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The Effect of Audit Partner Digitalization Expertise on Audit Fees

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ABSTRACT This study focuses on the effects of digitalization on the auditing industry and the impact of audit partner expertise in digitalization on audit fees. Using data from listed U.S. companies between 2016 and 2021, we document a statistically and economically significant audit fee premium for audit partners who specialize in digitalization. This premium is separate from the partner's industry specialization and is strongest in industries with a high level of digitalization, especially during the first half of the sample period. Our subsample analysis shows that, while the premium appears to be diminishing in less digitalized industries, it remains significant in highly digitalized industries. This change may be due to the general increase in digitalization expertise among audit partners, leading to diminishing returns to specialization for less digitalized audits.

> There is no question that technology is reshaping every element of our lives, with every advancement pushing the boundaries of what the human race is capable of. This is also true for organisations and how they are audited.
>
> Marc Bena, Partner and Digital Audit Leader, PwC

1. Introduction

Digitalization[1] has significantly transformed the way firms operate and continues to do so. Firms have transitioned toward more digitally oriented business models, such as e-commerce, online marketplaces, and platform-based ecosystems (Hanelt et al., 2021). The digital transformation has enabled customers to purchase goods or subscribe to services using their mobile devices while requiring employees to adapt to new jobs and acquire new technological skills. Digital

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[1] 'Digitalization,' 'digital transformation,' and 'digital orientation' are used interchangeably in this manuscript. These terms refer to considerable organizational changes, especially in the business models and conduct catalyzed by digitization, digital technologies, or strategic orientation. Digitization entails encoding analog information into digital format or platforms to make the content more addressable, programmable, communicable, and traceable (Kindermann et al., 2021; Fotoh & Lorentzon, 2021, and the references cited therein).

technologies, such as application programming interfaces, artificial intelligence, big data analytics, and cloud computing provide the necessary infrastructure and capabilities for firms to operate digitally (McAfee & Brynjolfsson, 2017).

For auditors, digitalization matters for three reasons. First, auditing is a client-specific service that must be tailored to each client's characteristics. Audit partners must understand their clients' business processes and information systems, which are increasingly digitally oriented, and need to select appropriate auditing tools for digital environments (Brazel & Agoglia, 2007; Christ et al., 2021; Huang & Vasarhelyi, 2019). Second, audit firms strive to add value with advanced data analytics beyond the verification role of audits (Appelbaum et al., 2017; Barr-Pulliam et al., 2022). The ability to add value to the digitalized client by utilizing audit data analytics is a particularly important factor when a client is choosing a new auditor (Eilifsen et al., 2020). Finally, audit firms are interested in digital technologies to reduce costs. Auditing is labor-intensive, with a significant portion of costs attributed to auditors' salaries. To increase audit efficiency and cut costs, audit firms are automating well-defined, repetitive audit procedures (Christ et al., 2021; Huang & Vasarhelyi, 2019).

Audit partners play a critical role in audit quality (Hardies et al., 2021; Lennox & Wu, 2018), as auditing requires significant judgment by audit partners at various stages in the process. This applies also to audits of highly digitalized businesses (Fotoh & Lorentzon, 2021). Audit partners' expertise in understanding digital business models and using digital technologies is essential in the audits of highly digitalized companies. In this respect, digitalization poses two significant challenges for audit partners. First, the partners must possess adequate knowledge of the client's digitalized business to identify critical audit matters, including potential risks related to complex information systems (Brazel & Agoglia, 2007). Even with digitalized audit methodologies, the audit partner bears the responsibility for planning the audit, supervising the audit team's work, and signing off on the quality of the audit. Second, the partner's knowledge of digital technologies is essential to harness the audit firm's own digital technology and produce sufficient audit evidence (Eilifsen et al., 2020; Yoon et al., 2015). However, what constitutes sufficient and appropriate audit evidence can only be determined by the partners' professional judgments (Brown-Liburd et al., 2015). Consequently, focusing on the audit partner perspective is necessary to enhance understanding of the nature of auditing in the digital age, as recent empirical research suggests that most of the variation in audit quality occurs at the individual level (Cameran et al., 2022).

This study aims to examine whether audit partners possessing expertise in auditing highly digitalized clients obtain an audit fee premium. Prior research suggests that auditor expertise originates from general business knowledge, knowledge of accounting and auditing principles, and subspecialty knowledge, which comprises both industry-specific and task-specific expertise (Bonner, 1990; Bonner & Lewis, 1990; Goldman et al., 2022). We argue that, while some aspects of audit partners' expertise in digitalization may stem from general and industry-specific knowledge, some of this expertise is task-specific and is gained only through experience from auditing highly digitalized clients. Expertise gained through experience is *tacit knowledge* that cannot be transferred from one individual to another (Polanyi, 1966). For audit partners, this tacit knowledge includes an understanding of the clients' business processes and information systems (Brazel & Agoglia, 2007) as well as the ability to employ advanced auditing technology in the audits of the highly digitalized clients (Eilifsen et al., 2020; Yoon et al., 2015). We contend that specialized digital knowledge emerging from experience with highly digitalized clients sets some audit partners apart from peers and results in an economically significant fee premium (Aobdia et al., 2021; Moizer, 1997). This study seeks to provide empirical evidence of the economic value of digitalization expertise for audit partners.

To measure audit partners' expertise in digitalization, we create a *digitalization index* at the client firm-year level. This index measures the degree of digital orientation of audit clients and is based on computer-aided textual analysis of digital terms in the business descriptions of 10-K disclosures by U.S. public firms. We use a validated digital term dictionary created by Kindermann et al. (2021) and measure the relative frequency of digital terms in four dimensions of digital resources to create a balanced measure of the firm's digitalization.[2] We use the digitalization index to calculate the extent to which audit partners and audit firms specialize in highly digitalized clients and then apply these variable constructs to explain potential audit fee differentials for 2016–2021.

We find that audit partners' digitalization expertise is associated with a fee premium of about 4 percent, independent of industry specialization at both the audit partner and audit firm level. The premium is higher in industries with greater digitalization but is not restricted to tech firms. We find that the premium is greater in the early years of the study period, indicating that digitalization expertise is growing among partners, resulting in smaller pricing discrepancies. We also discover that more digitalized clients and clients identified with digitalization-related critical audit matters (CAMs) pay higher audit fees, independent of the audit partner's or firm's expertise. Furthermore, we observe that digitalization experts are more likely to report digitalization-related CAMs, supporting the construct validity of our digitalization expertise variable. To ensure the reliability of the results, we conduct various analyses to determine the model's sensitivity, address potential self-selection bias, and account for potential covariate imbalances through various matching methods, all of which produce similar results, increasing confidence in the study's findings.

To the best of our knowledge, this is the first study to estimate the fee premium that audit partners earn from their digital expertise. We contribute to the auditing literature in three main ways. First, our study adds to the understanding of the factors that drive audit fees and illuminates the value of specialized expertise in the digitalization of audit services. More generally, our study adds to the literature that investigates pricing differences between audit partners (e.g., Gul et al., 2013; Taylor, 2011). Second, we provide empirical evidence that adds to the literature on auditor expertise (Bonner & Lewis, 1990) by showing that auditing digitalized clients is a subspecialty knowledge similar to that arising from industry specialization. Finally, building on the Kindermann et al. (2021) digital orientation index, we operationalize a new empirical measure of audit partners' digital expertise. This measure provides opportunities for further research on the effects of digitalization on auditing.

2. Related Literature and Hypothesis Development

As discussed in the previous section, audit partners play a critical role in the audit process (Hardies et al., 2021; Lennox & Wu, 2018). In this section, we discuss further why audit partner's knowledge and skills in digital technologies are essential for auditing highly digitalized companies, but first we probe deeper into the concept of digitalization. Digitalization is not only about investments in information technology (IT) but takes many forms. For highly digitalized companies, digital transformation is a key driver of how they add value to their customers. Focusing on the role of digitalization in firms' strategies, Kindermann et al. (2021) propose a concept of *digital orientation*. They define it as 'an organization's guiding principle to pursue digital technology-enabled opportunities to achieve competitive advantage' (p. 649) and argue

[2]These four dimensions are technology scope, digital capabilities, digital ecosystem coordination, and digital architecture configuration (Kindermann et al., 2021; Hanelt et al., 2021).

that it encompasses four dimensions: digital technology scope, digital capabilities, digital ecosystem coordination, and digital architecture configuration. Next, we will illustrate how these four dimensions manifest themselves in practice and how we use computer-aided textual analysis to identify digitally oriented companies.

The first dimension of digital orientation, digital technology scope, refers to technologies that enable firms to offer digital or digitally enhanced products and services to create value for their customers. An excerpt from the 10-K business description section of Synchronoss Technologies, a U.S. company that provides e-commerce transaction management software, illustrates digital technology scope in practice:

> Our Synchronoss **IoT** solutions feature unique deployments across our **cloud**, digital and messaging platforms, products and solutions to create device activations for emerging devices such as **drones**, connected automobiles and connected **app**liances, **sensors**, etc.; orchestration of back end and device data and the presentation of smart alerts in chat **bots** to create better management of **IoT** use cases in ecosystems such as smart cities and **cloud** storage and intelligent exchange of data from connected devices to **IoT** administrators. (Synchronoss Technologies 10-K for the fiscal year ended December 31, 2017).

The words highlighted in the excerpt correspond to the digital technology scope in Kindermann et al.'s (2021) digital orientation dictionary (Appendix B). For this company, the digital technology scope is exemplified by IoT, bots, sensors, and other advanced devices.

The second dimension, digital capabilities, refers to the human and organizational aspects of digitalization. Kindermann et al. (2021) note that it captures skills and knowledge at both the managerial and employee level, including competencies in big data analytics, machine- and deep learning engineering, computing capabilities, and artificial intelligence. We use text from Altair Engineering Inc.'s 10-K business description as an example of digital capabilities:

> Altair Engineering Inc. is a global technology company providing software and cloud solutions in the areas of simulation, high-performance **computing** (HPC), data **analytics**, and **artificial intelligence** (AI). We enable organizations across broad industry segments to compete more effectively in a connected world while creating a more sustainable future. (Altair Engineering Inc. 10-K for the fiscal year ended December 31, 2020)

The emphasized words in the 10-K of Altair Engineering are listed under digital capabilities in the digital orientation dictionary. From the business description, it is evident that Altair Engineering Inc's digital capabilities are showcased by its proficiency in delivering business solutions using advanced analytical technologies.

The third dimension, digital ecosystem coordination, captures the coordinating efforts on how firms interact with various stakeholders, such as external producers and consumers, in open technological ecosystems. ChannelAdvisor Corporation's 10-K business description provides an example of how digital ecosystem coordination may be part of a company's digital strategy:

> We are a leading provider of **software-as-a-service**, or **SaaS**, solutions and our mission is to connect and optimize the world's commerce. Our proprietary **e-commerce** cloud platform, which is accessed through a standard **web** browser, helps brands and retailers worldwide improve their **online** performance by expanding sales channels, connecting with consumers around the world. (ChannelAdvisor Corp. 10-K for the fiscal year ended December 31, 2018).

The highlighted words in the 10-K text fall under digital ecosystem coordination in the digital orientation dictionary, signifying that ChannelAdvisor Corp.'s digital strategy is rooted in digital ecosystem coordination. This coordination is exemplified by the company's e-commerce cloud platform, which offers online channels and on-demand software via the Internet to its clients.

The fourth dimension, digital architecture configuration, encompasses the technological and organizational mechanisms that enable firms to use digital technology developed elsewhere, including organizational designs that allow them to digitize formerly analog routines. Our computer-aided textual analysis identifies TransUnion as an example of a company that builds its digital orientation on digital architecture configuration. TransUnion is a consumer credit reporting agency and its digital strategy relies on its proprietary databases that it has created by refining and re-organizing consumer data with AI.

> Our solutions are based on a foundation of **data** assets across financial, credit, alternative credit, identity, phone activity, **digital** device information, marketing, bankruptcy, lien, judgment, insurance claims, automotive and other relevant information obtained from thousands of sources including financial institutions, private **databases** and public records repositories. We refine, **standardize** and enhance this **data** using sophisticated **algorithms** to create proprietary **databases**. Our acquisition of Neustar, Inc. ('Neustar'), and particularly its OneID platform, will further enhance our ability to deliver **real-time**, persistent identity resolution of disparate data fragments and attributes in a privacy compliant manner. (TransUnion 10-K for the fiscal year ended December 31, 2021).

TransUnion is an example of a digitally oriented company that adds value through automated work processes and generative actions which create new digital assets.

As the texts and emphasized words from the above 10-K business descriptions show, applying computer-aided textual analysis and the digital orientation dictionary to the business descriptions identifies the nature and extent of the digital orientation of the companies. In addition, the above cases illustrate how the four dimensions of digital orientation look in practice.

The effect of digital transformation on auditing is twofold. First, auditors need the knowledge and skills in digitalization to understand their client's digitalized business to be able to plan the audit. Second, they need to apply appropriate advanced technology to be able to audit the digitalized client.[3] As the audit partner is the key person[4] in the audit process, the partner's knowledge and skills in digital technologies are critical. To harness audit firm's advanced technology in auditing, the partner will involve IT experts in an audit engagement, as needed. However, the partner's decisions on how to involve those experts depend on the partner's own IT knowledge and ability to interact with and supervise them (Bauer et al., 2019; Brazel & Agoglia, 2007; Hux, 2017).

Prior literature suggests that auditors who have less knowledge and experience in IT are more likely to fail to identify significant audit risks related to digitalization and therefore will refrain from involving IT experts, even if warranted (Brazel & Agoglia, 2007). Additionally, an audit partner with less IT knowledge may find it challenging to translate an IT specialist's work into audit evidence in audit work papers and therefore may decide to use traditional audit procedures, even if the digitalized methods are more efficient (Eilifsen et al., 2020). Thus, to communicate with IT experts and to use their work in auditing requires that a partner sufficiently understands digitalized auditing, including audits of IT systems and data analytics (Hux, 2017). The more digitalized the client's business processes and information systems, the more inefficient the traditional audit procedures and the more valuable the partner's ability to take advantage of the IT specialist's knowledge and skills. In the most extreme cases, an audit using traditional audit procedures is impossible. This is the case with clients in e-business, which requires not only an understanding of their digital systems, data, and access mechanisms but also a digital auditing approach instead of a traditional one (Kotb & Roberts, 2011).

To illustrate the effect of digital transformation on auditing in practice, we use the same approach as above. We apply computer-aided textual analysis and a digital orientation dictionary (Appendix B) to CAMs in the audit reports (see, Panel B of Appendix C). Based on emphasized

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[3] Marc Bena, partner and digital audit leader for PwC, said auditors in his firm 'approach technology in two different ways: auditing digital and digital auditing.' https://www.icaew.com/technical/audit-and-assurance/faculty/audit-and-beyond/audit-and-beyond-archive/audit-and-beyond-2019/audit-and-beyond-december-2019/a-simple-revolution-for-digital-auditing-and-auditing-digital.

[4] Auditing involves a great deal of judgment and decision-making. An audit partner is a key person, responsible for making decisions not only about how the audit should be conducted but also for reviewing the audit team's work, including that of the IT specialists.

words (from the dictionary) in CAMs, our approach flags Magnite Inc. as a company whose revenue process poses a challenge to the auditors, due to its digitalized nature.

> The Company's revenue consists of transaction-based fees and is made up of a significant volume of low-dollar transactions, sourced from multiple systems, **databases**, and other tools. Due to the fact that revenue transactions do not consist of the transfer of physical goods, but are **web**- or **app**-based, the processing and recording of revenue is highly **automated** and is based on contractual terms with advertisers and publishers. Because of the nature of the Company's transaction-based fees, the Company uses **automated** systems to process and record its revenue transactions. We identified revenue as a critical audit matter because the of the **information technology** (IT)-dependent nature of the Company's revenue stream and the significant audit effort required in performing our audit procedures, including involvement of **professionals with expertise in IT** to identify, test, and evaluate the Company's systems, **softwareapplications**, and **automated** controls related to the revenue cycle. (Magnite Inc. 10-K for the fiscal year ended December 31, 2020)

As can be seen from the CAM, the audit partner has flagged Magnite Inc.'s vast number of web-based transactions and the fact that the recording of them is highly automated. Thus, auditing the company's revenue process requires the involvement of IT experts. Based on the CAM description, it seems that auditing Magnite Inc.'s revenues using traditional audit procedures is impossible. Next, using the same approach as above, we present the response of Magnite Inc.'s auditors to the CAM:

> How the Critical Audit Matter Was Addressed in the Audit: Our audit procedures related to the Company's systems to process revenue transactions included the following, among others: We tested the effectiveness of system **interface** controls and **automated** controls within the revenue process, as well as controls designed to ensure the accuracy and completeness of revenue. [...] We evaluated recorded revenue and revenue trends and used **dataanalytics** to analyze transactional revenue **data**. (Magnite Inc. 10-K for the fiscal year ended December 31, 2020)

The auditor's response shows that the key issue in the audit is to use data analytics[5] on revenue data. In essence, auditing digital clients requires digital auditing (see footnote 3). As the volume of accessible data has exploded, businesses must adopt digital technologies to compete in this data-driven environment (Barr-Pulliam et al., 2022), and audit firms have responded to this development by investing heavily in data analytics.

As noted above, an audit partner's knowledge and skills in digital technologies are critical in auditing highly digitalized companies because they determine how IT experts are involved in the audit (Bauer et al., 2019; Brazel & Agoglia, 2007; Hux, 2017). Despite extensive training on digitalization that audit firms provide to their auditors, it is plausible that at least some element of expertise in digitalization emerges from the audit partners' own *experiences* from auditing highly digitalized client firms. According to Polanyi (1966), experiences are *tacit* knowledge that cannot be articulated and transferred from one individual to another. Given this, the audit partner becomes an expert in auditing digitalized businesses by specializing in highly digitalized clients, similar to well-documented industry specialization (Aobdia et al., 2021; Bae et al., 2019; Goodwin & Wu, 2014; Zerni, 2012). It may be that some aspects of digitalization are industry-specific, but it is likely that other aspects are common to highly digitalized businesses, regardless of the industry. The audit partner's tacit knowledge related to these aspects of digitalization—gained through experience in auditing highly digitalized clients—allows the partner to develop broad expertise in digitalization beyond industry-specific expertise and earn a fee premium over non-expert counterparts.

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[5]Data analytics available to auditors can be categorized in four types of ascending complexity: descriptive, diagnostic, predictive, and prescriptive (Barr-Pulliam et al., 2022). Descriptive data analytics typically answer the question 'what happened?' by simple visualization of the data. Diagnostic analyses answer the question 'why did it happen?' using data mining and correlations. Predictive analyses answer the question 'what is likely to happen?' by using statistical methods, including regression, pattern matching, and predictive modeling on large datasets. Finally, prescriptive analyses answer the question 'what should be done?' This most complex type of data analytics uses for example simulation, neural networks, and machine learning.

However, it is not self-evident that audit partners who have specialized in highly digitalized clients earn a fee premium over non-specialists. The client's willingness to pay a premium depends on two conditions. First, the partner's expertise must add value to the client to justify a premium. However, it might be that the critical knowledge and skills in digital technologies are industry-specific and possibly integrated into the skillset of industry specialists, in which case there would be no distinct premium for digital skills alone. Second, such expertise must be scarce to warrant a fee premium. However, digitalization skills might be transferable between partners within the audit firm instead of being non-transferrable tacit knowledge accumulated over time from the partner's individual experience with digitalized clients. Even if the expertise would not be transferrable but based on the partner's tacit knowledge, it might be that this expertise is not scarce enough to justify a fee premium. On the contrary, it might be that audit partners generally possess enough experience-based digitalization expertise – to the extent that specialization in highly digitalized clients brings no additional value that would justify a fee premium. Moreover, the competition in the audit market suggests that the premium for such expertise might be short-lived.

In balance, however, we have grounds to argue that the audit partner's specialization in highly digitalized clients can lead to scarce expertise that clients are willing to pay a premium for. Such premium is plausible given that auditing is a tailor-made service for each client, and the critical role of the partner's tacit knowledge and professional judgment in audit quality (Brown-Liburd et al., 2015; Hardies et al., 2021; Lennox & Wu, 2018; Moizer, 1997; Polanyi, 1966). This is further supported by evidence that much of the variation in audit quality is at the individual level (Cameran et al., 2022). Accordingly, we propose the hypothesis that the partner's knowledge and skills in digitalization are priced in audits:

HYPOTHESIS: *Audit partners who have specialized in highly digitalized clients earn a fee premium over their nonspecialist counterparts.*

3. Research Design and Variable Definitions

3.1. Research Design

We use the widely accepted audit fee model to test whether audit partners specializing in highly digitalized clients earn a fee premium (Francis, 1984; Hay et al., 2006; Simunic, 1980).[6] Specifically, using unbalanced panel data, we estimate the following OLS regression:

$$LNFEE_{it} = \alpha + \beta_1 DIGI\_SPEC\_P_{jt} + X'\gamma + YEAR_t + INDUSTRY_i + \varepsilon_{it}, \quad (1)$$

where the dependent variable, the natural logarithm of the audit fee ($LNFEE_{it}$), is regressed on our measure of auditor digitalization expertise ($DIGI\_SPEC\_P_{jt}$). A positive coefficient on β_1 would support our hypothesis that audit partners specialized in highly digitalized clients earn a fee premium over nonspecialist audit partners. Subscripts i, j, and t denote audit client, audit partner, and fiscal year, respectively. To ensure the robustness of our inferences, we include a vector of control variables, X, that are commonly used in studies investigating the pricing of audit services. We draw our control variables from prior studies, such as the work of Hay et al. (2006), and include client- and auditor-specific factors, such as auditor industry specialization,

[6]We use several alternative estimation methods and model specifications to estimate fee premiums. These are described in Section 5.

which has been identified as an important factor affecting audit fees (Casterella et al., 2004). Additionally, we control for fiscal year (*YEAR*) and industry (*INDUSTRY*) fixed effects, where the industries are defined at the two-digit SIC (Standard Industrial Classification) level. All variables are discussed in detail in Section 3.2. and defined in Appendix A. Given the panel data nature of our study, we cluster the standard errors by client firm (Petersen, 2008).

3.2. Sample and Variable Descriptions

Our sample consists of publicly listed U.S. firms for the fiscal years 2016–2021. We merge audit-related data from Audit Analytics with financial data from Compustat Fundamentals Annual and Historical Segments databases. To evaluate the digital orientation of audit clients, we retrieve the clients' business descriptions by downloading their annual 10-K filings from the U.S. Securities and Exchange Commission's EDGAR database. After excluding financial and insurance firms (SIC codes 6000–6999), firms with a market capitalization of less than USD 10 million, and missing observations, our final sample consists of 12,889 firm-year observations.

3.2.1. Measure of audit partner's digitalization specialization

Our variable of main interest, *DIGI_SPEC_P*, is the measure of an audit partner's digitalization expertise based on the digital orientation index (*DIGI_ORIENT*) of the partner's previous year's clients. Specifically, *DIGI_SPEC_P* takes the value of one if the average digital orientation index of the client base belonged to the highest quartile in that year. *DIGI_SPEC_P* indicates the partner's ability to serve clients who are likely to be more digitally oriented and require specialized knowledge related to digital technologies, business models, and products as well as understanding their economic implications. Therefore *DIGI_SPEC_P* can be considered as a proxy for the partner's digitalization expertise, and its coefficient in a regression model can help identify whether partners with more digitalization expertise can extract higher audit fees than those with less expertise, all else equal.

An audit partner's level of digital expertise may not be relevant if the audit client does not engage significantly in digital activities. To account for the degree to which the audit engagement concerns highly digitalized clients or systems, we include a digital orientation index of the audit client, *DIGI_ORIENT*, in our audit fee model as a control variable. We calculate *DIGI_ORIENT* by determining the percentage of words in the business description section of the audit client's most recent 10-K filing that match with a digital orientation dictionary. This dictionary, created and validated by Kindermann et al. (2021) and listed in Appendix B, includes a comprehensive list of keywords related to digitalization, such as 'e-commerce,' 'cloud-based,' 'cybersecurity,' and 'analytics.' The matching is conducted using computer-aided textual analysis and is illustrated in Panel A of Appendix C.

The digital orientation dictionary enables us to assess the extent to which a client's business is digitally oriented and provides a numerical measure of its level of digitalization. The findings of Han et al. (2016) and Eulerich et al. (2022) suggest that the digitalization of a client's systems and processes may increase audit fees. Han et al. (2016) find that IT investments relate positively to abnormal audit fees, the probability of auditors' issuance of a going-concern opinion, and the likelihood of auditors' Type II errors. Eulerich et al. (2022) find that the client's technological capabilities are perceived to deliver efficiency gains and more insightful recommendations in the audit but also to be more costly, due increase in the size of the internal audit function. These findings suggest that, while the digitalization of a client's systems and processes may lead to greater efficiency and effectiveness in the audit, it may also result in increased audit fees, due to the added complexity and risk associated with auditing digital systems.

Audit firms invest heavily to train their auditors in digitalization. The skills that are shared within the audit firm are *explicit knowledge*, contrary to personal experiences, which are *tacit knowledge* that cannot be transferred from one individual to another (Polanyi, 1966). To control for the audit firm's digital expertise and resources, we construct an audit-firm level indicator for digitalization expertise, *DIGI_SPEC_F*. Similar to its partner-level counterpart, *DIGI_SPEC_F* is a binary variable that takes the value of one if an audit firm's previous year's client base is on average in the highest quartile of digital orientation and zero otherwise. While *DIGI_SPEC_P* captures the digitalization expertise of individual auditors, *DIGI_SPEC_F* captures the specialization of entire firms in auditing highly digitalized clients. The total effect on audit fees depends on the extent that digitalization skills are transferable within the audit firm, rather than being held by a few specific partners.

3.2.2. Other control variables

Following audit fee studies (Hay et al., 2006), we control for client and auditor characteristics. We control for auditor's industry specialization at individual audit partner and firm level based on market shares. Variable *IND_SPEC_P* takes the value of one if the total audit fees of audit partner *j* for a given industry in year *t-1* are in the highest quartile of its distribution and zero otherwise. We expect a positive coefficient for this variable (Casterella et al., 2004; Goodwin & Wu, 2016; Zerni, 2012). Variable *IND_SPEC_F* takes the value of one if the total audit fees of the audit firm *i* for a given industry in year *t-1* are in the highest quartile of its distribution and zero otherwise. The impact of including industry specialization variables on *DIGI_SPEC_P* and *DIGI_SPEC_F* will depend on the degree of correlation between industry and digitalization specialization as well as any potential interaction effects between the two types of specializations. For example, an audit partner with both industry-specific and digitalization expertise may be able to command higher fees due to a unique combination of skills.

Like prior studies (Hay et al., 2006), we control for client size (*LNTA*) measured as the natural logarithm of total assets, ratio of inventory and receivables to total assets (*INVREC*), complexity of client operations (*SEG, FOREIGN*), loss-making firms (*LOSS*), client financial performance in general (*CATA, ROA, LEV, OPINION*), Big 4 auditor (*BIG4*), non-audit fees (*LNNFEE*), and busy season (*BUSY*). Except for *CATA* and *ROA*, we expect positive coefficients for these control variables, as client size, auditor quality, complexity, and inherent audit risk increase audit effort (Hay et al., 2006; Krishnan, 2005). Being inverse measures of financial risk, *CATA* and *ROA* are expected to have negative coefficients.

We also control for new audit engagement with an indicator variable that equals one if the audit partner has changed from the previous year (*CHANGE*). We expect a negative coefficient for *CHANGE* (DeAngelo, 1981; Francis, 1984).

4. Results

4.1. Descriptive Statistics

Table 1 presents summary statistics for the variables used in our analyses. The average logarithmic audit fee (*LNFEE*) is 14.039, equivalent to USD 1.25 million. Audits conducted by audit partners with digitalization expertise (*DIGI_SPEC_P*) represent 19.7 percent of the sample, which means that 2,539 client-year observations in our sample are audited by a digitalization expert. Audits conducted by audit firms with digital expertise (*DIGI_SPEC_F*) represent 13.6 percent of the sample. The clients of industry-specialist partners (*IND_SPEC_P*) and audit firms (*IND_SPEC_F*) are 16.4 and 15.1 percent of the sample, respectively. The average digital

Table 1. Descriptive statistics ($N = 12{,}889$)

	Mean	Std. Dev.	Min	Median	Max
LNFEE	14.039	1.256	9.105	14.116	17.817
DIGISPEC_P	0.197	0.398	0.000	0.000	1.000
DIGISPEC_F	0.136	0.343	0.000	0.000	1.000
INDSPEC_P	0.164	0.370	0.000	0.000	1.000
INDSPEC_F	0.151	0.358	0.000	0.000	1.000
DIGI_ORIENT	1.650	1.395	0.000	1.077	11.126
LNTA	20.405	2.091	16.118	20.439	27.036
BIG4	0.691	0.462	0.000	1.000	1.000
INVREC	0.203	0.170	0.000	0.170	0.938
LOSS	0.435	0.496	0.000	0.000	1.000
CATA	0.505	0.265	0.000	0.479	1.000
ROA	− 0.080	0.310	− 5.843	0.016	2.460
OPINION	0.045	0.207	0.000	0.000	1.000
SEG	1.441	0.533	1.000	1.414	6.403
CHANGE	0.282	0.450	0.000	0.000	1.000
BUSY	0.765	0.424	0.000	1.000	1.000
LEV	0.489	0.243	0.002	0.503	5.346
FOREIGN	0.607	0.488	0.000	1.000	1.000
LNNFEE	9.798	4.823	0.000	11.401	18.058

Notes: See Appendix A for detailed variable definitions.

orientation (*DIGI_ORIENT*) in the sample is 1.650, which corresponds to approximately 139 digitalization-related references in an average-length business description (8,402 words).

The average firm size, the natural logarithm of total assets (*LNTA*), is 20.41, equivalent to USD 731 million. Approximately 69 percent of the firms in the sample are audited by one of the Big 4 audit firms. The complexity of client operations, as approximated by the square root of the number of operating segments (*SEG*), averages 1.44, indicating that the typical client operates in two geographic segments. The mean ratio of inventory and receivables to total assets (*INVREC*) is 20.3 percent. In terms of financial performance, 43.5 percent of the firm-years report a negative net profit (*LOSS*). The mean values of the *CATA*, *ROA*, and *LEV* financial ratios are 0.51, − 0.08, and 0.49, respectively. The average logarithmic non-audit fees (*LNNFEE*) are 9.8, equivalent to USD 18,033.[7] The average auditor change (*CHANGE*) is 28.2 percent, indicating a four-year rotation cycle. Three out of four firms (76.5 percent) in the sample end their fiscal year in December. In the sample, 4.5 percent of the firms receive going concern opinions (*OPINION*), and 60.7 percent earned foreign income (*FOREIGN*).

Table 2 presents the results of the univariate analysis, which compares the summary statistics for digitalization expert partners and non-experts. The results demonstrate that the average audit fees for digitalization expert partners are significantly higher than those of non-experts, with a difference of approximately 16 percent (14.166 versus 14.008). The fee differential reduces to 10 percent when comparing the groupwise median fees (14.194 versus 14.089) but remains economically significant. These findings provide preliminary evidence that digitalization expertise significantly influences audit fees. However, noteworthy differences exist in the auditor and client characteristics of the two groups, which may affect the estimated audit fee premium. We address these covariate imbalance issues in the subsequent analysis.

[7] Sample mean values include observations in which the client has not purchased any non-audit services from the auditor. These zero observations reduce significantly the mean values of non-audit fees. For this reason, median value (11.4) of *LNNFEE* is much higher.

Table 2. Univariate analysis

	DIGISPEC_P = 1 (N = 2,537)		*DIGISPEC_P = 0* (N = 10,352)		Kruskal-Wallis test
	Mean	Median	Mean	Median	Chi^2
LNFEE	14.166	14.194	14.008	14.089	25.082***
DIGISPEC_F	0.181	0.000	0.125	0.000	54.011***
INDSPEC_P	0.207	0.000	0.153	0.000	42.506***
INDSPEC_F	0.220	0.000	0.135	0.000	114.302***
DIGI_ORIENT	2.568	2.201	1.424	0.987	1102.439***
LNTA	20.396	20.342	20.408	20.467	1.012***
BIG4	0.759	1.000	0.675	1.000	67.109***
INVREC	0.158	0.125	0.215	0.184	219.688***
LOSS	0.551	1.000	0.407	0.000	172.514***
CATA	0.574	0.585	0.489	0.459	204.143***
ROA	– 0.124	– 0.019	– 0.069	0.022	146.284***
OPINION	0.050	0.000	0.043	0.000	1.832
SEG	1.543	1.414	1.416	1.414	0.163
CHANGE	0.115	0.000	0.323	0.000	433.261***
BUSY	0.793	1.000	0.758	1.000	14.012***
LEV	0.461	0.462	0.496	0.512	45.963***
FOREIGN	0.688	1.000	0.587	1.000	86.905***
LNNFEE	10.096	11.532	9.725	11.362	9.355***

Notes: This table reports univariate comparisons between digitalization expert partners and non-experts based on Kruskal-Wallis rank sums. See Appendix A for variable definitions.

4.2. Regression Results

Table 3 displays the findings of our multiple regression analysis. In column (1), we present the results of the baseline audit fee model with industry specialist indicator variables. In column (2), we augment the baseline model with the digital orientation index of the audit client (*DIGI_ORIENT*) to control for the client's digitalization. Column (3) reports the outcomes for our variables of primary interest: the digitalization expertise of the audit partner (*DIGI_SPEC_P*) and the audit firm (*DIGI_SPEC_F*). Column (4) presents the results of interacting partner-level industry and digitalization expertise (*DIGI_SPEC_P* × *IND_SPEC_P*).

In column (1) of Table 3, the results of the baseline audit fee model are consistent with prior research (DeAngelo, 1981; Francis, 1984; Hay et al., 2006; Krishnan, 2005). As predicted based on the studies by Zerni (2012) and Goodwin and Wu (2016), we observe a statistically significant positive coefficient on the indicator variables for industry specialist partners and audit firms (*IND_SPEC_P*, *IND_SPEC_F*), which holds in all four regression models reported in Table 3. The estimated coefficient for *IND_SPEC_P* is 0.162, implying an industry specialist fee premium of approximately 17.6 percent, compared to nonspecialist partners. The coefficient of 0.069 for the *IND_SPEC_F* variable suggests a 7 percent premium for audit-firm-level industry specialization, implying that industry knowledge is partially transferrable within the audit firm.

The client characteristic of particular interest is the degree of digital orientation of the client (*DIGI_ORIENT*). In column (2) of Table 3, the regression results reveal a positive and statistically significant coefficient on *DIGI_ORIENT* (0.031, $t = 4.91$), suggesting that clients with higher digital orientation tend to pay higher audit fees. This result is consistent with the findings of Han et al. (2016) and Eulerich et al. (2022). The estimated effect size is economically significant, as a one standard-deviation increase in *DIGI_ORIENT* is associated with a 4.3 percent increase in the audit fee (100 × 0.031 × 1.395).

In column (3), our findings indicate that the main variable of interest, *DIGI_SPEC_P*, has a positive and statistically significant coefficient (0.038; $t = 2.54$). This implies that audit partners

Table 3. The effect of audit partner's digitalization expertise on audit fees

	Dependent variable = *LNFEE*			
	(1)	(2)	(3)	(4)
DIGISPEC_P			0.038**	0.040**
			(2.54)	(2.57)
DIGISPEC_F			0.006	0.006
			(0.32)	(0.32)
DIGISPEC_P × INDSPEC_P				− 0.012
				(− 0.36)
INDSPEC_P	0.162***	0.158***	0.158***	0.161***
	(11.18)	(10.95)	(10.97)	(10.13)
INDSPEC_F	0.069***	0.069***	0.066***	0.066***
	(4.50)	(4.52)	(5.04)	(5.05)
DIGI_ORIENT		0.031***	0.028***	0.028***
		(4.91)	(4.28)	(4.27)
LNTA	0.465***	0.465***	0.464***	0.464***
	(69.28)	(69.33)	(69.33)	(69.32)
BIG4	(19.58)	(19.94)	(19.83)	(19.85)
	(19.58)	(19.94)	(19.83)	(19.85)
INVREC	0.460***	0.455***	0.467***	0.466***
	(8.00)	(7.92)	(8.08)	(8.08)
LOSS	0.110***	0.105***	0.103***	0.102***
	(6.90)	(6.56)	(6.45)	(6.44)
CATA	0.122***	0.100**	0.092**	0.092**
	(3.12)	(2.52)	(2.31)	(2.31)
ROA	− 0.127***	− 0.135***	− 0.137***	− 0.136***
	(− 3.50)	(− 3.61)	(− 3.66)	(− 3.66)
OPINION	0.080**	0.081**	0.080**	0.080**
	(2.24)	(2.27)	(2.24)	(2.25)
SEG	0.095	0.094	0.087	0.089
	(0.20)	(0.19)	(0.18)	(0.18)
CHANGE	0.029*	0.031**	0.033**	0.034**
	(1.88)	(2.05)	(2.21)	(2.22)
BUSY	0.069***	0.079***	0.078***	0.078***
	(3.54)	(4.03)	(3.98)	(3.96)
LEV	0.394***	0.399***	0.400***	0.400***
	(11.31)	(11.43)	(11.46)	(11.46)
FOREIGN	0.251***	0.229***	0.229***	0.229***
	(13.74)	(12.12)	(12.12)	(12.10)
LNNFEE	0.002	0.002	0.001	0.001
	(1.18)	(0.93)	(0.90)	(0.89)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Constant	3.111***	3.108***	3.125***	3.123***
	(5.95)	(5.84)	(5.95)	(5.95)
Observations	12,889	12,889	12,889	12,889
Adjusted R^2	0.865	0.866	0.866	0.866

Notes: The main test variables are bolded. See Appendix A for variable definitions. Standard errors are clustered by firm. ***, **, * indicate statistical significance at the 0.01, 0.05, and 0.10 level, respectively.

with digital expertise charge four percent higher fees, compared to other audit partners, controlling for potential industry specialization, client's digital orientation, and other confounding factors.[8] Column (4) shows similar results, further supporting our hypothesis that audit partners specializing in digitalized clients earn a fee premium. However, our interaction analysis reveals that the audit firm-level specialization variable (*DIGI_SPEC_F*) and the interaction variable

[8]The percentage effect of a dummy variable is approximated as: $100 \times \{exp(\beta) - 1\}$.

(*DIGI_SPEC_P* × *IND_SPEC_P*) are not statistically associated with audit fees. This suggests that audit-firm-level digital expertise is not associated with a fee premium, and the positive effect of *DIGI_SPEC_P* on audit fees is not moderated by the industry expertise of the audit partner.

Overall, the results in Table 3 provide important insights into the determinants of audit fees in the context of digitalization. Our findings suggest that clients with higher digital orientations pay higher audit fees and that audit partners with digitalization expertise charge four percent higher fees, compared to non-expert partners. The audit fee associated with digitalization specialist partners is incremental to and coexists with the positive audit fee effect of an audit partner's industry specialization. This implies that industry and digitalization expertise are two distinct sources of a specialization premium.

4.2.1. Do all clients pay the same premium for digitalization expertise?

While it is plausible that all audit clients benefit from their auditors' knowledge and skills on digitalization in the current business environment, the benefits may increase with the degree of the client's digitalization, as those skills will become more critical in the audit engagement. To explore this possibility, we conduct more nuanced tests with cross-sectional subsamples of more and less digitalized industries. The high and low digitalization groups are determined by calculating the average digitalization orientation index (*DIGI_ORIENT*) across industries and then using the top tertile (66 percentile – high digitalized) and bottom tertile (33 percentile – low digitalized) of those values as the cutoff to create the groups.

Table 4 reports separate results for each subsample in columns (1) and (2), respectively. The comparison of results shows that digitalization specialist auditors (*DIGI_SPEC_P*) charge a fee premium from their clients in highly digitalized industries (0.070, t-value = 3.11), and the premium is even larger in the top quartile of digitalized industries (0.081, t-value = 3.48; see Table A1 of Online Appendix). In the industries with less digitalization, the audit fees are less driven by audit partner specialization—the coefficient on *DIGI_SPEC_P* is insignificant. These results suggest that the level of client digitalization plays an important role in determining the size of the fee premium charged by digitalization specialist auditors.

To address concerns that the results may be influenced by clients in a single highly digitalized industry, we excluded clients from the ICT industry (SIC codes 7370–7379). As shown in Table 4 column (3), the findings remain consistent and suggest that audit partners with digital expertise charge higher audit fees, compared to their nonspecialist counterparts, and that this effect is not driven by the ICT industry alone.

4.2.2. The effects over time and the demand for auditor expertise

Due to the rapid increase in digitalization during our sample period, we conducted additional analysis by splitting our data into two periods: 2016–2018 and 2019–2021. Table 5 columns (1) and (2) present interesting insights into the development of digitalization-related audit fee premia over time. Notably, the effect of partner-level digitalization expertise is more pronounced in the first sample period (0.059, t-value = 2.91) but decreases in the latter period (0.031, t-value = 1.81). Similarly, audit firm specialization is positively associated with audit fees (0.054, $t = 2.09$) in the first sample period but negatively associated with audit fees (-0.115, $t = -4.88$) in the latter period. The reason for the weakened effect of digitalization expertise on audit fees in the 2019–2021 period may be due to the general increase in digitalization expertise among audit partners, leading to diminishing returns on specialization (Carson & Fargher, 2007; Casterella et al., 2004). To further understand the difference between the changes in the earlier and later periods we split the sample to the subsamples based on the industry digitalization level. According to the results in Table A2 of the Online Appendix, the premium for audit partners

Table 4. Audit fee regression analysis by industry digitalization level

	Dependent variable = *LNFEE*		
	(1) Highly digitalized industries	(2) Less digitalized industries	(3) Without ICT firms
DIGISPEC_P	0.070***	0.013	0.039**
	(3.11)	(0.43)	(2.42)
DIGISPEC_F	− 0.018	0.016	0.002
	(− 0.66)	(0.52)	(0.09)
INDSPEC_P	0.135***	0.147***	0.160***
	(5.49)	(6.45)	(10.53)
INDSPEC_F	0.065***	0.075***	0.061***
	(2.95)	(3.59)	(4.36)
DIGI_ORIENT	− 0.005	0.020	0.031***
	(− 0.51)	(1.31)	(3.84)
LNTA	0.477***	0.470***	0.466***
	(43.84)	(43.62)	(65.24)
BIG4	0.465***	0.386***	0.437***
	(11.97)	(10.58)	(18.77)
INVREC	0.448***	0.030	0.457***
	(4.20)	(0.31)	(7.61)
LOSS	0.150***	0.099***	0.097***
	(5.90)	(3.66)	(5.87)
CATA	0.018	0.403***	0.113***
	(0.29)	(5.10)	(2.60)
ROA	− 0.177***	− 0.055	− 0.139***
	(− 2.77)	(− 0.75)	(− 3.61)
OPINION	0.118**	0.023	0.088**
	(2.03)	(0.30)	(2.38)
SEG	0.049	− 0.202	0.264
	(0.10)	(− 0.38)	(0.51)
CHANGE	− 0.002	0.031	0.034**
	(− 0.06)	(1.19)	(2.13)
BUSY	0.094***	0.060**	0.092***
	(3.25)	(2.04)	(4.38)
LEV	0.247***	0.585***	0.420***
	(4.06)	(8.39)	(11.38)
FOREIGN	0.246***	0.218***	0.231***
	(6.49)	(6.96)	(11.73)
LNNFEE	− 0.001	0.006**	0.002
	(− 0.18)	(2.17)	(1.36)
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Constant	3.288***	3.382***	2.877***
	(5.86)	(5.49)	(5.11)
Observations	4,061	4,645	11,754
Adjusted R^2	0.880	0.861	0.867

Notes: Columns (1) and (2) are based on audit client's average digitalization orientation index (*DIGI_ORIENT*) across industries, using the industries' 66 and 33 percentile as a cutoff point to high and low industry groups. Column (3) excludes clients in ICT industry (SIC codes 7370-7379). See Appendix A for variable definitions. Standard errors are clustered by firm. ***, **, * indicate statistical significance at the 0.01, 0.05, and 0.10 level, respectively.

who specialize in digitalization is similar for the top quartile of the highest digitalized industries. However, the premium weakens in the second half of the sample period for the top tertile of the digitalized industries. This might indicate that larger numbers of auditors start to specialize in digitalization by bringing down the fee premium for less demanding clients.

The latter sample period provides an opportunity to test two alternative explanations for the documented decrease in the partner digitalization premium using critical audit matter (CAM)

Table 5. Split sample analysis, including additional explanatory variables

	Dependent variable = *LNFEE*		
	(1)	(2)	(3)
	2016–2018	2019–2021	2019–2021
DIGISPEC_P	0.059***	0.031*	0.030*
	(2.91)	(1.81)	(1.76)
DIGISPEC_F	0.054**	– 0.115***	– 0.116***
	(2.09)	(– 4.88)	(– 4.91)
INDSPEC_P	0.139***	0.170***	0.169***
	(7.33)	(9.21)	(9.14)
INDSPEC_F	0.039**	0.182***	0.187***
	(2.31)	(6.44)	(6.60)
DIGI_ORIENT	0.030***	0.026***	0.024***
	(4.00)	(3.66)	(3.39)
IT_SPEC			– 0.032
			(– 1.57)
DIGI_CAM			0.050***
			(2.95)
LNTA	0.463***	0.464***	0.463***
	(61.34)	(61.64)	(60.70)
BIG4	0.437***	0.424***	0.425***
	(16.54)	(17.40)	(17.45)
INVREC	0.380***	0.550***	0.555***
	(5.79)	(8.25)	(8.30)
LOSS	0.105***	0.101***	0.098***
	(5.02)	(5.38)	(5.21)
CATA	0.121**	0.063	0.063
	(2.45)	(1.45)	(1.45)
ROA	– 0.079	– 0.185***	– 0.186***
	(– 1.51)	(– 4.08)	(– 4.07)
OPINION	0.071	0.092**	0.092**
	(1.28)	(2.36)	(2.35)
SEG	0.376	– 0.089	– 0.062
	(0.69)	(– 0.18)	(– 0.13)
CHANGE	0.016	0.040**	0.039*
	(0.69)	(1.96)	(1.89)
BUSY	0.070***	0.082***	0.083***
	(3.10)	(3.89)	(3.93)
LEV	0.398***	0.401***	0.401***
	(9.77)	(9.59)	(9.56)
FOREIGN	0.255***	0.202***	0.201***
	(11.49)	(9.89)	(9.83)
LNNFEE	0.004*	– 0.001	– 0.001
	(1.92)	(– 0.28)	(– 0.36)
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Constant	2.730***	3.496***	3.488***
	(4.65)	(6.56)	(6.65)
Observations	6,270	6,619	6,619
Adjusted R^2	0.861	0.871	0.872

Notes: Main test variables are bolded. See Appendix A for variable definitions.

descriptions in the Audit Analytics database from 2019 onward. First, the audit partner's expertise in digitalization may not be fully utilized during the audit engagement, in which case it may not necessarily translate into higher fees. Second, the digitalization skills of the audit team or external IT specialists may be more critical than the audit partner's individual skills. For these purposes, the audit partner's description of the CAM provides insights into the level of digitalization skills required for the audit, including specific digital technologies and external experts used in the audit engagement.

To identify audit engagements that may require the audit partner's expertise in digitalization, we use computer-aided textual analysis to search for CAM disclosures related to digitalization. We operationalize the results of this analysis by creating a *DIGI_CAM* variable that equals one if any CAM in the auditor's report contains more digitalization-related words than the median number and zero otherwise (see Appendix B for the digitalization dictionary). In addition, while the exact composition of the audit team is unknown and therefore its average level of digitalization expertise cannot be controlled for, we control for the use of IT and data specialists in the audit engagement. Specifically, we use an indicator variable *IT_SPEC* to control audit engagements where the audit team has reportedly used the services of IT or data specialists, as indicated in the CAM response. The operationalization of *DIGI_CAM* and *IT_SPEC* variables are illustrated in Panels B and C of Appendix C, respectively.

We incorporated the two additional explanatory variables (*IT_SPEC* and *DIGI_CAM*) in the audit fee model for the latter sample period to determine whether alternative explanations diminish the effect of audit partner digitalization expertise. As shown in Table 5 column 3, the findings are consistent with our earlier results, indicating that digitalization specialists charge higher fees. Additionally, the involvement of IT specialists (*IT_SPEC*) has no significant impact on audit fees. On the other hand, *DIGI_CAM* is significantly and positively associated with audit fees (0.050, t-value = 2.95), suggesting an extra premium if the client's critical audit matters relate to digitalization. Nevertheless, it should be noted that our empirical results suggest that digitalization experts (*DIGI_SPEC_P*) still earn a fee premium, even if the critical audit matters are not particularly digitally demanding, and highly digitalized clients (*DIGI_ORIENT*) need to pay more for the audit engagement.

4.2.3. Do digitalization experts disclose more digitalization-related CAMs?

To investigate whether digitalization expert auditors can apply their expertise during audit engagements, we examine whether expert auditor status predicts CAMs that arise from digitalization issues. We expect that digitalization specialist auditors, due to their accumulated knowledge of digital business models, technologies, and information systems from previous audit engagements, can better identify digitalization-related critical audit matters in the current engagement. Table 6 demonstrates that digitalization experts are more likely than non-experts to report digitalization-related CAMs. Therefore, in addition to charging an audit fee premium, their expertise is also reflected in their audit reports. This finding strengthens the construct validity of our *DIGI_SPEC_P* variable.

4.3. Robustness Analyses

To address potential selection bias and covariate imbalance in our empirical analysis, we conduct several robustness analyses. First, we use entropy-balanced regressions (Hainmueller, 2012) to address a potential imbalance in covariates. Second, we use two matching methods: propensity score matching (Rosenbaum & Rubin, 1983) and coarsened exact matching (Blackwell et al., 2009). The advantage of matching as an approach to multiple regression analysis is that we need minimal assumptions about the functional form of the relationship between the outcome and control variables (Angrist & Pischke, 2009). We employ propensity score matching by limiting the selection of covariates in the most susceptible candidates (Minutti-Meza, 2013) and use coarsened exact matching in combination with propensity score matching (DeFond et al., 2017). Coarsened exact matching does not rely on matching a single probability score; instead, data are

Table 6. Digitalization-related Critical Audit Matters and auditor digitalization specialization

	Dependent variable = *DIGI_CAM*
DIGISPEC_P	0.044***
	(2.61)
DIGISPEC_F	− 0.041**
	(− 1.99)
INDSPEC_P	0.057***
	(2.91)
INDSPEC_F	− 0.057**
	(− 2.13)
DIGI_ORIENT	0.022***
	(3.44)
LNTA	− 0.018***
	(− 2.83)
BIG4	− 0.069***
	(− 3.39)
INVREC	− 0.105*
	(− 1.88)
LOSS	0.113***
	(6.69)
CATA	0.064*
	(1.69)
ROA	0.008
	(0.31)
OPINION	0.040
	(1.36)
SEG	− 0.736**
	(− 2.10)
CHANGE	0.080***
	(4.67)
BUSY	− 0.057***
	(− 3.29)
LEV	− 0.019
	(− 0.51)
FOREIGN	− 0.012
	(− 0.70)
LNNFEE	0.002
	(1.56)
Year FE	Yes
Industry FE	Yes
Constant	1.778***
	(4.47)
Observations	6,619
Adjusted R^2	0.126

Notes: Main test variable is bolded. See Appendix A for variable definitions.

temporarily coarsened and exactly matched on these coarsened data, and then hypothesis testing is conducted using the matched samples of uncoarsened data (Blackwell et al., 2009).

Following the approach recommended by Shipman et al. (2017), we use the covariates in the full audit fee model of Equation (1) as the first-stage propensity score matching and match on all the variables other than auditor specializations. In the coarsened exact matching, we match on client size, industry, and year. As there is no consensus on the best design choices in propensity score matching, we follow the convention in accounting literature and use one-to-one matching without replacement, setting the caliper distance to 0.01 (Shipman et al., 2017, p. 227).

The results of the robustness analyses are presented in Table 7. Overall, the balanced and matched-sample results resemble the main results in Table 3. Specifically, the coefficient

Table 7. Additional analyses using various covariate balancing methods

	Dependent variable = *LNFEE*		
	(1) EB	(2) PSM	(3) CEM
DIGISPEC_P	0.039**	0.041**	0.039**
	(2.50)	(2.36)	(2.54)
DIGISPEC_F	– 0.039*	– 0.036	0.001
	(– 1.65)	(– 1.45)	(0.04)
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Constant	3.802***	3.371***	3.463***
	(5.61)	(5.08)	(6.63)
Observations	12,889	4,452	12,636
Adjusted R^2	0.855	0.861	0.855

Notes: The main test variable is bolded. Columns (1)-(3) report results using entropy balancing (EB), propensity score matching (PSM), and coarsened exact matching (CEM) methods. See Appendix A for variable definitions. Standard errors are clustered by firm. ***, **, * indicate statistical significance at the 0.01, 0.05, and 0.10 level, respectively.

on *DIGI_SPEC_P* is positive and statistically significant for all data samples and matching techniques. In propensity score matching, all three sets of covariates (all variables, client characteristics and year fixed effects, and client size plus industry and year fixed effects) yield similar results. Overall, the robustness analyses confirm the findings of the main analysis and support the conclusion that audit partner's digital specialization is positively associated with audit fees.

5. Conclusions

This paper examines the effect of audit partner's digitalization expertise on audit fees. The prevalence of digital interactions in our daily lives has led to a growing expectation for the audit profession to understand digital business and employ digital technologies in audits. In this context, digital transformation presents an opportunity for those responsible for the quality and efficiency of audit services, particularly audit partners, to deliver value to their digitally oriented clients. Building on the concepts of task-specific subspecialty knowledge (Bonner, 1990; Bonner & Lewis, 1990; Goldman et al., 2022), this study posits that digitalization expertise arises from the experiences gained while auditing highly digitalized client firms.

The results are consistent with our hypothesis: audit partners with digitalization expertise charge higher fees than other auditors. Specifically, we estimate a fee premium of approximately four percent for digitalization specialist partners, which is incremental to and coexists with the positive audit fee effect attributed to an audit partner's industry specialization. Our results also suggest that the fee premium is attributable to audit partners but not to audit firms. This finding is consistent with the concept of craftsmanship, indicating that a partner's expertise is tacit knowledge (Polanyi, 1966) that is not easily transferable, even within the same audit firm. Cross-sectional analyses reveal that the premium is higher in highly digitalized industries and during the first half of the sample period, implying changing dynamics of competition and expertise in digital auditing. This might indicate that more auditors start to gain expertise in digitalization which creates more competition in the market and lowers the premium, especially for less demanding digitalization cases. Finally, we find that more digitalized clients and clients identified with digitalization-related critical audit matters pay higher audit fees, regardless of the level of expertise of the audit partner or audit firm.

Our study makes several contributions to the auditing literature. First, to our knowledge, this is the first study to estimate the fee premium earned by audit partners for their digitalization expertise. This study contributes to the understanding of factors that drive audit fees and illuminates the value of expertise in the digitalization of audit services. Additionally, this study adds to the literature that investigates pricing differences between audit partners (Gul et al., 2013; Taylor, 2011). Second, our empirical evidence adds to the literature on auditor expertise (Bonner & Lewis, 1990) by demonstrating that auditing digitalized clients provides subspecialty knowledge similar to one arising from industry specialization. Third, we develop a new empirical measure of audit partners' expertise in digitalization using the Kindermann et al. (2021) digital orientation index. This new measure provides opportunities for further research on the effects of digitalization on auditing. Finally, to our knowledge, this study is the first to document a positive, robust relationship between client's digitalization and audit fees. Overall, our study contributes to the literature on expertise in the audit profession and its impact on audit fees in the context of digitalization.

Our study has several limitations that provide opportunities for future research. First, our data only cover the period from 2016 to 2021 and only include U.S. public firms. Therefore, the generalizability of our findings to other contexts may be limited. Future research could examine the impact of digitalization expertise on audit fees in other countries and contexts. Second, we use a computer-aided textual analysis of digital terms in the 10-K business descriptions to create our digitalization index. While this approach provides a balanced measure of a firm's digitalization, it may not capture all its aspects. Third, our study only examines the impact of digitalization expertise on audit fees and does not investigate its impact on audit quality. Future research could examine the relationship between digitalization expertise and audit quality. Fourth, our test variable (namely, *DIGI_SPEC_P*) is an indirect measure of partner's digital auditing competence. Future research might consider more direct proxies (e.g., formal education on IT systems). Finally, and relatedly, we have no information about the competence of the audit engagement team besides the signing partner. Although we attempt to control for the involvement of data analysts and IT specialists, we cannot rule out their effect. Future research might address this limitation.

In conclusion, our study has implications for a range of stakeholders in the auditing profession. Our results imply that audit firms stand to benefit from leveraging audit partners' digitalization expertise, particularly by focusing on developing advanced digital skills tailored to provide specialized services in highly digitalized industries. Against the backdrop of our finding that the value of digitalization expertise appears to be diminishing in less digitalized industries, focusing on highly digitalized industries helps auditors maintain a sustainable competitive edge as basic digital skills become more commonplace. Additionally, the study's findings may guide audit regulators in evaluating and promoting the development of audit standards, guidelines, and professional examinations that account for the critical role of digitalization expertise in ensuring audit quality. Finally, our findings have broader implications for the accounting profession, highlighting the need for accountants not only to acquire the necessary digital knowledge and skills but also to continuously advance these skills. In a business landscape progressively shaped by digital technologies, cultivating such expertise is crucial for audit professionals to remain competitive.

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Supplemental Data and Research Materials

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Data Availability

All data are publicly available from the sources identified in the text.
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