AUDITING: A JOURNAL OF PRACTICE & THEORY
Vol. 37, No. 3
August 2018
pp. 47–69

American Accounting Association
DOI: 10.2308/ajpt-51820

Earnings Autocorrelation, Earnings Volatility, and Audit Fees

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SUMMARY: This study proposes that earnings autocorrelation and earnings volatility are associated with audit fees. Autocorrelation and volatility are time-series of earnings characteristics that may affect an auditor's perception of inherent risk. In response to greater inherent risk, auditors should conduct more extensive substantive testing to reduce the overall risk associated with the audit. We find a negative (positive) association between earnings autocorrelation (volatility) and audit fees. The results indicate that a shift in the interquartile range in earnings autocorrelation and earnings volatility combined is associated with a 4.0 percent change in audit fees, which amounts to approximately $95,600 for the average firm-year observation in our primary sample. We also find that the relation between earnings autocorrelation and audit fees is attenuated for industry-specialist auditors, consistent with specialists responding to lower earnings autocorrelation more efficiently than non-specialists.

Keywords: audit fees; auditor industry specialization; earnings autocorrelation; earnings volatility.

INTRODUCTION

We propose that earnings autocorrelation and earnings volatility are important earnings characteristics that impact audit risk.[1] Although these characteristics may constitute elements of inherent risk for the auditor, the associations and directions are ambiguous for reasons discussed later. As inherent risk increases, auditors should perform more substantive testing to reduce the overall risk associated with the audit. We anticipate that this additional effort will drive audit fees higher. Our findings are consistent with lower (higher) earnings autocorrelation (volatility) increasing the auditor's assessment of inherent risk, leading to an economically significant effect on audit fees.

Autocorrelation is a time-series of earnings characteristic that captures the way in which prior-period earnings relate to current-period earnings. Firms with positive autocorrelation have earnings that tend to move in the same direction over time, whereas firms with negative autocorrelation have earnings that tend to reverse in direction from year to year. Firms can also

We thank Bruce Billings, Allen Blay, Landon Mauler, Robbie Moon, Rick Morton, Josette Pelzer, and the workshop participants at Florida State University and Louisiana State University for their helpful comments on prior versions of this study. We also thank Marleen Willekens (editor) and two anonymous reviewers.

Editor's note: Accepted by Marleen Willekens, under the Senior Editorship of Jeffrey R. Cohen.

Submitted: July 2015
Accepted: May 2017
Published Online: June 2017

[1] Auditing standards specify audit risk as the product of three components: inherent risk, control risk, and detection risk (American Institute of Certified Public Accountants [AICPA] 2006; Public Company Accounting Oversight Board [PCAOB] 2010). Inherent risk represents the auditor's assessment of the risk of a material misstatement without considering a firm's internal control over financial reporting; control risk is the auditor's assessment of the risk that a material misstatement will not be prevented or detected by the firm's system of internal control; and detection risk is the risk that the auditor will not detect a material misstatement during the course of the audit (AICPA 2006). The audit risk model implies that if an auditor assesses a higher level of inherent risk or control risk, then more substantive testing must be conducted to lower detection risk so that overall audit risk is reduced to an acceptable level. Therefore, factors that cause auditors to assess a higher degree of inherent risk or control risk should increase the amount of effort the auditor has to put forth during the audit.

lack significant levels of autocorrelation, indicating that prior-period earnings are not informative about current-period earnings. Volatility reflects the dispersion in earnings over time, with higher volatility indicating more widely dispersed earnings. Prior research finds that earnings have become more volatile over time (e.g., Givoly and Hayn 2000; Dichev and Tang 2008), making volatility an increasingly critical earnings characteristic.

We argue that time-series of earnings characteristics can affect auditor assessments of inherent risk and, in turn, influence auditor effort and audit fees. The impact of earnings autocorrelation on the auditor's perception of risk is likely to depend on both the sign and magnitude of the autocorrelation. Earnings autocorrelation can range from −1 to +1. When autocorrelation takes a value near zero, the time-series of earnings is characterized by uncertainty because prior-period earnings do not provide information about current-period earnings, making it more difficult for auditors to assess earnings against a benchmark expectation and increasing the difficulty of determining the reasonableness of earnings. In addition, an auditor may observe an uncertain time-series of earnings and interpret it as a signal of underlying business risks, increasing the auditor's perception of risk. When autocorrelation is negative, we expect earnings to be difficult for auditors to interpret and understand because negative autocorrelation indicates earnings that waver back and forth over time, potentially increasing the auditor's perception of risk. In contrast, we anticipate positive earnings autocorrelation to be relatively easier for auditors to interpret and understand because positive autocorrelation indicates an earnings pattern that consistently flows in the same direction over time.[2]

We also expect earnings volatility to affect auditor risk assessments. As earnings volatility increases, earnings are less predictable (Dichev and Tang 2009) and more difficult to assess against a benchmark expectation, thus making it harder for auditors to determine the reasonableness of current-period earnings. This implies greater difficulty in auditing earnings. In addition, earnings volatility may also affect auditor risk assessments because more complex auditing issues are likely to arise when earnings are volatile.

In addition to impacting inherent risk itself, lower autocorrelation or higher volatility may also make *assessing* inherent risk more difficult. We expect greater auditor effort to be required when it is more difficult to make assessments of inherent risk, implying higher audit fees.

While lower autocorrelation and higher volatility are expected to make earnings harder to audit, on the other hand, those same earnings characteristics may indicate a lower risk of managerial manipulation of earnings, which can reduce the auditor's assessed risk of fraud in the financial statements. These competing potential drivers of audit risk create an interesting framework for examining whether and how auditors incorporate these earnings characteristics into their audit risk assessments. Factors viewed as increasing risk exposure will lead the rational auditor to expend additional effort to manage that risk.

We also examine whether auditor industry specialization affects the association between earnings autocorrelation (volatility) and audit fees. Prior research finds that in-depth industry knowledge allows industry-specialist auditors to provide higher-quality audits than non-specialists (e.g., Balsam, Krishnan, and Yang 2003; Gul, Fung, and Jaggi 2009; Lim and Tan 2010; Reichelt and Wang 2010; Jayaraman and Milbourn 2015). In addition to specialization promoting higher-quality audits, Willenborg (2002) posits that specialization may also facilitate more efficient audits, as well. Supporting this idea, Moroney (2007), as well as Hammersley (2006), provide experimental evidence implying that industry specialists are more efficient than non-specialists. If this is the case, then specialists may respond to lower earnings autocorrelation or higher earnings volatility more efficiently than non-specialists, suggesting a weaker association between earnings autocorrelation (volatility) and audit fees for industry-specialist auditors. Alternatively, specialists may respond to lower earnings autocorrelation or higher earnings volatility by auditing more thoroughly than non-specialists. This could occur if, relative to non-specialists, specialists are either (1) more concerned about protecting a reputation for providing high-quality audits, or (2) better equipped to identify the risks associated with lower earnings autocorrelation and higher earnings volatility. These reasons imply a strengthening in the association between earnings autocorrelation (volatility) and audit fees.

Our study provides strong evidence of a negative (positive) association between earnings autocorrelation (volatility) and audit fees. We also find that the association between earnings autocorrelation and audit fees is attenuated for industry-specialist auditors, consistent with specialists responding more efficiently to lower earnings autocorrelation than non-specialists. However, we do not find evidence that earnings volatility affects audit fees differently for industry specialists.

This study provides two primary contributions to the literature. First, prior research frequently examines whether one particular earnings attribute, accruals, affects auditor perceptions of risk (e.g., Gul, Chen, and Tsui 2003; Abbott, Parker, and Peters 2006; Schelleman and Knechel 2010; Krishnan, Sun, Wang, and Yang 2013), but whether earnings characteristics affect

[2] As discussed, we argue that autocorrelation will affect auditor risk assessments. It is important to note that auditors do not need to explicitly calculate autocorrelation for this effect to occur, or even be consciously aware that autocorrelation is impacting their risk assessments. All that is required is that the auditor observes and responds to patterns in earnings. For example, consider a firm that has autocorrelation with a value near zero, which indicates that its earnings are characterized by uncertainty. An auditor may observe the firm's earnings pattern and find it difficult to understand. In turn, the auditor may assess a higher degree of risk, leading to higher audit fees. In this case, the autocorrelation is the underlying source of the auditor's difficulty in understanding earnings, even though the auditor does not realize it.

auditor risk assessments more generally is an understudied research area. We help fill this void in the literature by identifying autocorrelation and volatility as two earnings characteristics that have an economically significant effect on audit fees. Our results suggest that a shift in the interquartile range in earnings autocorrelation and earnings volatility is associated with a change in audit fees of 2.17 percent and 1.83 percent, respectively, for a combined impact of 4.0 percent. This corresponds to an audit fee of approximately $95,600 for the average firm-year observation in our primary sample. By comparison, a shift in the interquartile range in total accruals, return on assets, and audit report lag is associated with a change in audit fees of 0.51 percent, 3.03 percent, and 4.13 percent, respectively. Thus, the magnitude of the combined impact of earnings autocorrelation and earnings volatility on audit fees is larger than or comparable to several previously established determinants of audit fees.

We also contribute to the auditor industry specialization literature. Willenborg (2002) posits that auditors choose to specialize in an industry because it allows them to audit both more effectively and more efficiently. By showing that specialists provide higher-quality audits (e.g., Balsam et al. 2003; Gul et al. 2009; Lim and Tan 2010; Reichelt and Wang 2010; Jayaraman and Milbourn 2015), extant literature provides evidence concerning the effectiveness of audits conducted by specialists. We find that the association between earnings autocorrelation and audit fees is attenuated for industry-specialist auditors, consistent with specialists responding to lower earnings autocorrelation more efficiently than non-specialists. Thus, while the existing literature provides abundant evidence that specialists provide more *effective* audits, we contribute to the literature by showing that specialists can also produce more *efficient* audits, as well. Therefore, we add to the prior research that documents benefits associated with auditor industry specialization.

The remainder of this paper is organized as follows. The second section develops the hypotheses, the third section presents our empirical methodology, the fourth section discusses the results of the study, and the fifth section concludes.

DEVELOPMENT OF THE HYPOTHESES

Earnings Autocorrelation, Earnings Volatility, and Audit Fees

A large body of literature, beginning with Simunic (1980), investigates the determinants of audit fees. An interesting question in this line of literature concerns how auditors respond to underlying risk drivers. Regarding inherent risk assessments, prior research finds that auditors charge a higher fee in response to greater inherent risk, and suggests that the higher fee is attributable to spending a greater number of hours on the engagement (e.g., Simunic and Stein 1996; Bell, Landsman, and Shackelford 2001; Schelleman and Knechel 2010) or, in other words, to greater auditor effort. We posit that autocorrelation and volatility are related to inherent risk and, thus, will affect audit fees if the auditor perceives them as impacting risk.

The notion that publicly observable financial metrics may convey incremental information about the auditor's assessment of risk and, thus, by extension, audit fees is well established in the audit fee literature. However, there is much that we still do not know regarding which factors are priced by auditors and how. In a related recent study, for example, Cassell, Drake, and Rasmussen (2011) examine the influence of short interest on audit fees. The authors argue that because short sellers are skilled at identifying firms with questionable financial reporting, short interest provides a signal of audit risk. The authors find a positive relation between short interest and audit fees, and furthermore find that changes in audit fees are correlated with past changes in short interest, suggesting that auditors may consider short interest when making risk assessments.[3] Similarly, we argue that one avenue by which earnings autocorrelation and earnings volatility may affect auditor risk assessments is through signaling underlying business risks and/or the risk of earnings manipulation.

Autocorrelation and volatility represent distinct time-series of earnings characteristics. Autocorrelation reflects the way in which prior-period earnings relate to current-period earnings. Firms with autocorrelation near zero have prior-period earnings that are not informative about current-period earnings, but that does not necessarily imply that earnings are highly dispersed. Likewise, earnings can be highly dispersed, but have high autocorrelation if prior-period earnings have value in predicting current-period earnings.[4] The notion that autocorrelation and volatility are distinct is supported in our data because we find that autocorrelation and volatility have a low degree of correlation, with a correlation coefficient of only 0.03. Therefore, either or both of these characteristics may constitute important elements of inherent risk for the auditor, but the associations and directions are ambiguous for reasons discussed later. If autocorrelation and volatility are associated with the auditor's assessment of inherent risk, then we expect to see this effect reflected in audit fees.

[3] However, as noted by Willekens (2011), an important unanswered question in the study is whether the association between short interest and audit fees is driven by "short sellers and auditors responding to common information risk (correlated information sets) or whether auditors use short interest as a source of information."

[4] To illustrate, imagine a firm where earnings increase by 50 percent every year. Dispersion in earnings, measured by the standard deviation, would be high. However, prior-period earnings would be able to perfectly predict current-period earnings, meaning there would be very high autocorrelation.

Firms with a value of earnings autocorrelation near zero have earnings that are characterized by uncertainty. We hypothesize two non-mutually exclusive explanations through which uncertainty in earnings could affect auditor assessments of inherent risk. First, the uncertainty in earnings itself could be difficult for auditors to interpret. When earnings are unpredictable from year to year, auditors are less able to benchmark current-year firm performance against prior-year performance. With a reduced ability to use past earnings to judge the reasonableness of current earnings, an auditor has one less analytical tool available to assess current-period earnings, implying greater risk.

Second, underlying business risks faced by the client that tend to cause uncertainty in earnings may also cause an auditor to perceive higher levels of inherent risk. For example, operating in a highly competitive environment could lead to uncertainty in earnings, and could also cause an auditor to view inherent risk as higher. In this way, earnings autocorrelation could serve as a valuable proxy to capture elements of the auditor's risk exposure that may be infeasible to directly measure empirically, yet are reflected as an uncertain time-series of earnings.[5] Alternatively, rather than responding directly to underlying business risks, auditors may observe an uncertain time-series of earnings and interpret it as a signal of underlying business risks. That is, if uncertainty in earnings is a "symptom" of underlying business risks, then an auditor may observe uncertainty in earnings and rationally perceive it as a signal of underlying business risks, causing the auditor to assess a higher degree of inherent risk. Both of these factors imply higher risk exposure, and hence higher audit fees, when earnings autocorrelation is near zero.

Firms with negative autocorrelation have earnings that teeter back and forth over time. We expect auditors to perceive a staggering earnings pattern as more difficult to interpret and understand because of the seemingly unstable nature of the earnings. As the difficulty of understanding an earnings pattern increases, we expect auditors to view earnings as being more difficult to audit, increasing the auditor's perception of inherent risk and leading to higher audit fees. In contrast, positive earnings autocorrelation indicates an earnings pattern that consistently flows in the same direction over time. We expect auditors to view this earnings pattern as relatively easier to interpret and understand, leading to lower perceived risk.

Alternatively, because positive autocorrelation indicates an earnings pattern with a stable and consistent trend, it could also potentially reflect earnings management. Intentional earnings manipulation is a direct causal factor in inherent risk, and prior research has provided evidence that earnings management is positively associated with audit fees (e.g., Gul et al. 2003; Abbott et al. 2006; Schelleman and Knechel 2010; Krishnan et al. 2013).[6] To the extent that higher earnings autocorrelation reflects managerial manipulation, we would expect to see auditors respond with heightened awareness and effort, and hence we would anticipate observing greater audit fees when autocorrelation is higher.

We also expect earnings volatility to affect auditor risk assessments. Volatile earnings are less predictable (Dichev and Tang 2009) and more difficult to assess against a benchmark expectation, making it harder for auditors to evaluate the reasonableness of current-period earnings and increasing the difficulty of the audit. Prior research provides support for the idea that volatile earnings are more difficult to assess (e.g., Dichev and Tang 2009; Graham, Harvey, and Rajgopal 2005). For example, Dichev and Tang (2009) find that analysts make systematic errors in evaluating volatile earnings, implying that volatility decreases earnings predictability. Further, survey evidence suggests that one reason executives view earnings volatility unfavorably is that they believe it makes assessing earnings more difficult for analysts (Graham et al. 2005).[7]

Earnings volatility may also affect auditor risk assessments by providing a signal of underlying economic conditions that could increase the difficulty of the audit and impose greater risk on the auditor. According to Dichev and Tang (2009), "earnings volatility captures the effects of real and unavoidable economic volatility." Under these conditions, more complex auditing issues are likely to arise. For instance, as earnings volatility increases, auditors may face more difficult valuation issues, such as whether an adjustment for impairment expense is necessary. Therefore, when an auditor observes volatile earnings, the auditor may interpret it as a signal of greater risk. These reasons imply a positive association between earnings volatility and audit fees.

Alternatively, low earnings volatility could reflect earnings management. Francis, LaFond, Olsson, and Schipper (2004) find that smooth earnings are associated with a lower cost of equity capital. This provides managers with a strong

[5] Note that this is similar to the intuition behind including audit report lag as a determinant in the audit fee model. Audit report lag captures problems or difficulties in an audit, which lead to a longer delay in filing the audit report and also lead to higher audit fees. Problems specific to each audit cannot feasibly be directly measured empirically because that information is not available; however, audit report lag is a useful proxy for audit-specific problems.

[6] Although we do not control for abnormal accruals in our main analysis, our results are robust to the inclusion of performance-adjusted abnormal accruals as a control variable.

[7] While we recognize that auditors have greater access to a firm's information than analysts, we believe the underlying notion that volatility makes earnings harder to understand is likely to apply to auditors, as well. That is, all else equal, we expect auditors to face greater difficulty interpreting more volatile earnings compared to less volatile earnings.

incentive to manipulate earnings volatility. Since earnings management is associated with higher audit fees (e.g., Gul et al. 2003; Abbott et al. 2006; Schelleman and Knechel 2010; Krishnan et al. 2013), to the extent that higher volatility reflects less earnings manipulation, we would expect to observe a negative association between earnings volatility and audit fees.

Because of these competing effects for both earnings autocorrelation and earnings volatility, we do not make directional predictions about their associations with audit fees. In addition, we do not view the competing effects as being mutually exclusive and, thus, they could potentially cancel each other out. Absent a perfect counterbalancing effect though, we should be able to observe a broad effect with sufficient statistical power. Since autocorrelation and volatility are conceptually and empirically distinct, the various theoretical factors linking them with audit fees may weigh significantly differently in the assessment of inherent risk. Hence, we express separate hypotheses for each, in alternative form, as follows:

H1: Earnings autocorrelation is associated with audit fees.

H2: Earnings volatility is associated with audit fees.

Auditor Industry Specialization

Industry specialization allows auditors to gain extensive industry experience and acquire in-depth industry knowledge, potentially leading to more efficient and higher-quality audits. With respect to audit quality, prior experimental research finds that more extensive industry experience is associated with better audit risk assessments (Low 2004), greater knowledge of non-error frequencies (Solomon, Shields, and Whittington 1999), and a better ability to detect fraud (Johnson, Jamal, and Berryman 1991), errors (Bedard and Biggs 1991; Owhoso, Messier, and Lynch 2002), and misstatements (Hammersley 2006). Prior archival research suggests that industry specialization is associated with higher earnings quality (e.g., Balsam et al. 2003; Gul et al. 2009; Krishnan 2003; Kwon, Lim, and Tan 2007; Lim and Tan 2010; Reichelt and Wang 2010), less fraud (Carcello and Nagy 2004), better quality disclosures (Dunn and Mayhew 2004), more conservatism (Krishnan 2005), a higher propensity to issue a going-concern audit opinion (Reichelt and Wang 2010), and less restatements (Chin and Chi 2009). In addition, Jayaraman and Milbourn (2015) find that CEO equity incentives are only associated with misreporting in clients of auditors who are not industry specialists.

Since industry specialists provide more effective audits, specialists may respond to lower earnings autocorrelation or higher earnings volatility more thoroughly than non-specialists, implying a stronger association between earnings autocorrelation (volatility) and audit fees. A more thorough response could occur for two reasons. First, specialists have an incentive to maintain a reputation for providing high-quality audits because specialization is associated with an audit fee premium (e.g., Francis, Reichelt, and Wang 2005; Carson 2009; Fung, Gul, and Krishnan 2012). Because of this incentive, specialists may respond more vigilantly to the risks posed by lower earnings autocorrelation or higher earnings volatility than non-specialists. Second, because of their superior industry knowledge, specialists may be better equipped to identify the risks associated with lower earnings autocorrelation or higher earnings volatility compared to non-specialists. If specialists are better able to identify these risks, then they may audit to a greater extent than non-specialists. These reasons imply a stronger association between earnings autocorrelation (volatility) and audit fees for industry-specialist auditors.

In addition to impacting audit quality, industry specialization may also facilitate the production of more efficient audits. Willenborg (2002) posits that auditors may specialize in an industry because it allows them to audit more efficiently. Consistent with this notion, two experimental studies imply that industry specialization is associated with greater audit efficiency. For example, Hammersley (2006) finds that, in response to a partial-cue pattern that may indicate a misstatement, industry-specialist auditors propose audit procedures that are more efficient in determining whether there is a misstatement, compared to non-specialists. Also, Moroney (2007) provides some evidence suggesting that industry specialization improves the efficiency of audit decision-making, although her results are fairly mixed. If extensive industry knowledge facilitates the production of more efficient audits, then specialists may respond to lower earnings autocorrelation or higher earnings volatility more efficiently than non-specialists. A more efficient response to these earnings characteristics implies a weaker association between earnings autocorrelation (volatility) and audit fees for industry-specialist auditors.

Given these opposing effects, we do not make a directional prediction concerning how the association between earnings autocorrelation (volatility) and audit fees is affected by auditor industry specialization. This leads to our third and fourth hypotheses, stated in alternative form, as follows:

H3: Auditor industry specialization affects the association between earnings autocorrelation and audit fees.

H4: Auditor industry specialization affects the association between earnings volatility and audit fees.

METHODOLOGY

Sample

We form our sample from the intersection of Compustat, CRSP, and Audit Analytics. We exclude firms in the financial, insurance, real estate, and utility industries (SIC codes 6000–6999 and 4900–4999), as well as foreign firms. Consistent with several recent audit fee studies, we also exclude observations with non-Big 4 auditors to make our sample more homogenous (e.g., Francis et al. 2005; Fung et al. 2012; Krishnan et al. 2013).[8] Last, we delete observations that are missing required data. The sample period begins in 2004 and extends through 2012. Our primary sample includes 13,214 firm-year observations from 2,643 unique firms.

In testing our auditor industry specialization hypotheses, we follow the sample selection procedure from Fung et al. (2012). Consistent with recent auditor industry specialization research, we measure specialization at the auditor city level (e.g., Francis et al. 2005; Reichelt and Wang 2010; Fung et al. 2012). We eliminate city-industry-year combinations if (1) there is only one observation in the industry (defined using two-digit SIC codes) in the auditor's city in that year, or (2) there is only one Big 4 auditor in the city in that year (Fung et al. 2012). This data requirement eliminates 4,097 firm-year observations,[9] leaving 9,117 firm-year observations from 2,085 unique firms in our specialization sample. Panels A and B of Table 1 provide summary statistics, and Panel C of Table 1 provides sample attrition information for our primary and specialization samples. Table 2 provides a correlation matrix for each sample.

Calculation of Earnings Autocorrelation

In calculating earnings autocorrelation, we utilize all earnings (net income before extraordinary items) data that are available from the five years preceding the firm-year. We exclude a firm-year if it has less than three prior years of earnings information available. We calculate autocorrelation on a rolling basis for each firm-year. That is, for each firm, the autocorrelation in any given year is based on the preceding five years of earnings information for that firm. We estimate earnings autocorrelation as the correlation between the percentage change in annual earnings series at the first lag. For instance, to find the autocorrelation for firm j in the year 2011, assuming firm j has complete data, we first calculate the percentage change in earnings for each firm-year from 2006 through 2010. Then, we estimate the correlation between the time-series of earnings changes in the current period and the time-series of earnings changes in the preceding period. To estimate the autocorrelation for firm j in the year 2012, we would repeat this procedure using earnings for each firm-year from 2007 through 2011.

The earnings autocorrelation coefficient can range from -1 to $+1$. A coefficient of $+1$ would be consistent with a percentage change in prior-period earnings leading to the exact same percentage change in current-period earnings, whereas a coefficient of -1 would be consistent with a percentage change in prior-period earnings leading to the exact same percentage change in current-period earnings, just in the opposite direction. A coefficient near zero would suggest that the percentage change in prior-period earnings does not carry over to the current period.

Empirical Approach

Our empirical model includes many determinants of audit fees identified in the prior literature (e.g., Simunic 1980; Whisenant, Sankaraguruswamy, and Raghunandan 2003; Francis et al. 2005; Antle, Gordon, Narayanamoorthy, and Zhou 2006; Hay, Knechel, and Wong 2006; J. Krishnan, J. Krishnan, and Song 2011; Ball, Jayaraman, and Shivakumar 2012; Krishnan et al. 2013). Since autocorrelation and volatility are likely to be substantially affected by industry, we use industry fixed effects and define industry by two-digit SIC codes.[10] We also use year fixed effects to control for differences in time periods. We cluster standard errors by firm. To minimize the influence of extreme observations, we winsorize all continuous variables at the 1st and 99th percentiles.[11] We test the first two hypotheses by estimating the following model, using the 13,214 observations in our primary sample:

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[8] Our inferences are unchanged when including non-Big 4 auditors and controlling for Big 4 auditors using an indicator variable.

[9] Fung et al. (2012) report having 25,287 observations remaining after applying all of their data screens except for the specialization data screen. They then lose 8,080 observations from the specialization data screen, which is approximately 32 percent of their sample (8,080/25,287). Similarly, we lose 31 percent of our observations from the specialization data screen (4,097/13,214).

[10] Additionally, to use the most refined definition of industry available, we also try using industry fixed effects with industry defined by four-digit SIC codes. We find that our results are robust to this alternative industry specification.

[11] The results are robust to removing observations with going-concern opinions, material weaknesses, and reporting non-zero extraordinary items. The results are also robust to truncating at the 1st and 99th percentiles rather than winsorizing.

TABLE 1

Descriptive Statistics

Panel A: Summary Statistics (Primary Sample)

	Primary Sample (n = 13,214)						
	Mean	**Median**	**Std. Dev.**	**1%**	**25%**	**75%**	**99%**
AUDIT FEES	2,391,752	1,287,000	3,214,927	205,000	735,380	2,566,740	20,000,000
TOTAL ASSETS	3,662.06	826.97	8,430.07	21.82	284.99	2,649.30	54,020.00
LNFEES	14.17	14.07	0.96	12.23	13.51	14.76	16.81
AUTO	−0.15	−0.21	0.41	−0.92	−0.42	0.08	0.92
IBVOL	0.09	0.05	0.14	0.01	0.02	0.11	0.89
LNAT	6.80	6.71	1.68	3.08	5.65	7.88	10.90
ROA	0.00	0.04	0.18	−0.81	−0.01	0.09	0.31
ACCR	0.09	0.06	0.10	0.00	0.03	0.10	0.61
CURR	0.49	0.48	0.23	0.05	0.32	0.66	0.97
FSALES	0.25	0.14	0.29	0.00	0.00	0.46	1.00
SEG	2.66	2.00	1.91	1.00	1.00	4.00	8.00
LEV	0.51	0.49	0.26	0.08	0.32	0.65	1.50
LOSS	0.28	0.00	0.45	0.00	0.00	1.00	1.00
DEC	0.71	1.00	0.46	0.00	0.00	1.00	1.00
LAG	99.10	96.00	27.49	56.00	83.00	112.00	257.00
TENURE	13.07	10.00	9.45	1.00	6.00	17.00	38.00
GC	0.02	0.00	0.14	0.00	0.00	0.00	1.00
XIDUM	0.02	0.00	0.13	0.00	0.00	0.00	1.00
ACQ	0.47	0.00	0.50	0.00	0.00	1.00	1.00
NYSE	0.44	0.00	0.50	0.00	0.00	1.00	1.00
NEWDEBT	0.50	0.00	0.50	0.00	0.00	1.00	1.00
NEWEQ	0.09	0.00	0.29	0.00	0.00	0.00	1.00
LIT	0.38	0.00	0.49	0.00	0.00	1.00	1.00
MTB	2.79	2.10	3.89	−13.13	1.31	3.44	22.89
LNNAF	12.10	12.21	1.65	7.50	11.09	13.23	15.72
RETVOL	0.12	0.11	0.07	0.03	0.08	0.15	0.43
RETSUM	0.11	0.12	0.49	−1.34	−0.14	0.36	1.67
MATWEAK	0.06	0.00	0.24	0.00	0.00	0.00	1.00

(continued on next page)

$$\begin{aligned} LNFEES = {} & \alpha + \beta_1 AUTO + \beta_2 IBVOL + \beta_3 LNAT + \beta_4 ROA + \beta_5 ACCR + \beta_6 CURR + \beta_7 FSALES + \beta_8 SEG + \beta_9 LEV \\ & + \beta_{10} LOSS + \beta_{11} DEC + \beta_{12} LAG + \beta_{13} TENURE + \beta_{14} GC + \beta_{15} XIDUM + \beta_{16} ACQ + \beta_{17} NYSE \\ & + \beta_{18} NEWDEBT + \beta_{19} NEWEQ + \beta_{20} LIT + \beta_{21} MTB + \beta_{22} LNNAF + \beta_{23} RETVOL + \beta_{24} RETSUM \\ & + \beta_{25} MATWEAK + \beta_i INDUSTRY + \beta_j YEAR + \varepsilon \end{aligned} \tag{1}$$

where:

LNFEES = natural logarithm of total audit fees;
AUTO = earnings autocorrelation, estimated as the correlation between the percentage change in annual earnings series at the first lag, using a five-year estimation window, as described previously;
IBVOL = the standard deviation of annual income before extraordinary items scaled by total assets at the beginning of the fiscal year, using a five-year estimation window;
LNAT = natural logarithm of total assets (in millions);
ROA = return on assets, measured as net income scaled by the average of total assets at the beginning and end of the fiscal year;
ACCR = the absolute value of total accruals scaled by total assets;
CURR = current assets divided by total assets;

TABLE 1 (continued)

Panel B: Summary Statistics (Specialization Sample)

	Specialization Sample (n = 9,117)						
	Mean	**Median**	**Std. Dev.**	**1%**	**25%**	**75%**	**99%**
AUDIT FEES	2,482,587	1,310,000	3,376,292	214,000	732,200	2,647,000	20,000,000
TOTAL ASSETS	3,766.29	821.68	8,777.51	21.69	271.51	2,712.90	54,020.00
LNFEES	14.19	14.09	0.97	12.27	13.50	14.79	16.81
AUTO	−0.15	−0.21	0.41	−0.92	−0.42	0.08	0.91
IBVOL	0.10	0.05	0.14	0.01	0.02	0.11	0.88
LNAT	6.79	6.71	1.71	3.08	5.60	7.91	10.90
ROA	0.00	0.04	0.18	−0.82	−0.01	0.09	0.29
ACCR	0.09	0.06	0.09	0.00	0.03	0.10	0.56
CURR	0.49	0.49	0.23	0.05	0.32	0.67	0.97
FSALES	0.27	0.18	0.29	0.00	0.00	0.48	1.00
SEG	2.64	2.00	1.94	1.00	1.00	4.00	8.00
LEV	0.50	0.48	0.26	0.07	0.31	0.63	1.43
LOSS	0.28	0.00	0.45	0.00	0.00	1.00	1.00
DEC	0.73	1.00	0.45	0.00	0.00	1.00	1.00
LAG	99.02	97.00	26.52	56.00	83.00	112.00	257.00
TENURE	13.00	10.00	9.36	1.00	6.00	17.00	38.00
GC	0.02	0.00	0.14	0.00	0.00	0.00	1.00
XIDUM	0.02	0.00	0.13	0.00	0.00	0.00	1.00
ACQ	0.47	0.00	0.50	0.00	0.00	1.00	1.00
NYSE	0.43	0.00	0.50	0.00	0.00	1.00	1.00
NEWDEBT	0.48	0.00	0.50	0.00	0.00	1.00	1.00
NEWEQ	0.09	0.00	0.29	0.00	0.00	0.00	1.00
LIT	0.40	0.00	0.49	0.00	0.00	1.00	1.00
MTB	2.87	2.17	3.84	−11.01	1.36	3.54	22.89
LNNAF	12.15	12.26	1.66	7.50	11.13	13.28	15.72
RETVOL	0.12	0.11	0.07	0.03	0.08	0.15	0.42
RETSUM	0.11	0.12	0.48	−1.25	−0.14	0.36	1.63
MATWEAK	0.06	0.00	0.24	0.00	0.00	0.00	1.00
SPEC	0.55	1.00	0.50	0.00	0.00	1.00	1.00

Panel C: Sample Attrition

Firm-years at the intersection of Compustat, CRSP, and Audit Analytics for the period 2004–2012	51,576
Less: Financial firms, utilities, foreign firms, and firm-years with non-Big 4 auditors	(31,054)
Less: Firm-years missing required data	(7,308)
Primary Sample	13,214
Less: Firm-years lost because (1) there is only one observation in the industry in the auditor's city in that year, or (2) there is only one Big 4 auditor in the city in that year.	(4,097)
Specialization Sample	9,117

(continued on next page)

FSALES = foreign sales divided by total sales;
SEG = number of business segments;
LEV = total liabilities scaled by total assets;
LOSS = an indicator variable that takes the value of 1 if income before extraordinary items is negative, and 0 otherwise;
DEC = an indicator variable that takes the value of 1 if a firm has a December fiscal year-end, and 0 otherwise;
LAG = number of days in between a firm's fiscal year-end and the issuance of the audit report;
TENURE = the length of the auditor-client relationship in years;
GC = an indicator variable that takes the value of 1 if a firm received a going-concern audit opinion during the year, and 0 otherwise;

TABLE 1 (continued)

Table 1 provides summary statistics and sample attrition information for our primary (specialization) sample of 13,214 (9,117) firm-year observations for the period 2004–2012. All continuous variables are winsorized at the 1st and 99th percentiles.

Variable Definitions:
AUDIT FEES = total audit fees in dollars;
TOTAL ASSETS = total assets in millions;
LNFEES = the natural logarithm of total audit fees;
AUTO = earnings autocorrelation, estimated as the correlation between the percentage change in annual earnings series at the first lag, using a five-year estimation window;
IBVOL = the standard deviation of annual income before extraordinary items scaled by total assets at the beginning of the fiscal year, using a five-year estimation window;
LNAT = the natural logarithm of total assets (in millions);
ROA = net income scaled by the average of total assets at the beginning and end of the fiscal year;
ACCR = the absolute value of total accruals scaled by total assets;
CURR = current assets divided by total assets;
FSALES = foreign sales divided by total sales;
SEG = the number of business segments;
LEV = total liabilities scaled by total assets;
LOSS = an indicator variable that takes the value of 1 if income before extraordinary items is negative, and 0 otherwise;
DEC = an indicator variable that takes the value of 1 if a firm has a December fiscal year-end, and 0 otherwise;
LAG = the number of days in between a firm's fiscal year-end and the issuance of the audit report;
TENURE = the length of the auditor-client relationship in years;
GC = an indicator variable that takes the value of 1 if a firm received a going-concern audit opinion during the year, and 0 otherwise;
XIDUM = an indicator variable that takes the value of 1 if extraordinary items is non-zero, and 0 otherwise;
ACQ = an indicator variable that takes the value of 1 if a firm engages in merger or acquisition activity during the year, and 0 otherwise;
NYSE = an indicator variable that takes the value of 1 if a firm is listed on the New York Stock Exchange, and 0 otherwise;
NEWDEBT = an indicator variable that takes the value of 1 if a firm issues long-term debt during the year, and 0 otherwise;
NEWEQ = an indicator variable that takes the value of 1 if a firm issues common stock in excess of 5 percent of its market value of equity during the year, and 0 otherwise;
LIT = an indicator variable that takes the value of 1 if a firm is in a high litigation risk industry (SIC codes 2833–2836, 3570–3577, 3600–3674, 5200–5961, and 7370–7374), and 0 otherwise;
MTB = the market value of equity divided by the book value of equity;
LNNAF = the natural logarithm of total nonaudit fees;
RETVOL (*RETSUM*) = the standard deviation (sum) of monthly stock returns during the fiscal year;
MATWEAK = an indicator variable that takes the value of 1 if a firm reports a material weakness in internal control over financial reporting, and 0 otherwise; and
SPEC = an indicator variable that takes the value of 1 if a firm in a given industry is audited by an auditor that specializes in that industry, and 0 otherwise. Auditors are classified as specialists if they have the highest market share (in terms of audit fees) in an industry in their city during a particular year.

XIDUM = an indicator variable that takes the value of 1 if extraordinary items is non-zero, and 0 otherwise;
ACQ = an indicator variable that takes the value of 1 if a firm engages in merger or acquisition activity during the year, and 0 otherwise;
NYSE = an indicator variable that takes the value of 1 if a firm is listed on the New York Stock Exchange, and 0 otherwise;
NEWDEBT = an indicator variable that takes the value of 1 if a firm issues long-term debt during the year, and 0 otherwise;
NEWEQ = an indicator variable that takes the value of 1 if a firm issues common stock in excess of 5 percent of its market value of equity during the year, and 0 otherwise;
LIT = an indicator variable that takes the value of 1 if a firm is in a high litigation risk industry (SIC codes 2833–2836, 3570–3577, 3600–3674, 5200–5961, and 7370–7374), and 0 otherwise;
MTB = market value of equity divided by book value of equity;
LNNAF = natural logarithm of total nonaudit fees;
RETVOL = the standard deviation of monthly stock returns during the fiscal year;
RETSUM = the sum of monthly stock returns during the fiscal year;
MATWEAK = an indicator variable that takes the value of 1 if a firm reports a material weakness in internal control over financial reporting, and 0 otherwise;
INDUSTRY = indicator variables for each two-digit SIC code in the sample; and
YEAR = indicator variables for each year in the sample.

In testing H1 and H2, we are interested in the coefficients on *AUTO* and *IBVOL,* respectively. In accordance with our hypotheses, we do not make directional predictions about the coefficients.

TABLE 2

Correlation Matrix

Panel A: Primary Sample (n = 13,214)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) *LNFEES*														
(2) *AUTO*	−0.03													
(3) *IBVOL*	−0.23	0.03												
(4) *LNAT*	0.81	0.00	−0.36											
(5) *ROA*	0.25	0.01	−0.40	0.40										
(6) *ACCR*	−0.16	0.00	0.30	−0.23	−0.52									
(7) *CURR*	−0.26	0.02	0.26	−0.47	−0.21	0.06								
(8) *FSALES*	0.35	−0.05	−0.03	0.17	0.11	−0.08	0.15							
(9) *SEG*	0.43	−0.01	−0.20	0.36	0.17	−0.14	−0.20	0.11						
(10) *LEV*	0.26	−0.02	−0.02	0.25	−0.17	0.16	−0.26	−0.12	0.09					
(11) *LOSS*	−0.22	−0.01	0.32	−0.35	−0.69	0.44	0.17	−0.07	−0.17	0.14				
(12) *DEC*	−0.00	−0.02	0.12	−0.01	−0.09	0.05	−0.11	−0.02	−0.01	0.10	0.07			
(13) *LAG*	−0.16	−0.01	0.19	−0.28	−0.21	0.14	0.10	−0.04	−0.13	−0.02	0.20	0.03		
(14) *TENURE*	0.25	0.00	−0.17	0.27	0.13	−0.11	−0.04	0.11	0.20	0.03	−0.15	−0.08	−0.18	
(15) *GC*	−0.08	−0.02	0.18	−0.16	−0.35	0.22	0.04	−0.03	−0.06	0.20	0.21	0.04	0.13	−0.02
(16) *XIDUM*	0.09	−0.02	−0.02	0.08	0.01	−0.02	−0.04	0.00	0.06	0.06	−0.01	0.01	−0.01	0.01
(17) *ACQ*	0.30	−0.02	−0.16	0.27	0.17	−0.12	−0.20	0.13	0.23	−0.02	−0.19	−0.02	−0.04	0.08
(18) *NYSE*	0.46	0.01	−0.28	0.53	0.24	−0.16	−0.32	0.04	0.30	0.22	−0.26	0.02	−0.27	0.22
(19) *NEWDEBT*	0.29	−0.00	−0.16	0.35	0.05	−0.07	−0.40	−0.02	0.19	0.37	−0.07	0.09	−0.09	0.05
(20) *NEWEQ*	−0.15	0.01	0.23	−0.18	−0.38	0.10	0.09	−0.09	−0.10	0.02	0.25	0.09	0.06	−0.11
(21) *LIT*	−0.14	0.01	0.20	−0.18	−0.17	0.10	0.29	0.03	−0.24	−0.16	0.15	−0.13	0.11	−0.07
(22) *MTB*	−0.02	0.01	0.09	−0.03	0.03	−0.02	0.13	0.00	−0.06	−0.07	−0.05	0.03	−0.02	−0.00
(23) *LNNAF*	0.63	−0.02	−0.18	0.58	0.22	−0.15	−0.20	0.25	0.33	0.16	−0.21	−0.01	−0.15	0.21
(24) *RETVOL*	−0.24	0.03	0.33	−0.35	−0.39	0.34	0.17	−0.03	−0.15	0.15	0.41	0.04	0.18	−0.16
(25) *RETSUM*	−0.01	0.03	−0.03	0.03	0.20	−0.14	0.02	0.01	0.02	−0.04	−0.18	−0.00	−0.07	0.01
(26) *MATWEAK*	0.04	−0.02	0.09	−0.09	−0.06	0.05	0.02	0.01	−0.01	0.03	0.09	−0.01	0.20	−0.07

Panel B: Primary Sample (continued)

	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)
(15) *GC*											
(16) *XIDUM*	0.00										
(17) *ACQ*	−0.09	0.02									
(18) *NYSE*	−0.09	0.05	0.14								
(19) *NEWDEBT*	−0.01	0.05	0.16	0.28							
(20) *NEWEQ*	0.13	−0.01	−0.09	−0.11	0.01						
(21) *LIT*	0.02	−0.03	−0.08	−0.32	−0.24	0.07					
(22) *MTB*	−0.04	−0.01	−0.02	−0.02	−0.07	0.04	0.08				
(23) *LNNAF*	−0.08	0.06	0.24	0.33	0.20	−0.11	−0.11	0.01			
(24) *RETVOL*	0.24	−0.04	−0.21	−0.22	−0.08	0.21	0.08	−0.06	−0.21		
(25) *RETSUM*	−0.15	0.01	−0.02	0.06	−0.02	0.05	−0.02	0.18	0.01	0.12	
(26) *MATWEAK*	0.07	0.03	−0.03	−0.09	−0.02	0.01	0.02	−0.01	−0.01	0.05	−0.05

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To test H3 and H4, we follow Fung et al. (2012) in calculating auditor industry specialization. We measure specialization at the auditor city level, with industry defined using two-digit SIC codes. If an auditor has the highest market share (in terms of total audit fees) in an industry in its city, then we consider the auditor to be an industry specialist for that particular year. In our regression, we utilize an indicator variable, *SPEC,* which takes the value of 1 if a firm in a given industry is audited by an auditor that specializes in that industry, and 0 otherwise. Panel B of Table 1 shows that 55 percent of the firm-year observations in our specialization sample are audited by an industry-specialist auditor.

TABLE 2 (continued)

Panel C: Specialization Sample (n = 9,117)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) *LNFEES*														
(2) *AUTO*	**−0.03**													
(3) *IBVOL*	**−0.25**	**0.04**												
(4) *LNAT*	**0.82**	*−0.00*	**−0.37**											
(5) *ROA*	**0.26**	*0.00*	**−0.41**	**0.40**										
(6) *ACCR*	**−0.16**	*0.01*	**0.29**	**−0.21**	**−0.51**									
(7) *CURR*	**−0.28**	**0.02**	**0.28**	**−0.49**	**−0.23**	**0.04**								
(8) *FSALES*	**0.38**	**−0.03**	**−0.07**	**0.20**	**0.14**	**−0.09**	**0.16**							
(9) *SEG*	**0.46**	**−0.02**	**−0.21**	**0.39**	**0.18**	**−0.15**	**−0.20**	**0.12**						
(10) *LEV*	**0.26**	**−0.02**	**−0.04**	**0.26**	**−0.16**	**0.15**	**−0.28**	**−0.11**	**0.11**					
(11) *LOSS*	**−0.23**	*−0.01*	**0.32**	**−0.35**	**−0.69**	**0.43**	**0.19**	**−0.09**	**−0.19**	**0.12**				
(12) *DEC*	*−0.01*	**−0.02**	**0.11**	*0.01*	**−0.10**	**0.06**	**−0.13**	**−0.08**	**−0.03**	**0.13**	**0.07**			
(13) *LAG*	**−0.16**	*−0.01*	**0.19**	**−0.28**	**−0.20**	**0.14**	**0.12**	**−0.07**	**−0.16**	**−0.05**	**0.19**	**0.03**		
(14) *TENURE*	**0.25**	*−0.00*	**−0.17**	**0.25**	**0.13**	**−0.10**	*−0.02*	**0.16**	**0.23**	**0.03**	**−0.15**	**−0.09**	**−0.18**	
(15) *GC*	**−0.07**	*−0.01*	**0.18**	**−0.14**	**−0.34**	**0.20**	**0.03**	**−0.03**	**−0.05**	**0.20**	**0.20**	**0.03**	**0.10**	*−0.01*
(16) *XIDUM*	**0.09**	**−0.03**	*−0.02*	**0.07**	*0.01*	**−0.02**	**−0.04**	*0.01*	**0.07**	**0.06**	*−0.01*	*0.01*	*−0.01*	*0.01*
(17) *ACQ*	**0.32**	*−0.02*	**−0.17**	**0.28**	**0.18**	**−0.12**	**−0.21**	**0.12**	**0.23**	*−0.01*	**−0.20**	**−0.04**	**−0.04**	**0.08**
(18) *NYSE*	**0.46**	*0.00*	**−0.29**	**0.54**	**0.24**	**−0.14**	**−0.36**	**0.05**	**0.32**	**0.25**	**−0.27**	**0.05**	**−0.28**	**0.20**
(19) *NEWDEBT*	**0.30**	*−0.01*	**−0.16**	**0.37**	**0.05**	**−0.06**	**−0.43**	*−0.01*	**0.21**	**0.39**	**−0.07**	**0.13**	**−0.10**	**0.03**
(20) *NEWEQ*	**−0.16**	*0.02*	**0.24**	**−0.17**	**−0.39**	**0.09**	**0.08**	**−0.12**	**−0.11**	*0.01*	**0.26**	**0.09**	**0.05**	**−0.10**
(21) *LIT*	**−0.15**	*0.01*	**0.22**	**−0.21**	**−0.19**	**0.10**	**0.31**	*0.02*	**−0.22**	**−0.19**	**0.16**	**−0.12**	**0.14**	**−0.07**
(22) *MTB*	**−0.04**	*0.01*	**0.10**	**−0.05**	*−0.00*	*−0.02*	**0.15**	*−0.00*	**−0.06**	**−0.05**	**−0.03**	**0.02**	*−0.01*	*−0.01*
(23) *LNNAF*	**0.63**	*−0.02*	**−0.20**	**0.59**	**0.23**	**−0.14**	**−0.22**	**0.25**	**0.35**	**0.18**	**−0.22**	*−0.02*	**−0.15**	**0.21**
(24) *RETVOL*	**−0.26**	**0.03**	**0.34**	**−0.35**	**−0.39**	**0.33**	**0.19**	**−0.05**	**−0.18**	**0.13**	**0.41**	**0.04**	**0.17**	**−0.15**
(25) *RETSUM*	*−0.01*	**0.03**	**−0.03**	**0.03**	**0.18**	**−0.13**	*0.01*	*−0.00*	*0.02*	**0.03**	**−0.17**	*0.01*	**−0.07**	*0.00*
(26) *MATWEAK*	**0.05**	**−0.03**	**0.10**	**−0.09**	**−0.05**	**0.04**	**0.03**	*0.02*	*0.00*	**0.02**	**0.09**	*−0.01*	**0.20**	**−0.07**
(27) *SPEC*	**0.21**	*0.01*	**−0.04**	**0.19**	**0.06**	**−0.04**	**−0.05**	**0.06**	**0.10**	**0.06**	**−0.07**	*0.00*	**−0.04**	**0.08**

Panel D: Specialization Sample (continued)

	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)
(15) *GC*												
(16) *XIDUM*	*0.01*											
(17) *ACQ*	**−0.08**	*0.01*										
(18) *NYSE*	**−0.07**	**0.05**	**0.14**									
(19) *NEWDEBT*	*−0.01*	**0.05**	**0.15**	**0.32**								
(20) *NEWEQ*	**0.12**	*−0.01*	**−0.10**	**−0.10**	*0.01*							
(21) *LIT*	*0.02*	**−0.04**	**−0.07**	**−0.37**	**−0.26**	**0.08**						
(22) *MTB*	**−0.03**	*−0.01*	**−0.04**	**−0.04**	**−0.06**	**0.06**	**0.09**					
(23) *LNNAF*	**−0.05**	**0.06**	**0.26**	**0.33**	**0.21**	**−0.12**	**−0.11**	*−0.02*				
(24) *RETVOL*	**0.22**	**−0.03**	**−0.21**	**−0.22**	**−0.08**	**0.22**	**0.10**	**−0.05**	**−0.22**			
(25) *RETSUM*	**−0.15**	*0.01*	*−0.02*	**0.06**	*−0.01*	**0.06**	**−0.03**	**0.18**	*0.00*	**0.13**		
(26) *MATWEAK*	**0.07**	**0.04**	*−0.02*	**−0.10**	**−0.03**	*−0.00*	**0.03**	*−0.02*	*−0.01*	**0.05**	**−0.06**	
(27) *SPEC*	*−0.01*	*0.02*	**0.07**	**0.08**	**0.06**	**−0.04**	*−0.01*	*0.02*	**0.14**	**−0.06**	*−0.00*	*0.02*

Panels A and B (C and D) of Table 2 present a Pearson correlation matrix for our primary (specialization) sample of 13,214 (9,117) firm-year observations for the period 2004–2012. All continuous variables are winsorized at the 1st and 99th percentiles. Bold values indicate statistical significance at the $p \leq 0.05$ level using a two-tailed test. Italic values indicate statistically insignificant associations ($p > 0.05$).
See Table 1 for a detailed description of the variables.

Since the association between audit fees and each of the control variables can vary based on whether the firm is audited by an industry-specialist auditor, we utilize a fully interacted model whereby all of our test variables and control variables are interacted with *SPEC* except for the year and industry indicator variables.[12] A fully interacted model allows the slope of each control variable to vary based on whether the firm has an industry-specialist auditor, which reduces the risk that our interactions of interest are picking up effects that are actually attributable to systematic differences in the association between the control variables and audit fees that occur when a firm is audited by a specialist. This approach provides a stronger test of our hypotheses. We estimate the following model to test our third and fourth hypotheses, using the 9,117 observations in our specialization sample:

$$\begin{aligned} LNFEES = {} & \alpha + \beta_1 AUTO + \beta_2 IBVOL + \beta_3 SPEC * AUTO + \beta_4 SPEC * IBVOL + \beta_5 SPEC + \beta_6 LNAT + \beta_7 ROA \\ & + \beta_8 ACCR + \beta_9 CURR + \beta_{10} FSALES + \beta_{11} SEG + \beta_{12} LEV + \beta_{13} LOSS + \beta_{14} DEC + \beta_{15} LAG + \beta_{16} TENURE \\ & + \beta_{17} GC + \beta_{18} XIDUM + \beta_{19} ACQ + \beta_{20} NYSE + \beta_{21} NEWDEBT + \beta_{22} NEWEQ + \beta_{23} LIT + \beta_{24} MTB \\ & + \beta_{25} LNNAF + \beta_{26} RETVOL + \beta_{27} RETSUM + \beta_{28} MATWEAK + \sum \beta_{29-51} SPEC * CONTROL \\ & + \beta_i INDUSTRY + \beta_j YEAR + \varepsilon \end{aligned} \tag{2}$$

where:

SPEC = an indicator variable that takes the value of 1 if a firm in a given industry is audited by an auditor that specializes in that industry (as discussed previously), and 0 otherwise. All other variables are as previously defined.

In testing H3 and H4, we are interested in the coefficients on *SPEC* ∗ *AUTO* and *SPEC* ∗ *IBVOL,* respectively. In accordance with our hypotheses, we do not make directional predictions about these coefficients.

RESULTS

Earnings Autocorrelation and Earnings Volatility

Table 3 presents the results of estimating Equation (1) using our primary sample of 13,214 firm-year observations. The first column shows the results from estimating the model while excluding our test variables. Consistent with prior research, the model explains a very high proportion of the variation in audit fees, with an adjusted R^2 of 79.79 percent. All of our statistically significant control variables load in the expected direction.

Next, we add earnings autocorrelation and earnings volatility into the model. To further assess whether *AUTO* and *IBVOL* are capturing different constructs, we add each variable into the regression separately in Columns (2) and (3), and then combined in Column (4) of Table 3. The results for *AUTO* (*IBVOL*) when in the model without *IBVOL* (*AUTO*) are similar to when both variables are in the model together, which provides further evidence that these variables are distinct. The results in Column (4) reveal a negative and highly significant coefficient on *AUTO* ($t = -3.45$; $p < 0.01$) and a positive and highly significant coefficient on *IBVOL* ($t = 3.56$; $p < 0.01$). These results provide strong support for H1 and H2.

We also estimate standardized regression coefficients to assess the economic significance of each variable. The results (untabulated) indicate that a shift in the interquartile range in earnings autocorrelation and earnings volatility is associated with a change in audit fees of 2.17 percent and 1.83 percent, respectively, for a combined effect on audit fees of 4.0 percent. This corresponds to an audit fee of approximately $95,600 for the average firm-year observation in our primary sample. Notably, the magnitude of the combined impact of earnings autocorrelation and earnings volatility on audit fees is larger than or comparable to several well-established determinants of audit fees. For example, a shift in the interquartile range in total accruals, return on assets, and audit report lag is associated with a change in audit fees of 0.51 percent, 3.03 percent, and 4.13 percent, respectively.

Auditor Industry Specialization

Before testing H3 and H4, we first examine whether our results for auditor industry specialization are consistent with the prior research that finds a fee premium for specialists (e.g., Francis et al. 2005; Carson 2009; Fung et al. 2012). The first column in Table 4 presents the results of estimating our audit fee model using our specialization sample of 9,117 firm-year observations, while only adding the main effect of auditor industry specialization into the model. Consistent with prior research, we find a positive and highly significant coefficient on *SPEC* ($t = 4.28$; $p < 0.01$), suggesting a fee premium for specialists.

[12] Our results are robust to using a model that is not fully interacted (i.e., a model where *SPEC* is only interacted with earnings autocorrelation and earnings volatility).

TABLE 3

Audit Fee Model Regression

DV = *LNFEES*	**(1)**	**(2)**	**(3)**	**(4)**
AUTO		−0.039		−0.042
		(−3.25)***		(−3.45)***
IBVOL			0.188	0.194
			(3.44)***	(3.56)***
LNAT	0.428	0.428	0.429	0.429
	(49.80)***	(49.90)***	(49.84)***	(49.93)***
ROA	−0.319	−0.320	−0.302	−0.303
	(−5.60)***	(−5.62)***	(−5.28)***	(−5.29)***
ACCR	−0.039	−0.039	−0.071	−0.072
	(−0.62)	(−0.62)	(−1.13)	(−1.15)
CURR	0.398	0.400	0.388	0.390
	(7.72)***	(7.77)***	(7.54)***	(7.59)***
FSALES	0.474	0.472	0.475	0.473
	(12.99)***	(12.95)***	(13.01)***	(12.97)***
SEG	0.052	0.052	0.053	0.053
	(11.01)***	(11.02)***	(11.08)***	(11.10)***
LEV	0.254	0.252	0.255	0.253
	(6.88)***	(6.84)***	(6.90)***	(6.86)***
LOSS	0.049	0.048	0.050	0.050
	(3.13)***	(3.12)***	(3.20)***	(3.20)***
DEC	−0.001	−0.001	−0.004	−0.004
	(−0.04)	(−0.06)	(−0.19)	(−0.21)
LAG	0.001	0.001	0.001	0.001
	(4.92)***	(4.92)***	(4.82)***	(4.81)***
TENURE	0.001	0.001	0.001	0.001
	(0.86)	(0.84)	(0.97)	(0.95)
GC	0.051	0.049	0.045	0.043
	(1.28)	(1.23)	(1.13)	(1.08)
XIDUM	0.122	0.120	0.121	0.119
	(4.21)***	(4.16)***	(4.21)***	(4.16)***
ACQ	0.070	0.070	0.071	0.071
	(5.44)***	(5.44)***	(5.49)***	(5.49)***
NYSE	0.109	0.110	0.112	0.112
	(4.97)***	(5.01)***	(5.09)***	(5.13)***
NEWDEBT	0.036	0.037	0.037	0.038
	(2.88)***	(2.92)***	(2.98)***	(3.03)***
NEWEQ	−0.003	−0.002	−0.009	−0.008
	(−0.16)	(−0.13)	(−0.46)	(−0.43)
LIT	0.002	0.002	−0.006	−0.005
	(0.05)	(0.07)	(−0.41)	(−0.16)
MTB	−0.000	−0.000	−0.001	−0.001
	(−0.14)	(−0.12)	(−0.41)	(−0.40)
LNNAF	0.067	0.067	0.067	0.067
	(12.43)***	(12.42)***	(12.38)***	(12.36)***
RETVOL	0.367	0.375	0.301	0.307
	(3.76)***	(3.85)***	(3.06)***	(3.13)***
RETSUM	−0.018	−0.017	−0.016	−0.016
	(−1.94)*	(−1.92)*	(−1.73)*	(−1.71)*
MATWEAK	0.329	0.329	0.325	0.325
	(14.41)***	(14.42)***	(14.30)***	(14.31)***
Intercept	9.509	9.491	9.503	9.483
	(45.88)***	(45.67)***	(46.24)***	(46.02)***

(continued on next page)

TABLE 3 (continued)

DV = *LNFEES*	(1)	(2)	(3)	(4)
Industry FE	Included	Included	Included	Included
Year FE	Included	Included	Included	Included
Adjusted R^2	79.79%	79.81%	79.83%	79.86%
n	13,214	13,214	13,214	13,214

***, * Indicate statistical significance at the 0.01 and 0.10 levels, respectively, using a two-tailed test.
t-statistics are in parentheses. Standard errors are clustered by firm. All continuous variables are winsorized at the 1st and 99th percentiles. Table 3 presents the results of estimating Equation (1) for our sample of 13,214 firm-year observations for the period 2004–2012. Year and industry indicator variables are omitted for brevity.
See Table 1 for a detailed description of the variables.

TABLE 4

Audit Fee Model Regression with Specialization

DV = *LNFEES*	(1)	(2)	(3)	(4)
AUTO		−0.061		−0.063
		(−3.10)***		(−3.16)***
IBVOL			0.121	0.127
			(1.66)*	(1.75)*
SPEC ∗ AUTO		0.054		0.053
		(2.07)**		(2.03)**
SPEC ∗ IBVOL			0.073	0.069
			(0.74)	(0.69)
SPEC	0.070	−0.055	−0.073	−0.061
	(4.28)***	(−0.32)	(−0.42)	(−0.35)
LNAT	0.420	0.405	0.405	0.406
	(42.63)***	(27.00)***	(26.98)***	(26.92)***
ROA	−0.381	−0.349	−0.347	−0.341
	(−5.96)***	(−3.86)***	(−3.80)***	(−3.74)***
ACCR	−0.107	−0.072	−0.103	−0.093
	(−1.43)	(−0.76)	(−1.08)	(−0.98)
CURRENT	0.348	0.353	0.340	0.343
	(6.01)***	(4.62)***	(4.45)***	(4.49)***
FSALES	0.528	0.521	0.529	0.523
	(12.58)***	(9.90)***	(9.99)***	(9.93)***
SEGMENTS	0.059	0.054	0.055	0.055
	(11.17)***	(7.47)***	(7.54)***	(7.50)***
LEV	0.226	0.199	0.205	0.200
	(5.19)***	(3.49)***	(3.56)***	(3.49)***
LOSS	0.039	0.015	0.016	0.016
	(2.22)**	(0.61)	(0.64)	(0.66)
DEC	0.023	0.021	0.019	0.018
	(0.96)	(0.64)	(0.57)	(0.56)
LAG	0.002	0.002	0.002	0.001
	(5.28)***	(3.41)***	(3.39)***	(3.36)***
TENURE	0.000	−0.001	−0.001	−0.001
	(0.02)	(−0.78)	(−0.71)	(−0.72)
GC	0.059	0.066	0.054	0.053
	(1.27)	(1.17)	(0.93)	(0.93)
XIDUM	0.114	0.088	0.095	0.090
	(3.22)***	(1.51)	(1.64)*	(1.57)
ACQ	0.076	0.087	0.088	0.088
	(4.97)***	(4.06)***	(4.10)***	(4.09)***

(continued on next page)

TABLE 4 (continued)

DV = *LNFEES*	(1)	(2)	(3)	(4)
NYSE	0.123	0.139	0.140	0.140
	(4.99)***	(4.24)***	(4.22)***	(4.26)***
NEWDEBT	0.033	0.044	0.044	0.043
	(2.28)**	(2.20)**	(2.16)**	(2.16)**
NEWEQ	−0.017	−0.035	−0.040	−0.039
	(−0.78)	(−1.22)	(−1.38)	(−1.36)
LIT	−0.014	−0.021	−0.029	−0.027
	(−0.37)	(−0.48)	(−0.66)	(−0.62)
MTB	−0.000	−0.002	−0.002	−0.003
	(−0.21)	(−0.80)	(−0.85)	(−0.90)
LNNAF	0.062	0.063	0.063	0.063
	(9.73)***	(7.07)***	(7.03)***	(7.01)***
RETVOL	0.309	0.606	0.541	0.554
	(2.74)***	(4.18)***	(3.71)***	(3.82)***
RETSUM	−0.013	−0.017	−0.015	−0.015
	(−1.16)	(−1.17)	(−1.04)	(−1.05)
MATWEAK	0.336	0.316	0.312	0.311
	(12.81)***	(8.27)***	(8.13)***	(8.16)***
Intercept	9.443	9.527	9.547	9.523
	(33.87)***	(32.71)***	(33.50)***	(32.84)***
Industry FE	Included	Included	Included	Included
Year FE	Included	Included	Included	Included
Adjusted R^2	80.93%	81.01%	81.01%	81.04%
n	9,117	9,117	9,117	9,117

***, **, * Indicate statistical significance at the 0.01, 0.05, and 0.10 levels, respectively, using a two-tailed test.
t-statistics are in parentheses. Standard errors are clustered by firm. All continuous variables are winsorized at the 1st and 99th percentiles. Table 4 presents the results of estimating Equation (2) for our specialization sample of 9,117 firm-year observations for the period 2004–2012. Year and industry indicator variables are omitted for brevity. Also omitted for brevity are the control variable interactions with *SPEC*. In Column (1), the regression is estimated without any interactions with *SPEC*.
See Table 1 for a detailed description of the variables.

We test H3 and H4 by estimating Equation (2). The results are presented in Columns (2)–(4) of Table 4. Although we interact each control variable with *SPEC* except the year and industry indicator variables, for brevity, we only present the interactions with *AUTO* and *IBVOL*. The results in Column (4) reveal a positive and significant coefficient on *SPEC* ∗ *AUTO* (t = 2.03; p = 0.04), which suggests that the association between earnings autocorrelation and audit fees is attenuated for specialist auditors, supporting H3. This result implies that specialists respond to lower earnings autocorrelation more efficiently than non-specialists. However, we do not find a statistically significant coefficient on *SPEC* ∗ *IBVOL* (t = 0.69; p = 0.49). Thus, we fail to find support for H4.

Further Analyses

Additional Business Risk Control Variables

Francis et al. (2004) examine the association between earnings characteristics and the cost of equity capital. As a part of their research design, the authors recognize that earnings attributes are affected by innate "features of firms' business models and operating environments" (Francis et al. 2004). Accordingly, the authors control for eight innate firm characteristics: firm size, cash flow variability, sales variability, the length of the firm's operating cycle, negative earnings, intangibles intensity, the absence of reported intangibles, and capital intensity (Francis et al. 2004). Because our study focuses on two earnings attributes, we test whether our results continue to hold when we control for these innate firm characteristics. We implement this test by augmenting Equation (1) with the innate firm characteristics used by Francis et al. (2004). Specifically, we add the following variables:

CFVAR = standard deviation of cash flows from operations, calculated over the preceding ten years;
SALESVAR = standard deviation of sales, calculated over the preceding ten years;
OPCYCLE = days in accounts receivable plus days in inventory;

NEGEARN = percentage of years in which a firm has reported negative earnings in the preceding ten years;
RD_ADV = research and development expense plus advertising expense, divided by total sales;
RD_ADV_IND = an indicator variable that takes the value of 1 if *RD_ADV* is equal to 0, and 0 otherwise; and
CAP_INT = net book value of property, plant, and equipment scaled by total assets.

The results of this analysis are presented in Table 5. Column (4) of Table 5 reveals a negative and significant coefficient on *AUTO* ($t = -3.19$; $p < 0.01$), consistent with our previous results. For earnings volatility, the coefficient on *IBVOL* remains positive, but is marginally significant ($t = 1.85$; $p = 0.06$). Thus, when controlling for these innate firm characteristics, we find that our results for earnings autocorrelation are similar to our previous results, but the results for earnings volatility are somewhat weaker.

Influence of Auditor Competition

Our results imply that industry-specialist auditors respond to lower earnings autocorrelation more efficiently than non-specialists, and furthermore suggest that industry specialists pass on some portion of the efficiency-related cost savings to clients. However, competition among auditors is likely to affect this relation. Specifically, a greater (smaller) proportion of the cost savings is likely to be passed on to the client when the auditor faces more (less) competition.

Numan and Willekens (2012) examine the influence of spatial competition in the audit market on audit pricing. The authors posit that industry specialization provides auditors with a strategy to differentiate from competitors, which can affect audit pricing. Specifically, the authors argue that a smaller distance between an incumbent auditor's degree of industry specialization and their closest competitor's degree of industry specialization leads to downward pressure on audit fees because of the increased competition in this product-space (Numan and Willekens 2012). Consistent with their hypothesis, the authors find that audit fees are higher (lower) when the distance between an incumbent auditor's degree of industry specialization and their closest competitor's degree of industry specialization is larger (smaller).

In light of this study, we examine whether our results are affected by spatial competition in the audit market. We expect that greater competition among auditors will increase the incentive for industry-specialist auditors to pass on efficiency-related cost savings to clients. To conduct this test, we create a new variable, *DCLOSEST,* which is calculated as the absolute value of the difference between the city-level industry market share of the incumbent auditor and the city-level industry market share of the incumbent auditor's competitor with the closest city-level industry market share (with industry defined by two-digit SIC codes). We then estimate Equation (2) by deciles of *DCLOSEST*.

Since we expect greater competition to encourage auditors to pass cost savings on to clients, and because lower values of *DCLOSEST* indicate greater competition, we anticipate the negative coefficient on *SPEC* ∗ *AUTO* to be most prevalent in the lower deciles of *DCLOSEST*. Our results (untabulated) indicate that only the two lowest deciles of *DCLOSEST* have a negative coefficient on *SPEC* ∗ *AUTO* that is at least marginally significant. Specifically, the coefficient on *SPEC* ∗ *AUTO* is negative and significant ($t = -1.98$; $p = 0.048$) in the lowest decile, and is negative and marginally significant ($t = -1.75$; $p = 0.08$) in the second-lowest decile. These results are consistent with the notion that industry-specialist auditors are more likely to pass on efficiency-related cost savings to clients when facing greater competition.

Alternative Auditor Industry Specialization Measures

As an additional analysis, we also test whether our results are robust to using other definitions of auditor industry specialization. We utilize two common measures from prior research that are based on auditor market share (e.g., Reichelt and Wang 2010). The first measure ("the dominance measure") considers an auditor to be an industry specialist during a given year if, within a given city, the auditor has the highest market share in an industry and its market share is at least 10 percentage points higher than the auditor with the second-highest market share (Reichelt and Wang 2010). The second measure ("the market share measure") considers an auditor to be an industry specialist during a given year if, within a given city, the auditor has a market share in an industry that exceeds 50 percent (Reichelt and Wang 2010).

The results from estimating our audit fee model, while only adding the main effect of auditor industry specialization into the model, are presented in Columns (1) and (3) of Table 6, using the dominance measure and the market share measure, respectively. The results in Columns (1) and (3) of Table 6 indicate a positive association between auditor industry specialization and audit fees for both the dominance measure ($t = 4.44$; $p < 0.01$) and the market share measure ($t = 3.74$; $p < 0.01$), respectively, consistent with prior research. Column (2) of Table 6 provides the results from estimating Equation (2) using the dominance measure of auditor industry specialization. The results show a positive and significant coefficient on *SPEC* ∗ *AUTO* ($t = 3.07$; $p < 0.01$) and a statistically insignificant coefficient on *SPEC* ∗ *IBVOL* ($t = -0.00$; $p = 0.99$). The results from estimating Equation (2) using the market share measure of auditor industry specialization, presented in Column (4) of Table 6, also show a positive and significant coefficient on *SPEC* ∗ *AUTO* ($t = 3.10$; $p < 0.01$) and a statistically insignificant

TABLE 5

Audit Fee Model Regression with Innate Firm Characteristics

DV = *LNFEES*	**(1)**	**(2)**	**(3)**	**(4)**
AUTO		−0.037		−0.038
		(−3.09)***		(−3.19)***
IBVOL			0.096	0.102
			(1.74)*	(1.85)*
LNAT	0.401	0.401	0.401	0.402
	(38.78)***	(38.84)***	(38.83)***	(38.89)***
ROA	−0.406	−0.406	−0.402	−0.402
	(−6.77)***	(−6.79)***	(−6.70)***	(−6.71)***
ACCR	−0.071	−0.071	−0.091	−0.092
	(−1.13)	(−1.12)	(−1.43)	(−1.45)
CURR	0.253	0.254	0.252	0.254
	(4.56)***	(4.60)***	(4.56)***	(4.59)***
FSALES	0.472	0.469	0.473	0.470
	(12.68)***	(12.63)***	(12.68)***	(12.64)***
SEG	0.049	0.049	0.049	0.049
	(10.49)***	(10.50)***	(10.52)***	(10.52)***
LEV	0.253	0.252	0.256	0.254
	(6.83)***	(6.80)***	(6.89)***	(6.86)***
LOSS	0.024	0.024	0.027	0.027
	(1.62)	(1.61)	(1.79)*	(1.79)*
DEC	−0.003	−0.003	−0.003	−0.004
	(−0.13)	(−0.15)	(−0.16)	(−0.18)
LAG	0.001	0.001	0.001	0.001
	(4.57)***	(4.56)***	(4.56)***	(4.55)***
TENURE	0.001	0.001	0.001	0.001
	(0.74)	(0.72)	(0.78)	(0.76)
GC	0.032	0.030	0.029	0.027
	(0.82)	(0.78)	(0.74)	(0.69)
XIDUM	0.116	0.114	0.116	0.114
	(4.11)***	(4.06)***	(4.13)***	(4.07)***
ACQ	0.062	0.062	0.063	0.062
	(4.96)***	(4.96)***	(4.97)***	(4.97)***
NYSE	0.120	0.120	0.120	0.120
	(5.50)***	(5.54)***	(5.50)***	(5.54)***
NEWDEBT	0.048	0.048	0.048	0.048
	(3.82)***	(3.85)***	(3.82)***	(3.86)***
NEWEQ	0.011	0.012	0.010	0.010
	(0.60)	(0.63)	(0.52)	(0.54)
LIT	−0.052	−0.051	−0.053	−0.052
	(−1.52)	(−1.50)	(−1.56)	(−1.54)
MTB	−0.001	−0.001	−0.001	−0.001
	(−0.41)	(−0.39)	(−0.51)	(−0.50)
LNNAF	0.062	0.062	0.062	0.062
	(11.71)***	(11.69)***	(11.69)***	(11.67)***
RETVOL	0.269	0.276	0.246	0.251
	(2.77)***	(2.85)***	(2.52)**	(2.58)***
RETSUM	−0.015	−0.015	−0.014	−0.014
	(−1.66)*	(−1.65)*	(−1.53)	(−1.52)
MATWEAK	0.328	0.327	0.325	0.325
	(14.38)***	(14.40)***	(14.30)***	(14.31)***
CFVAR	0.000	0.000	0.000	0.000
	(2.00)**	(2.00)**	(1.93)*	(1.93)*

(continued on next page)

TABLE 5 (continued)

DV = *LNFEES*	(1)	(2)	(3)	(4)
SALESVAR	0.000	0.000	0.000	0.000
	(2.65)***	(2.65)***	(2.66)***	(2.65)***
OPCYCLE	−0.000	−0.000	−0.000	−0.000
	(−2.29)**	(−2.25)**	(−2.26)**	(−2.22)**
NEGEARN	0.090	0.090	0.075	0.075
	(2.61)***	(2.63)***	(2.10)**	(2.09)**
RD_ADV	−0.040	−0.040	−0.040	−0.040
	(−5.47)***	(−5.43)***	(−5.47)***	(−5.43)***
RD_ADV_IND	−0.095	−0.095	−0.094	−0.095
	(−3.65)***	(−3.67)***	(−3.64)***	(−3.67)***
CAP_INT	−0.332	−0.331	−0.325	−0.323
	(−5.21)***	(−5.19)***	(−5.08)***	(−5.05)***
Intercept	10.013	9.995	10.008	9.989
	(50.88)***	(50.66)***	(50.92)***	(50.70)***
Industry FE	Included	Included	Included	Included
Year FE	Included	Included	Included	Included
Adjusted R^2	80.57%	80.59%	80.58%	80.60%
n	13,064	13,064	13,064	13,064

***, **, * Indicate statistical significance at the 0.01, 0.05, and 0.10 levels, respectively, using a two-tailed test.
t-statistics are in parentheses. Standard errors are clustered by firm. All continuous variables are winsorized at the 1st and 99th percentiles. Table 5 presents the results of estimating Equation (1) augmented with the innate firm characteristics identified by Francis et al. (2004). Year and industry indicator variables are omitted for brevity.
See Table 1 for a detailed description of the variables that are not defined below.

Variable Definitions:
CFVAR = the standard deviation of cash flows from operations, calculated over the preceding ten years;
SALESVAR = the standard deviation of sales, calculated over the preceding ten years;
OPCYCLE = days in accounts receivable plus days in inventory;
NEGEARN = the percentage of years in which a firm has reported negative earnings in the preceding ten years;
RD_ADV = research and development expense plus advertising expense, divided by total sales;
RD_ADV_IND = an indicator variable that takes the value of 1 if *RD_ADV* is equal to 0, and 0 otherwise; and
CAP_INT = net book value of property, plant, and equipment scaled by total assets.

coefficient on *SPEC* ∗ *IBVOL* (t = 1.05; p = 0.29). Therefore, the results obtained using these alternative definitions of auditor industry specialization are consistent with our previously reported results.

In addition to investigating measures of auditor industry specialization that are based on market share, we also measure industry specialization using the portfolio share approach. The portfolio share approach determines specialization based on "the relative distribution of audit services and related fees across the various industries for each audit firm considered individually" (Neal and Riley 2004). Using this approach, an auditor is considered to be a specialist in a particular industry during a given year if: (office audit fees from clients in the industry)/(office audit fees in total) is greater than (1/number of industries available to be audited in the office's city).

Whereas the market share approach to measuring specialization captures the extent to which an audit firm is a major player in an industry, the portfolio share approach captures the extent to which an audit firm devotes itself to a specific industry. Either or both of these measures could impact the association between audit fees and our variables of interest. In the case of the market share approach, the auditor presumably has a greater volume of relevant observations against which to benchmark and evaluate the observations for a specific client. In the case of the portfolio share measure, the auditor presumably has a more focused investment in training and greater industry alignment with the specific client (Numan and Willekens 2012). Following Numan and Willekens (2012), and to differentiate the two approaches to identifying industry specialization, we will refer to the portfolio share measure as "client alignment."

When estimating our audit fee model, while only adding the main effect of client alignment, we find (untabulated) a positive and significant association between client alignment and audit fees (t = 9.11; p < 0.01), consistent with an audit fee premium. We then estimate Equation (2) while replacing the market share specialization measure with client alignment. The results (untabulated) reveal statistically insignificant coefficients on the interaction of client alignment with both autocorrelation

TABLE 6

Audit Fee Model Regression with Specialization—Alternative Auditor Industry Specialization Measures

	Dominance Measure		Market Share Measure	
DV = *LNFEES*	**(1)**	**(2)**	**(3)**	**(4)**
AUTO		−0.064		−0.069
		(−3.76)***		(−3.89)***
IBVOL		0.168		0.122
		(2.64)***		(1.87)*
SPEC ∗ AUTO		0.081		0.081
		(3.07)***		(3.10)***
SPEC ∗ IBVOL		−0.000		0.110
		(−0.00)		(1.05)
SPEC	0.072	0.063	0.063	−0.067
	(4.44)***	(0.38)	(3.74)***	(−0.39)
LNAT	0.420	0.420	0.420	0.410
	(42.79)***	(34.13)***	(42.80)***	(31.84)***
ROA	−0.377	−0.348	−0.378	−0.306
	(−5.89)***	(−4.28)***	(−5.90)***	(−3.69)***
ACCR	−0.108	−0.065	−0.105	−0.063
	(−1.44)	(−0.74)	(−1.40)	(−0.71)
CURRENT	0.351	0.362	0.347	0.331
	(6.06)***	(5.36)***	(5.99)***	(4.65)***
FSALES	0.528	0.521	0.530	0.535
	(12.59)***	(11.13)***	(12.58)***	(10.87)***
SEGMENTS	0.059	0.055	0.059	0.055
	(11.12)***	(8.90)***	(11.16)***	(8.43)***
LEV	0.227	0.216	0.228	0.223
	(5.21)***	(4.13)***	(5.23)***	(4.14)***
LOSS	0.039	0.035	0.038	0.030
	(2.24)**	(1.55)	(2.18)**	(1.31)
DEC	0.022	0.017	0.022	0.028
	(0.94)	(0.59)	(0.95)	(0.95)
LAG	0.002	0.001	0.002	0.001
	(5.23)***	(3.68)***	(5.29)***	(3.67)***
TENURE	−0.000	−0.000	−0.000	−0.001
	(−0.01)	(−0.35)	(−0.01)	(−0.45)
GC	0.063	0.080	0.061	0.097
	(1.33)	(1.42)	(1.30)	(1.79)*
XIDUM	0.112	0.079	0.114	0.103
	(3.17)***	(1.66)*	(3.22)***	(2.12)**
ACQ	0.076	0.094	0.076	0.087
	(5.01)***	(5.09)***	(4.97)***	(4.52)***
NYSE	0.121	0.115	0.123	0.117
	(4.94)***	(4.09)***	(4.99)***	(3.99)***
NEWDEBT	0.034	0.030	0.033	0.033
	(2.29)**	(1.72)*	(2.22)**	(1.84)*
NEWEQ	−0.018	−0.033	−0.018	−0.027
	(−0.82)	(−1.28)	(−0.84)	(−1.06)
LIT	−0.016	−0.026	−0.013	−0.018
	(−0.42)	(−0.64)	(−0.36)	(−0.45)
MTB	−0.000	−0.002	−0.000	−0.001
	(−0.21)	(−0.57)	(−0.19)	(−0.48)
LNNAF	0.063	0.061	0.063	0.064
	(9.82)***	(7.88)***	(9.83)***	(7.96)***
RETVOL	0.306	0.417	0.317	0.442
	(2.72)***	(3.24)***	(2.80)***	(3.35)***

(continued on next page)

TABLE 6 (continued)

	Dominance Measure		Market Share Measure	
DV = *LNFEES*	**(1)**	**(2)**	**(3)**	**(4)**
RETSUM	−0.013	−0.020	−0.013	−0.011
	(−1.23)	(−1.54)	(−1.19)	(−0.85)
MATWEAK	0.335	0.309	0.336	0.296
	(12.81)***	(9.36)***	(12.83)***	(8.46)***
Intercept	9.436	9.455	9.434	9.485
	(34.21)***	(34.00)***	(33.83)***	(34.11)***
Industry FE	Included	Included	Included	Included
Year FE	Included	Included	Included	Included
Adjusted R^2	80.93%	81.05%	80.90%	81.04%
n	9,117	9,117	9,117	9,117

***, **, * Indicate statistical significance at the 0.01, 0.05, and 0.10 levels, respectively, using a two-tailed test.
t-statistics are in parentheses. Standard errors are clustered by firm. All continuous variables are winsorized at the 1st and 99th percentiles. Table 6 presents the results of estimating Equation (2) for our specialization sample of 9,117 firm-year observations for the period 2004–2012. Year and industry indicator variables are omitted for brevity. Also omitted for brevity are the control variable interactions with *SPEC*. In Columns (1) and (3), the regression is estimated without any interactions with *SPEC*. In Columns (1) and (2), we use the dominance measure of auditor industry specialization, which considers an auditor to be an industry specialist during a given year if, within a given city, the auditor has the highest market share in an industry and its market share is at least 10 percentage points higher than the auditor with the second-highest market share (Reichelt and Wang 2010). In Columns (3) and (4), we use the market share measure of auditor industry specialization, which considers an auditor to be an industry specialist during a given year if, within a given city, the auditor has a market share in an industry that exceeds 50 percent (Reichelt and Wang 2010).
See Table 1 for a detailed description of the variables.

(*SPEC* ∗ *AUTO*) and volatility (*SPEC* ∗ *IBVOL*). Thus, although the fees themselves are associated with client alignment, the associations between audit fees and our variables of interest are not affected by client alignment.

Other Additional Tests

We also examine whether our results are robust to controlling for earnings management and managerial incentives to engage in earnings management. Gul et al. (2003) find that (1) abnormal accruals are positively associated with audit fees, (2) this positive association is attenuated by high managerial stock ownership, and (3) the negative interaction between abnormal accruals and high managerial stock ownership is weakened when managers have a large amount of accounting-based compensation. We examine whether our results continue to hold when controlling for these effects. To conduct this test, we create the following variables:

ABACC = performance-adjusted abnormal accruals;
C = an indicator variable that takes the value of 1 if inside directors' total compensation scaled by the firm's total assets is in the top quartile of the sample; and
M = an indicator variable that takes the value of 1 if inside directors' stock ownership represents more than 5 percent of the firm's total stock ownership.

We then augment Equation (1) with the following variables: *ABACC, C, M, ABACC* ∗ *C, ABACC* ∗ *M, C* ∗ *M,* and *ABACC* ∗ *C* ∗ *M*. When including these additional control variables, we find a negative and significant coefficient on *AUTO* and a positive and significant coefficient on *IBVOL,* consistent with our previously reported results.

A fundamental assumption of ordinary least squares regression is that the independent variables are exogenous. To address concerns about endogeneity, we utilize a two-stage least squares regression using the average annual percentage change in sales over the previous five years (*AVECHSALES*) and the average annual percentage change in property, plant, and equipment scaled by total assets over the previous five years (*AVECHPPE*) as instruments for earnings autocorrelation and earnings volatility, respectively. We find positive and significant associations between *AVECHSALES* and *AUTO* and between *AVECHPPE* and *IBVOL,* indicating that the instruments are correlated with our variables of interest. In addition, we have no reason to believe that the instruments are correlated with the error term. Thus, we believe that our choice of instrumental variables is appropriate. Using this model, we continue to find (untabulated) a negative and significant coefficient on *AUTO* and a positive and significant coefficient on *IBVOL*. Thus, our results continue to hold when using a regression model that addresses correlated omitted variable, simultaneity, and errors-in-variables biases.

We also investigate whether auditor tenure affects the association between earnings autocorrelation (volatility) and audit fees. Our results imply that auditors respond to lower earnings autocorrelation or higher earnings volatility by increasing auditor effort and charging a higher audit fee. However, as an auditor gains more experience with a client, the auditor may gain a better understanding of the firm's time-series of earnings, and learn how to more efficiently respond to autocorrelation and volatility. If this is the case, then the influence of these earnings characteristics on audit fees may weaken as auditor tenure lengthens. To examine this possibility, we split our sample based on the median value of ten years of auditor tenure and estimate Equation (1) for each of the subsamples. For the subsample of firms with ten years of tenure or less, our results (untabulated) continue to show a negative (positive) and significant association between earnings autocorrelation (volatility) and audit fees. Similarly, for the subsample of firms with more than ten years of auditor tenure, we also find (untabulated) a negative (positive) and significant association between earnings autocorrelation (volatility) and audit fees. Thus, auditor tenure does not appear to affect the association between earnings autocorrelation (volatility) and audit fees.

Although we have shown that autocorrelation and volatility are distinct variables, an unanswered question is whether each variable only affects audit fees at a certain level of the other variable. That is, perhaps autocorrelation only matters when volatility is high, or perhaps volatility only matters when autocorrelation is low. To examine this possibility, we split our primary sample of 13,214 observations into two subsamples based on the median value of *AUTO*. We then estimate Equation (1) for each subsample and find (untabulated) that the coefficient on *IBVOL* is positive and significant in both subsamples. Similarly, when we estimate Equation (1) for two subsamples created by splitting our primary sample on the median value of *IBVOL,* we find (untabulated) that the coefficient on *AUTO* is negative and significant in both subsamples. Therefore, the presence of a significant association between earnings autocorrelation (volatility) and audit fees does not depend on the level of earnings volatility (autocorrelation).

CONCLUSION

This study examines the influence of earnings autocorrelation and earnings volatility on audit fees. We find a negative (positive) and highly significant association between earnings autocorrelation (volatility) and audit fees. We also show that the association between earnings autocorrelation and audit fees is attenuated for industry-specialist auditors. However, we do not find evidence that auditor industry specialization affects the association between earnings volatility and audit fees.

This study makes two primary contributions to the literature. First, prior research frequently examines whether one particular earnings attribute, accruals, affects auditor perceptions of risk (e.g., Gul et al. 2003; Abbott et al. 2006; Schelleman and Knechel 2010; Krishnan et al. 2013), but whether earnings characteristics affect auditor risk assessments more generally is an understudied research area. We help fill this void in the literature by identifying autocorrelation and volatility as two earnings characteristics that have an economically significant effect on audit fees. We also contribute to the auditor industry specialization literature. We find that the association between earnings autocorrelation and audit fees is attenuated for industry-specialist auditors, consistent with specialists responding to lower earnings autocorrelation more efficiently than non-specialists. While the prior literature provides abundant evidence that specialists provide more effective audits, we contribute to the literature by showing that specialists can also produce more efficient audits, as well.

This study has limitations worth noting. First, while we suggest avenues by which earnings autocorrelation and earnings volatility may impact audit fees, we are unable to definitively identify the underlying drivers of these associations.[13] Second, we are unable to determine whether lower (higher) earnings autocorrelation (volatility) increases audit fees through increasing auditor effort, an audit risk premium, or some combination of both. Proprietary data containing information about audit hours used would be necessary to make this determination. Third, since the archival methodology inherently restricts the ability to infer causality, we can only observe the association between earnings autocorrelation (earnings volatility) and audit fees. A potential avenue for future research could be to use an experimental approach to examine whether the level of earnings autocorrelation and earnings volatility *cause* increased and/or decreased audit fees.

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[13] The inability to identify the underlying drivers of observed associations is an important, but common, limitation in prior research. For example, as discussed, Cassell et al. (2011) argue that short interest provides a signal of audit risk, and the authors find a positive relation between short interest and audit fees. However, in Willekens' (2011; emphasis in the original) discussion paper of Cassell et al. (2011), she points out that the authors are unable to determine "*how* the (supposedly) incremental information embedded in (publicly-available) short interest affects the audit process."

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