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CPAs and Big 4 office audit quality

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A B S T R A C T

Both accounting firms and regulators recognize the importance of human capital in the audit function, yet we know little about whether and how the level of professionally qualified human capital varies across offices of an audit firm and whether it is associated with audit quality. In this paper, we examine the association between office professionally qualified human capital and audit quality. Using hand-collected data on Big 4 audit firm office CPA levels from 30 U.S. cities, we find that offices with relatively more professionally qualified human capital deliver higher quality audits, with this benefit being more pronounced for audits performed during busy season than for non-busy season audits. The results underscore the importance of the availability of professionally qualified human capital in an audit office to the office's audit quality. Our finding of CPA levels being an office-level audit quality indicator will potentially help the PCAOB in their ongoing Audit Quality Indicator (AQI) project, whose goal is to assist audit firms, clients, and investors in measuring audit quality. Furthermore, the results lend credibility toward the CPA designation, which helps justify the AICPA's, NASBA's, and state Accountancy Boards' regulatory roles of admitting and licensing qualified candidates.

1. Introduction

Accounting regulators, practitioners, and academics have taken great interest in the human capital of accounting firms. A firm's success relies heavily upon the proficiency of its personnel (Munter 2017).[1] Regulators have expressed concern that audit firms' qualified human capital capacity constraints might affect audit quality (EC 2006; ACAP 2008; IAASB 2009; PCAOB 2015). For example, International Standard on Quality Control 1 (ISQC1) states that an audit firm needs to have policies and procedures ensuring it has "sufficient personnel with the competence, capabilities and commitment to ethical principles necessary to perform engagements in accordance with GAAS and enabling the firm or engagement partners to issue reports that are appropriate in the circumstances" (IAASB 2009, Para. 29). However, we do not know *ex ante* if these human capital capacity constraints matter to office audit quality. Recent research finds that the past decade has seen a significant decline in the number of CPAs in the profession due to increasing education requirements and other circumstances (Barrios 2021). Further, prior research finds that the ability of auditors to compete in the public company audit market is bound by local labor markets (Beck, Francis, and Gunn 2018) and that high growth offices struggle to handle the increase in their workload and temporarily experience a decrease in audit quality (Bills, Swanquist, and Whited 2016) presumably because of resource constraints. While

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[1] Taken from the remarks of Helen Munter at the time she was the PCAOB Director of Inspections and Registration.

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human capital capacity constraints might matter to audit quality, the concern expressed by regulators has not been directly tested empirically. Both accounting firms and regulators recognize the importance of human capital in the audit function, yet we know little about whether and how the level of *professionally qualified* human capital varies across offices of an audit firm and whether professionally qualified human capital capacity is associated with office audit quality. In this paper, we first provide descriptive evidence on the levels of professionally qualified human capital among the offices of the Big 4 audit firms in the U.S. Then we test whether professionally qualified human capital capacity is associated with office audit quality.

Economics literature broadly defines human capital to encompass individuals' knowledge, education, skills, training, and experience that allows for productive labor (Becker 1962; Campbell, Coff, and Kryscynski 2012). We use the term qualified human capital to refer to the professional qualification and competency of audit firm personnel. Drawing on economic theory, we predict that audit offices with relatively higher qualified human capital will produce higher quality audits. We argue that a higher level of available qualified human capital in an audit firm office provides teams with more competent, experienced personnel to perform audits. These teams would more likely be populated with supervisory personnel to coach and mentor junior staff, to provide face-to-face reviews of junior staff work, and to better review the working papers to ensure material audit issues are not missed (Brazel et al., 2004; Persellin, Schmidt, Vandervelde and Wilkins 2019).[2] Furthermore, we expect workload compression to affect the relation between qualified human capital and office audit quality. Based on prior research, we predict that the effect of qualified human capital on audit quality will be more pronounced for audits performed during auditors' busy season than those performed in their non-busy season.

We introduce a novel measure of qualified human capital based on the number of Certified Public Accountants (CPAs) employed by audit firm offices scaled by office-level issuer audit fees. CPA licensure requires an individual to have extensive business education of at least 150 h, to pass a rigorous four-part exam, in most states to meet minimum experience requirements, and then commit to lifelong learning (AICPA 2020). The CPA license is required for promotion to the supervisory levels in most U.S. public accounting firms. We reason that offices with proportionally more (fewer) CPAs face less (more) qualified human capital constraints, which results in higher (lower) audit quality.

First, we provide descriptive statistics of CPA levels for the period 2009 to 2014 for offices of U.S. Big 4 firms located across 30 metropolitan areas. The results reveal that the CPA levels vary considerably among both the Big 4 firms and across years. The overall mean (median) of our test variable is 5.50 (4.70) and it ranges from an average of 4.81 to 6.29 among the firms, and from 4.84 for 2013 to 6.09 for 2010. Next, we estimate audit quality regression models (restatements and discretionary accruals) using a sample of around 5,600 company-year observations consisting of companies audited by Big 4 U.S. offices during the period 2009 to 2014. The results show a significant, negative association between office qualified human capital and restatements as well as performance-adjusted discretionary accruals (earnings management). These negative associations imply that there is a positive association between audit office qualified human capital and audit quality. In addition, we find evidence from the audit quality regressions that this relationship with audit quality is driven more by busy season audits, when workload compression is at its highest, than by non-busy season audits. As a test of the construct validity of our measure, we also (1) model the determinants of our measure at the office level, (2) test for endogeneity using the local unemployment rate as the exclusion criterion, and (3) conduct cross-sectional tests for high versus low complexity audits, large versus small offices, and high versus low growth offices. Overall, our results suggest that audit offices with more qualified human capital are associated with higher quality audits.

This study makes several contributions to the literature. First, we contribute to the human capital stream of audit research. To our knowledge, this is the first study to examine professionally qualified human capital at the office level. While prior studies have examined human capital attributes of the local metropolitan areas in which firm offices are located (e.g., Beck et al. 2018) and human capital constraints proxied by office growth (Bills et al. 2016), they have not provided direct empirical evidence of how office audit quality varies as a function of human capital contained in audit firm offices. Those measures could be capturing something else, like learning curve effects, rather than office human capital constraints. Our qualified human capital metric – the number of CPAs - is a more direct measure of office qualified human capital than those used in previous studies. Furthermore, we include the prior studies' indirect human capital metrics as control variables in our regression models. We find that our direct measure of office qualified human capital has an incremental effect on audit quality, above and beyond the effects of the indirect measures documented in prior studies. Our paper provides evidence that there is a positive association between office qualified human capital and engagement audit quality.

Second, this study identifies a discernable office-level audit quality indicator, the office's qualified human capital, measured as the number of CPAs in an office, scaled by office issuer audit fees. The PCAOB's (2015) Audit Quality Indicator (AQI) project proposed 28 potential audit quality indicators that fall into three groups but provided little evidence of their efficacy, instead asking for comments and research on the proposed indicators. The first group, audit professionals, includes measures dealing with the "availability," "competence," and "focus" of those performing the audit (PCAOB 2015). These disclosures are intended, in part, to provide information to help assess the human resource capabilities of the accounting firm to deliver high quality audits. Our results respond to the PCAOB's request for research into the proposed and other potential AQIs. Currently, the PCAOB does not mandate that audit offices report the composition of their office in terms of CPAs or qualifications and experience levels. Given the AQI proposal, our study suggests that the PCAOB should consider diving

[2] We acknowledge that today, junior staff and associates perform some levels of review and they may or may not have passed the CPA exam. Also, 1-year of experience is sufficient for CPA licensure in many states. However, on average, we reason that licensed CPAs will represent more experienced professionals that perform more supervisory tasks.

deeper into potential human capital disclosures at the office level, possibly in Form AP. Our study provides a first insight into audit office human capital, and we encourage future research to further help the PCAOB in identifying human capital AQIs.

Lastly, the study's results lend some credibility to the value of the CPA designation and the work of the American Institute of Certified Professional Accountants (AICPA), the National Association of State Boards of Accountancy (NASBA), and state Accountancy Boards in promoting, regulating, and hopefully advancing this professional license/designation. We admit that the CPA measure may be correlated with other audit-quality-enhancing characteristics, such as experience and education level, and thus our results may not reflect the CPA designation *per se*. Nonetheless, the results show a positive association between CPA designation and audit quality at the office level. We call on future research to disentangle the potential individual auditor characteristics correlated with CPA designation that may be driving the results.

2. Literature review and hypotheses development

Human capital capacity refers to an organization's level of sufficiently qualified employees that it can utilize in the right place and at the right time to allow the organization to achieve its objectives (Ulrich, Brockbank, Yeung, and Lake 1995). A lack of human capital has a direct impact on an organization's ability to perform tasks and deliver services, whereas too much human capital results in idle resources and diminishes profitability. Lovelock (1984) and Sridharan (1998) describe the difficulty firms in constrained systems face when attempting to maintain delivery dependability and high standards of quality while also attempting to achieve desired levels of profitability. Lovelock (1984) suggests that, unlike manufacturing organizations' use of inventory to absorb temporary imbalances between supply and demand, human capital capacity-constrained service organizations must find other strategies to face the variations in demand levels.

There is limited research on the accounting firm production function and audit firm risk-management that considers human capital or the nature of human capital assigned to clients. Banker, Chang, and Cunningham (2003) examine the productivity levels of accounting firms and their changing mix of audit, tax, and advisory services using firm-level revenue and partner, professional, and support staff data. They measure the productivity of CPA firms using the average marginal revenue product of partners and professionals. They find evidence of productivity increases over the time period they examined, 1995–1999. Banker, Chang, and Natajaran (2005) expand on that production function and examine the role of technical progress on changes in firm productivity. They find that technical progress and growth in management advisory services rather than an improvement in relative efficiency was the reason for the productivity increase. Banker, Chang, and Kao (2002) further examine how changes in one accounting firm's IT system improved the firm's productivity. They find that this firm's investment in audit software and knowledge-sharing applications significantly improved productivity. Johnstone and Bedard (2003) discuss how firms may hire and assign more experienced or specialist personnel to higher risk clients as a risk management strategy. The authors use proprietary firm data to model and test firm portfolio management decisions with risk to client acceptance and continuance. Taken together, while this body of prior literature considers audit firm productivity and risk management strategies, it does not consider the role of qualified human capital in engagement audit quality.

Several recent studies investigate the association between different aspects of firm or local area human capital on audit production. Beck et al. (2018) examine the association between the local area level of human capital in U.S. cities and audit offices' ability to conduct high-quality audits. Specifically, they show that a city's average educational attainment and the number of accountants in a city are associated with lower absolute abnormal accruals and fewer going concern audit opinion errors (higher audit quality). Bills et al. (2016) document a negative relation between the acquisition of new clients and audit quality at the office level. They hypothesize that increases in office-level workload result in the reallocation of resources away from existing client engagements, resulting in capacity constraints that temporarily impair audit quality as offices experience growth. This research stream examines situations where human capital capacity is expected to be constrained, e.g., during periods of growth (Bills et al. 2016) and within environments of low educational attainment and fewer accountants (Beck et al. 2018). While making valuable contributions to the human capital auditing literature, the indirect human capital measures used in these studies are noisy. It is difficult to discern the many potential confounding effects of other factors on audit quality. For example, more educational attainment in a city may be capturing states that have good educational infrastructure, where students are more likely to return back home after completing their education. Or perhaps the learning curve on new clients resulting from office growth may be driving lower audit quality. We contribute to this research stream by measuring the number of CPAs in an audit firm office, a more direct proxy for qualified human capital capacity within audit firm offices.

Sherwood, Nagy, and Zimmerman (2020) examine whether the percentage of non-CPAs that make up total employees in U.S. Big 4 firm offices is associated with office audit quality. They find that a higher percentage of non-CPAs in the office is associated with higher engagement audit quality, and that this result is more pronounced for complex audits. The authors conclude that the availability of non-CPAs, particularly the specialist services provided by the consulting/advisory group, support the audit engagement teams. Our study differs from Sherwood et al. (2020) in that we examine the *incremental* effect of qualified human capital (number of CPAs scaled by office issuer audit fees) on audit quality, whereas their study focuses on the influence of the availability of non-CPAs (e.g., in-house specialists) on audit quality. We argue that audit quality improves *both* from the greater availability of non-audit specialists to assist audit teams with audits of complex and specialized estimates (Sherwood et al. 2020) *and* professionally qualified human capital to perform audit procedures and oversee audit work of non-yet-certified audit staff and specialists.

Other related studies examine human capital capacity issues within different audit regimes. Using Chinese data, Lo, Lin, and Wong (2019) examine how partner leverage and workload affect audit quality. They find that CPA firms with smaller staff-to-partner ratios are associated with a lower likelihood of restatements of their clients' financial statements (suggesting higher audit quality) and that this association is less evident when engagement partners have excessive workloads. Cameran, Ditillo, and Pettinicchio (2018) use proprietary data obtained from two Big 4 audit firms in Italy to examine how audit team attributes influence audit quality and audit efficiency. They find that a higher proportion of hours spent by the partner and managers on a specific engagement relative to the number of hours spent by seniors and staff decreases audit quality and that this effect is reduced by audit firm tenure (i.e., client-specific experience). Bröcheler, Maijoor, and Van Witteloostuijn (2004) examine whether the levels of education and experience of the founders of small Dutch audit firms affect the firms' survival and exit rates. They find that higher levels of education and experience of founders are associated with higher audit firm performance.

Several other studies use only certain partner characteristics to proxy for qualified human capital. However, the partner is only one member of the engagement team and among the core engagement team members typically spends the fewest hours on the audit. There is some recent evidence using PCAOB data on U.S. engagements that partners are not the most important input into audit quality (Aobdia, Choudhary, and Newberger 2021). Partner characteristics include the partner's age, gender, education, and experience (see Lennox and Wu (2018) for a more complete listing of characteristics and description of this research).[3] Beyond just partner characteristics, Hoopes, Merkley, Pacelli, and Schroeder (2018) examine whether salaries paid to audit personnel are associated with audit quality, arguing that higher salaries attract higher quality personnel. Barrios (2021) examines the 150-hour requirement for CPA certification in the U.S. and its effect on personnel tenure and quality. We extend this stream of research by examining the audit quality effect of another auditor characteristic, CPA designation, measured at the audit office level.

Professional licensure such as the CPA license is important for establishing minimum quality standards for a profession such as auditing (Leland 1979). In the U.S., CPA licensure is required to sign audit opinions. According to NASBA, "a CPA license is a high standard recognized by employers and their clients, governments and the public as an assurance of skill, dedication and quality. In today's business world, a CPA represents a trusted voice in business and financial consulting and is a sought-after commodity among all walks of professional organizations" (NASBA 2020a). CPA licensure requires an individual to have extensive business education of at least 150 h, to pass a rigorous four-part exam, in most states, to meet minimum experience requirements, pass an ethics exam, and then commit to lifelong learning (AICPA 2020).[4] Large public accounting firms in the U.S. reward and promote CPA licensure. They commonly pay for CPA review courses and/or offer cash bonuses for passing the CPA exam to recently hired employees. Importantly, they require staff to obtain the CPA license for promotion to supervisory levels.[5] Krippel, Moody, and Mitchell (2016) estimate that accountants who obtain the CPA license enjoy earnings premiums that reach six figures over their careers, and the earnings premium increases significantly with the size of the accounting firm. In sum, the business community values the CPA designation of professional accountants.

Drawing on the broader human capital literature (Bills et al. 2016; Beck et al. 2018), we propose that a higher level of qualified human capital in an audit firm office, proxied by CPAs, provides teams with more competent, experienced personnel to perform audits.[6] These teams are more likely to be populated with supervisory personnel to coach and mentor junior staff, to provide face-to-face reviews of junior staff work, and to better review audit working papers to ensure material audit issues are not missed (Brazel et al. 2004; Persellin et al. 2019). This leads to our first hypothesis:

HYPOTHESIS 1: *Engagement audit quality is positively related to the level of audit firm office qualified human capital.*

Next, we expect workload compression to moderate the relation between office qualified human capital and audit quality. Sweeney and Summers (2002) survey public accountants and document average workloads in the pre-SOX era of 49 and 63 h per week for non-busy season and busy season, respectively, indicating that employees of public accounting firms work under time constraints. Lambert, Jones, Brazel, and Showalter (2016) survey thirty-two retired audit partners, and report that time pressures increase the difficulty of evaluating clients' complex estimates and in resolving proposed audit adjustments. More recently, Persellin et al. (2019) survey auditors of U.S. accounting firms and find that auditors work, on average, 20 h per week above the threshold at which they believe audit quality begins to deteriorate during the peak of busy season. The surveyed auditors perceive deadlines and *staffing shortages* as two of the primary reasons for high workloads that

[3] Sundgren and Svanstrom (2014) and Goodwin and Wu (2016) provide evidence that older partners provide lower quality audits. Other studies find that female auditors generally provide higher quality audits than their male counterparts (Ittonen, E. Vahamaa, and S. Vahamaa 2013; Hardies, Breesch, and Branson 2016; Li, Qi, Tian, and Zhang 2017; Lee, Nagy, Zimmerman 2019; Burke, Hoitash, and Hoitash 2019). There is mixed evidence on the association between partners' educational characteristics (such as degree level and accounting major) and audit outcomes (Gul, Wu, and Yang 2013; Li et al. 2017). Prior studies document a positive relation between auditor experience and audit quality (Bonner 1990; Libby and Frederick 1990; Chen, Dai, Kong, and Tan 2017).

[4] There are currently over 650,000 actively licensed CPAs (NASBA 2020b).

[5] See for example, https://www.journalofaccountancy.com/newsletters/2020/jan/position-yourself-promotion.html and https://www.nysscpa.org/news/publications/nextgen/nextgen-article/pwc-announces-you-don't-need-to-be-cpa-to-move-to-senior-but-it-helps-030819.

[6] We recognize that within an audit office, not all audit engagement team members are CPAs, and not all CPAs are available to work on audit engagements. However, PwC's recent combination of their assurance and tax lines of services into a single operating segment, suggests that the demarcation line between the lines of services is not so deep as to presume there is no cross-over between them.

decrease audit quality via compromised audit procedures, impaired audit judgment, and *difficulty of retaining qualified human capital* (Persellin et al. 2019). López and Peters (2012) find that workload compression during the busy season reduces audit quality. We seek to deepen our understanding of workload compression effects on audit quality by examining if the association between audit quality and qualified human capital is greater during the busy season. Based on prior research, we expect the effect of qualified human capital on audit quality to be driven more by audits performed in the auditors' busy season than those performed in their non-busy season. This leads to hypothesis 2 stated as follows:

HYPOTHESIS 2: *The effect of office qualified human capital on engagement audit quality is more pronounced for busy season than for non-busy audit engagements.*

3. Research design

3.1. Measuring office-level qualified human capital

The number of CPAs employed by an office scaled by office-level issuer audit fees is our proxy for qualified human capital. We gather the number of CPAs employed by the largest accounting firms in major U.S. cities from published listings in business news publications obtained through our libraries and office-level audit fees from Audit Analytics. Office-level issuer audit fees is a common measure of office size and workload used in prior research such as Francis and Yu (2009). We scale the number of CPAs by office-level issuer audit fees because audit fees better captures both the size of the office portfolio and client risk requiring more auditor effort and expertise than other scalars such as the number of office issuer clients or issuer client total assets. Our test variable, *OFFICEQHC*, is estimated using Equation (1):

$$OFFICEQHC = \text{Number of CPAs / total office audit fees from issuer audits} \tag{1}$$

Equation (1) represents the number of CPAs in an accounting firm's office scaled by office size, which is the sum of audit fees paid to the office by public company audit clients.[7,8] A larger *OFFICEQHC* value indicates higher qualified human capital (CPAs) *relative to* office-level audit fees in comparison to other offices.[9]

3.2. Audit quality models specification

Following suggestions from DeFond and Zhang (2014), we measure audit quality using (1) material misstatements that result in the subsequent restatement of audited annual financial statements and (2) performance-adjusted discretionary accruals. Based on prior research, we employ the following material misstatement likelihood logistic regression model to test H1:

$$\begin{aligned} Prob(RESTATE = 1) = {} & b_0 + b_1 OFFICEQHC + b_2 NONCPA\% + b_3 OFFICEGRTH + b_4 MSAPOPLVL + b_5 MSAEDULVL \\ & + b_6 SIZE + b_7 ROA + b_8 LEVERAGE + b_9 LOSS + b_{10} BM + b_{11} ISSUE + b_{12} RESTRUCT \\ & + b_{13} MERGER + b_{14} SEG + b_{15} LITIND + b_{16} FOREIGN + b_{17} ICMW + b_{18} AUDTEN + b_{19} SI \\ & + b_{20} CAPITAL + b_{21} INDSPE + b_{22} GC + b_{23} BUSY + b_{24} OFFICESIZE + b_{25} NASFEES \\ & + b_{26} FEERATIO + b_{27} CLIENTIMP + IndustryandYearfixedeffects + e \end{aligned} \tag{2}$$

The dependent variable, *RESTATE*, equals one when a firm's audited annual financial report contained a material misstatement and was restated in a subsequent period (Big R restatements) and zero otherwise. The estimated coefficient of *OFFICEQHC* captures the intercept shift of the change in the likelihood of a material misstatement due to a change in the audit office's qualified human capital. A negative estimated coefficient would indicate that higher levels of qualified human capital are associated with a lower likelihood of a misstatement (higher audit quality) and would support H1.

The control variables for equation (2) are drawn from the prior literature on misstatements (Francis and Michas 2013; Francis, Michas, and Yu 2013; Lobo and Zhao 2013). These variables encompass various proxies for firm performance and audit risk, both of which affect the likelihood of a material misstatement being undetected by auditors. Client size is

[7] In a few major cities (e.g., New York City), accounting firms may have multiple physical office locations. However, the Book of Lists report personnel figures for all of an accounting firm's offices within a city in total (i.e., the MSA level). We map auditor offices (per the audit report) into MSAs, which allows us to match audit office data with Book of Lists data according to MSA. Based on discussions with the Big 4 audit firms, due to the geographical proximity of auditor offices within an MSA, there is a consistent tone across offices within an MSA. In a sensitivity analysis, we limit our sample to include only the primary signing office within each MSA and find substantially the same results as when using the full sample.

[8] As a robustness measure, we compute the denominator as the office level sum of total fees (both audit and non-audit) paid by public companies and find results consistent with those presented in the Results section. See additional analyses section for details.

[9] For example, presume offices A and B of the same audit firm have approximately $4M and $5M in issuer client audit fees and 21 and 25 CPAs, respectively. In this example, the *OFFICEQHC* value is 5.25 for office A (21 CPAs/$4M in public company audit engagement fees) and 5 for office B (25 CPAs/$5M in public company audit engagement fees). Therefore, while office B is larger based on both number of CPAs and audit fees, office A has a higher *OFFICEQHC* value. Thus, the *OFFICEQHC* variable is not simply an alternative measure of audit office size, but rather a measure of the relative distribution of audit fees across CPAs. The inclusion of office-level audit fees in the denominator of equation (1) is not expected to 'work for' or 'work against' the predicted relation in H1. Rather it is to allow the *OFFICEQHC* measure to be viewed relative to other accounting firm offices.

measured as the natural log of the client's total assets (*SIZE*). Firm performance and profitability controls include return on assets (*ROA*), the debt-to-total assets ratio (*LEVERAGE*), the capital level (*CAPITAL*), net losses (*LOSS*), and the amount of special item income (*SI*). Firm complexity control variables include restructuring charges (*RESTRUCT*), mergers and acquisitions (*MERGER*), a highly litigious industry indicator (*LITIND*), foreign transactions (*FOREIGN*), the number of business segments (*SEG*) and weaknesses in the company's internal control environment, proxied by the existence of material weaknesses in internal controls over financial reporting (*ICMW*). The book-to-market equity ratio (*BM*) and the issuance of new debt or equity (*ISSUE*) control for financing activities. Characteristics of the firm's audit firm, such as industry specialization at the national and city level (*INDSPE*), auditor tenure (*AUDTEN*), and the size of the audit office performing the audit in terms of the number of clients *(OFFICESIZE)* are included as additional control variables.[10] Furthermore, we control for engagement level factors, such as the natural logarithm of the *client's* non-audit fees (*NASFEES*), as well as the non-audit services fee ratio and client bargaining power, measured as the client's degree of importance to the audit office (*FEERATIO* and *CLIENTIMP,* respectively).

In addition to the standard group of control variables for misstatement models discussed above, we include four more control variables that are relevant to this study's setting. The first set of variables, *NONCPA%* and *OFFICEGRTH*, measure the audit-office characteristics of the availability of non-CPA specialists and year-over-year growth, respectively (Sherwood et al. 2020; Bills et al. 2016). The remaining control variables, *MSAPOPLVL* and *MSAEDULVL*, measure the specific MSA factors of size and education level, respectively (Francis et al. 2013; Beck et al. 2018). Full definitions of the control variables can be found in the Appendix.

We again rely on prior research and employ the following discretionary accruals regression model to test H1:

$$
\begin{aligned}
DA = {} & b_0 + b_1 OFFICEQHC + b_2 NONCPA\% + b_3 OFFICEGRTH + b_4 MSAPOPLVL + b_5 MSAEDULVL + b_6 SIZE \\
& + b_7 LEVERAGE + b_8 LITIND + b_9 SCALEDOANCF + b_{10} SALEGR + b_{11} GC + b_{12} FOREIGN + b_{13} SEG + b_{14} ICMW \\
& + b_{15} AUDTEN + b_{16} BUSY + b_{17} OFFICESIZE + b_{18} NASFEES + b_{19} FEERATIO + b_{20} CLIENTIMP \\
& + IndustryandYearfixedeffects + e
\end{aligned}
\tag{3}
$$

The dependent variable (*DA*) is the absolute value of performance-adjusted discretionary accruals (Kothari, Leone, and Wasley 2005). A significant, negative estimated coefficient on *OFFICEQHC* will indicate that client discretionary accruals are lower (less extreme earnings management) for clients of offices with relatively greater qualified human capital. The lower the discretionary accruals, the greater the constrained earnings management of the audited company and, therefore, the higher the audit quality, which would support H1.

We follow prior discretionary accruals studies to obtain control variables for equation (3) (Hribar and Nichols 2007; Francis and Yu 2009; Reichelt and Wang 2010). Most of these control variables are described in the misstatement model above. They include company size, leverage, litigation risk, financial distress, foreign operations, number of segments, internal control material weaknesses, audit firm tenure, busy season audit, and the size of the audit firm office performing the audit. In addition to these control variables, the *DA* model includes volatility of operating cash flows (*SCALEDOANCF)* and sales growth (*SALEGR*). Like in the misstatement model, we also include *NONCPA%*, *OFFICEGRTH*, *MSAPOPLVL,* and *MSAEDULVL* to control for various audit office and local area economy characteristics. See the Appendix for full variable definitions.

3.2.1. Sample, data, and test measure descriptive statistics

We gathered the number of CPAs employed by the largest accounting firms in major U.S. cities for the years 2009–2014 from published listings. The lists are in a special annual publication entitled "The Book of Lists" by either *American City Business Journals* or *Crain's Business Journals*. We limit our sample to offices of Big 4 accounting firms that have the necessary CPA data from the Book of Lists for at least three of the years of our sample period.[11,12] Our sample represents a large cross-section of the MSAs within the U.S.[13] However, we recognize that due to source data limitations, the sample does not contain every MSA that contains a Big 4 audit office. We address this concern in the additional analysis section later in the paper.

[10] We use the log of public company clients as a measure of office size (following Francis and Yu (2009)) instead of the log of client audit fees because audit fees are a component of our test variable. As noted in Francis and Yu (2009), the office size variable when measured by log of number of clients may be insignificant.

[11] We limit the sample to offices of Big 4 accounting firms because it allows for the largest, and most homogeneous population. In untabulated results, mean and standard deviation values of *OFFICEQHC* are 26.61 and 46.78, respectively, for the Next 3 non-Big 4 firms sub-sample of 1,171 observations, and are 90.41 and 111.78, respectively, for the Non-Top 7 sub-sample of 1,435 observations. In comparison, per Table 4, the mean and standard of the Big 4 population of 5,639 observations, are 5.52 and 4.70, respectively. In practical terms, these figures suggest that on average, each member of the qualified human capital capacity pool represents ~$181K ($1,000,000/5.52), in annual audit revenue for the Big 4 sample, which appears reasonable. Whereas, for the Next 3 and Non-Top 7 sub-samples, each member of the qualified human capital capacity pool represents only ~$37K ($1,000,000/26.61) and ~$11*K* ($1,000,000/90.41) in annual audit revenue, neither of which appear to be reasonable. Presumably, this is a result of the inability of the available audit revenue data to account for audit revenue from non-public companies' (e.g., audits of private companies, governmental entities, universities) audit engagements. While the numerator of our measure is likely accurate regardless of audit firm type, the denominator is likely undervalued, especially for non-Big 4 firms, which rely more heavily on audit revenues from non-public company audit engagements.

[12] While we only require Books of Lists data to be available for three of the six years within our sample period to include an MSA in our sample, we find that the MSAs in our sample average 5.5 years of data necessary for our analysis.

[13] Our restatement test sample consists of 104 unique audit offices and 1,536 unique client firms, while our discretionary accrual sample consists of 103 unique audit offices and 1,636 unique client firms.

Table 1
Sample selection for engagement audit quality analysis.

Panel A: Sample for Misstatement Analysis	
Merge of Top Accounting Firm by City/Year Data with Audit Analytics and Compustat Databases for 2009–2014, Big 4 audited observations only	18,048
Less: Financial Institutions and Utilities	6,890
Sub-Total	11,158
Less: Observations Missing Control Variables for Misstatement Analysis	5,465
Total Company-Year Observations in Misstatement Sample	**5,693**
Panel B: Sample for Discretionary Accruals Analysis	
Observations between fiscal years 2009 and 2014 (inclusive)	11,158
Less: Observations Missing Control Variables Required in Discretionary Accruals Analysis	5,783
Discretionary Accruals Analysis Sample	**5,375**

Note: Table 1 reports the sample determination process for each of the main analyses conducted in the paper. As described within the manuscript, samples are limited to companies that engage a Big 4 auditor and are located within an MSA listed in Table 2. The Panel A sample consists of 104 unique audit offices and 1,536 unique client firms, while the Panel B sample consists of 103 unique audit offices and 1,636 unique client firms.

We merge the audit office data with the audit engagement data from Audit Analytics, based on the audit office's MSA, and then with client-level financial reporting data from Compustat. This results in a combined dataset of 25,405 company-year observations between 2009 and 2014. We limit our sample to the 18,048 observations audited by a Big 4 firm. Due to their unique regulatory environment, and in-line with prior research, we omit 6,890 financial institutions and utility companies, resulting in a base sample of 11,158 company-year observations. Per Table 1, Panel A, we reduce the misstatement analysis sample by 5,465 observations for missing data necessary to estimate our regression model. This results in a sample of 5,693 observations. Per Panel B, we reduce the discretionary accruals analysis sample by 5,783 observations for missing data to compute discretionary accruals, resulting in a sample of 5,375 observations.

Table 2 provides details of the MSAs that comprise our sample. Our sample is spread across 30 MSAs throughout the United States. The majority of MSAs (20 of 30) include observations for each of the Big 4 firms. Panel A presents the mean value of our test variable (*OFFICEQHC*) by Big 4 firm across the sample's MSAs. Panel B presents the mean value of our test variable (*OFFICEQHC*) by year across the sample period.

Table 2 shows variation in *OFFICEQHC* across firm offices. This variation may reflect different recruiting strategies, recruiting effectiveness, CPA exam incentives, labor markets, client mix, and service line focus among the offices. An in-depth examination of *OFFICEQHC* variation among audit firm offices is beyond the scope of this study and is left for future research. However, we attempt to offer some high-level insight on our test variable's variation by estimating a determinants model of our test variable (*OFFICEQHC*). The dependent variable (*OFFICEQHC*) is regressed against several office level and MSA level independent variables. We use the contemporaneous values of all predictor variables (i.e., non-lagged) as these values represent the auditor's situation when evaluating workload demands and making staffing decisions. In our setting, the lagged values represent stale information, much of which the auditor will have already considered. The office's MSA level variables, obtained from the U.S. Census Bureau, measure population level (*MSAPOPLVL*), education level (*MSAEDULVL*), and unemployment level (*MSAUNEMP*). The office level variables include office size in terms of the number of issuer clients (*OFFICESIZE*), office growth from the prior year in terms of issuer audit fees (*OFFICEGRTH*), and non-audit service fees by audit clients (*OFFICENAS*). Further, the office-level measures include aggregated measures reflecting the characteristics of the office's issuer audit clients for each year. These measures consist of the percentage of busy season audits (*OFFICEBUSYPCT*), the percentage of clients that issued new securities (*OFFICEISSUEPCT*), the percentage of clients that are in litigious industries (*OFFICELITPCT*), and the percentage of clients with merger and acquisition activity that year (*OFFICEMERGPCT*). We also include year and state fixed effects. All variable definitions may be found in the Appendix.

As shown in Table 3, the determinants model on 531 audit office-year observations is significant with an adjusted R-squared of 0.3901. The positive and significant coefficient on *MSAEDULVL* suggests that accounting firm offices located in MSAs with a higher percentage of the population holding post-secondary degrees tend to have more qualified human capital than those offices located in MSAs with lower percentages of the population holding post-secondary degrees. The significant and positive *OFFICENAS* coefficient suggests that offices with more non-audit workload (e.g., tax work) tend to have more CPAs than those offices with less non-audit workloads. The significant, negative coefficient on *OFFICEGRTH* suggests that offices which have recently added new audit clients may not have adjusted their staffing levels at the same time. The significant, negative coefficient on *OFFICESIZE* suggests that offices with more issuer clients (with no consideration of client size) tend to have less *OFFICEQHC*. This may be because larger offices have more economies of scale or are more likely to employ alternative methods (i.e., greater use of technology or offshoring of audit work). *OFFICEISSUEPCT* is negative and the only significant client characteristic. The remaining variables in the model are not significant at any conventional level.

Table 4 reports descriptive statistics (mean, median, and standard deviation) of the variables used in the model estimations. The average and median *OFFICEQHC* of the misstatement sample (5.52, 4.70) and the discretionary accruals sample (5.53, 4.71) are nearly identical and these statistics indicate that on average, close to five CPAs were available to perform

Table 2

Panel A: Listing of MSAs and mean *OFFICEQHC* by Big 4 firm

MSA Name	MSA Code	DT	EY	KPMG	PwC
Albany-Schenectady-Troy [a]	10,580	N/A	N/A	13.32	8.30
Albuquerque [a]	10,740	N/A	N/A	23.18	N/A
Atlanta - Sandy Springs - Marietta [a]	12,060	5.80	3.29	5.80	10.17
Austin - Round Rock [a]	12,420	N/A	5.63	N/A	4.24
Baltimore - Towson [a]	12,580	N/A	3.15	10.40	4.34
Birmingham - Hoover [a]	13,820	4.81	5.26	N/A	8.60
Boston - Cambridge - Quincy [a]	14,460	6.50	2.42	7.39	5.41
Buffalo - Cheektowaga - Tonawanda [a]	15,380	20.01	10.59	9.70	N/A
Chicago-Naperville-Joliet [b]	16,980	4.41	5.52	6.52	6.73
Cincinnati - Middletown [a]	17,140	3.10	6.04	9.33	3.73
Cleveland-Elyria-Mentor [b]	17,460	8.73	6.91	12.08	7.75
Dallas-Fort Worth-Arlington [a]	19,100	4.45	4.40	5.83	6.29
Dayton [a]	19,380	16.11	14.46	N/A	2.25
Denver-Aurora [a]	19,740	6.72	4.02	3.78	3.59
Detroit-Warren-Livonia [b]	19,820	2.62	4.84	25.53	3.41
Greensboro-High Point [a]	24,660	N/A	16.35	6.18	4.18
Houston-Baytown-Sugar Land [a]	26,420	4.59	3.12	2.84	2.81
Jacksonville [a]	27,260	13.42	8.19	4.61	21.79
Kansas City [a]	28,140	5.45	11.19	6.10	17.76
Louisville [a]	31,140	N/A	6.69	2.95	3.55
Milwaukee-Waukesha-West Allis [a]	33,340	3.27	7.11	12.02	1.89
New York-Northern New Jersey-Long Island [b]	35,620	6.87	10.32	6.14	4.53
Philadelphia-Camden-Wilmington [a]	37,980	4.02	3.54	3.89	3.53
Phoenix-Mesa-Scottsdale [a]	38,060	5.92	3.32	2.89	3.16
Pittsburgh [a]	38,300	8.94	3.63	15.11	2.63
San Antonio-New Braunfels [a]	41,700	N/A	4.32	1.76	N/A
San Jose-Sunnyvale-Santa Clara [a]	41,940	5.81	1.73	N/A	N/A
St. Louis [a]	41,180	5.17	3.35	2.44	6.16
Tampa-St. Petersburg-Clearwater [a]	45,300	8.41	5.79	10.26	10.58
Washington-Arlington-Alexandria [a]	47,900	4.96	N/A	11.82	N/A
Average		6.29	4.81	6.18	5.33

Panel B: Listing of MSAs and mean *OFFICEQHC* by Year

MSA Name	MSA Code	2009	2010	2011	2012	2013	2014
Albany-Schenectady-Troy [a]	10,580	9.65	10.18	10.79	12.08	11.34	N/A
Albuquerque [a]	10,740	N/A	N/A	28.16	35.71	15.26	13.59
Atlanta - Sandy Springs - Marietta [a]	12,060	5.84	6.04	6.53	6.81	6.09	6.27
Austin - Round Rock [a]	12,420	5.58	5.04	3.65	4.65	3.00	8.74
Baltimore - Towson [a]	12,580	6.06	4.97	5.82	5.85	6.17	6.88
Birmingham - Hoover [a]	13,820	7.64	7.99	5.94	5.18	4.84	6.61
Boston - Cambridge - Quincy [a]	14,460	5.37	6.14	6.16	5.07	4.89	4.95
Buffalo - Cheektowaga - Tonawanda [a]	15,380	14.55	9.06	10.66	16.19	19.70	13.78
Chicago-Naperville-Joliet [b]	16,980	6.63	5.81	5.47	5.27	N/A	N/A
Cincinnati - Middletown [a]	17,140	5.72	5.16	5.85	5.84	6.33	4.42
Cleveland-Elyria-Mentor [b]	17,460	11.26	N/A	10.08	N/A	7.48	6.65
Dallas-Fort Worth-Arlington [a]	19,100	4.94	5.76	4.47	6.12	5.21	4.98
Dayton [a]	19,380	8.56	19.27	23.66	17.41	13.96	8.60
Denver-Aurora [a]	19,740	4.58	4.48	4.28	4.77	4.54	N/A
Detroit-Warren-Livonia [b]	19,820	6.06	10.15	10.33	9.73	3.79	N/A
Greensboro-High Point [a]	24,660	6.87	8.35	12.73	6.90	9.97	4.72
Houston-Baytown-Sugar Land [a]	26,420	3.34	3.57	3.56	3.30	3.19	3.09
Jacksonville [a]	27,260	16.70	10.09	13.18	10.67	8.11	4.91
Kansas City [a]	28,140	9.84	10.89	9.67	8.67	9.50	12.17
Louisville [a]	31,140	4.77	5.15	4.35	4.47	3.49	4.14
Milwaukee-Waukesha-West Allis [a]	33,340	N/A	N/A	N/A	6.28	5.84	6.09
New York-Northern New Jersey-Long Island [b]	35,620	6.90	7.15	6.94	6.87	N/A	N/A
Philadelphia-Camden-Wilmington [a]	37,980	3.67	3.70	4.26	3.77	3.54	3.82
Phoenix-Mesa-Scottsdale [a]	38,060	N/A	N/A	4.44	4.08	3.55	3.61
Pittsburgh [a]	38,300	4.00	5.82	9.01	7.26	5.98	6.07
San Antonio-New Braunfels [a]	41,700	3.76	3.42	3.45	2.61	2.50	2.49
San Jose-Sunnyvale-Santa Clara [a]	41,940	2.98	N/A	4.53	3.59	2.15	N/A
St. Louis [a]	41,180	3.90	4.12	4.41	4.36	4.42	5.15
Tampa-St. Petersburg-Clearwater [a]	45,300	7.02	N/A	9.93	8.90	8.32	9.28
Washington-Arlington-Alexandria [a]	47,900	11.44	14.02	13.55	11.68	11.74	6.72
Average		5.58	6.09	5.93	5.52	4.84	4.88

Note: This table presents the accounting firm offices included in this study's sample. The sample is limited to the MSAs and years for which sufficient data, including the number of CPAs within the office, are available. Data are available in the annual Top Accounting Firms listings published for the given year for

each of the listed cities. We indicate MSAs for which we obtain data published by American City Business Journals (http://www.bizjournals.com) and Crain's (http://www.crain.com) with an a and b, respectively.
Note: This table presents which MSAs and years are included in this study's sample. The sample is limited to the MSA/year combinations for which sufficient data, including the number of CPAs within the office, are available. Data are available in the annual Top Accounting Firms listings published for the given year for each of the listed cities. We indicate MSAs for which we obtain data published by American City Business Journals (http://www.bizjournals.com) and Crain's (http://www.crain.com) with an a and b, respectively.

Table 3
Determinants of office-level qualified human capital.

Dependent Variable:	*OFFICEQHC*		
Variables	**Coef.**	***t*-stat**	
INTERCEPT	12.813	0.579	
MSAEDULVL	1.447	1.941	*
MSAPOPLVL	−0.189	−0.120	
MSAUNEMP	−9.982	−1.380	
OFFICEBUSYPCT	9.274	1.224	
OFFICEGRTH	−9.071	−2.062	**
OFFICEISSUEPCT	−27.616	−2.344	**
OFFICELITPCT	0.303	0.070	
OFFICEMERGPCT	−4.697	−0.927	
OFFICENAS	0.052	2.280	**
OFFICESIZE	−15.975	−2.907	***
Year and State FE		Yes	
N of Office-Year Observations		531	
Adj. R-squared		39.01 %	

Note: This table reports the results of estimating a prediction model for *OFFICEQHC*. The model is estimated using OLS regression with standard errors that are robust to heteroskedasticity. *, **, *** indicates statistical significance at the 0.10, 0.05, and 0.01 levels, respectively, in two-tailed tests. See the Appendix for variable definitions.

the work for every $1 million dollars of revenue from *SEC* issuer audit engagements.[14] The control variables common among models are consistent across the samples, with all differences between them being insignificant. Table 5 reports the Pearson correlation coefficients among the models' variables. *OFFICEQHC* is significantly correlated with the majority of the variables.

4. Results of hypotheses tests

4.1. Restatements

Column 1 of Table 6 reports the results of estimating the restatement model using the full sample, and columns 2 and 3 show the results using the busy-season and non-busy season subsamples, respectively. The model is estimated with standard errors that are robust to heteroskedasticity. The area under the ROC curve ranges from 0.707 to 0.822, indicating an acceptable model fit (Hosmer and Lemeshow 2000).[15] The negative (-0.053) and significant estimated coefficient on *OFFICEQHC* suggests that having more qualified human capital available to service issuer audits is associated with lower restatement rates. This result is consistent with H1. Economically speaking, as *OFFICEQHC* increases from the 25th percentile to the 75th percentile, the likelihood of a Big R restatement is reduced by approximately 14.87 percent.[16] We consider this to be a small to moderate change; however, since we capture every CPA and do not separate out levels of auditors (senior, manager, partners), our results could be the floor (minimum) and further refinement is needed to increase the magnitude of the effects.

The estimated coefficient on *OFFICEQHC* for the busy season subsample is negative (-0.090) and statistically significant. On the other hand, the estimated coefficient on the *OFFICEQHC* for the non-busy season subsample is negative (-0.042) but statistically insignificant. Further, when comparing the estimated coefficients of a simultaneous regressions estimation, the magnitude of the busy season estimated coefficient is found to differ significantly (Chi-Square = 1.85, $p < 0.10$ one-tailed test) from the magnitude of the non-busy season estimated coefficient. This result indicates that the negative *OFFICEQHC*

[14] We find that at the firm-level, the number of CPAs per $1 million in audit fees ranges from 4.81 to 6.29. Thus, the within firm variation at the audit office does not appear to translate to variation in across-firm staffing levels.

[15] We note that the variance inflation factors on all independent variables in our regression models are below 7, which is below the point at which multicollinearity typically becomes a concern.

[16] We compute this as the percentage difference in the estimated likelihood of a Big R restatement when the *OFFICEQHC* value is at the 75th and 25th percentiles. In untabulated results, we find the estimated restatement likelihood to be 0.0695 and 0.0798 at the 75th and 25th percentiles, respectively. We compute the estimated percentage difference as 0.0695–0.0798 = −0.0103; −0.0103/0.0695 = −0.1487 or an estimated 14.87% reduction in the likelihood of a Big R restatement.

Table 4
Descriptive statistics for variables by analysis.

Sample	Restatement (N = 5,639)			Disc. Accruals (N = 5,375)			Difference between samples		
Variable	**Mean**	**Median**	**St. Dev**	**Mean**	**Median**	**St. Dev**	**Mean**	**Median**	**St. Dev**
AUDTEN	2.48	2.48	0.90	2.49	2.48	0.89	−0.01	0.00	0.01
BM	0.48	0.44	0.95						
BUSY	0.73	1.00	0.45	0.72	1.00	0.45	0.01	0.00	0.00
CAPITAL	0.27	0.18	0.24						
CLIENTIMP	0.06	0.02	0.12	0.06	0.02	0.11	0.00	0.00	0.01
DA				0.05	0.03	0.06			
FEERATIO	0.15	0.12	0.14	0.16	0.12	0.14	−0.01	0.00	0.00
FOREIGN	0.38	0.00	0.49	0.39	0.00	0.49	−0.01	0.00	0.00
GC	0.02	0.00	0.15	0.02	0.00	0.14	0.00	0.00	0.01
OFFICEQHC	5.52	4.70	4.16	5.53	4.71	3.90	−0.01	−0.01	0.26
ICMW	0.03	0.00	0.16	0.02	0.00	0.15	0.01	0.00	0.01
INDSPE	0.19	0.00	0.39						
ISSUE	0.92	1.00	0.26						
LEVERAGE	0.24	0.20	0.27	0.25	0.21	0.28	−0.01	−0.01	−0.01
LITIND	0.33	0.00	0.47	0.34	0.00	0.47	−0.01	0.00	0.00
LOSS	0.31	0.00	0.46						
MERGER	0.11	0.00	0.31						
MSAEDULVL	0.35	0.38	0.06	0.35	0.34	0.06	0.00	0.04	0.00
MSAPOPLVL	15.37	15.37	0.75	15.37	15.37	0.75	0.00	0.00	0.00
MSAUNEMP	1.90	1.95	0.27	1.90	1.95	0.26	0.00	0.00	0.01
NASFEES	8.73	10.61	4.94	8.89	10.70	4.87	−0.16	−0.09	0.07
NONCPA%	0.61	0.64	0.15	0.61	0.64	0.15	0.00	0.00	0.00
OFFICEGRTH	0.03	0.03	0.01	0.03	0.03	0.01	0.00	0.00	0.00
OFFICESIZE	0.04	0.02	0.18	0.04	0.02	0.18	0.00	0.00	0.00
RESTRUCT	0.48	0.00	0.50						
ROA	0.03	0.08	0.33						
RESTATE	0.07	0.00	0.26	0.07	0.00	0.25	0.00	0.00	0.01
SALESGR				0.10	0.05	0.52			
SCALEDOANCF				0.06	0.09	0.21			
SEG	3.02	3.00	1.96	3.07	3.00	1.95	−0.05	0.00	0.01
SI	0.02	0.01	0.06						
SIZE	7.03	7.06	1.83	7.09	7.11	1.79	−0.06	−0.05	0.04

Note: This table reports the descriptive statistics of the variables in the restatement model and discretionary accruals model estimations. The first three columns present the statistics of the variables comprising the misstatement estimation sample. The middle three columns present the statistics of the variables comprising the discretionary accruals estimation sample. The final three columns present the difference between the two samples. Based on a two-tailed test, none of the differences between the summary values of the variables common to the restatement and discretionary accruals models are statistically significant. Variable definitions are listed in the Appendix.

effect on the likelihood of restatements appears to be more pronounced for audits conducted during busy season, consistent with H2.

4.2. Discretionary accruals

Column 1 of Table 7 reports the results of estimating the absolute value (unsigned) performance-adjusted discretionary accruals model using the full sample, and columns 2 and 3 show the results using the busy season and non-busy season subsamples, respectively. The models are significant ($p < 0.001$), with adjusted R squared values ranging from 0.175 to 0.188. The negative (-0.0005) and significant ($p < 0.05$) *OFFICEQHC* coefficient for the full sample suggests that having more qualified human capital is associated with less extreme discretionary accrual levels and thus higher audit quality. This result is consistent with H1. Economically speaking, as *OFFICEQHC* increases from the 25th percentile to the 75th percentile, the audit client's discretionary accruals are reduced by approximately 3.2 percent. We consider this to be a small to moderate change; however, since our measure captures all CPAs and does not separate out levels of auditors (senior, manager, partners), our results could be the floor (minimum) and further refinement is needed to increase the magnitude of the effects. The negative, significant ($p < 0.05$) and insignificant coefficients ($p > 0.10$) on *OFFICEQHC* for the busy season and non-busy season subsamples, respectively, suggest that the *OFFICEQHC* effect is more pronounced during the auditors' busy season, consistent with H2. The Chi-Squared test of coefficient differences using simultaneous regression estimation suggests the magnitude of the busy season estimated coefficient differs significantly (Chi-Square = 1.76, $p < 0.10$ one-tailed test) from the magnitude of the non-busy season estimated coefficient. This result indicates that the negative *OFFICEQHC* effect on discretionary accrual levels appears to be more pronounced for audits conducted during the auditors' busy season, consistent with H2.

Taken together, the restatement and discretionary accruals results suggest that offices with more qualified human capital provide higher quality audits. Additionally, the influence of *OFFICEQHC* is incremental to the influence of other office-level factors (e.g., *NONCPA%* and *OFFICEGRTH*) identified in prior studies. In sum, offices with a higher *OFFICEQHC* appear to pro-

Table 5
Pearson correlation coefficients for variables.

	Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
1	*OFFICEQHC*	1.000														
2	*AUDTEN*	−0.016	1.000													
3	*BM*	0.022	**0.035**	1.000												
4	*BUSY*	**−0.079**	**−0.096**	−0.070	1.000											
5	*CAPITAL*	**−0.087**	**−0.039**	0.074	0.113	1.000										
6	*CLIENTIMP*	**0.432**	**0.132**	**−0.025**	**−0.071**	0.013	1.000									
7	*DA*	**−0.017**	**−0.132**	**−0.056**	**0.045**	**−0.103**	**−0.106**	1.000								
8	*FEERATIO*	−0.002	**0.055**	**−0.023**	−0.008	**−0.078**	0.013	**−0.038**	1.000							
9	*FOREIGN*	**−0.039**	**0.051**	**−0.049**	−0.007	**−0.148**	0.018	**−0.035**	**0.048**	1.000						
10	*GC*	0.011	**−0.050**	**−0.301**	0.019	**0.030**	**−0.036**	**0.182**	**−0.051**	**−0.041**	1.000					
11	*ICMW*	**0.049**	**−0.060**	−0.011	**−0.023**	−0.012	**0.045**	**0.034**	**−0.043**	**0.049**	**0.038**	1.000				
12	*INDSPE*	0.018	**0.061**	**−0.033**	**−0.024**	0.017	**0.042**	−0.003	**0.049**	−0.021	0.006	0.001	1.000			
13	*ISSUE*	−0.013	0.013	**−0.032**	0.012	0.016	**0.043**	**−0.031**	**0.056**	**0.036**	**−0.059**	**−0.035**	0.016	1.000		
14	*LEVERAGE*	**−0.048**	**−0.084**	**−0.268**	**0.100**	**0.197**	**0.027**	**−0.039**	**0.026**	**−0.081**	**0.130**	0.003	**0.037**	**0.025**	1.000	
15	*LITIND*	**0.064**	−0.018	−0.002	**−0.176**	**−0.257**	−0.010	**0.142**	−0.002	**−0.035**	0.019	**0.028**	0.021	0.019	**−0.173**	1.000
16	*LOSS*	**−0.028**	**−0.181**	−0.018	**0.053**	−0.013	**−0.098**	**0.212**	**−0.119**	**−0.049**	**0.203**	**0.087**	−0.014	**−0.073**	**0.105**	**0.091**
17	*MERGER*	0.002	−0.009	0.013	0.007	**−0.061**	0.016	−0.013	**0.057**	0.006	**−0.037**	−0.019	**−0.023**	**0.066**	**0.027**	**−0.026**
18	*MSAEDULVL*	**0.091**	**−0.027**	**0.038**	**−0.048**	**−0.051**	**−0.038**	−0.005	**0.025**	−0.004	0.013	**−0.048**	−0.008	**−0.062**	**0.023**	**−0.069**
19	*MSAPOPLVL*	−0.006	**−0.036**	−0.008	**0.028**	−0.021	**−0.375**	0.002	**0.061**	**0.071**	**−0.026**	−0.007	**0.065**	**−0.025**	**0.047**	**−0.072**
20	*MSAUNEMP*	**0.097**	**−0.023**	**0.044**	**−0.049**	**−0.048**	**−0.037**	−0.008	**0.029**	−0.004	0.014	**−0.049**	−0.008	**−0.058**	0.018	**−0.071**
21	*NASFEES*	−0.002	**0.165**	**−0.068**	**0.027**	**−0.063**	**0.160**	**−0.115**	**0.442**	**0.090**	**−0.060**	**−0.029**	**0.071**	**0.085**	**0.089**	**−0.077**
22	*NONCPA%*	**−0.245**	**−0.056**	−0.009	**0.046**	**0.072**	**−0.121**	**0.025**	**−0.061**	0.002	0.004	0.002	**−0.103**	0.011	**−0.031**	0.014
23	*OFFICEGRTH*	**−0.078**	−0.012	0.000	0.012	0.005	0.005	0.008	−0.005	0.011	−0.016	**0.066**	**0.049**	**0.025**	−0.002	0.003
24	*OFFICESIZE*	**−0.256**	**−0.040**	−0.015	0.019	**−0.111**	**−0.568**	**0.073**	**0.044**	**0.099**	−0.005	−0.004	**0.027**	**0.025**	**−0.056**	**0.042**
25	*RESTATE*	−0.013	−0.012	**0.047**	−0.018	0.005	**−0.027**	0.002	**0.051**	**−0.051**	**−0.023**	**0.056**	0.006	0.010	**0.026**	**0.042**
26	*RESTRUCT*	0.007	**0.114**	**−0.057**	**−0.052**	**−0.151**	**0.095**	**−0.065**	**0.084**	**0.154**	0.014	**0.028**	0.015	**0.027**	**0.080**	**−0.067**
27	*ROA*	**0.049**	**0.120**	−0.002	**−0.084**	**0.088**	**0.107**	**−0.344**	**0.093**	**0.063**	**−0.280**	**−0.050**	−0.009	**0.022**	0.018	**−0.160**
28	*SCALEDOANCF*	−0.021	**−0.101**	−0.021	**0.047**	**−0.025**	**−0.048**	**0.165**	−0.006	−0.017	−0.013	−0.015	0.005	**0.035**	0.002	**0.045**
29	*SALEGR*	**0.024**	**0.071**	**0.035**	**−0.065**	**0.174**	**0.080**	**−0.279**	**0.074**	**0.048**	**−0.359**	**−0.024**	**−0.024**	**0.035**	**−0.117**	**−0.131**
30	*SEG*	−0.017	**0.076**	−0.006	−0.021	**−0.072**	**0.065**	**−0.072**	**0.054**	**0.211**	**−0.040**	**0.029**	0.005	**0.042**	**−0.079**	−0.004
31	*SI*	−0.001	**−0.043**	**−0.078**	−0.017	−0.044	−0.012	**0.262**	−0.020	0.019	**0.135**	**0.053**	−0.020	**−0.042**	**0.140**	−0.002
32	*SIZE*	**−0.096**	**0.245**	**−0.050**	**0.034**	**0.228**	**0.319**	**−0.292**	**0.200**	**0.089**	**−0.174**	**−0.040**	**0.133**	**0.123**	**0.181**	**−0.212**

	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.
16.	1.000															
17.	**−0.059**	1.000														
18	−0.004	**−0.028**	1.000													
19	**−0.023**	−0.015	**0.233**	1.000												
20	−0.008	**−0.023**	**0.991**	**0.228**	1.000											
21	**−0.137**	**0.082**	**0.049**	**0.110**	**0.052**	1.000										
22	**0.072**	0.013	**−0.252**	**−0.111**	**−0.252**	**−0.068**	1.000									
23	**−0.022**	**0.025**	**−0.236**	0.002	**−0.232**	0.003	**0.033**	1.000								
24	**0.072**	**−0.023**	**0.103**	**0.726**	**0.101**	**0.032**	**0.059**	0.015	1.000							
25	**−0.078**	0.019	**−0.074**	−0.009	**0.024**	**0.045**	**0.056**	**−0.103**	−0.013	1.000						
26	**0.051**	**0.023**	**0.099**	**0.067**	**0.093**	**0.169**	**−0.070**	−0.002	**0.044**	**−0.103**	1.000					
27	**−0.518**	**0.066**	**0.059**	**0.027**	**0.063**	**0.145**	**−0.079**	0.009	**−0.096**	**0.049**	**0.039**	1.000				
28	−0.003	**0.072**	**−0.076**	0.017	**−0.073**	−0.006	**0.029**	**0.043**	**0.056**	−0.014	−0.092	**−0.044**	1.000			
29	**−0.379**	**0.030**	**0.040**	0.016	**0.043**	**0.108**	**−0.051**	0.006	**−0.084**	0.005	−0.003	**0.686**	**−0.048**	1.000		
30	**−0.087**	0.009	**−0.025**	−0.010	**−0.026**	**0.089**	**0.040**	0.008	0.017	**0.132**	**0.137**	**0.127**	**−0.043**	**0.108**	1.000	
31	**0.287**	**0.044**	**0.063**	−0.008	**0.058**	−0.010	0.015	−0.015	0.005	**0.145**	**0.145**	**−0.080**	−0.007	**−0.121**	−0.005	1.000
32.	**−0.342**	**0.034**	−0.007	**0.095**	−0.008	**0.447**	**−0.074**	**0.032**	**−0.043**	**0.192**	**0.195**	**0.386**	**−0.061**	**0.366**	**0.135**	**−0.097**

Note: This table represents the correlation between each of the main variables employed within this study. Bold correlations are significant at the 0.05 level. See the Appendix for variable definitions.

Table 6
Office qualified human capital and likelihood of material misstatement resulting in restatement analysis.

Dependent Variable:	**Restatement**						
		Full Sample Column (1)		Busy Season Column (2)		Non-Busy Season Column (3)	
Variable	***Prediction***	***Coef.***	***z-stat***	***Coef.***	***z-stat***	***Coef.***	***z-stat***
INTERCEPT		−9.002	−4.23***	−11.300	−4.44***	−5.670	−1.28
OFFICEQHC	–	−0.053	−2.61***	−0.090	−2.92***	−0.042	−1.41
NONCPA%		−0.682	−1.81*	−1.358	−3.09***	0.105	0.14
OFFICEGRTH		0.433	1.54	0.362	0.91	0.552	1.63
MSAPOPLVL		0.347	2.48**	0.489	2.95***	0.121	0.42
MSAEDULVL		3.178	1.99**	2.943	1.55	6.643	1.79*
SIZE		−0.017	−0.40	−0.070	−1.38	0.000	−0.01
ROA		−0.323	−1.92*	−0.372	−2.01**	0.156	0.20
LEVERAGE		0.343	1.94*	0.485	2.13**	−0.344	−0.63
LOSS		−0.109	−0.77	−0.300	−1.67*	0.497	1.64
BM		0.235	3.34***	0.285	3.08***	0.011	0.10
ISSUE		0.435	1.86*	0.460	1.53	0.685	1.51
RESTRUCT		−0.233	−2.03**	−0.298	−2.17**	−0.043	−0.17
MERGER		−0.019	−0.11	−0.079	−0.39	0.267	0.86
SEG		0.260	2.25**	0.326	2.36**	0.023	0.09
LITIND		−0.246	−1.27	−0.324	−1.41	−0.321	−0.65
FOREIGN		−0.439	−3.50***	−0.287	−1.93*	−0.811	−3.00***
ICMW		0.900	3.32***	0.882	2.41**	0.775	1.54
AUDTEN		−0.079	−1.27	0.024	0.31	−0.355	−2.44**
SI		1.579	2.24**	1.582	1.77*	2.209	1.16
CAPITAL		−1.004	−2.79***	−0.764	−1.77*	−1.409	−1.57
INDSPE		0.005	0.04	0.048	0.29	0.130	0.46
GC		−0.242	−0.58	−0.368	−0.68	−0.374	−0.51
BUSY		−0.068	−0.51				
OFFICESIZE		−0.360	−2.68***	−0.227	−1.46	−0.866	−3.15***
NASFEES		0.017	1.12	−0.006	−0.32	0.066	1.95*
FEERATIO		1.160	2.84***	1.032	2.09**	2.591	2.84***
CLIENTIMP		−0.024	−0.04	0.909	0.95	−1.735	−1.32
Industry and Year FE	Yes			Yes		Yes	
N of Obs.		5,693		4,132		1,561	
Pseudo R-Squared	0.087			0.107		0.211	
Area Under ROC	0.707			0.738		0.822	
Restatements = 1		411		290		121	

Note: This table reports the results of estimating the likelihood of material misstatement for fiscal years 2009 to 2014. Models are estimated using logistic regression with standard errors that are robust to heteroskedasticity. *, **, *** indicates statistical significance at the 0.10, 0.05, and 0.01 levels, respectively, in two-tailed tests. See the Appendix for variable definitions.

duce higher quality audits in terms of the number of restatements and earnings management. The two sets of consistent audit quality results underscore the important role that qualified human capital plays in office-level audit quality.

4.3. Additional analyses and robustness tests

4.3.1. Test of endogeneity

The level of *OFFICEQHC* may be a choice of the audit office such that offices that desire higher audit quality have higher *OFFICEQHC*. Therefore, our measure may suffer from endogeneity. Endogeneity can take two general forms: correlated omitted variables and reverse causality (also frequently referred to as "simultaneity") (Glaeser and Guay 2017). Accounting researchers generally use instrumental variables in an attempt to mitigate the biases caused by endogeneity of the predictor variables or to identify a system of simultaneous equations (Larcker and Rusticus 2010). To address endogeneity concerns related the office-level qualified human capital, we first perform the Heckman (1979) procedure with MSA-year unemployment level as the exclusion (instrumental) variable (Larcker and Rusticus 2010; Tucker 2010). The unemployment level in the MSA (city) has been used as an instrumental variable in prior labor economics and other human capital related research (e.g., Rosenthal and Strange 2008). The significant correlation between our test variable and MSA unemployment level, as well as the insignificant relation between our audit quality measures (discretionary accruals) and MSA unemployment level, further support the use of MSA unemployment level as an instrumental variable. We estimate the inverse mills ratio from the first stage model predicting our measure, which we bifurcate into a dummy variable cut at the median of the distribution for this purpose. We then include the inverse mills ratio in our engagement-level audit quality (untabulated) analyses. We find (untabulated) that the inverse mills ratio is not significant in our audit quality models and the *OFFICEQHC* coefficients remain significant in the direction of higher audit quality.

Table 7
Office qualified human capital and performance-adjusted discretionary accruals analysis.

Dependent Variable:	**Performance-adjusted discretionary accruals**						
		Full Sample Column (1)		Busy Season Column (2)		Non-Busy Season Column (3)	
Variable	***Prediction***	***Coef.***	***t-stat***	***Coef.***	***t-stat***	***Coef.***	***t-stat***
INTERCEPT	0.076	2.24*	0.068	1.68*	0.112	2.36**	
OFFICEQHC	–	−0.0005	−2.40**	−0.001	−2.02**	−0.0002	−0.63
NONCPA%		−0.008	−1.37	−0.011	−1.46	−0.001	−0.14
OFFICEGRTH		0.006	1.33	0.015	2.63**	−0.007	−1.25
MSAPOPLVL		0.001	0.61	0.002	1.04	−0.004	−1.17
MSAEDULVL		0.038	1.79*	0.035	1.39	0.017	0.41
SIZE		−0.007	−8.79***	−0.007	−7.54***	−0.008	−5.47***
LEVERAGE		−0.011	−1.73*	−0.013	−1.81*	0.003	0.365
LITIND		0.013	4.18***	0.010	2.60***	0.022	3.51***
SCALEDOANCF		−0.039	−3.51***	−0.040	−3.20***	−0.037	−2.37**
SALESGR		0.015	4.00***	0.014	3.54***	0.023	2.28**
GC		0.047	4.21***	0.044	3.41***	0.056	2.75***
FOREIGN		−0.0002	−0.12	−0.001	−0.38	0.003	1.06
SEG		−0.003	−1.65*	−0.004	−1.90*	−0.0001	−0.03
ICMW		0.007	1.24	0.006	0.78	0.009	0.86
AUDTEN		−0.003	−2.48**	−0.002	−1.83*	−0.002	−1.47
OFFICESIZE		0.0002	0.12	−0.001	−0.63	0.006	1.70*
BUSY		0.003	1.51				
NASFEES		0.0001	0.06	0.000	0.58	−0.0004	−2.33**
FEERATIO		0.008	1.22	0.021	2.39**	−0.023	2.19**
CLIENTIMP		0.016	1.93*	0.020	1.66*	0.025	1.73*
Industry and Year FE		Yes		Yes		Yes	
N of Obs.		5,375		3,873		1,502	
F-Value		15.76		12.63		6.25	
Prob > F		0.000		0.000		0.000	
Adj. R-Squared		0.175		0.176		0.188	

Note: This table reports the results of estimating the firm-level performance adjusted discretionary accruals using firm-year observations from 2009 to 2014. Models are estimated using OLS regression with standard errors that are robust to heteroskedasticity. *, **, *** indicates statistical significance at the 0.10, 0.05, and 0.01 levels, respectively, in two-tailed tests. See the Appendix for variable definitions.

4.3.2. Client complexity analyses

Our next set of additional analyses examine whether client complexity affects the association between *OFFICEQHC* and audit quality. By their nature, audit engagements of increased complexity and risk should require additional attention from the external auditor. Thus, we might find a more pronounced association between *OFFICEQHC* and audit quality among more complex clients as compared to less complex clients. We compute an annual measure of client complexity by MSA and audit firm.[17] We employ the following three measures to proxy for audit client complexity and complex estimates: client firm size, annual pension and retirement expense, and deferred taxes and investment tax credits (Sherwood et al. 2020; Zimmerman, Barr-Pulliam, Lee, and Minutti-Meza 2021). Panel A of Table 8 shows the estimated coefficients of the *OFFICEQHC* variable when estimating the restatement regression model using the low complexity and high complexity subsamples. The estimated coefficient of *OFFICEQHC* is negative and statistically significant for all of the high complexity subsamples.[18] Panel B of Table 8 presents the results of the discretionary accruals model. The coefficient on *OFFICEQHC* is negative and significant for two of the three high complexity subsamples and insignificant for two of the three low complexity subsamples. In addition, we find (untabulated) that when the division between high and low complexity is based on measures that would not be expected to be correlated with our qualified human capital measure, such as accounts payable and fixed assets, the likelihood of misstatement and the level of discretionary accruals are *not* significantly associated with *OFFICEQHC*. These non-results provide some counterfactual evidence of the complexity effect described above. In sum, the results suggest that the main audit quality findings are driven by higher complexity clients whose audits are most likely to benefit from more qualified human capital. It is also possible that complex clients are assigned more qualified human capital; however, our measure is at the office level rather than the engagement level and if selection issues occur, it is because the client is choosing an office with more qualified human capital, not necessarily that more complex clients are assigned such offices.

[17] Audit client complexity varies both between and within audit firms based on the characteristics of the client base at the MSA level. Further, the local client base is subject to change on an annual basis due to potential of clients switching auditors from one year to the next. Therefore, we compute the median (for example) client pension and retirement expense levels for each office in our test sample on an annual basis. We then use the median client pension and retirement expense account value of each audit office (i.e., audit firm-MSA combination) to bifurcate the office's clients into high and low complexity samples, based on clients having pension and retirement expenses above and below the annual median of the audit office's client base.

[18] For brevity, the additional analyses tables only report the estimated coefficient of the *OFFICEQHC* variable. However, each of the estimated models include the control variables and fixed effects as described in the research design section of the study. Further, all the empirical models are statistically significant at p<0.01.

Table 8
Additional analyses of audit quality for high versus low accounting complexity clients.

Panel A: Restatement Tests

		Accounting Complexity Measure					
		Firms Size		Pension & Retirement Exp		Deferred Taxes and Investment Tax Credits	
	Variable	***Coef.***	***z-stat***	***Coef.***	***z-stat***	***Coef.***	***z-stat***
Low Complexity Sample	*OFFICEQHC*	−0.093	−1.62	−0.057	−4.44	−0.038	−5.15
High Complexity Sample	*OFFICEQHC*	−0.032	−2.31	−0.102	−5.08	−0.105	−2.44
Coefficient Difference Test		1.91*		3.53**		3.27**	

Panel B: Discretionary Accruals Tests

		Accounting Complexity Measure					
		Firms Size		Pension & Retirement Exp		Deferred Taxes and Investment Tax Credits	
	Variable	***Coef.***	***t-stat***	***Coef.***	***t-stat***	***Coef.***	***t-stat***
Low Complexity Sample	*OFFICEQHC*	−0.00002	−0.06	−0.00305	−2.28	−0.00148	−1.38
High Complexity Sample	*OFFICEQHC*	−0.00075	−1.92	−0.00603	−3.39	−0.00465	−2.77
Coefficient Difference Test		2.23*		1.79*		2.54*	

Note: This table reports the results of additional analyses using samples bifurcated between clients with high and low accounting complexity. We employ the following three measures of accounting complexity: firm size, pension and retirement expense, and deferred taxes and investment tax credits. *Firm Size* is the natural log of total assets. *Pension & Retirement Exp* is the Compustat variable *XPR*. *Deferred Taxes and Investment Tax Credits* is the Compustat variable *TXDIT*. Panel A reports the results of estimating the restatement model equation, while Panel B reports the results of estimating the discretionary accruals model. In each panel, the results using the low complexity sample are shown on the top row, while the results using the high complexity sample are shown on the second row. For brevity, the estimated coefficient and z(t)-statistic are only shown for the *OFFICEQHC* variable. However, the estimations include the control variables, intercept, and fixed effects as described within the manuscript, with standard errors robust to heteroskedasticity. The bottom row displays the chi2 and Prob > chi2 test that the difference between the estimated coefficients is 0. *, **, *** indicates statistical significance at the 0.10, 0.05, and 0.01 levels, respectively, in one-tailed tests.

4.3.3. Office size and office growth analyses

Furthermore, we conduct additional analyses that pertain to office size and office growth. First, we explore the possibility that the *OFFICEQHC* variable may simply be capturing office size effects on audit quality. Similar to the process used in the client complexity analyses, we classify each audit office on an annual basis as large or small. We then estimate the audit quality regression models on the large and small offices' client subsamples determined by the median office total issuer audit fees cutoff. We find that the *OFFICEQHC* coefficients do not differ statistically in size, direction, or significance between the large and small office size subsamples.

Second, we explore whether qualified human capital resource constraints are different in high growth versus low growth offices. Following Bills et al. (2016), we define office growth (*OFFICEGRTH*) as the percentage change of an audit office's total year-over-year issuer audit fees. The high/low growth offices are determined by using a split at the median of the distribution of *OFFICEGRTH*. In untabulated analyses, we find that the coefficient on *OFFICEQHC* for the estimated restatement model is significantly higher in the high office growth subsample than in the low office growth subsample, $p < 0.05$. The coefficient of *OFFICEQHC* for the estimated discretionary accruals model is also significantly higher in the high office growth subsample than in the low office growth subsample. These results indicate that higher office qualified human capital reduces resource constraints more in high growth versus low growth offices.

4.3.4. Source data availability bias

Finally, the Book of Lists dataset does not cover all U.S. Big 4 offices, as it does not report accounting firm information for all of the MSAs where the Big 4 reside. For example, there are Big 4 offices located in both Midland, MI, and Charleston, WV, and neither of these MSAs are included in a Book of Lists publication. In addition, due to source data variation, not every MSA included in a Book of Lists publication is suitable for inclusion in our study; we can only include MSAs if the publication for that MSA reports both the number of CPAs and the number of employees for Big 4 firms located in that MSA. For example, Minneapolis, Portland, and San Francisco each have an annual Book of Lists publication; however, either the number of CPAs, the total number of employees, or both are not reported within the accounting firms' listings. The non-reporting of the data elements necessary for inclusion in our sample appears to be random, suggesting that the MSAs with missing data do not differ systematically from the MSAs for which the data are available. Nonetheless, we recognize that the incomplete data set limits the generalizability of our results.

Moreover, the fact that our sample is limited to the MSAs in which The Book of Lists publications provide complete data for our analyses raises the concern that there may be fundamental differences between the MSAs with and without Book of Lists data that are influencing our results. In an attempt to address this concern, we replace *OFFICEQHC* with a dummy variable set to 1 if the observation is from an MSA with Book of Lists data and included in our sample, and 0 if there is no Book of Lists data available for the observation. We then re-estimate the audit quality models equations using the full sample (i.e., both observations with and without Book of Lists data available) including the Book of Lists sample dummy variable. We find that in both regressions, the coefficient on the Book of Lists sample dummy variable is insignificant. This finding suggests that the presented results are not significantly influenced by any potential underlying differences between the sample of clients in MSAs with Book of Lists data available and the sample of clients in MSAs without Book of Lists data.

Furthermore, the Book of Lists data originate from two sources: *American Business Journals* and *Crain's Business*. We are unaware of any systematic differences in how each publication obtains, compiles, and presents the local accounting firm personnel data. Further, we include MSA control variables when estimating each regression to account for MSA-specific conditions that might affect the regression estimation. Nonetheless, as an additional analysis, we bifurcate the sample based on the data source and estimate the regression models separately for the *Crain's* sample and the *American City Business Journal* sample. We find that the direction, significance and size of our test variable's estimated coefficients do not differ when estimating the model using the different data source samples.[19] We conclude that the originating source of the Book of Lists data does not significantly affect the main results of our study.

In addition, some of the MSAs have less than three years of available CPA and total employee data and thus are excluded from the main samples.[20] In untabulated analyses, we estimate the regression models using three alternative samples: 1) the study's primary sample plus all MSAs with a single year of *OFFICEQHC* data, 2) the study's primary sample plus all MSAs with two years of *OFFICEQHC* data, and 3) the study's primary sample plus all MSAs with either one or two years of *OFFICEQHC* data. For each of the alternative samples, we find the results are similar in direction, magnitude, and significance as those reported in the main tables.[21]

4.3.5. Limitations

This study is subject to several limitations. First, due to the limitations of our data, we are unable to fully discern the underlying drivers of the positive association between *OFFICEQHC* and the office's audit quality. We recognize the possibility that the level of not yet licensed audit staff may be associated with audit quality. According to former Big 4 office managing partners that we interviewed, unlicensed staff and office support are proportionally similar across offices and regions within the same firm because such staffing levels are determined and monitored by regional- and firm-level administrators. However, we do not have empirical evidence to support this anecdotal evidence. We call for future research to disentangle the individual effects of the unlicensed human capital groups on audit quality.

We recognize that our test measure, *OFFICEQHC*, is noisy. For example, the metric's numerator does not account for non-CPA subject-matter specialists on audit engagement teams, while it does account for already certified first or second-year staff CPA associates. Furthermore, in some areas, such as tax and forensics, specialists may be more likely to have a CPA background and not perform audits. If the qualified human capital in an office are not members of audit engagement teams, this will bias against finding results that qualified human capital is positively associated with audit quality. Without engagement-specific data, we cannot further refine our qualified human capital measure and must recognize this as a limitation of our study.

We also recognize that the Book of Lists data originates from two sources: *American Business Journals* and *Crain's Business*. We are unaware of any systematic differences in how each publication obtains, compiles, and presents the local accounting firm personnel data. Further, we include MSA control variables when estimating each regression to account for MSA specific conditions that might affect the regression estimation. However, the unlikely event that systematic differences do exist between the publications is a limitation of the study.

Finally, our analysis provides evidence of an association rather than a causal effect. Future empirical archival research using natural, quasi-experimental settings or proprietary data would be best suited for causal inferences of the effect of qualified human capital on audit quality. Nonetheless, our paper provides some initial broad archival empirical evidence of an association between audit quality and office qualified human capital.

5. Conclusion

This paper examines whether professionally qualified human capital is associated with audit quality for Big 4 audit offices throughout the U.S. Prior research suggests that audit firms facing human capital capacity constraints produce lower quality audits (Beck et al. 2018; Bills et al. 2016), and the PCAOB has emphasized the importance of availability, competence, and focus of individual auditors in maintaining audit quality (PCAOB 2015). Despite this interest from academics and regulators,

[19] We find that when comparing the estimated coefficients of a simultaneous regressions estimation, the probability of the estimated coefficients does not differ significantly from zero (one-tailed).

[20] The following MSAs provide CPA and total employee data for a single year during our sample period: Charlotte, Miami, Nashville, and Wichita, while the following three MSAs provide the data for two years within our sample period: Los Angeles, Memphis and Seattle. Due to the limited number of years for which total CPAs and total employees are available, the main sample does not include these MSAs.

[21] When using the sample that requires at least 1 year; (at least 2 years); (at least 1 or 2 years) of BOL data to estimate the restatement model, the estimated coefficients of *OFFICEQHC* are −0.048; −0.079, −0.048; (-0.050; −0.077, −0.042); (-0.048; −0.078, and −0.040) for the full, busy season and non-busy season samples, respectively. The estimated coefficients of the *OFFICEQHC* variable in the DA model are −0.000498; −0.000698, and −0.000162; (-0.000495; −0.000688, and −0.000179); and (-0.000496; −0.000699, and −0.000158) for the full, busy season, and non-busy season samples, respectively, when using samples that only require at least 1, at least 2, or at least 1 or 2 years of BOL data. Statistical significance of the estimated coefficients is consistent with those presented in the paper.

there has been limited archival research on whether human capital constraints impact audit quality. This study fills this void by examining whether qualified human capital is associated with audit quality at the office level.

Our proxy for qualified human capital is the CPA designation. The CPA designation is a high standard recognized by the business community as an assurance of quality and an appropriate proxy for qualified human capital for audit firms. We gathered the number of CPAs employed by the largest accounting firms in major U.S. cities for the years 2009–2014 from published listings in business journals. Two audit quality regression models, restatements and discretionary accruals, were estimated using a sample of around 5,600 firm-year observations. The results of the audit quality regression models provide evidence of a significant and positive association between qualified human capital and engagement audit quality. Furthermore, the results of the coefficient difference tests across busy and non-busy season audit samples suggest that this association is more pronounced for busy season audits. Several additional analyses and sensitivity tests were performed to consider potential endogeneity issues, office size and growth effects, client complexity, and data source and availability bias effects. The additional analyses and sensitivity tests support the validity and robustness of our main results.

These results should be of interest to the AICPA, NASBA, academics, accounting practitioners, and regulators. Our study informs the AICPA, NASBA, Accountancy Boards, and the PCAOB in their joint efforts to improve audit quality. The results of our study support the AICPA's focus on properly designing the CPA licensure exam and enabling professionals to attain higher quality performance at least from an audit perspective. The PCAOB may consider CPA levels of audit offices as a possible AQI for their ongoing AQI project. Audit firm leaders, audit committee members, and investors may also evaluate qualified human capital levels of the auditor's office and/or team when assessing audit quality. We call on future research to identify and examine other aspects of the qualified human capital effects on audit quality, perhaps considering determinants at the engagement team and/or individual auditor levels.

Data Availability.

Data on office CPA composition was hand-collected from the annual Book of Lists publications of U.S. city business journals. Data on other variables are publicly available, as indicated in the paper. Data may be provided upon request.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix

Variable Definitions

Variable Name	Variable Definition
Dependent Variables	
DA	Absolute value of performance-adjusted current discretionary accruals. In order to calculate it, we partition the entire population of Compustat firms, excluding financial sector firms, by two-digit SIC code, and remove industries with<15 firms. We estimate parameters for normal accruals for each two-digit SIC industry by year using the following equation: $NA_t = \beta 0 + \beta 1\ (1/TA_{t-1}) + \beta 2\ (\Delta Rev_t) + \beta 3\ (ROA_{t-1}) + \varepsilon t$, where: NA_t = current accruals, reflected by net income before extraordinary items plus depreciation and amortization minus operating cash flows scaled by total assets at the beginning of year. TA_{t-1} = total assets at the beginning of the fiscal year *t*. ΔRev_t = net sales in year *t* less net sales in year *t*-1 scaled by the beginning of the year total assets. ROA_{t-1} = income before extraordinary items scaled by total assets in year *t*-1. All variables are winsorized at the 1st and 99th percentiles. The parameters estimated from the above equation are used to calculate expected current accruals (ENA): $ENA_t = b0 + b1\ (1/TA_{t-1}) + b2\ (\Delta Rev_t - \Delta AR_t) + b3\ (ROA_{t-1})$, where ΔAR_t = accounts receivable in year *t* less accounts receivable in year *t*-1, scaled by the beginning of year total assets. The current discretionary accruals (*DA*) are calculated as follows: $DA_t = NA_t - ENA_t$.

(*continued*)

Variable Name		Variable Definition
RESTATE	=	1 if the audited financial statements issued for the fiscal year end were subsequently restated due to a material misstatement (Big R restatements) and 0 otherwise (Audit Analytics).
Test Variables		
OFFICEQHC	=	Number of CPAs per accounting firm at the MSA level (from the Book of Lists for a given year) scaled by the sum of issuer engagement audit fees (in millions of dollars), for a given year at the MSA level (Audit Analytics).
Control Variables		
AUDITFEES	=	Natural logarithm of the audit fees paid to the external auditor in conjunction with the annual financial statement audit (obtained from Audit Analytics).
AUDTEN	=	Natural log of the number of years the client firm has engaged the opining auditor (Audit Analytics).
BM	=	The firm's book-to-market ratio defined as its book value (CEQ) divided by market value of equity (CSHO*PRCC_F).
BUSY	=	1 if client fiscal year end is between December 1 and March 31, 0 otherwise.
CAPITAL	=	Net plant, property, and equipment (PPENT) divided by total assets (AT).
CLIENTIMP	=	Each individual client's audit engagement fee divided by the sum of the office-level audit fees charged to all audit clients by the opining audit office.
FEERATIO	=	The ratio of non-audit fees to total fees paid by the client to the external auditor.
FOREIGN	=	1 if a client has foreign transactions (FCA not equal to zero) and 0 otherwise.
GC	=	Indicator variable set to 1 if the auditor issues a going concern modified audit opinion for the client and zero otherwise.
ICMW	=	1 if the firm has an internal controls material weakness related to the fiscal year end 0 otherwise.
INDSPE	=	1 if the auditor is a national industry specialist and an MSA-level industry specialist, both based on a 30 % market share of audit fees in the industry and year, 0 otherwise.
ISSUE	=	1 if a client issued new debt (DLTIS) or equity (SSTK) and 0 otherwise.
LEVERAGE	=	Long term debt (DLTT) + short-term debt reported in current liabilities (DLC)/total assets (AT).
LITIND	=	1 if a client operates in the following industries: biotechnology (2833–2836 and 8731–8734), computers (3570–3577 and 7370–7374), electronics (3600–3674), and retail (5200–5961) industries (based on Francis et al., 1994), and 0 otherwise.
LOSS	=	1 if the firm's net income before extraordinary items (IB) is negative, and 0 otherwise.
MERGER	=	1 if a client undertook a large merger or acquisition (AQS not equal to zero), and 0 otherwise.
MSAEDULVL	=	The percent of the population 25 and older with a bachelor's degree or higher within an MSA, per U.S. Census Bureau data.
MSAPOPLVL	=	The median population within an MSA, per U.S. Census Bureau data.
MSAUNEMP	=	The annual unemployment rate, within an MSA, per U.S. Census Bureau data.
NASFEES	=	Natural logarithm of the non-audit service fees, less the tax fees, paid by the auditee to the external auditor.
NONCPA%	=	Number of non-CPAs per accounting firm at the MSA level divided by the total number of employees per firm at the MSA level.
OFFICEBUSYPCT	=	The percentage of an audit office's clients with a busy season year-end.
OFFICEGRTH	=	The percentage change in an audit office's total year-over-year audit fees.
OFFICEISSUEPCT	=	The percentage of an audit office's clients that issue new debt or equity.
OFFICELITPCT	=	The percentage of an audit office's clients that are in a highly litigious industry.
OFFICEMERGPCT	=	The percentage of an audit office's clients that undergo a merger that year.
OFFICENAS	=	The audit office total non-audit services fees paid by issuer clients.
OFFICESIZE	=	The total number of publicly traded audit clients of the audit firm in year t, measured at the MSA level.
RESTRUCT	=	1 if aggregate restructuring charges (RCP) in years t and t–1 is negative, 0 otherwise.
ROA	=	The firm's return-on-asset ratio calculated as net income before extraordinary items (IB) divided by beginning of the year total assets (lagged AT).
SALEGR	=	(Sales in year t – Sales in year t_{-1})/Sales in year t_{-1}
SCALEDOANCF	=	Standard deviation of cash flows from operations over the prior ten years scaled by total assets (OANCF)/assets (AT).
SEG	=	The logarithm of the sum of the number of business segments reported by the Compustat Segments database.

(*continued on next page*)

(*continued*)

Variable Name		Variable Definition
SI	=	Special items (SPI) divided by total assets (AT).
SIZE	=	The natural log of the firm's total assets (AT) measured in millions of dollars.
Industry dummies	=	Industry dummy variable based on firms' two-digit SIC code.
Year dummies	=	Indicator variable based on the fiscal year end of the audited financial statements.

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