Journal of Contemporary Accounting & Economics 21 (2025) 100467

Contents lists available at ScienceDirect

Journal of Contemporary Accounting & Economics

journal homepage: www.elsevier.com/locate/jcae

CPA exam score and auditors' salaries

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ARTICLE INFO

Keywords:
CPA exam
compensation
competencies
Big 4

ABSTRACT

The research presents two competing views on the welfare effects of occupational licensing. One stream of literature suggests that licensing is a barrier to entry into professions, limiting competition and resulting in economic rents. A second stream suggests that they can increase well-being by alleviating information problems. We use data on CPAs' salaries before and after certification to test these conflicting hypotheses. Consistent with the information-alleviation hypothesis, we find a positive correlation between performance on the CPA exam and auditors' salaries after the exam but not before the exam when the competencies have developed. Furthermore, we find that the positive association is stronger for auditors working at Big 4 firms, younger auditors and male auditors. The abovementioned results indicate that auditors' technical competencies are valued more highly by Big 4 firms than by non-Big 4 firms. After the CPA certification, we do not observe salary increases that are greater than expected based on previous years' increases and auditors' performance on the CPA exam, as the barrier-to-entry theoretical approach suggests. We discuss the implications of the results for the role of CPA regulation.

1. Introduction

The consequences of occupational licensing have been a fertile area for research in auditing and other professions (Barrios 2022, Bryson and Kleiner, 2019). Two competing explanations for the regulatory requirement of occupational licensing with opposing policy implications monopolize the debate. The first is that occupational licensing is a barrier to entry, limiting competition and resulting in economic rents for auditors (Stigler, 1971; Lee et al., 1999). The second is that policy interventions such as CPA certifications are justified because they increase social welfare by alleviating information problems (Leland, 1979; Shaked and Sutton, 1981; Shapiro, 1986). The purpose of this work is to empirically test predictions of these competing theories by studying the evolution of auditors' salaries around the CPA exam and the relationship between scores on the CPA exam and auditors' salaries.

To our knowledge, this is the first paper that uses the salaries of auditors around the CPA exam to empirically test the implications of the theories (i.e., barrier-to-entry vs. information problems). A few studies in other professions have investigated the incentives provided by occupational licenses (see Kleiner, 2000; Kleiner and Krueger, 2013; Gittleman et al., 2018; Blair and Chung, 2019; Bryson and Kleiner, 2019). Guided by the barrier-to-entry theory, most of this research estimates the premium related to licensing by

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https://doi.org/10.1016/j.jcae.2025.100467
Received 28 May 2024; Received in revised form 24 March 2025; Accepted 25 March 2025
Available online 28 March 2025

comparing the salaries of licensed and nonlicensed (as equivalent as possible) occupations.

Prior empirical research on the impact of CPA regulations has focused almost exclusively on the educational requirements for becoming a CPA, and most of this research is consistent with the view that licensing requirements restrict the supply of entrants and do little to improve quality (e.g., Young, 1986; Roberts and Kurtenbach, 1998; Grant et al. 2002; Carpenter and Stephenson, 2006; Allen and Woodland, 2010; Barrios, 2022; Sutherland et al., 2024). The dimensions of CPA certifications other than the educational requirements have not received attention in the literature.

We use Swedish data to test the competing theories regarding the CPA licensing regulation. Swedish regulations require that an auditor has at least three years of experience working at an audit firm before taking the CPA exam. The exam is designed to ensure that auditors have sufficient theoretical knowledge to conduct audits in companies of different sizes and with different types of operations and that the auditor can apply this knowledge in their auditing practices. Therefore, the CPA exam score provides a measure of auditors' technical competencies. The sample used includes 3,321 auditor-year observations for 643 auditors and covers three years before the CPA exam, the year when the CPA exam results are published, and two years after the publication. This data design allows us to follow the same auditors over time, control for trends in their annual salary increases and, more novelly, investigate the relationships between CPA exam scores and salaries to test predictions of the information problems theory.

Obviously, the competencies tested in the CPA exam have been developed through education and practical experience before taking the exam. Therefore, if there were no information problems, salaries would reflect the competence level of auditors before the publication of the exam results. We find no support for this prediction. On the other hand, the information problem perspective predicts that a link between salaries and competencies tested in the CPA exam is observed after the publication of the exam results. The score in the CPA exam reveals new information about auditors' competence level. Consistent with this perspective, we find a significant association between salaries and the CPA score after the publication of the exam results.

Furthermore, for those auditors who obtain the certification with the minimum score for passing the exam, we find that salary increases after the certification are of a similar size as the salary increases before passing the exam. We interpret this result as being inconsistent with the view that CPA certification results in a salary premium. Overall, our results are consistent with the stream of literature suggesting that CPA regulation has a role in reducing information problems (Leland, 1979; Shaked and Sutton, 1981; Shapiro, 1986) and inconsistent with the research suggesting that CPA regulation is just a barrier to entry. One implication of our results is that CPA regulations increase auditors' incentives to develop competencies beyond the incentives that would exist without such regulations.

We make several contributions to the literature. First, we add to the occupational licensing research in auditing. The extant research has focused on the effects of the 150-hour rule in the U.S., which increased the educational requirements for becoming a CPA from four years to five years of study (e.g., Young, 1986; Roberts and Kurtenbach, 1998; Grant et al. 2002; Allen and Woodland, 2006; Carpenter and Stephenson, 2006; Allen and Woodland, 2010; Boone et al., 2006; Barrios, 2022; Sutherland et al., 2024). Most of this research presents results that are consistent with the view that more demanding educational requirements are a barrier to entry into the profession. For example, Barrios (2022) concluded that increases in educational requirements for licensing do little to improve quality in the labor market but restrict the supply of entrants to the audit profession, supporting the barrier to entry theory. In contrast to prior research, our results support CPA certification as a mechanism for reducing information problems.

We also add to the literature examining why Big 4 audit firms provide higher-quality services than non-Big 4 audit firms do. Our results show that Big 4 firms generally pay their auditors more than non-Big 4 firms do and that the association between the CPA exam score and salaries is significantly stronger for Big 4 firms than for non-Big 4 firms. These results suggest that Big 4 firms should be able to attract more competent auditors and that they provide auditors with stronger incentives to develop their technical competencies. At a general level, these results are consistent with those of Che et al. (2020), who found that Big 4 firms are able to recruit audit partners that deliver higher quality and that Big 4 firms provide partners with stronger incentives. Thus, our results indicate that some of the observations by Che et al. (2020) apply to junior auditors as well.

Our study contributes to the literature on the gender salary gap in the auditing industry. There is a vivid literature in economics and other disciplines analyzing gender pay gaps (e.g., Blau and Kahn, 2017), and this literature highlights that gaps are especially important in occupations such as auditing, in which personal, long-term relationships with customers and the fulfillment of deadlines are important. Studies of highly educated workers (Noonan et al., 2005; Bertrand et al., 2010) suggest that at the beginning of professional careers, gender wage gaps are small but become accentuated over the career. We study auditors at the beginning of their careers and find that female auditors have lower salaries than male auditors do. Furthermore, the results show that for each additional point on the exam, the salary increase is smaller for female auditors than for male auditors. The difference between male and female auditors in income and professional competency can be driven by discrimination or by differences in career choices. We are not able to separate between these explanations.

Finally, we test how the age of the auditor when he or she takes the exam impacts the magnitude of the salary increase associated with a higher score on the exam. Consistent with the prediction that the audit firm has more information from other sources than the CPA exam does for older auditors, we find that the association between the score and salary is moderated by age. Indeed, another explanation of this result is that auditors who are older simply need more time to make themselves ready for the exam, indicating that they have lower ambitions and learning capabilities; therefore, they are paid less than younger auditors who do equally well on the exam. We are not able to separate these explanations from the data at hand.

The remainder of this paper is organized as follows. Section 2 presents the institutional setting, and Section 3 presents the hypotheses of the study. Section 4 describes the data and methods used to test the hypotheses. Section 5 presents the main empirical findings, and Section 6 includes additional analyses. Section 7 concludes the paper.

2. Institutional setting

2.1. The Swedish audit market

Like in other EU countries, in Sweden, audits are required for privately and publicly held companies. EU directives give countries the right to exempt smaller entities from statutory audit requirements. Until 2010, Sweden had not used this exemption but instead required all limited liability companies to be audited regardless of size. Since 2010, the smallest limited liability companies have been exempted from statutory audit requirements. However, the vast majority of all firms audited are privately held companies.

The Swedish audit market has more than 900 audit firms and is led by the Big 4 audit firms. On the basis of figures from 2009, the revenues of Big 4 firms equal 81.2% of all revenues from auditing and nonauditing services.[4] The revenues of PwC, EY, KPMG and Deloitte were 4,175; 1,983; 1,814 and 1,356 SEK million, respectively, whereas the numbers of employees were 3,402; 1,465; 1,814 and 1,076 respectively. For example, approximately 25% of the employees at PwC were auditors. The Big 4 firms employed approximately 50% of the certified auditors (CPAs), and in those firms, approximately 30% of the CPAs were partners. The number of CPAs has declined over the period analyzed, from 4,152 CPAs in 2005 to 3,994 in 2009 and 3,857 in 2013.

2.2. CPA certification

To be eligible to take the CPA exam, the audit associate should have a bachelor's degree and at least three years of practical experience. The Swedish Inspectorate of Auditors (SIA) established the topics that the theoretical education of the candidate must cover as part of the bachelor's degree or as a complement to it.[5] The CPA exam is designed to ensure that auditors have sufficient theoretical knowledge to conduct statutory audits in companies of different sizes and with different types of operations. Furthermore, the exam is designed to ensure that auditors can apply the relevant theoretical knowledge in their auditing practices (Auditing Decree § 3).

The SIA organizes the CPA exam twice a year (May and December). In each call, all of the candidates take the same CPA exam. The results of the exam are published in July/August of the same year and January of the following year. Passing associates receive the CPA certification after the publication of the exam results.[6]

The examination process is organized as follows. An audit firm (typically one of the Big 4) is hired to prepare exam drafts and correct exams. There is just one exam in Sweden, i.e., not several modules, as in, for example, the UK. The exam tests candidates' knowledge of accounting and auditing but may also include questions related to information technology, taxation law or corporate law. The questions on the exam focus on the auditing of private and public companies. Different types of experts at the audit firm, such as lawyers and accounting experts, provide input to the CPA exam preparation process. An examination committee consisting of three practicing auditors and two university professors' comments on exam drafts and supervises the preparation and correction of the exam. The audit firm responsible for correcting the exam receives anonymous files with the applicants' answers.

Files with the results of the exam are available upon request from the SIA. The data include information about the exam date and the individual's exam score, name, gender and birth date, as well as the name of the candidate's employer and the location of the audit office where the exam was taken.

To maintain certification, the auditor must be professionally active (at least 1,500 hours over a 5-year period), be employed by an audit firm and undertake continuous education. Failure to adhere to these requirements leads to the loss of certification (Auditing Act §§ 4 and 8; Auditing Decree § 8). Therefore, having another job (e.g., as a chief financial officer or university professor) and maintaining CPA certification are not possible.[7]

3. Theoretical background

3.1. Previous related literature: The CPA exam as an occupational license

Academics' interest in occupational licensing seems relatively limited compared with its economic relevance (see Kleiner 2000; Bryson and Kleiner 2019; Kleiner and Krueger, 2013). Accounting research views CPA certifications as occupational licenses and is influenced by economists' perspectives (e.g., Barrios, 2022).

[4] The data come from the financial statements of auditing firms. Not all of them refer to the same period. In this case, we use the available data between 2009 and 2010. During the period analyzed, there were no substantial changes.

[5] Further information can be found at https://www.revisorsinspektionen.se/en/English/.

[6] Until 2013, auditors (after completing two years of experience and meeting certain other requirements) were able to take an additional exam and apply to become an *authorized* public accountant. After a change in the law in 2013, only one type of certification exists. The analyses in this study are based on the results of the "first" CPA exam, which qualifies an auditor to complete audits of all types of companies (including listed companies).

[7] Until 2019 (i.e., throughout the period covered in the empirical analyses), an auditor was required to conduct at least 1,500 hours of auditing-related work over a 5-year period. There is currently no hour rule in the regulations. However, the Swedish Inspectorate of Auditors points out on its website that to meet the requirements of the Auditing Act and Auditing Decree, as a rule, an auditor must conduct audits at least half-time. Exemptions to this rule can be granted, however.

Initially, economists saw occupational licenses as entry barriers that benefit incumbents, leading to reduced competition and lower social welfare (e.g., Stigler, 1971; Lee et al., 1999). Later, different arguments based on informational problem issues were developed to explain why occupational licenses can increase social welfare.

Building on the Akerlof (1970) lemons model, several papers (e.g., Leland, 1979; Shaked and Sutton, 1981) analyzed how occupational licenses can serve as a signal of quality in service markets with adverse selection. In the case of CPA regulation, auditing firms have less information about the competencies of auditors. Shapiro (1986) analyzed how occupational licenses provide incentives to invest in training in markets with moral hazard. In the case of CPA regulation, auditing firms have less information than auditors about their training efforts.

Indeed, one assumption underlying the view that licensing can reduce information problems is that the audit firm does not observe how auditors develop competencies through training (moral hazard) or observe the abundant signals about the auditor's innate abilities (adverse selection) during three or more years in which the auditor works at the audit firm. However, an important point here is whether potential employers also have access to this information or whether auditors can provide credible signals to them. Prior research suggests that conclusions similar to those of initial models can be derived from models that assume that incumbent employers and their employees have the same information about their employees' competencies, but this is not the case for outside potential employers (Kahn, 2013). In the literature regarding informational-problem issues (Leland, 1979; Shaked and Sutton, 1981), the occupational license is a second-best solution, as it provides valuable information but comes with associated costs. As a result, the increase in social welfare from having information is greater than that in a scenario without any information but lower than that in a scenario with freely available information or that costs less.

Empirically, some efforts have been made to test some predictions of the entry barriers and informational problems theories. A significant part of the empirical literature on CPA licensing is based on data from the U.S. and focuses on the 150-hour rule, which requires applicants to complete 150 instead of 120 semester hours of education prior to taking the CPA exam (e.g., Young, 1986, 1988, 1991; Brahmasrene and Whitten, 2001; Grant et al., 2002; Boone et al., 2006; Allen and Woodland, 2006, 2010; Carpenter and Stephenson, 2006; Barrios, 2022; Sutherland et al., 2024). One issue of interest in this research is whether increasing the educational requirements impacts the pass rate. Overall, the research suggests that educational requirements have little effect on the pass rate. Furthermore, the research suggests that the 150-hour rule results in higher audit fees but has no effect on audit quality (Young, 1986; Allen and Woodland, 2010). Barrios (2022) concluded that the 150-hour rule reduces the supply of CPAs. Furthermore, he found no effect of the rule on applicants' writing skills. Therefore, and consistent with previous studies, the findings of Barrios (2022) support the notion that CPA certification serves primarily as an entry barrier to the audit market. In a recent study, Sutherland et al. (2024) found a greater entry decline for minority CPA candidates than for nonminority CPA candidates, suggesting that higher educational requirements foster discrimination. Furthermore, consistent with Barrios (2022), they found that higher educational requirements do little to improve quality. However, evidence concerning whether the CPA exam provides new information to the market is lacking. Next, we detail how we fill this gap in the literature.

3.2. The theoretical approach: Research questions about exam scores and salaries

The CPA exam is a measure of auditors' competencies at the moment of taking the exam. These competencies were developed before the exam and could even be innate. On the basis of prior research (Leland, 1979; Shaked and Sutton, 1981; Shapiro, 1986), the basic assumption underlying the prediction that the CPA exam can serve as a partial solution to informational problems is that i) auditors' competencies are relevant to audit firms, ii) those competencies are imperfectly observed in the market and iii) the CPA exam provides information about those competencies. Therefore, the relevant research questions are whether the CPA exam score has economic significance and, specifically, whether auditors' salary increases are positively related to their exam score before or after they obtain the publication of the CPA exam results. An association before the exam results are published would indicate that the competencies revealed by the score in the CPA exam were known by the incumbent audit firm and potential employers before the exam results were published, whereas an association after the publication indicates that the score provides new information about the auditor's competence in the job market.

The fact that workers' competencies are relevant for firms is not an exclusive prediction of the informational problems literature. The human capital literature (Becker, 1964; Mincer, 1974; Blaug, 1976) stresses the incentives for investing in training provided by the labor market, predicting that individuals who invest more in training tend to receive higher salaries.

Signaling theory (Spence, 1973; Weiss, 1995) opens the debate about whether training merely signals preexisting competencies to the market or develops competencies. Providing conclusive empirical evidence in favor of one explanation over the other is challenging because both predict a positive association between training and salaries. In the human capital literature, competencies are developed during the training process, whereas in the signaling literature, they are innate competencies revealed by the amount of time invested in training.

From the beginning, the literature distinguished between on-the-job and formal training (Mincer, 1962). Preparatory courses for CPA exams are examples of formal training. Therefore, the theoretical arguments presented above predict that if we observe annual salaries, increases in salaries reflect the new training accumulated during the year. This training is expected to be more important at the beginning of auditors' careers because it can be used for more years. Training allows auditors to develop (or signal) their competencies, and performance on the CPA exam is a measure that we, as researchers, have about the differences in competencies among auditors.

A common point of the abovementioned theoretical arguments is that the relationship between salaries and competencies is based on an implicit contract. Salaries change when market agents update information about auditor competencies. We do not know of the

existence of explicit contracts, specifically written contracts in which salaries are based on auditors' performance on the CPA exam or reasons for such contracts. Notably, competencies, either innate or developed through training, are available before the exam. Therefore, the relationship between salaries and auditors' performance on the CPA exam is interpreted in terms of the information provided about the competencies of those auditors. Notably, auditors do not have to make their performance on the CPA exam public. However, by just showing their incumbent employer their score on the CPA exam, the employer is expected to realize that this information can be easily and credibly transmitted to potential employers.

If the CPA exam provides information about auditors' competencies already available prior to the CPA exam, a positive association between the CPA score and the salary before the exam would be expected. Under this scenario, the score in the CPA exam is unlikely to alleviate information problems because information about the auditor's competences is already known and priced by the incumbent and potential employers. We summarize this scenario in the following hypothesis:

Hypothesis 1a. A positive relationship exists between the exam score and the auditor's salary before the auditor obtains the CPA certification.

When the information about auditors' competencies provided by the CPA exam is completely new, we expect the rejection of Hypothesis 1a. A main assumption underlying the prediction that the CPA exam can serve as a partial solution to informational problems is that auditors' competencies are imperfectly observed by the employer of the auditor and/or other audit firms prior to the publication of the CPA exam results. The publication of the exam scores provides a certification of the auditor's competencies that can be shown to the incumbent and potential employers. If the CPA exam reduces information problems, we expect a positive association between the CPA score and salary only after the publication of the exam results. We formulate the following hypothesis:

Hypothesis 1b. A positive relationship exists between the exam score and auditor salary variations after the auditor obtains CPA certification.

Information asymmetries about auditors' competencies are not the only argument leading to Hypothesis 1b (and explaining the rejection of Hypothesis 1a). For example, an alternative argument is that the CPA exam evaluates the competencies to carry out statutory audits, which can be performed only after the CPA is obtained. Therefore, those competencies are less useful for the tasks developed before the exam than for the tasks developed later in their careers. Although this alternative argument explains Hypothesis 1b (and rejects Hypothesis 1a), it does not justify the existence of an occupational license.

An alternative explanation for the existence of occupational licenses is their role as a barrier to entry that allows licensed professionals to obtain economic rents. A comparison of the salaries of similar occupations with and without licenses has been interpreted as an indication of economic rents (see Kleiner and Krueger, 2013). In our case, we can compare the yearly salary of the same auditor before and after certification. Notably, at early career stages, yearly salary increases are expected through training, and therefore, it is important to control for these expected increases. A significant abnormal annual increase in the salary for all auditors, irrespective of their score on the CPA exam, would suggest that licensed auditors obtain a salary premium. We summarize the prediction in the following hypothesis:

Hypothesis 2. Annual salary variations following CPA certification are greater than precertification annual salary variations for auditors who pass the exam, independent of their exam score.

Note that we observe auditors' salaries three years before the CPA exam, the year when the CPA exam results are published, and two years after the results are published, and all the hypotheses refer to these periods. Although we expect the effects described in Hypotheses 1b and 2 to occur once, we do not have a clear prediction of exactly what year they will occur. It is possible that the salary changes take place when the exam results are published, when certifications are provided, or when companies make salary reviews. In fact, different companies can have different timings to update salaries.

3.3. Exam scores and salary associations for different auditors

The usefulness of competencies gained during the preparation for the CPA exam may vary across different groups of auditors. One possible explanation for these differences can be observed from the theoretical models of licensing (Shapiro, 1986; Leland, 1979 or Shaked and Sutton, 1981). According to these models, licensing regulations primarily benefit providers of high-quality services.

Over the years, Big 4 firms have established a strong reputation in the audit market. Evidence in the auditing literature suggests that Big 4 firms, on average, provide higher-quality services than non-Big 4 firms do (DeFond and Zhang, 2014; Francis, 2023). To provide such quality, the competencies of auditors play a role. Che et al. (2020) provide evidence that differences in the competencies of auditors are related to differences in the quality of service of the companies where they are employed. One way to hire and retain competent people is to pay them sufficiently well and adopt compensation policies that incentivize auditors to develop their competencies. Consequently, we expect that the impact of CPA exam scores on salaries is stronger in Big 4 firms than in non-Big 4 firms, which is stated by the following hypothesis:

Hypothesis 3. The relationship between auditors' exam scores and their salaries is stronger for auditors at Big 4 firms.

In the literature on labor market discrimination (Neumark, 2018), gender and age have been extensively studied as key factors of salary discrimination. Such discrimination may stem from employer preferences (Becker, 1971) or expected productivity differences.

With respect to gender, a large and growing body of literature (for a review, see Blau and Kahn, 2017) documents lower salaries for women in the labor market. Some research has specifically examined partner positions in auditing firms, controlling for proxies of

professional competencies (Knechel et al., 2013; Dekeyser et al., 2021). Although previous evidence from other professions (Noonan et al., 2005; Bertrand et al., 2010) suggests that the gender salary gap may be narrower in the early stages of a professional career, Brahmasrene and Whitten (2001) and Brannan et al. (2021) provide evidence that women have a lower chance of passing the CPA exam, indicating the presence of potential discrimination. Indeed, one possible alternative explanation is the greater likelihood of women facing more work interruptions or having shorter working hours (Blau and Kahn, 2017), which are often associated with motherhood (Sigle-Rushton and Waldfogel, 2007).

The literature examining the impact of gender on audit outcomes suggests that female partners constrain earnings management more than male auditors do (Ittonen et al. 2013; Cameran et al., 2018; Li et al., 2017) and are more likely to issue going-concern opinions for financially distressed firms (Hardies et al., 2016). Overall, this literature suggests that women consistently deliver higher-quality audits than men do. Because we do not have a clear prediction, we propose the following null hypothesis:

Hypothesis 4. There are no differences in the relationships between auditors' exam scores and salaries between male and female auditors.

We next discuss how auditor age impacts the association between exam score and salary. First, assuming that all auditors initiate their auditor career at a similar age, being older when passing the CPA exam indicates that they have delayed taking the exam. This could indicate that auditors who pass the exam when they are older have weaker learning capabilities than those who pass when they are younger. According to the career concerns literature (Dewatripont et al.,1999), this can be viewed as an indication of lower productivity. Second, a person's productive ability is revealed through observations of current and prospective employers. Therefore, if an auditor pursues her career as an auditor in a later phase, the audit firm will have more information about her capabilities than if an auditor pursues her career immediately after graduating from the university, suggesting that a high (or low) score comes less as a surprise when an auditor is older. We summarize the discussion in the following hypothesis:

Hypothesis 5. The relationship between auditors' exam scores and salaries after they obtain CPA certification is stronger for younger auditors.

4. Research design

4.1. Sample selection

We examine an unbalanced data panel of Swedish auditor salaries. The auditors in the sample took the CPA exam from 2006 to 2010. For each auditor, we have a maximum number of six observations—three years before exam results are published, the year of publication, and two years after publication. Next, we detail the sample sources and construction.

The data sources are SIA and Ratsit. SIA provided us with the name, individual score on the CPA exam, date of the exam, date of certification, gender, date of birth, name of employer and location of the audit office. Ratsit provided us with information about the annual salary for a ten-year period (2002–2011) for certified auditors active at the end of 2011. Ratsit collects information from personal income taxes.

The sample is composed as follows. We received information on the CPA exam score for all candidates who took (passed or failed) the exam from 2006 to 2012, for a total of 2,386 observations. To obtain income data at least one year after the exam, we study auditors who passed the exam between 2006 and 2010. We omit the following observations from the sample. First, since we have income data only for auditors who eventually passed the exam, we omit auditors who failed. Second, we exclude auditors who had an old type of examination that entitled them to audit small clients before taking the CPA exam. Third, we exclude auditors with less than SEK 240,000 in annual salary.[8] The reason for this omission is that we want to reduce the risk that parental leave and part-time work influence the results. Finally, for inclusion in the sample, we require that all variables be available for the year during which the exam results are published and for the previous year, leaving 643 auditors.

We use an unbalanced panel with observations three years before the CPA exam results are published (t=-3, -2, -1), the year during which the results of the CPA exam are published (t=0) and two years after publication (t=1, 2). As discussed in Section 2, auditors normally receive the CPA certification within a few months after the publication of the exam results. Therefore, the exam publication year corresponds with the certification year. The choice to include three years before the exam is based on the requirement that applicants have at least three years of practical experience before the exam. We expect that all the information contained in the scores will result in salary increases within two years after the exam (t=0, 1).

The panel includes six years of data for 285 of the 643 auditors, five years for 203 auditors, four years for 132 auditors, and less than four years of data for 23 auditors, for a total of 3,321 observations. However, as a robustness check, we discuss the results when our models are estimated on a balanced panel with fewer auditors and years in the additional analysis section of the paper. Table 1 displays the sample by year and exam publication year (t). Since the results of the December exam are published in the next year, each year in Table 1 includes auditors who took the exam in May of the same year and auditors who took the exam in December of the previous year. For example, in 2006, 113 auditors took the exam, 33 of whom took it in the spring. The exam results for the 80 auditors who took the exam in December were published in 2007. The 83 auditors whose exam scores were published in 2011 took the exam in December 2010. Overall, 66% of the auditors (427/623) took the exam in the autumn, and 33% (216/623) took the exam in the spring.

[8] The average salary in Sweden in 2006 was a little bit more than SEK 300.000 based on OCDE sources.

Table 1
Sample composition by year

Exam publicationyear	Number of auditors by year	Observations by year									
		2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
2006	33	27	31	33	33	32	32				188
2007	132		114	124	132	132	132	126			760
2008	83			67	78	83	83	80	82		473
2009	138				104	129	138	138	133	132	774
2010	174					128	162	174	174	171	809
2011	83						70	81	83	83	317
Total number of auditors/observations	643	27	145	224	347	504	617	599	472	386	3,321

4.2. Variable definitions

The above information is summarized in the following variables. *Salary* is a time-variant variable measured in thousands of SEKs inflated with the consumer price index to reflect the 2011 price level. In most analyses, we use the natural logarithm of the salary. The difference in the logarithm of salaries between two consecutive years can be interpreted as an approximation of the annual percentage increase in salaries.

We use different variables to capture the period during which the auditor is observed. *Time* takes the value of 0 when the auditor is observed three years prior to the publication, 1 when it is observed two years prior to the publication and continues until 5 when the auditor is observed two years after the publication of the exam results. $Cert_t$ are six indicator variables that take the value of one in year t (remember that t=0 is the year of the publication of the exam results) and zero otherwise. In our econometric models, we use different specifications that avoid perfect collinearity, which are equivalent in terms of their predicted salaries. First, we omit the constant, the variable *Time,* and introduce the six indicator variables $Cert_t$. Second, we introduce the constant and omit one of the $Cert_t$ indicators; the omitted indicator will be $Cert\_3$ jointly with the variable *Time*. Third, we introduce a constant, the variable *Time*, and drop two indicator variables, in this case, $Cert\_3$ and $Cert\_2$. The estimated models are equivalent in terms of predicted salaries and therefore explanatory power, but the coefficients allow us to test different hypotheses. We use one or the other specification depending on the hypotheses we want to test. Because auditors did the exam in different years, we also included indicator dummies for each year. Robustness tests are performed, including nine indicator variables (*Exam time FE*) on the basis of whether the CPA exam was taken in the spring or autumn from 2006 to 2010.

Big 4 is a dummy variable indicating whether the auditor is employed in PwC, EY, KPMG or Deloitte. Information about the location of the office where the auditor worked is summarized via three dummies, Stockholm, Gothenburg and Malmo, with the excluded category being the remaining cities. Although they are time-variant variables, we do not have information about the firm and the office at which the auditor worked before taking the exam. In the two years after the exam, only 4% percent of the auditors changed firms, with 1.7% changing from non-Big 4 firms to Big 4 firms and 2.3% changing the other way around. The Big 4 affiliation and office location prior to the exam is based on the audit firm at which the auditor worked when he or she took the exam.[9]

The remaining variables are time-invariant variables provided when auditors pass the exam. The maximum number of points on the CPA exam is 100, the minimum is 0, and at least 75 points are required to pass the exam. As all the auditors in the sample pass the exam, the variable *Score* is the points received minus the minimum to pass the exam. Auditors that barely pass the exam have a *Score* equal to zero, and there are no negative values because we use a single exam score for each auditor. We also include the *Age* of the auditor in the year during which the auditor took the CPA exam and *Female*, a dummy variable with a value of one when the auditor is a woman. Table 2 summarizes all these variables.

5. Results

5.1. Descriptive statistics

Table 3 presents evidence of auditors' annual average salary in the different periods of CPA certification. The table displays salaries, the natural logarithm of the salary, the average annual change in salary, and correlations between annual salary changes.

Column 6 of Table 3 shows the correlations between the increase in salary and the exam score. The correlations are insignificant in years before the exam, whereas they are positive and significant in the year when the exam result is published and in years after publication. Consequently, the univariate evidence supports Hypothesis 1b but not Hypothesis 1a. Columns 7 to 10 of Table 3 present the correlations between the salary increases of the different auditors during the six periods analyzed.

Hypothesis 2 predicts that annual salary increases are greater after than before CPA certification. However, the univariate evidence in Column 5 of Table 3 suggests that the average annual increase in salary decreases from 8.6% one year before certification to 5.8% two years after certification; therefore, if something occurs, the average annual salary increase is reduced.

Table 4 presents further descriptive statistics for the variables. The average Score is 4.731, and the median score is 4. Ten percent of

[9] Those changing to Big 4 firms have an average score of 78.91 and age of 31.95, whereas the figures for those changing to non-Big 4 firms are 78.73 and 32.88. Take note that the number of changes is very small, 11 and 15 cases, respectively.

Table 2
Variable explanations

Variable	Definition
Score	Score on the CPA exam less 75. The minimum score to pass the exam is 75.
Lnsalary	Natural logarithm of the salary income in thousands of Swedish Krona. The salary is adjusted with the Consumer Price Index to reflect the price level in 2011.
Big 4	Indicator variable that takes the value one if the auditor is employed by PwC, EY, KPMG or Deloitte.
Female	Indicator that takes the value one for women.
Age	Age of the auditor in the year during which he or she took the CPA exam.
Time	Variable taking an integer number from 0 (three years prior to the exam) to 5 (two years after the exam).
$Cert_t$	Indicator variables taking the value one for the year t (t=0 the year of the publication of the CPA exam results).
Stockholm	An indicator variable taking the value one if the auditor work in Stockholm (the capital of Sweden)
Gothenburg	An indicator variable taking the value one if the auditor work in Gothenburg (the second largest city)
Malmo	An indicator variable taking the value one if the auditor work in Malmo (the third largest city)
Year FE	Indicator variables for the years 2003 to 2011.
Exam time FE	Nine indicator variables based on whether the CPA exam was taken in the spring or autumn in the years 2006 to 2010.

Table 3
Evolution of compensation and its relationship with exam scores

Descriptive statistics Averages					Correlation matrix					
N-Observations. (1)	Periods(2)	*Salary (SEK)* (3)	*LnSalary* (4)	Annual variations (*ds*)(5)		*Score* (6)	ds_{-1}(7)	ds_0(8)	ds_1(9)	ds_2(10)
510	3 years before (t=-3)	319.143	5.751		$LnSal_{-3}$	-0.035	**-0.297**	0.002	**-0.158**	-0.034
605	2 years before (t=-2)	340.737	5.815	0.064	ds_{-2}	-0.016	0.017	**-0.130**	0.060	-0.036
643	1 year before (t=-1)	371.639	5.901	0.086	ds_{-1}	0.081				
643	Publication year (t=0)	400.799	5.976	0.075	ds_0	**0.130**	**-0.228**			
548	1 year after (t=1)	430.457	6.043	0.067	ds_1	**0.141**	-0.072	**-0.171**		
372	2 years after (t=2)	458.288	6.101	0.058	ds_2	0.019	-0.043	-0.071	**-0.205**	
Total: 3,321	Average	383.005	5.923	0.070	Correlation: $LnSal_{-3}$ *with* ds_{-2} is **-0.404**					

Note: $LnSal_{-3} = LnSalary_{t=-3}$; $ds_t = LnSalary_t - LnSalary_{t-1}$. The correlations in bold are significant at the 1% level.

the auditors have a score that is more than 11 points above the passing level. The table also shows that 41.5% of the auditors are women, and approximately 60% work at a Big 4 firm at the time the results of the exam were published. The average age of the auditors at that time of the exam is 32 years.

Table 5 presents the correlation matrix among the variables. The results show that *Big 4* and *Age* are positively correlated with *Lnsalary*, whereas *Female* is negatively correlated with *Lnsalary*. The correlation matrix also suggests that auditors in Stockholm (the capital of Sweden) have a higher salary. Younger auditors and those at Big 4 auditors perform better on the exam, whereas there are more females and younger auditors at Big 4 audit firms than at non-Big 4 firms.

5.2. Econometric specification

The univariate evidence may be influenced by correlated omitted variables, so for our main tests of the hypotheses, we use the estimations of three models, ordered from less to more general. The first model is as follows:

$$Lnsalary = \beta_0 + \beta_1 Time + \sum_{t=-1}^{2} \beta_{t+3} Cert_t + \sum_{x=1}^{3} \beta_{x+5} Mediator_x + Locationfixedeffects + Yearfixedeffects + \varepsilon \quad (1)$$

where βs are the parameters to be estimated and ε is the error term. With an unbalanced data panel, we cannot compute the annual wage variations without losing observations. The use of levels and auditor fixed effects allows us to estimate annual salary variations with all the observations.[10] The estimated annual salary change of the same auditor between periods t=-2 and t=-3 is the coefficient of *Time* (i.e., β_1). Between periods t=-1 and t=-2, the annual salary change is the coefficient associated with *Time* plus the one associated with $Cert_{t=-1}$, $\beta_1 + \beta_2$, whereas that between periods t=0 and t=-1 is the coefficient associated with *Time* plus the difference of the coefficients associated with $Cert_{t=0}$ and $Cert_{t=-1}$, $\beta_1 + \beta_3 - \beta_2$, and so on. In short, to support Hypothesis 2, we should be able to empirically reject the null hypotheses that all the coefficients associated with $Cert_t$ are zero. The regressions also include dummies for the mediator variables *Big4*, *Female* and *Age*. Finally, we include location fixed effects to control for differences associated with compensation for the cost of life, as well as year indicators for controlling real income changes.

[10] The results with the change in salary as the dependent variable are qualitatively similar.

Table 4
Descriptive statistics during the year the exam scores were published (t=0)

	Mean	Median	P10	P90	SD	N
Lnsalary	5.976	5.963	5.766	6.182	.181	643
Score	4.731	4	0	11	4.264	643
Big 4	0.605	1.000	0.000	1.000	0.489	643
Female	0.415	0.000	0.000	1.000	0.493	643
Age	32.131	31.028	28.137	37.333	4.231	643
Stockholm	0.294	0.000	0.000	1.000	0.456	643
Gothenburg	0.101	0.000	0.000	1.000	0.302	643
Malmo	0.078	0.000	0.000	0.000	0.268	643
Other cities	0.527	1.000	0.000	1.000	0.450	643

Note: The variable explanations are in Table 2. The variables are measured during the year the CPA exam scores were published (t=0). Score and Female are time invariant. *Age* corresponds to t=0, and the age of the auditor in any of the periods analyzed is *Age* +*Time* -3, which is not included in the analyses to avoid perfect collinearity. We observe only 26 changes in firms and 20 changes in locations (only 3 auditors change both) after CPA certification.

Table 5
Correlation matrix (N=3,321)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Lnsalary (1)	1								
Score (2)	**0.364**	1							
Big 4 (3)	**0.049**	**0.075**	1						
Female (4)	**-0.126**	-0.006	**0.088**	1					
Age (5)	**0.063**	**-0.091**	**-0.158**	0.012	1				
Stockholm (6)	**0.244**	0.028	**-0.046**	**0.036**	**-0.120**	1			
Gothenburg (7)	0.032	0.012	**-0.061**	**-0.046**	-0.028	**-0.216**	1		
Malmo (8)	0.005	-0.018	**0.042**	0.032	**-0.065**	**-0.186**	**-0.098**		
Other cities (9)	**-0.243**	-0.023	**0.057**	-0.022	**0.161**	**-0.679**	**-0.358**	**-0.308**	1

Note: The figures in bold indicate significance at the 5% level. The variables are explained in Table 5.

In a second specification, we include the score multiplied by $Cert_t$ variables:

$$Lnsalary = \beta_0 + \beta_1 Time + \sum_{t=-1}^{2} \beta_{t+3} Cert_t + \sum_{x=1}^{3} \beta_{x+5} Mediator_x + \sum_{t=-3}^{2} \beta_{t+12} Score{*}Cert_t + Locationfixedeffects + Yearfixedeffects + \varepsilon \quad (2)$$

The coefficients of *Score* * $Cert_t$ (i.e., β_9 to β_{14}) provide tests of hypotheses 1a and 1b. Recall that the sample includes observations three years before the exam, the exam year and three years after the publication of the score in the CPA exam. Therefore, if we can reject the null hypothesis that all the coefficients referring to periods before certification (β_9 to β_{11}) are zero, we find support for Hypothesis 1a. If we can reject the null hypothesis that all the coefficients referring to periods when the auditor has the certification (β_{12} to β_{14}) are zero, we find support for Hypothesis 1b. The coefficients of *Score* * $Cert_t$ measure the salary increase compared with the first year in the sample, and the annual salary increase is the difference between the estimates of *Score* * $Cert_t$ and *Score* * $Cert_{t-1}$. For example, if $\beta_{13} = \beta_{14}$, this implies that the estimated salary increase between periods t=2 and t=1 is zero.

Note that Equation (2) should not be interpreted in terms of causality. If the equation is interpreted as a causal model, it would suggest that the score in the exam influences the salary in years before the exam results are published, which is not the case. We see the exam score as a proxy for factors underlying salary variability that could cause variability in exam scores and that the competencies measured in the exam are the main underlying factor. Because those competencies are developed before the exam, they can affect salaries before or after the results of the exam become public.

In a third specification, we interact *Score* * $Cert_t$ with the mediator variables *Big4*, *Female* and *Age*:

$$Lnsalary = \beta_0 + \beta_1 Time + \sum_{t=-1}^{2} \beta_{t+3} Cert_t + \sum_{x=1}^{3} \beta_{x+5} Mediator_x + \sum_{t=-3}^{2} \beta_{t+12} Score{*}Cert_t + \sum_{x=1}^{3} \times \sum_{t=-3}^{2} \beta_{6(x-1)+(t+3)+15} Mediator_x{*}Score{*}Cert_t + Locationfixedeffects + Yearfixedeffects + \varepsilon \quad (3)$$

This allows us to test hypotheses 3 to 5, i.e., how the effects of the score on wages are moderated by the *Big4*, *Female* and *Age* variables. All the specifications have been estimated without and with auditors' fixed effects. Finally, we have to omit *Score* * $Cert_{t=-3}$ (and multiplication with moderators) to avoid perfect collinearity because the score is a time-invariant variable.

5.3. Model Estimations

We estimate Equation (1) via ordinary least squares (OLS) with and without auditor fixed effects to report the effects of time-invariant variables on salary, including the CPA exam score. Section 4.2 describes the controls that ensure that the CPA exam measures the capacity of auditors to conduct statutory audits. Differences in the capacities developed could be due to differences in auditors' personal characteristics (such as their capacity for effort, their learning capabilities or soft skills). These personal characteristics are arguably permanent and valued by firms. For example, permanent personal characteristics could affect the selection of previous educational institutions, such as universities, and the performance of auditors in those institutions and grades. Although this information is usually incorporated into the curricula of auditors, we do not have access to it or the information related to the performance of auditors in their previous and current jobs. We expect that salaries reflect this information, so they are captured by an auditor fixed effect.

In the estimated auditor fixed-effects model, the time-invariant regressors *Female*, *Age*, *Score*Cert*$_{-3}$ and their interactions are excluded from these regressions because of perfect collinearity. When the regressions with auditor fixed effects are interpreted, changes in Big 4 affiliation and location are few, suggesting that the coefficient estimates of these variables are imprecise.

5.4. Main results

Table 6 presents the OLS estimates of Model (1). Columns 1 and 2 test Hypotheses 1 and 2, whereas Column 3 tests Hypotheses 3 to 5. All regressions are significant at the 0.001 level, and most have an R-square of approximately 40%. Table 7 presents regressions with auditor fixed effects. The within R-squared values of these regressions are between 56% and 59%, and the overall R-squared values are between 27% and 29%. Furthermore, F tests show that auditor fixed effects are highly significant (p values < 0.0001).

The coefficients associated with the interactions *Score* * *Cert*$_{-3}$, *Score* * *Cert*$_{-2}$, and *Score* * *Cert*$_{-1}$ are not positive and statistically significant in any of the estimations in Tables 6 or 7. Therefore, we reject Hypothesis 1a; we do not find an association between the score and salaries before the publication of the exam results.

The interactions *Score* * *Cert*$_0$, *Score* * *Cert*$_1$, and *Score* * *Cert*$_2$ measure the associations between the CPA exam score and the salary in the years during which the exam results are published, one year after publication and two years after publication, respectively. Consistent with Hypothesis 1b, the coefficients are significantly positive in Column 2 of Tables 6 and 7. The dependent variable is measured in logs, implying that the estimated coefficient approximately expresses the change in salary as a percentage; that is, auditors with one more point on the exam have a 0.4–0.5% higher salary in the year during which the CPA exam results are published and 0.7–0.8% higher thereafter. Wald tests reveal that the differences between *Score* * *Cert*$_{-1}$ and *Score* * *Cert*$_0$ and between *Score* * *Cert*$_0$ and *Score* * *Cert*$_1$ are significant at the 0.05 level or at the 0.10 level in column 2 of Tables 6 and 7. The difference between *Score* * *Cert*$_1$ and *Score* * *Cert*$_2$ is insignificant. In conclusion, these results suggest that *Score* impacts the salary in the examination year and that the impact of *Score* on the salary is greater one year after the exam than in the exam publication year and is maintained later.[11]

Hypothesis 2 focuses on whether auditors receive exceptional salary increases when they take the exam and receive the CPA certification. We control for a constant salary increase with *Time*; therefore, positive coefficients on the indicators *Cert*$_0$, *Cert*$_1$, and *Cert*$_2$ would indicate that auditors receive higher than predicted salaries in the certification and subsequent years. The *Cert* indicators in Column 1 measure the increase in salary over the long-term trend without controlling for the score in the CPA exam, whereas the *Cert* indicators in Columns 2 and 3 show the association for auditors with the minimum score to pass the exam. Tables 6 and 7 show that the coefficients of *Cert*$_0$, *Cert*$_1$, and *Cert*$_2$ are insignificant or negatively significant at the 0.10 level.[12] Therefore, the results do not support Hypothesis 2. Overall, the coefficients of *Time* suggest that the annual increase in salaries is approximately 6–7%.[13]

Hypothesis 3 states that the association between the CPA exam score and salary is stronger for auditors at Big 4 firms. The results presented in Column 3 of Tables 6 and 7 strongly support this prediction. The interactions between Big 4 and Score in the certification year and subsequent years have positive coefficients that are significant at the 0.05 or 0.01 level. Furthermore, the results suggest that the association between the salary and the score on the CPA exam is significantly stronger years after the exam than before the exam for auditors at Big 4 firms. Wald tests show that the difference between the coefficient estimates of Big4 * Score * Cert$_{-1}$ and Big4 * Score * Cert$_0$ is significant at the 0.10 level, and the differences between Big4 * Score * Cert$_{-1}$ and Big4 * *Score* * *Cert*1 and between Big4 * Score * Cert$_{-1}$ and Big4 * Score * Cert$_2$ are significant at the 0.05 level in Tables 6 and 7. In conclusion, the results suggest that Big 4 auditors

[11] We include year indicators to control for real changes in salaries. However, the sample covers a short period, which raises the question of whether multicollinearity problems could arise because of the correlation between the exam time and year indicators. The coefficients of *Score* * *Cert*$_0$, *Score* * *Cert*$_1$ and *Score* * *Cert*$_2$ are positive and significant at the 0.05 level in the OLS and fixed-effect regressions when the year indicators are eliminated from the models. The coefficients of *Score* * *Cert*$_{-1}$ and *Score* * *Cert*$_{-2}$ are insignificant. Thus, the results related to H1a and H1b are qualitatively and quantitatively similar when year indicators are dropped.

[12] The coefficients of *Time* are 0.069 and 0.070 in Columns 2 and 3 in Table 7, while the coefficients of *Cert*$_2$ are -0.071 and -0.070, respectively, suggesting that the change in the inflation-adjusted salary two years after the CPA certification for auditors that pass the exam with minimum points is close to zero.

[13] The variance inflation factors (VIFs) of the test variables *Cert-*$_1$, to *Cert*$_2$ in Regression (1) are between 5.59 and 27.62. The reason for the high VIFs of variables *Cert-*$_1$, to *Cert*$_2$ is that we include *Time* in the regressions. When we drop *Time* from Regression (1) in Table 6, the VIFs of *Cert-*$_1$, to *Cert*$_2$ are below 3. An alternative way to test H2 is to study whether the salary change the year before the exam (*Cert-*$_2$ to *Cert-*$_1$) is different from the salary change the year after the exam (*Cert-*$_1$ to *Cert*$_0$) when *Time* is dropped. Consistent with the results in Table 6, the results suggest that we fail to find support for Hypothesis 2.

Table 6
Score on the CPA exam and auditor salaries: OLS regressions

Model		1			2			3	
Dependent Variable:LnSalary	*β*		*t value*	*β*		*t value*	*β*		*t value*
*Score * Cert_3* (H.1a)				-0.002		-0.84	-0.003		-0.83
*Score * Cert_2* (H.1a)				-0.001		-0.84	-0.006	**	-2.42
*Score * Cert_1* (H.1a)				0.002		1.32	-0.001		-0.38
*Score * Cert$_0$* (H.1b)				0.004	**	2.55	-0.002		-0.62
*Score * Cert$_1$* (H.1b)				0.007	***	3.50	-0.001		-0.28
*Score * Cert$_2$* (H.1b)				0.007	***	2.76	0.005		1.42
Big 4	0.047	***	4.35	0.044	***	4.07	0.017		1.03
*Big 4 * Score * Cert_3* (H.3)							0.001		0.30
*Big 4 * Score * Cert_2* (H.3)							0.006	*	1.75
*Big 4 * Score * Cert_1* (H.3)							0.004		1.05
*Big 4 * Score * Cert$_0$* (H.3)							0.007	**	2.19
*Big 4 * Score * Cert$_1$* (H.3)							0.011	***	2.77
*Big 4 * Score * Cert$_2$* (H.3)							0.011	**	2.52
Female	-0.067	***	-6.15	-0.066	***	-6.13	-0.064	***	-3.85
*Female * Score * Cert_3* (H.4)							0.005		1.51
*Female * Score * Cert_2* (H.4)							0.005		1.59
*Female * Score * Cert_1* (H.4)							0.001		0.39
*Female * Score * Cert$_0$* (H.4)							-0.001		-0.40
*Female * Score * Cert$_1$* (H.4)							-0.003		-0.89
*Female * Score * Cert$_2$* (H.4)							-0.012	***	-3.02
Age (centered)	0.007	***	3.43	0.007	***	3.61	0.007	**	2.17
Age (cent) Score * Cert_3*(H.5)							0.002	**	2.38
Age (cent) Score * Cert_2*(H.5)							0.001	*	1.71
Age (cent) Score * Cert_1* (H.5)							0.000		-0.45
Age (cent) Score * Cert$_0$* (H.5)							-0.001		-1.09
Age (cent) Score * Cert$_1$* (H.5)							-0.001		-1.42
Age (cent) Score * Cert$_2$* (H.5)							0.000		-0.12
Time	0.062	***	8.25	0.061	***	6.38	0.063	***	6.49
Cert_1 (H.2)	0.032		1.33	-0.006		-0.17	-0.002		-0.07
Cert$_0$ (H.2)	0.015		1.55	-0.001		-0.06	0.000		-0.04
Cert$_1$ (H.2)	0.023		1.34	-0.002		-0.09	0.000		0.00
Cert$_2$ (H.2)	0.016		0.50	-0.026		-0.58	-0.028		-0.63
Intercept	5.727	***	147.81	5.736	***	147.97	5.745	***	151.75
Year FE	Yes			Yes			Yes		
Location FE	Yes			Yes			Yes		
Auditor FE	No			No			No		
Number of observations	3,321			3,321			3,321		
R-squared		0.40			0.41			0.43	
Wald-tests:				F value					
*Score * Cert$_0$ = Score * Cert_1*				3.00	*				
*Score * Cert$_1$ = Score * Cert$_0$*				3.60	*				
*Score * Cert$_2$ = Score * Cert$_1$*				0.03					

The *t* values are based on robust standard errors clustered by auditor. The variable explanations are provided in Table 1. *. ** and *** denote statistical significance at 0.10. 0.05 and 0.01, respectively, according to two-tailed tests.

value the technical knowledge tested in the exam more than non-Big 4 auditors do.[14]

Hypothesis 4 predicts that the association between the CPA exam score and salary differs between male and female auditors. The findings in Tables 6 and 7 suggest that women receive a smaller salary increase in the certification and subsequent years for a given CPA exam score than do male auditors; however, the difference is not statistically significant in all regressions.[15]

Hypothesis 5 predicts that the relationship between Score and Lnsalary is negatively associated with age. However, this pattern is not clearly observed in the OLS estimations in Table 6. In the fixed effects estimations in Table 7, the coefficients of the interactions between Score and Age are negative and of a similar magnitude in all years analyzed. On average, for an auditor who took the exam

[14] The results in the study do not necessarily mean that auditors at Big 4 firms on average have the better technical knowledge needed for the job than auditors at non-Big 4 firms do, because the exam may to a larger extent measure the skills needed when working at Big 4 firms. For example, the exam should test the ability of the auditor to audit clients of different sizes. While auditors at Big 4 firms may have large as well as small clients, auditors at non-Big 4 firms mostly have smaller and privately held clients. In essence, the questions focusing on public clients in the CPA exam might not be as relevant for auditors at non-Big 4 firms.

[15] The sum of the coefficients *Score * Cert$_t$* and *Female * Score * Cert$_t$* expresses the association between the score in the exam and the salary for female auditors. The sum is insignificant in all years except two years after the exam, when the association is negatively significant at the 0.10 level. A possible explanation for the unexpected result that the association is negative is that female auditors that do well on the exam are in the phase of life when they are on maternity leave or work part time to take care of their children. We are not able to examine these possibilities any further with the data that we have.

Table 7
Score on the CPA exam and auditor salaries: Auditor fixed effects

Model	1			2			3		
Dependent Variable:LnSalary	*β*		*t value*	*β*		*t value*	*β*		*t value*
*Score * Cert_2* (H.1a)				0.000		-0.29	-0.003		-1.14
*Score * Cert_1* (H.1a)				0.003		1.46	0.002		0.61
*Score * Cert_0* (H.1b)				0.005	**	2.39	0.001		0.49
*Score * Cert_1* (H.1b)				0.008	***	3.26	0.003		0.92
*Score * Cert_2* (H.1b)				0.007	***	2.58	0.006	*	1.71
Big 4	0.000		0.01	-0.002		-0.07	-0.013		-0.56
*Big 4 * Score * Cert_2* (H.3)							0.004	*	1.87
*Big 4 * Score * Cert_1* (H.3)							0.002		0.67
*Big 4 * Score * Cert_0* (H.3)							0.005	**	2.07
*Big 4 * Score * Cert_1* (H.3)							0.007	**	2.25
*Big 4 * Score * Cert_2* (H.3)							0.008	**	2.23
*Female * Score * Cert_2* (H.4)							0.000		-0.20
*Female * Score * Cert_1* (H.4)							-0.004		-1.49
*Female * Score * Cert_0* (H.4)							-0.006	**	-2.32
*Female * Score * Cert_1* (H.4)							-0.008	**	-2.52
*Female * Score * Cert_2* (H.4)							-0.014	***	-4.22
*Age (cent) * Score * Cert_2*(H.5)							-0.001	**	-1.98
*Age (cent) * Score * Cert_1*(H.5)							-0.002	***	-4.34
*Age (cent) * Score * Cert_0* (H.5)							-0.002	***	-5.61
*Age (cent) * Score * Cert_1* (H.5)							-0.002	***	-5.39
*Age (cent) * Score * Cert_2* (H.5)							-0.002	***	-3.57
Time	0.066	***	9.68	0.069	***	7.57	0.070	***	7.65
Cert_1 (H.2)	0.006		0.27	-0.043		-1.37	-0.038		-1.20
Cert_0 (H.2)	0.014		1.50	-0.005		-0.41	-0.005		-0.37
Cert_1 (H.2)	0.011		0.68	-0.020		-0.93	-0.017		-0.77
Cert_2 (H.2)	-0.021		-0.68	-0.071	*	-1.74	-0.070	*	-1.73
Intercept	5.773	***	170.25	5.773	***	171.09	5.773	***	178.73
Year FE	Yes			Yes			Yes		
Location FE	Yes			Yes			Yes		
Auditor FE	Yes			Yes			Yes		
Number of observations	3,321			3,321			3,321		
R-Square	0.27/0.56			0.29/0.56			0.28/0.59		
Wald-tests									
*Score * Cert_0 = Score * Cert_1*				2.95	*				
*Score * Cert_1 = Score * Cert_0*				5.13	**				
*Score * Cert_2 = Score * Cert_1*				0.25					

The *t* values are based on robust standard errors clustered by auditor. The variable explanations are provided in Table 5. *. ** and *** denote statistical significance at 0.10. 0.05 and 0.01, respectively, according to two-tailed tests. The first R-square is within, and the second is overall.

when he or she was one year younger, the firm was already paying a 0.2% higher salary for an extra point on the CPA exam before taking it. [16]

The coefficients associated with *Score * Cert_t* in Columns 3 of Tables 6 and 7 are mostly insignificant, showing that the positive association between the CPA exam score and salary is driven by young, male-auditors working at Big 4 firms. A related observation that can be made from Table 6 is that auditors at Big 4 firms have a significantly higher salary than auditors at non-Big 4 firms. Table 6 also shows that female auditors have approximately 7% lower salaries than male auditors and that auditors who are older when they take the exam have a higher salary of approximately 0.7% for each additional year in age.[17]

6. Additional analyses

The results in the previous section use as many observations as possible, so we work with an unbalanced data panel. This means that auditors are not equally represented; for 23 of the 643 auditors, we have only two or three years of data. The way to avoid such problems is to use a balanced data panel. We estimate OLS regressions on a balanced sample with 513 auditors over four years (two years before the publication of the exam results, the year during which the exam results are published, and one year after publication).

[16] Although our sample mainly includes auditors in an early phase of their career, the sample includes 36 auditors (5.6% of all the auditors in the sample) who were older than 40 years when they took the CPA exam. A possible reason they may have taken the CPA exam at an older age is that they worked as accountants before starting their career as auditors. When we exclude auditors whose ages are above 40 years, the coefficient of *Age (centered) * Score * Cert_0* is negatively significant at the 0.10 level and that of *Age (centered) * Score * Cert_1* is negatively significant at the 0.05 level in the OLS regressions. These results are consistent with the prediction in Hypothesis 5.

[17] To investigate the presence of multicollinearity between the dependent variables in Regressions (2) and (3) in Table 6, we calculate the VIFs. The VIFs of *Score * Cert_t* (the test variables) in Regression (2) are between 2.03 and 2.31, below the usual critical values. The VIFs of the test variables *Score * Cert_t * Big 4, Score * Cert_t * Gender* and *Score * Cert_t * Age* in Regression (3) of Table 6 are all below 5.

The main results are maintained. Consistent with the prediction in Hypothesis 1a, the coefficients associated with the interactions *Score* * $Cert_{-2}$ and *Score* * $Cert_{-1}$ are statistically nonsignificant. Consistent with the prediction in Hypothesis 1b, the coefficients of *Score* * $Cert_0$ and *Score* * $Cert_1$ have positive coefficients that are significant at the 0.05 level. These results are qualitatively and quantitatively similar to the results in Column 2 of Table 6. Additionally, consistent with Hypothesis 3, the regression shows that the association between salaries and the CPA exam score is significantly stronger for auditors at Big 4 firms.

We next test the robustness of our results to the inclusion of additional control variables. The CPA exam is organized twice a year, the results from the May exam are published in August, and the results from the December exam are published in January of the next year. The exam results published in January can influence the salary during most of the year, whereas the results published in August can influence the salary only in the final months of the year. To take this possibility into account, we interact a *May exam* indicator with *Score* * $Cert_t$. The term *MayExam* * *Score* * $Cert_0$ has a negative but insignificant coefficient in an OLS regression with the same control variables as in Column 2 of Table 6 (coefficient and t value of -0.003 and 0.94, respectively). *MayExam* * *Score* * $Cert_0$ has a negative but insignificant coefficient in a regression with auditor fixed effects as well (coefficient and t value of -0.001 and 0.35, respectively). Additionally, we replicate some of the estimations in the previous section, restricting the sample to the auditors who take the exam in December. This reduces the sample size to 2,186 observations for 427 auditors. The coefficients of *Score* * $Cert_0$, *Score* * $Cert_1$, *and Score* * $Cert_2$ are 0.005, 0.009 and 0.010, respectively, in an OLS regression with the same variables as those in Column 2 of Table 6. The corresponding coefficient estimates are 0.005, 0.010 and 0.008 when the regression includes auditor fixed effects. Wald tests show that the coefficient of *Score* * $Cert_1$ is significantly greater than the coefficient of *Score* * $Cert_0$ (p value < 0.05). In conclusion, the analyses result in quantitatively and qualitatively similar conclusions as those reported in the main section.

Some auditors have failed the exam at least once before they pass the exam.[18] Failing the exam may indicate that the auditor has lower capabilities than those passing at the first attempt. To consider this information, we construct an indicator variable taking a value of one if the auditor has failed at least once before passing the exam, interact *Failed* with $Cert_t$ and add these interactions to the models with the same variables as those in Column 2 in Tables 6 and 7. The coefficients of *Failed* * $Cert_t$ are mostly negative, but the only coefficient that is negatively significant at the 0.05 level is *Failed* * $Cert_{-1}$ in an OLS regression with the same controls as in column 2 of Table 6. The insignificance of the interactions in the regressions with auditor fixed effects indicates that failing the exam does not result in a significantly lower salary.

The period analyzed covers the global financial crisis initiated in 2007, which also affected Sweden. Unlike many other countries, GDP growth was positive in 2010. One could argue that the crisis would reduce the sensitivity of salaries to the CPA exam. Therefore, our results could be explained by the fact that the crisis period (2007 to 2008 in Sweden) includes more precertification observations than postcertification observations. To test this possibility, we construct an indicator *Crisis*, which takes a value of 1 in 2007 and 2008. We interact *Crisis* with *Score* * $Cert_t$ in a fixed effect regression with the same variables as in Column 2 of Table 7, except that we drop the year indicators from the regressions. The *Crisis* * *Score* * $Cert_t$ have negative but insignificant coefficients in the regression. The coefficients of *Score* * $Cert_t$ capture the association between *Lnsalary* and *Score* for the noncrisis years, and consistent with Hypothesis 1b, the coefficients of *Score* * $Cert_0$, *Score* * $Cert_1$ and *Score* * $Cert_2$ are positively significant at the 0.05 level. Furthermore, the null hypothesis that the coefficients of *Score* * $Cert_{-2}$ and *Score* * $Cert_{-1}$ cannot be rejected at the 0.05 level. In conclusion, the main results hold when we control for the impact of the financial crisis on salaries.

Finally, the variables in the models are correlated such that $Cert_t$ is constructed ($\sum_{t=-3}^{t=2} Cert_t = 1$). Since we have a priori information about the relationships among these variables, we can properly interpret the estimated coefficients (see Gujarati and Porter 2009, p.342). However, as an additional way to test the hypotheses substantially reduce the correlations between the independent variables, we estimate six regressions, one for each year prior to or after certification (i.e., for t=-3 to 2, where observations with $Cert_t$=1 are selected). We estimate the OLS regressions without *Time* and $Cert_t$. The number of observations ranges from 372 (two years after the exam) to 643 (the exam publication year).

Hypothesis 1a predicts no association between *Score* and salary before the exam results are published, whereas Hypothesis 1b predicts a positive association after the exam. Consistent with Hypothesis 1a, the coefficients of *Score* are insignificant in the regressions on samples with observations three to one year prior to the exam publication year. Furthermore, consistent with Hypothesis 1b, the coefficients of *Score* are positive and significant at the 0.05 level in the regressions on samples with observations one and two years after the exam. *Score* has a positive coefficient that is significant at the 0.10 level when the sample includes observations from the exam publication year.[19]

As a further test of Hypotheses 3 to 5, we estimate the regressions with the *Big 4* * *Score, Gender* * *Score* and *Age (centered)* * *Score* for each year prior to (or after) the CPA exam publication year. The coefficients of the *Big 4* * *Score* are positive and significant at the 0.05 or 0.10 levels when the regressions are estimated on samples with observations from the exam publication year, the year after the publication and two years after the publication. The coefficients of the *Big 4* * *Score* are insignificant when the regressions are estimated on observations before the exam publication year. Furthermore, the coefficients of *Gender* * *Score* and *Age(centered)* * *Score* are

[18] For example, for auditors taking the exam from 2006–2012, 59.91% passed the exam on the first attempt and 18.59% passed the exam on the second attempt; for 13.51%, we do not know whether they did or did not pass the exam in further attempts after the first two tries.

[19] We use Wald-tests to examine whether the coefficients of *Score* one and two years after the publication are significantly different from the coefficients three to one year before the publication. The coefficients one and two years after are significantly different from the coefficients two and three years before the publication (p-value < 0.05 in two-tailed test). The coefficient two years after is significantly different from the coefficient one year before at the 0.10 level, while the coefficient one year after is not significantly different from the coefficient one year before the publication year.

insignificant. In conclusion, when we estimate the regression by year prior to and after the exam publication year, we receive support for Hypothesis 1b and Hypothesis 3 but fail to find significant support for Hypothesis 1a, Hypothesis 4 and Hypothesis 5.

7. Conclusion

One stream of literature on occupational licensing suggests that licensing is harmful since it restricts the supply of entrants to the profession and makes it possible to earn abnormally high salaries, whereas another stream suggests that licensing can increase social welfare by alleviating information problems between employees and employers. We use data on salaries and the scores on the CPA exam to empirically examine these competing theories. To investigate whether the CPA exam is associated with abnormally high salary increases, we study whether auditors with just the minimum score to pass the exam have higher salary increases after than before certification. Controlling for the linear trend in salary increases when auditors progress from being an associate to positions that require a CPA certification, we find no support for the prediction that the CPA certification is associated with a significant salary increase.

The information-alleviation hypothesis suggests that the CPA certification conveys new information about auditors' competences to current employers or prospective employers. To test this prediction, we assume that the score on the CPA exam reflects the technical competence of the auditor, and we examine whether a higher score on the exam is associated with a higher salary before and after the certification. Consistent with this hypothesis, we find positive significant associations between the score and salaries after certification, but not before, when the competences are developed. Furthermore, such associations are stronger for young auditors, which is consistent with the hypothesis that the market has less information about their competences.

Compared with non-Big 4 firms, Big 4 firms are generally believed to supply higher-quality audit services. We contribute to the literature examining the sources of the Big 4 effect by analyzing whether Big 4 firms provide stronger incentives to auditors to develop their technical competence. In line with this prediction, we find that the association between the score on the CPA exam and salaries is much stronger for auditors at Big 4 firms than for auditors at non-Big 4 firms.

Furthermore, we find that females have a lower salary than male auditors do, and some of our analyses suggest that the association between the score on the CPA exam and salary is weaker for female auditors than for male auditors. One interpretation of the results is that there is gender discrimination in the auditing profession. However, we cannot rule out that females have more working interruptions or shorter working hours.

This study has several limitations. First, the Swedish CPA exams are based on the requirements of the directives of the EU Commission, leading us to anticipate that the results could be generalized to other EU member countries and other countries with comparable legislation and auditing markets. However, additional research is necessary to confirm this assertion. Second, we test the prediction on the basis of barrier-to-entry theory that the CPA certification is associated with an economic rent to the auditor by comparing the salary before and after certification. We encourage future research using different approaches to compare auditors' salaries under regimes with and without CPA certification. Finally, the score in the CPA exam arguably reflects auditors' technical competences. We encourage future research to examine the impacts of other competences (such as social and leadership competences) on salaries.

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.

Acknowledgments

We acknowledge the useful feedback received in the review process and seminars at the Umeå School of Business and Economics. We thank Tobias Svanström for his comments on previous versions. Ana Millán and Pedro Ortín-Ángel acknowledge funding from the Spanish Ministry of Innovation and Science, MCIN/AEI/10.13039/501100011033 (project PID2020-115018RB-C32). Ana Millán acknowledges funding from the Spanish Ministry of Innovation and Science (project PID2020-115183RB-C22). Stefan Sundgren acknowledges funding from "Jan Wallanders och Tom Hedelius Stiftelse" (P2015-0104:1).

Data availability

The authors do not have permission to share data.

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