) level expert, 0 otherwise
RD_EXPERT	=	the interaction of RD_INTENSITY and EXPERT
TENURE	=	number of years for an audittee served by a specific auditor

Appendix 2

Panel A: Descriptive Statics (N = 23,439)

Variable Name	Mean	Median	Standard Deviation	25th percentile	75th percentile
AUDFEE	1,416.27	473.43	3,062.28	162.09	1,312.94
LAUDIT	6.18	6.16	1.45	5.09	7.18
RD_INTENSITY	0.14	0.06	0.28	0.01	0.15
ASSETS	2,402.77	179.51	11,123.12	35.23	928.32
BM	0.40	0.38	0.95	0.19	0.67
BUSY	0.67	1.00	0.47	0.00	1.00
ROA	-0.34	0.01	1.31	-0.22	0.07
QUICK	2.79	1.67	3.35	0.98	3.24
LEVERAGE	0.71	0.43	1.53	0.24	0.64
LOSS	0.46	0.00	0.49	0.00	1.00
INV_REC	0.28	0.25	0.23	0.11	0.39
SPITEM	0.64	1.00	0.48	0.00	1.00
BIGN	0.73	1.00	0.44	0.00	1.00
NSEG	1.99	1.00	1.48	1.00	3.00
FOPS	0.50	1.00	0.49	0.00	1.00
GCM	0.10	0.00	0.31	0.00	0.00
REPORT_LAG	111.34	102.00	54.40	87.00	118.00
TENURE	8.59	6.00	7.60	3.00	11.00
EXPERT	0.42	0.00	0.49	0.00	1.00

Panel B: Correlationamong Variables – Pearson (below)/ Spearman (above)

Bold indicate correlation significant at p< 0.10 level. See Appdenix1 for variable definition.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1) LAUDIT	1	**-0.25**	**0.86**	**0.10**	0.01	**0.39**	**-0.07**	**0.14**	**-0.37**	**0.07**	**0.35**	**0.43**	**0.60**	**0.51**	**-0.34**	**-0.28**	**0.45**	**0.25**
(2) RD_INTENSITY	**-0.30**	1	**-0.40**	**-0.29**	**0.11**	**-0.44**	**0.32**	**-0.14**	**0.43**	**-0.28**	**-0.07**	**-0.29**	**-0.10**	**-0.08**	**0.20**	**0.20**	**-0.14**	**-0.28**
(3) Log(at)	**0.86**	**-0.45**	1	**0.18**	**-0.02**	**0.50**	**-0.05**	**0.09**	**-0.47**	**0.08**	**0.32**	**0.44**	**0.57**	**0.57**	**-0.43**	**-0.37**	**0.47**	**0.29**
(4) BM	**0.07**	**-0.22**	**0.18**	1	**-0.10**	**0.12**	**0.14**	**-0.34**	**-0.13**	**0.14**	**0.09**	**0.15**	**0.14**	**0.12**	**-0.33**	**-0.02**	**0.11**	**0.08**
(5) BUSY	0.01	**0.08**	**-0.02**	**-0.06**	1	**-0.11**	**0.06**	**0.03**	**0.10**	**-0.13**	**0.02**	-0.01	**-0.04**	**0.06**	**0.04**	**0.04**	**-0.07**	0.00
(6) ROA	**0.33**	**-0.62**	**0.49**	**0.30**	**-0.05**	1	**0.05**	**-0.15**	**-0.85**	**0.34**	0.01	**0.25**	**0.36**	**0.23**	**-0.42**	**-0.27**	**0.27**	**0.16**
(7) QUICK	**-0.18**	**0.02**	**-0.1**	**0.10**	**0.06**	**0.10**	1	**-0.74**	**0.03**	**-0.22**	**-0.11**	**-0.17**	0.00	**0.14**	**-0.31**	**0.08**	0.01	**-0.14**
(8) LEVERAGE	**-0.20**	**0.44**	**-0.36**	**-0.44**	**0.04**	**-0.75**	**-0.22**	1	**0.07**	**0.09**	**0.15**	**0.17**	**0.02**	**-0.07**	**0.31**	**-0.08**	**0.02**	**0.11**
(9) LOSS	**-0.37**	**0.36**	**-0.47**	**-0.09**	**0.10**	**-0.35**	**0.13**	**0.18**	1	**-0.32**	**-0.01**	**-0.27**	**-0.34**	**-0.21**	**0.33**	**0.27**	**-0.25**	**-0.17**
(10) INV_REC	**-0.03**	**-0.23**	0.00	**0.06**	**-0.11**	**0.17**	**-0.24**	**-0.05**	**-0.25**	1	**-0.03**	**0.17**	**0.17**	**-0.05**	**-0.16**	**-0.11**	**0.03**	**0.08**
(11) SPITEM	**0.35**	**-0.1**	**0.31**	**0.03**	**0.02**	**0.05**	**-0.16**	**-0.01**	**-0.01**	**-0.07**	1	**0.20**	**0.26**	**0.18**	**-0.05**	**-0.09**	**0.15**	**0.07**
(12) NSEG	**0.47**	**-0.23**	**0.47**	**0.06**	0.01	**0.16**	**-0.20**	**-0.07**	**-0.27**	**0.07**	**0.20**	1	**0.34**	**0.18**	**-0.16**	**-0.22**	**0.21**	**0.18**
(13) FOPS	**0.59**	**-0.25**	**0.55**	**0.09**	**-0.04**	**0.26**	**-0.14**	**-0.15**	**-0.34**	**0.08**	**0.26**	**0.34**	1	**0.33**	**-0.29**	**-0.23**	**0.30**	**0.08**
(14) BIGN	**0.51**	**-0.19**	**0.58**	**0.13**	**0.06**	**0.29**	**0.04**	**-0.25**	**-0.21**	**-0.10**	**0.18**	**0.18**	**0.33**	1	**-0.34**	**-0.18**	**0.47**	**0.23**
(15) GCM	**-0.34**	**0.41**	**-0.49**	**-0.36**	**0.04**	**-0.56**	**-0.15**	**0.48**	**0.33**	**-0.09**	**-0.05**	**-0.15**	**-0.29**	**-0.34**	1	**0.14**	**-0.23**	**-0.10**
(16) REPORT_LAG	**-0.18**	**0.1**	**-0.24**	**-0.04**	**-0.01**	**-0.13**	0.00	**0.08**	**0.18**	**-0.02**	**-0.04**	**-0.13**	**-0.16**	**-0.15**	**0.14**	1	**-0.24**	**-0.14**
(17) TENURE	**0.44**	**-0.16**	**0.46**	**0.06**	**-0.06**	**0.17**	**-0.10**	**-0.10**	**-0.25**	0.01	**0.15**	**0.29**	**0.30**	**0.38**	**-0.18**	**-0.17**	1	**0.20**
(18) EXPERT	**0.25**	**-0.16**	**0.29**	**0.06**	0.00	**0.11**	**-0.09**	**-0.05**	**-0.17**	**0.06**	**0.07**	**0.19**	**0.08**	**0.23**	**-0.10**	**-0.08**	**0.21**	1

Appendix 3

Testing the Association between Audit Fees and R&D Intensity

Variables	Predicted Sign	Coefficient	t-Statistic	p-value
INTERCEPT	?	3.074	63.36	0.000
RD_INTENSITY	?	0.210	7.26	0.000
EXPERT	+	0.033	2.30	0.022
LOGAT	+	0.447	80.55	0.000
BM	-	-0.017	-3.28	0.000
BUSY	+	0.097	5.45	0.000
ROA	-	-0.039	-5.38	0.000
QUICK	-	-0.029	-13.80	0.000
LEVERAGE	+	0.013	2.25	0.024
LOSS	+	0.134	10.18	0.000
INV_REC	+	0.053	1.74	0.081
SPITEM	+	0.108	8.11	0.000
NSEG	+	0.063	10.02	0.000
FOPS	+	0.278	15.13	0.000
BIGN	+	0.362	17.16	0.000
GCM	+	0.064	2.78	0.006
REPORT_LAG	+	0.001	11.51	0.000
TENURE	+	0.002	1.96	0.049
N			23,439	
Adjusted R^2			0.84	

*Significance of t-statistics are two-tailed. Industry and year dummies are included, but not reported. *,**,*** represent significance levels of 10 percent, 5 percent, and 1 percent, respectively. Standard errors are clustered by company following Petersen 2009 and Gow et al. 2010. Variables are defined in Appendix1.*

Appendix 4

Testing the Association between Audit Fees, R&D Intensity and Moderating Effect of City Level Audit Specialist

Variables	Predicted Sign	Coefficient	t-Statistic	p-value
INTERCEPT	?	3.068	62.94	0.000
RD_INTENSITY	?	0.216	7.50	0.000
RD_EXPERT	-	-0.010	-4.37	0.000
EXPERT	+	0.033	2.31	0.022
LOGAT	+	0.448	81.01	0.000
BM	-	-0.017	-3.25	0.000
BUSY	+	0.097	5.90	0.000
ROA	-	-0.039	-5.45	0.000
QUICK	-	-0.030	-14.58	0.000
LEVERAGE	+	0.014	2.33	0.020
LOSS	+	0.135	10.23	0.000
INV_REC	+	0.053	1.73	0.083
SPITEM	+	0.106	10.07	0.000
NSEG	+	0.063	10.70	0.000
FOPS	+	0.278	15.23	0.000
BIGN	+	0.373	17.73	0.000
GCM	+	0.066	2.82	0.005
REPORT_LAG	+	0.001	11.47	0.000
TENURE	+	0.002	1.97	0.049
N			23,439	
AdjustedR^2			0.84	

*Significance of t-statistics are two-tailed. Industry and year dummies are included, but not reported. *,**,*** represent significance levels of 10 percent, 5 percent, and 1 percent, respectively. Standard errors are clustered by company following Petersen 2009 and Gow et al. 2010. Variables are defined in Appendix1.*