Evidence of Industry Scale Effects on Audit Hours, Billing Rates, and Pricing

SIMON DEKEYSER, *KU Leuven*
ANN GAEREMYNCK, *KU Leuven*
MARLEEN WILLEKENS, *KU Leuven and BI Norwegian Business School*†

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† Corresponding author: marleen.willekens@econ.kuleuven.be

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Abstract

Using a proprietary dataset consisting of all private firm audit engagements in 2000 from one Big 4 firm in Belgium, we investigate: (1) whether audit office industry scale is associated with a reduction of total, partner and staff audit hours and thus with efficiency gains triggered by organizational learning from servicing more clients in an industry; and (2) whether the extent of efficiency pass-on from the auditor to its clients depends on the audit firm's market power. We find that auditor office industry scale is associated with efficiency gains and a reduction of the variable costs (i.e., fewer total audit hours, partner hours, and staff hours), ceteris paribus. Our results also suggest that, on average, realized efficiencies are entirely passed on as evidenced by a non-significant effect of auditor industry scale on the auditor's billing rate. Furthermore, we find that the extent of the efficiency pass-on decreases with the market power of the audit firm in the industry market segment as we document a higher billing rate for auditors with high market power (versus low market power). In addition, we find that the lower audit hours associated with auditor industry scale do not compromise audit quality.

Keywords: industry knowledge, audit efficiency, industry market power, efficiency pass-on

JEL-classification: M41, M42

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1. Introduction

In this article, we study the effects of audit office industry scale derived from specializing and investing in a particular client industry on audit hours, audit fees, and billing rates (fee per hour).[1] We argue that a larger audit office industry scale results in more industry-specific knowledge, which is an important attribute for attaining a comprehensive understanding of the client's operating environment and accounting practices. Theoretically, higher industry knowledge could result in two distinct outcomes: a higher-quality audit service (Reichelt and Wang 2010) or an audit service that has the same level of quality but is more efficient (Casterella et al. 2004; Bills, Jeter and Stein 2015). The learning curve paradigm from management science literature suggests that the cumulative expertise gained from servicing more clients in a specific industry (i.e., a higher industry scale) results in enhanced organizational knowledge about the client's industry, and hence in more efficient audits (i.e., fewer audit hours).[2] We therefore hypothesize that auditor industry scale is negatively associated with the number of audit hours performed on engagements in that industry (Hypothesis 1).

Next, we investigate whether efficiencies realized from industry scale are passed on from the auditor to its clients and whether the extent of efficiency pass-on depends on the audit firm's market power in the relevant audit market (industry) segment. Theoretical models of the relationship between pricing and organizational learning (Cabral and Riordan 1994; Besanko et al. 2010) predict a full pass-on of efficiencies and even pricing below marginal cost. The latter phenomenon is known as predatory pricing or price undercutting (Cabral and Riordan 1994). Obtaining a client allows the firm to go further down its learning curve, achieving additional efficiency gains. At the same time, rivals are prevented from achieving similar learning effects, which increases the firm's

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[1] In this paper we refer to the actual fee per hour (staff or partner) for effort performed on the engagement as the "billing rate." Therefore, the billing rate reflects how much the audit firm is compensated for each hour invested in the engagement.

[2] The learning paradigm has also been applied to manufacturing (Argote and Epple1990) as well as to service firms (Boone et al. 2008; Boh et al. 2007; Reagans et al. 2005; Pisano et al. 2001; Darr et al. 1995). Cahan et al. (2011) argue that industry specialization can be achieved either through increased quality or decreased cost and that audit firms are more likely to pursue the latter strategy in small client settings.

competitive advantage. Consequently, in the short run, a firm is willing to pass on efficiencies to its clients because having more clients results in a stronger competitive position. In the long run, however, such initial predatory pricing may drive competitors out of the market resulting in non-competitive markets with fewer suppliers, higher market power for the remaining competitors, and higher prices (Dasgupta and Stiglitz 1988; Besanko et al. 2010). Besanko et al. (2010) show that the extent of pass-on decreases as firms become more asymmetric, which occurs for example when firms have differential market power.[3] We therefore predict that the extent of efficiency pass-on is conditional on an auditor's market power: the greater an auditor's market power, the smaller the extent of efficiency pass-on (Hypothesis 2).

Prior research on auditor industry knowledge has devoted considerable attention to the audit pricing and quality effects of market share-based industry specialization, i.e., an auditor's industry knowledge *relative* to its competitors (Craswell et al. 1995; Ferguson et al. 2003; Francis et al. 2005; Gul et al. 2009; Reichelt and Wang 2010; Cahan et al. 2011). The results are mixed, but a majority of studies support the claim that market share-based industry specialists charge higher audit fees, provide higher quality, and perform more audit hours (Bae et al. 2016). On the contrary, research on the effects of auditor industry scale (or an auditor's internal, i.e., *within* audit firm, industry focus) is relatively scarce. Fung et al. (2012) study audit office industry scale and report a negative association with audit fees which they attribute to efficiency gains. However, Fung et al. (2012) do not use audit hours data in their analysis (but audit fees), and therefore are presenting *indirect* evidence of efficiency gains. In this paper, we add to the literature by examining the effect of industry knowledge arising from a larger office industry scale on audit hours thereby providing a *direct* test to differentiate between these two theories.

As indicated, we also study whether realized efficiency gains are passed on to the audit clients. Prior literature in this area is scarce and again the inferences are mainly based on audit fee models (Casterella et al. 2004; Fung et al. 2012; Bills et al. 2015). As these fee studies do not account for audit hours, they are unable to unravel the source of the documented fee discounts, which could be attributable to: (i) more or less efficiency pass-on; or (ii) differences in the size of realized efficiency gains. A notable exception is a study by Bae et al. (2016) which does use an audit hours and billing rate model to test industry knowledge effects, but the focus is on market-share based

[3] Competing audit firms are deemed 'asymmetric' (or different) when they are dissimilar to one another, for instance, in terms of know-how or market share.

measures of industry specialization instead of within-audit firm industry scale effects. Both proxies for industry specialization capture different aspects of industry expertise, and market share based proxies of industry specialization are likely to also capture to some extent an auditor's market power. We add to the literature by examining whether efficiency gains (i.e., reduction in audit hours) from audit office industry scale, if realized, are indeed passed on to audit clients via lower billing rates and whether the extent of the efficiency pass-on depends on the audit firm's market power.

To test our hypotheses, we use a unique proprietary dataset of all (895) private firm audit engagements from one Belgian Big 4 firm for the year 2000, containing audit hours as well as audit fees. We augment this data with the financial information contained in the clients' annual reports. In line with prior research, we measure and test scale at the audit office level as knowledge transfer from the office to the national level is imperfect because industry-specific knowledge is tacit and difficult to codify (Francis et al. 2005). We specify two measures of office industry scale: (1) a continuous measure based on Fung et al. (2012) capturing the number of clients in each office industry; and (2) a dummy variable equal to one for the three industries in which the audit office has invested most of its resources. Finally, we measure an auditor's market power within the relevant industry market segment using the absolute market share distance to the closest competitor (Numan and Willekens 2012; Bills and Stephens 2016).

Our results show that audit office industry scale is negatively associated with the number of audit hours spent on engagements. These results are in line with the learning curve paradigm: servicing more clients in a particular industry, or having a higher scale, allows a firm to go down on the learning curve thereby increasing audit efficiency and decreasing the cost of production. The results also illustrate that, on average, realized efficiencies are entirely passed on to clients via fee discounts as evidenced by a significantly lower audit fee but an insignificant difference in the billing rate. The results further show that when the audit firm's market power is strong, the extent of the efficiency pass-on decreases. When market power is low, efficiency gains due to scale are entirely passed on to clients, but the extent of efficiency pass-on decreases when market power is high resulting in a higher billing rate. Supplementary analysis reveals that our measures of audit office industry scale are not associated with accruals–based earnings management and thus do not result in a decrease of the audit quality supplied (Dutillieux 2009; Reichelt and Wang 2010; Cahan et al. 2011; Willekens et al. 2017).

We contribute to the literature in the following ways. First, we contribute to the scarce literature on audit office industry scale by examining effects on audit hours instead of audit fees. To our knowledge, no prior study directly examines auditor industry scale effects on audit hours. Second, we also investigate whether the scale effects vary for different types of audit hours and find efficiency gains at the staff level (documented for both industry scale measures adopted) and at the partner level (documented for one industry scale measure). As such we contribute to the growing literature of research on individual partner effects in auditing research (Taylor 2011; Knechel et al. 2015). Third, by examining auditor industry scale effects on billing rates and audit fees, we evaluate whether the efficiencies are passed on to clients. Note that this kind of analysis could not be performed in Bills et al. (2015) and Fung et al. (2012) due to lack of audit hours data. Note further that prior research has investigated the effect of demand-side characteristics such as (relative) client size on audit fees (Casterella et al. 2004; Fung et al. 2012; Bills and Stephens 2016) or focus on the homogeneity of the industry (Bills et al. 2015) while we take a supply-side perspective by focusing on the firm's market power and the billing rate. Fourth, different from Fung et al. (2012) and Bae et al. (2016), we study audit clients in the private firm segment of the audit market. While some prior studies analyze audit production function in public firms, little is known about audit production in the private client segment. Finally, we add to the debate on the measurement of auditor industry specialization (Minutti-Meza 2013; Audousset-Coulier et al. 2015). Our results show a different audit hour and audit fee effect of our portfolio-based measures of industry expertise (such as our audit office industry scale measures) versus our market-share based measure of industry expertise (the market leadership measure often used in the literature and included as a control variable in our models). This corroborates our argument that market share-based and portfolio share-based measures of industry specialization most likely capture two distinct aspects of auditor industry knowledge.

The remainder of this article is organized as follows: Section 2 provides an overview of the literature and develops the hypotheses to be tested. Section 3 describes the research design and section 4 discusses the sample and the data. In section 5, we report the main results. Section 6 reports some sensitivity checks. We discuss the conclusions and the limitations of this study in section 7.

2. Previous literature and hypotheses

Prior literature on auditor industry knowledge: Economies of scale or quality premium?

It is well established in the auditing literature that industry-specific (accounting) knowledge is a valuable attribute for the execution of audit engagements (Danos et al. 1989; Craswell et al. 1995; Balsam et al. 2003; Francis et al. 2005; Malhotra and Morris 2009). The auditing literature shows that auditor industry knowledge is associated with higher fees (Ferguson et al. 2003; Francis et al. 2005; Craswell et al. 1995; Cahan et al. 2011; Numan and Willekens 2012; Bills et al. 2015), higher audit quality (Balsam et al. 2003; Gul et al. 2009; Reichelt and Wang 2010),[4] and even higher audit effort (Bae et al. 2016). Other studies report decreased audit fee premiums or even fee discounts associated with industry knowledge, depending on several factors: the type of audit firm (DeFond et al. 2000), the proportion of clients audited in that industry (Cahan et al. 2011), the client bargaining power (Fung et al. 2012; Casterella et al. 2004), and industry characteristics (Bills et al. 2015). These results are mainly attributed to efficiency gains, although none of these studies actually empirically examine audit hours.

A relevant observation in this light is that prior studies typically use market share-based proxies of industry specialization to capture enhanced auditor industry expertise, such as industry leadership. Market share-based measures of industry specialization, however, represent how well an audit firm "has *differentiated itself from its competitors in terms of market share within a particular industry*" (Neal and Riley 2004, 170; italics in original), and thus, by construction, also pick up an auditor's location (and thus market power) relative to other competitors in the market (Numan and Willekens 2012). Market share-based measures of industry specialization are not necessarily suitable measures of auditor industry *scale* derived from specializing and investing in a particular client industry. At the extreme, using market share-based measures of industry specialization, an auditor can be deemed an industry expert with only one or two large clients in its portfolio if there are only a few clients from that industry present in the market segment (Neal and Riley 2004). Consistent with this observation, Fung et al. (2012) introduce a different measure to capture auditor industry scale. Note that Fung et al. (2012) do not use audit hours and therefore present *indirect* evidence of efficiency gains by examining audit fee discounts. Audit fee discounts can occur for two theoretically distinct reasons. First, a larger scale allows a firm to divide the *fixed* costs, such as training and office rent, over more clients, thereby decreasing the average cost and subsequently the audit fee. Second, a larger scale could also increase audit efficiency, thereby decreasing the *variable* production cost of the audit service and hence the audit hours necessary to execute the engagement. Testing the effects of scale using an audit fee model as done in

[4] Studies that investigate industry knowledge at the partner level—rather than the firm or office level—find that higher industry knowledge leads to a better understanding of possible material misstatements in pre-audited financial statements, resulting in a higher likelihood of those misstatements being detected and resolved (Hammersley 2006), and a better understanding of a client's business environment (Eichenseher and Danos 1981), as well as of industry-specific accounting practices (Taylor 2000).

Fung et al. (2012) precludes disentangling these two competing explanations, as it is unclear whether the observed negative audit fee effects stem from lower variable costs (i.e., more efficient audits) or the distribution of fixed costs over more engagements (i.e., lower billing rate). Our study extends the literature by simultaneously examining audit hours and billing rates.

Economies of industry scale and audit efficiency (H1)

The first objective of this study is to test the effect of office industry *scale* on audit hours. We rely on two non-mutually exclusive theories to predict the direction of this effect: economies of scale and organizational learning.

Economies of scale refer to the decreasing cost per unit of a product or service as the scale of operation increases (Besanko et al. 2010). Economies of scale arise primarily from the division of fixed costs over more units leading to lower average costs and occur often in capital-intensive industries. Hence, economies of scale primarily predict a negative effect of office industry scale on the billing rate as each engagement has to cover a smaller component of the fixed costs. However, this theory does not necessarily impact the variable costs, such as the number of audit hours spent on an engagement.

Nonetheless, a larger scale can also lead to a reduction in variable audit engagement costs. We rely on organizational learning theory from the management science literature to argue that industry scale leads to greater industry knowledge and subsequently to audit efficiency or lower audit hours, ceteris paribus. Organizational learning is a change in the organization's knowledge that occurs as a function of cumulative experience and is often observed in labor intensive industries (Argote and Miron-Spektor 2011). This knowledge will result in a change in cognition, audit behavior, and/or performance and can manifest itself as a positive impact on efficiency (i.e., fewer audit hours) (Argote and Epple 1990; Boone et al. 2008; Cahan et al. 2011). The "learning curve" links organizational learning and performance, and can be defined as the rate of improvement in the performance of a task (i.e., more efficiency) resulting from gains in cumulative production experience (Boone et al. 2008). Prior empirical studies provide ample evidence of organizational learning in both manufacturing (Argote and Epple 1990) and service firms, such as architectural-engineering or software-development firms (Darr et al. 1995; Pisano et al. 2001; Reagans et al. 2005; Boh et al. 2007; Boone et al. 2008). Because audit firms are knowledge-intensive professional service firms and their production function relies on a substantial body of complex knowledge, we argue that learning curve effects also take place within these firms.[5] Furthermore, a larger scale allows industry-specific knowledge to accumulate faster, enabling the audit office to move down its learning curve faster. This results in more efficient audits because fewer hours are required to perform audits of similar quality.

A further question in this context is at what level (individual partner, audit office, or audit firm level) is industry-specific knowledge shared within the audit firm. We follow recent studies that argue that a significant proportion of industry-specific knowledge is tacit and difficult to codify, which hinders the transfer of knowledge from the office level to the national level (Francis et al. 2005; Numan and Willekens 2012; Fung et al. 2012). Furthermore, because experience, motivation, and know-how are all relevant in the audit profession, an IT-based system can never guarantee full knowledge transfers, and personnel interaction remains relevant (Vera-Munoz et al. 2006). Hence, we argue that industry learning curve effects will be strongest at the office level.[6]

To summarize, when applied to the audit context, organizational learning suggests that the cumulative expertise gained from servicing more audit clients in a specific industry (i.e., a higher industry office scale), results in enhanced organizational knowledge about the client's industry and hence more efficient audits (i.e., fewer audit hours). Our first hypothesis is thus as follows:

HYPOTHESIS 1. *Ceteris paribus, an auditor's office industry scale is negatively associated with the number of audit hours spent on an engagement.*

[5] Because each audit engagement is unique and requires a high level of customization, learning does not occur through repetition of the same task, but through the generation of knowledge that can be implemented across all projects (Boone et al. 2008) or audit engagements. Note further that organizational learning in audit firms is stimulated by the profit sharing rules that exist in these firms. When partners share their individual knowledge with other partners, audit efficiency and effectiveness is enhanced (Chow et al. 2008; Vera-Munoz et al. 2006). Hence, profit sharing rules that encourage knowledge sharing positively affect organizational learning (Chow et al. 2008; Liu and Simunic 2005; Vera-Munoz et al. 2006).

[6] There is also some evidence of national level industry-specific knowledge. For example, clients of industry specialists measured at the national level have lower discretionary accruals and higher earnings response coefficients (Balsam et al. 2003), pay higher fees (Craswell et al. 1995; Defond et al. 2000), and have a higher analyst ranking of disclosure quality in unregulated industries (Dunn and Mayhew 2004). The motivation for focusing on the office instead of the national level is threefold. First, it enables us to introduce industry fixed effects, which decreases the likelihood of the omitted variable problem at audit firm level. Second, we are able to define scale efficiencies in a more refined way because scale efficiencies can differ between offices in the same industry. Third, in line with recent studies about industry specialization, we expect that scale efficiencies are more difficult to transfer between offices (Francis et al. 2005).

Economies of industry scale, efficiency discounts, and auditor market power (H2)

Next, we examine whether the audit firm's market power affects the extent of efficiency pass-on to audit clients. Prior studies document an association between client-auditor bargaining power and audit pricing (Fung et al. 2012; Casterella et al. 2004; Mayhew and Wilkins 2003). Fung et al. (2012) and Casterella et al. (2004) take a client-side (i.e., demand-side) perspective by defining bargaining power as the importance of the client to the audit office, while Mayhew and Wilkins (2003) take an auditor-side (supply-side) perspective by arguing that industry leaders that sufficiently differentiate themselves from the second audit firm in the market (i.e., have at least 10 percent market share difference) have higher bargaining power. Although these studies provide important insights, the inferences are based on testing audit fees. Therefore, it is impossible to assess whether the magnitude of the observed fee discounts is due to passing on a larger part of the efficiency gain (thereby decreasing the auditor's margin—in other words, resulting in a lower billing rate), or results from a decrease in audit hours (i.e., larger efficiency gains, thereby maintaining the auditor's margin and thus the billing rate).

We argue that an auditor's market power affects the pass-on of efficiencies. In markets with organizational learning, attracting new clients allows firms to move further down on their learning curve, thereby achieving greater efficiency and lower marginal production costs (Besanko et al. 2010; Cabral and Riordan 1994). Simultaneously, it also prevents competitors from moving down their own learning curves and achieving similar efficiencies. Hence, attracting new and retaining existing clients is of paramount importance in markets with learning effects because efficiency gains result in lower costs, allowing firms to set prices below those of their rivals. An audit firm's client portfolio is thus an important asset and the firm with the largest portfolio has a strong competitive advantage. Given these market dynamics, firms can be expected to adopt aggressive pricing strategies, evident in, for example, completely passing on efficiency gains to clients via price discounts, in order to attract or retain these clients. However, recent studies show that a full efficiency pass-on is not the only possible outcome in markets where learning curve effects occur (Besanko et al. 2010). The long run equilibrium outcome may result in a less than complete efficiency pass-on or even prices close to the monopoly level (Besanko et al. 2010) as the most efficient firms will be able to drive competitors out of the market, which could subsequently result in a less competitive market with fewer suppliers and higher prices (Dasgupta and Stiglitz 1988; Besanko et al. 2010). Consequently, the remaining firms in the market will gain greater market power and are eventually able to increase their prices above marginal cost (Dasgupta and Stiglitz 1988).[7] The actual equilibrium outcome depends on the market power a firm has achieved (Dasgupt and Stiglitz 1988). The higher the audit firm's market power, the more the client-auditor bargaining power shifts in favor of the auditor. Even if the client would switch to a competitor, the immediate efficiency gains realizable by this smaller market power competitor are likely to be too small to threaten the high market power firm in the short run. The high market power auditor will thus be less inclined to pass on all the realized efficiencies to clients. In this respect, Besanko et al. (2010, 475) conclude that "price competition between firms with similar stocks of know-how is intense but abates once firms become asymmetric." The higher the firm's market power, the less similar the audit firm is to its competitors. This results in more asymmetry and hence weaker price competition. This leads to our second hypothesis:

HYPOTHESIS 2. *Ceteris paribus, the size of the audit fee discount attributable to economies of office industry scale (or the efficiency pass-on) is smaller when the auditor's market power in the relevant industry market segment is higher.*

3. Proprietary audit hours data from Belgium

As stressed earlier, we require data on audit engagement hours and fees to reliably test our predictions. In Belgium, between 1998 and 2000, audit firms were required to disclose the audit hours they spent on each audit engagement, together with the audit fee charged to the Belgian Institute of Auditors (IBR-IRE, Instituut van de Bedrijfsrevisoren – Institut des Reviseurs d'Entreprise). These data are not publicly available and were used by the Institute of Auditors to monitor low-balling and to safeguard audit quality. Since 2001, audit firms no longer have to disclose audit hours to the Institute of Auditors; that is, they only have to report the audit fees charged for each engagement. Since 2007, audit fees became publicly available in clients' annual reports. We were able to retrieve from the

[7] The degree to which driving competitors out of the market results in greater market power depends on entry barriers, among other factors. In addition, audit markets are generally not characterized as homogeneous markets. Indeed, spatial-differentiation theory applied to the audit market (Numan and Willekens 2012) suggests that firms can maintain prices above marginal cost (i.e., with partial efficiency pass-on) without losing market share if the firm is able to successfully differentiate itself from its competitors, thereby increasing its market position relative to clients.

Institute of Auditors the list of audit engagements of one Big 4 firm, including the audit hours per engagement as well as the audit fees charged for the year 2000.

As we use proprietary data from a Belgian Big 4 firm, it is relevant to describe some key features of the Belgian audit environment. In Belgium, all public and private firms exceeding certain size thresholds are required to appoint a statutory auditor (Vander Bauwhede and Willekens 2004).[8] Because the hours and fee data of *all* audit engagements were disclosed to the IBR-IRE, we were able to compute scale measures that are based on all engagements an audit firm has in an industry, and not only the audit engagements relating to public clients, as is the case in various prior studies that are based on Anglo-American datasets. There are significant differences, however, between public and private companies with respect to the regulatory environment, accounting practices, and required disclosure levels. Combining both public and private companies may therefore negatively affect our ability to make inferences. Because the proportion of publicly listed clients in a typical Belgian audit firm's portfolio is very low, we removed the publicly listed clients from our sample.[9]

Note that private firm audits may differ substantially from public firm audits, and that this could create a bias against finding support for Hypothesis 1. First, from an audit production perspective, potential efficiency gains from industry scale are less likely if the required industry expertise to conduct audits in a private client setting is lower than in a public client setting. Second, privately held clients may have a lower demand for high-quality financial reporting (Ball and Shivakumar 2005; Cahan et al. 2011), which, in turn, may induce audit clients to value the audit less and therefore exercise higher audit fee pressure. These market characteristics create an environment where cost minimization strategies are likely to be more successful than audit quality differentiation strategies (Cahan et al. 2011). Such incentives to keep audit costs low may already lead to highly efficient audit practices making additional efficiency gains hard to achieve. Note further that audit fees were not publicly available in 2000, the year of our study. This means that client firms could not signal financial statement quality to stakeholders by

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[8] Firms have to appoint an auditor if they average at least 100 employees (on yearly basis) or exceed two of the following criteria: (i) they employ 50 people, (ii) they have sales of 6.250 million EUR, and (iii) they have total assets of 3.125 million EUR.

[9] We do this in order to obtain a more homogeneous sample of client firms. As a result, the reported effects of economies of scale and market power are not attributable to the differences in regulatory environments between public and private companies. We thank an anonymous reviewer for pointing this out. The results are qualitatively similar when including the seven publicly listed clients.

paying higher audit fees. The absence of this signaling device allows for a clearer test of efficiency pass-on because it rules out client incentives for paying a higher audit fee. If signaling were present, client firms could have incentives to resist efficiency pass-on because lower fees could be interpreted by the client's stakeholders as reflecting lower financial statement quality.

From a supply perspective, the concentration of audit firms in the Belgian audit market is typically lower than in U.S. markets (Dutillieux 2009; Willekens and Achmadi 2003; Schaen and Majoor 1997; Weets and Jegers 1997). Dutillieux (2009) reports that the mean number of audit firms active in a 2-digit SIC industry is 42 in Belgium compared with 18 in the United States. Hence, in contrast to the U.S. audit market, the Belgian market has more variation in audit supplier concentration and auditor market power across industries. Note, however, that this could also be partially due to the fact that a more complete list of audit engagements (both public and private) is included in the Belgian databases.

Finally, it is relevant to note that Belgium is geographically less dispersed than the United States and Australia, countries on which many other auditor industry expertise studies focus. In 2000, the average Belgian Big 5 audit firm had about four to five offices, not all big accounting firms had offices in every major city, and audit firms were competing for the same clients from different offices. A single office can even have clients from across the country. This feature hinders the definition of market segments and measuring market power at the city-specific level.

4. Research design

Measures of auditor industry scale

We made a number of motivated choices when specifying our measures of auditor industry scale. We follow Fung et al. (2012) and construct a first measure of office industry scale, defined as *SCALE*, based on the number of clients. We start by calculating the number of clients in each office-industry pair. Thereafter, the number of clients is ranked across all office-industries. We then measure *SCALE* as the percentile rank of the number of clients where higher values of *SCALE* reflect more clients in the office-industry. Hence, *SCALE* ranges from 0.01 to 1. Next, we specify a second measure of industry scale similar to studies using portfolio share measures of industry specialization (Krishnan 2001; Krishnan 2003; Neal and Riley 2004). Portfolio share based measures fit the underlying theory used to motivate our hypotheses because they capture the resources invested in each industry within an audit office. More specifically, we define a within-office industry portfolio share measure based on the square root of total assets audited in each client industry.[10] We construct a dummy variable, defined as *TOP3,* which equals one for the three largest portfolio share industries in each office, and zero otherwise (Neal and Riley 2004). Additionally, to receive a value of one for *TOP3*, we require that the office has at least five clients in each office-industry because the operating scale is otherwise unlikely to be large enough to result in organizational learning and thus scale economies. We use 2-digit SIC codes to define client industries consistent with prior literature (e.g., Francis et al. 2005).

We link each client to the office from which it is audited in the following manner. First, we identify the partner auditing each engagement. Second, we match each partner to an audit office by using their registered professional location as it appears in the Instituut van de Bedrijfsrevisoren (IBR) membership list, as published in Het Belgisch Staatsblad in 2000. Whereas prior audit studies *assume* one office per geographical location (Francis et al. 2005; Numan and Willekens 2012), this procedure allows us to exactly match all clients with the corresponding audit office, irrespective of the clients' location.

Measure of auditor market power and relevant market segments in Belgium

The literature has not reached a consensus about which measures are better for capturing audit firms' market power. We use the absolute value of market share distance to the closest competitor, defined as *DISTANCE*, as the basis for our measure of market power (Numan and Willekens 2012).[11] This measure is derived from spatial competition research in industrial organizations. We believe that this is a valid market power measure in this setting for the following reasons. First, we need a firm-specific measure of industry market power because our sample consists of

[10] We use client assets rather than client fees because any measure based on audit fees is, by construction, correlated with the dependent variable in the fee model and leads to spurious correlations. The formula of the portfolio share of each office-industry is described below where *i* represents the audit client, *j* the industry in which the client operates, and *o* the audit office that audits the client. In addition, *n* reflects the number of clients of the audit office in the industry of the client, while m reflects the number of clients of the audit office across all industries: $(\sum_{i=1}^{n}\sqrt{ASSETS_{ijo}})/\sum_{i=1}^{m}\sqrt{ASSETS_{io}}$.

[11] We measure *DISTANCE* in the following way: $|\min(MS_i - MS_{i+1}; MS_i - MS_{i-1})|$ where *MS* represents market share, *i* represents the sample firm; *i*+1 is the closest firm that has a market share that is higher than the sample firm, and *i*−1 is the closest firm that has a market share that is lower than the sample firm:

(all) audit engagements of one audit firm. *DISTANCE* captures the extent of differentiation between an audit firm and its closest competitor and thus varies between firms within the same industry. This measure is therefore better suited to the purposes of this study than is the Herfindahl-Hirschman index, which assumes that all firms within an industry have the same market power. Second, following Besanko et al.(2010) we need a measure of competition that captures how (a)symmetric competing audit firms are. The market share distance measure reflects how (a)symmetric or (dis)similar the audit firm is with its closest competitor and is thus consistent with the model used by Besanko at al. (2010).

As the distribution of *DISTANCE* is highly skewed (see also Table 3), we construct a dummy variable *HIGHMP* to differentiate between industry segments in which an audit firm has high and low market power. *HIGHMP* is equal to one when *DISTANCE* is higher than its p75-value (0.038), and zero otherwise. By constructing a dummy variable, we are also able to split our sample based on the audit firm's market power in order to test Hypothesis 2.

To calculate an auditor's market share we need to identify the relevant audit market segments in which auditors compete. We follow recent studies that delineate audit markets based on industries within a geographical area and construct these measures based on client location (Francis et al. 2005; Reichelt and Wang 2010; Numan and Willekens 2012). In the Belgian context, there are three regions (the Flemish Region, the Walloon Region, and the Brussels Capital Region) that are relevant geographical areas within which auditors compete. This geographical classification into three regions is motivated by the following arguments. First, both the OECD and Eurostat construct their regional economic indicators based on these regions.[12] Second, besides cultural and language differences between these regions, important parts of economic policy fall under the purview of the regional governments in Belgium. Hence, significant economic and competitive differences may exist between the regions.[13] Hence, the relevant market segments are the different industries within each of these three regions.

[12] Eurostat, for instance, uses the Nomenclature of Territorial Units for Statistics (NUTS) to provide a single, uniform breakdown of territorial units. The three Belgian regions correspond to NUTS1, which denotes major socio-economic regions (European Commission 2015).

[13] Note that dividing each region into smaller areas (like cities or MSAs) to construct office- or city-specific market segments is not appropriate for the following reasons. First, the clients audited by a single audit office are not all located within the same city or the same province or geographical location. Some clients are audited by an office that is further away than the closest office of

Control variables

In line with previous research (Hay et al. 2006), we include several other controls in the audit-hours, audit-fee and billing rate models. First, consistent with Bae et al. (2016), we construct a market share-based measure of industry specialization. We include a dummy variable equal to one when the audit firm is an industry leader in the region with a market share distance of at least 10 percent, and zero otherwise (*DOM_LEADER*). Second, we control for several client-side characteristics such as size (*LN_ASSETS* and *LN_SALES*), complexity (*SUBSIDIARIES*, *PUBLIC*), audit risk (*RECINV*), financial risk (*QUICK*, *DEBT*, *LOSS*, *ROA*), and the provision of additional services (*LN_NAS*). We also include the following engagement-specific characteristics: the initial mandate (i.e., lower or equal to a tenure of 3 years) (*INITIAL*), the timing of the audit (*BUSY*) and the presence of a joint audit (*JOINT*). Since our sample firms had taken over some smaller audit firms and offices, we control for whether the client was attracted due to the acquisition of a rival firm given that these clients may differ from the other clients (*ACQUIR*). Finally, we also include office and industry fixed effects to control for any audit-office and industry differences other than office industry scale in audit hours and audit fees (Stein et al. 1994).[14,15]

Tests of the hypotheses

To test our Hypothesis 1, we specify an audit engagement hours model which includes the following explanatory variables: (i) a variable capturing auditor industry scale; (ii) a variable capturing the auditor's market power; and (iii) a number of control variables similar to those used in prior studies (Hay et al. 2006):

$$\begin{aligned} LN\_HOURS = {} & \alpha_0 + \alpha_1 SCALE/TOP3 + \alpha_2 HIGHMP + \alpha_3 DOM\_LEADER + \alpha_4 LN\_ASSETS + \alpha_5 LN\_SALES \\ & + \alpha_6 RECINV + \alpha_7 QUICK + \alpha_8 DEBT + \alpha_9 ROA + \alpha_{10} BUSY + \alpha_{11} LOSS + \alpha_{12} INITIAL + \alpha_{13} JOINT \\ & + \alpha_{14} ACQUIR + \alpha_{15} LN\_NAS + \alpha_{16} SUBSIDIARIES + \textit{Office and industry fixed effects} + \varepsilon . \qquad (1) \end{aligned}$$

the same firm, while in other locations clients tend to divide themselves evenly across two different offices of the same audit firm. It is unlikely, given their shared brand name, that these offices would compete against each other. Second, not all big accounting firms are located in the same city and most cities do not have an office of each big accounting firm. Third, the geographical distance between cities within Belgium is short; one can cross the entire country in three hours by car. The distance between the two most distinct audit offices in our sample is about 200 km. These characteristics make establishing geographical boundaries for office-specific markets challenging and any choice would necessarily be ad hoc.

[14] For instance, we find that audit fees of the Brussels office are higher than those of other offices.
[15] If firm-level expertise leads to more efficient audits, then industry-specific fixed effects should also capture these effects.

Definitions of the variables in equation (1) are provided in Table 1.

We test Hypothesis 1 using three specifications of audit engagement hours: (i) total hours (*LN_HOURS*), (ii) partner hours (*LN_PARTHOURS*) and (iii) staff hours (*LN_STAHOURS*). The first hypothesis predicts a negative α_1-coefficient for the industry scale variables (*SCALE* and *TOP3).* To examine whether efficiency gains are passed on to clients, we also estimate equation (1) with audit fees as dependent variable. As the error terms of these different models are likely correlated, we estimate these models using Seemingly Unrelated Regressions (SUR), a methodology that is also used in other recent accounting studies (Fresard 2010; Byard et al. 2011; Armstrong et al. 2012).[16] Note that we also test whether a larger scale allows the firm to divide fixed costs over more clients by estimating a billing rate model, where the dependent variable is defined as the natural logarithm of the total audit fee divided by the total hours (*BILLRATE*), and the same set of explanatory variables as in equation (1). When the coefficient of *SCALE* and *TOP3* is significantly negative in the billing rate model, this implies that fixed costs are spread out over more clients, leading to lower average costs and a lower billing rate.

To test the second hypothesis, we specify the following regression models:

$$\begin{aligned} &\textit{LN\_HOURS} \text{ and } \textit{LN\_FEE/BILLRATE} = \beta_0 + \beta_1 \textit{SCALE/TOP3\_LOWMP} + \beta_2 \textit{SCALE/TOP3\_HIGHMP} + \beta_3 \textit{HIGHMP} \\ &\quad + \beta_4 \textit{DOM\_LEADER} + \beta_5 \textit{LN\_ASSETS} + \beta_6 \textit{LN\_SALES} + \beta_7 \textit{RECINV} + \beta_8 \textit{QUICK} + \beta_9 \textit{DEBT} \\ &\quad + \beta_{10} \textit{ROA} + \beta_{11} \textit{BUSY} + \beta_{12} \textit{LOSS} + \beta_{13} \textit{INITIAL} + \beta_{14} \textit{JOINT} + \beta_{15} \textit{ACQUIR} + \beta_{16} \textit{LN\_NAS} \\ &\quad + \beta_{17} \textit{SUBSIDIARIES} + \textit{Office and industry fixed effects} + \delta \,. \qquad (2) \end{aligned}$$

We split *SCALE* and *TOP3* into two distinct variables depending on the value of *HIGHMP*. More specifically, the variable *SCALE/TOP3_LOWMP* equals the value of *SCALE* or *TOP3* if *HIGHMP* equals zero, and zero otherwise. In contrast, the variable *SCALE/TOP3_HIGHMP* equals the value of *SCALE* or *TOP3* if *HIGHMP* equals one, and zero otherwise.

We test Hypothesis 2 in two ways. First, we test equation (2) by estimating two distinct dependent variables, audit fees (*LN_FEE*) and audit hours (*LN_HOURS*), simultaneously using SUR. This allows us to

[16] SUR estimates the different models simultaneously and accounts for the correlations of error terms across equations, in contrast to OLS regression. Given that audit hours and audit fees are not independent, their error terms are likely to be correlated. Analysis reveals significant correlation of the error terms across the audit hours and audit fee model (e.g., $r = 0.66$, p-value < 0.01), and the Breusch-Pagan test rejects the null hypothesis that the audit hours and audit fee equations are independent ($\chi^2 = 393.03$, p-value < 0.01) based on the base model without *SCALE, TOP3*, or *MPOWER*.

compare the coefficients of the fee model with the coefficients of the audit hours model using a Chi-square test of equal regression coefficients (Fresard 2010; Byard et al. 2011; Armstrong et al. 2012).[17] The second hypothesis is supported when the Chi-square test of equal regression coefficients indicates that the coefficient of *SCALE/TOP3_HIGHMP* has a significantly lower value in the audit hours model than in the audit fee model, indicating that the percentage decrease in audit fees is significantly smaller than the corresponding percentage decrease in audit hours. Second, we use billing rates (see Bae et al. 2016; Redmayne et al. 2010) as the dependent variable (*BILLRATE*) and estimate equation (2). Hypothesis 2 is supported when *SCALE/TOP3_HIGHMP* is significantly positively associated with *BILLRATE*.

5. Sample selection

We use a proprietary dataset of 1,258 individual engagements from one Belgian Big 4 firm for the year 2000 containing audit hours as well as audit fees. We merge these audit hours data with the clients' financial statement data found in the database BEL-FIRST.[18] From the initial sample, we remove 228 observations that were missing data for audit hours (62), control variables (122), or audit fees (44). We also exclude 120 observations from the financial and real-estate industries (SIC code 6000–6999) and 7 public clients. Finally, in order to calculate market share measures that are meaningful, we exclude industries with less than five clients at the regional level, as the market share measures in those industries (and hence *HIGHMP* and *DOM_LEADER*) can be subject to considerable measurement error. This leads to a loss of 8 observations, resulting in a final sample of 895 observations. This sample size is significantly larger than those used in prior audit hours studies (O'Keefe et al. 1994; Schelleman and Knechel 2010).

We also use BEL-FIRST to gather information about the total audit market in Belgium, using all clients that were required to appoint a statutory auditor in 2000. Our initial sample contains 15,733 observations. After

[17]In contrast to OLS regression, SUR estimates the audit hours and audit fee models simultaneously, accounts for the correlations of error terms across equations and allows for a Chi-square test of equal regression coefficients across equations. Comparing coefficients across a fee and an hours regression model, in which both dependent variables are measured as a logarithmic transformation, is equivalent to testing the null hypothesis that the percentage change in hours attributable to office industry scale is equal to the percentage change in audit fees attributable to office industry scale (a formal proof of this statement is available upon request).

[18] BEL-FIRST is a product of Bureau Van Dijk Electronic Publishing (www.bvdep.com). It contains financial-statement information from all the firms in Belgium and Luxembourg that are required to file financial statements.

removing observations that had missing values for total assets (299 observations), for the appointed audit firm (2,354 observations), or for the SIC code (1,807 observations), we arrive at a final sample of 11,343 observations, which we use to calculate the market power proxy. An overview of our sample-selection procedure can be found in Table 2.

[Insert TABLE 2 about here]

6. Results

Descriptive statistics

Table 3 provides the descriptive statistics for the variables we use in our empirical tests. Panel A shows that the average (median) client pays audit fees of 15,006 EUR (8,393 EUR) and that the average (median) audit engagement is performed using approximately 163 (98) audit hours, 10 (4) partner hours and 153 (92) staff hours. Panel B shows that the average (median) value of *SCALE* is 0.780 (0.880). Our second office industry scale measure, *TOP3*, equals one in 38.7 percent of the observations. The descriptive statistics for the control variables in panel C show that the average (median) value of *LN_ASSETS* is 19.376 (19.262), the average debt-to-assets ratio (*DEBT*) is 74.9 percent, and the mean (median) return on assets (*ROA*) is 0.020 (0.027), which is similar to prior research (Schelleman and Knechel 2010). Finally, panel D of Table 3 shows substantial variation in the distance to the closest competitor. The average (median) distance is 3.4 percent (1.3 percent), with a maximum distance of 85.7 percent. Overall, descriptive statistics for this variable are equivalent to those reported in Dutillieux (2009), who also uses the Belgian setting.

[Insert TABLE 3 about here]

In Table 4, we provide Pearson and Spearman correlations. Our audit office industry scale variables are negatively correlated with *LN_HOURS* (*SCALE*: –0.0651; *TOP3:* –0.0477), *LN_PARTHOURS* (*SCALE*: –0.0712; *TOP3:* –0.0764), *LN_STAHOURS* (*SCALE*: –0.0624; *TOP3:* –0.0481) and *LN_FEE* (*SCALE*: –0.0772, *TOP3*: –0.0625), albeit mostly insignificantly at the 5 percent level. In addition, the audit office industry scale variables are not associated with the firm's market power (*SCALE*: –0.0095; *TOP3:* 0.0212).[19] Finally, correlations between the other variables are acceptable and in line with previous research, the highest absolute correlation of 0.7063 being between *LN_SALES* and *LN_ASSETS*.

[Insert TABLE 4 about here]

Regression results: Test of Hypothesis 1

Table 5 reports the results of estimating equation (1) with adjusted standard errors for heteroscedasticity and clustered standard errors by industry and tests Hypothesis 1.[20] We find a significant negative coefficient for both office industry scale measures in the audit hours regression (*SCALE*: –0.558, p-value < 0.05; *TOP3*: –0.155, p-value < 0.10), in support of Hypothesis 1. In economic terms, we find that an increase of one standard deviation in *SCALE* results in an efficiency gain of 13.45 percent. The engagements of clients of one of the largest three portfolio industries of an audit office are performed with 14.36 percent fewer audit hours. In addition, we find that staff hours (*SCALE*: –0.581, p-value < 0.05; *TOP3*: –0.155, p-value < 0.10) and partner hours decrease with industry scale, albeit the latter only using the *TOP3* proxy (coeff: –0.252, p-value < 0.05). These results support the first hypothesis that office industry scale results in more efficient audits, and show that higher industry scale reduces the variable costs of the engagement.

Note that the results show that market share-based industry expertise is associated with higher audit hours (*DOM_LEADER*). We thus find a negative effect of office industry scale on audit hours, in addition to a positive effect of market share-based industry specialization (Bae et al. 2016). This confirms that market share-based and portfolio share-based measures (which are by construction correlated with scale) of industry specialization may

[19]Theoretically, a positive mechanical correlation between our measures of *SCALE* and *DOM_LEADER* is plausible. Indeed, all else equal and if all industries would be of equal size, being the leader in an industry requires a higher market share than competitors, which would increase the operating scale in that industry. However, since the reported correlations between *SCALE* and *DOM_LEADER* are negative we do not believe that such mechanical correlation drives our results.

[20] Depending on the proxy of office industry scale, we find an adjusted R^2 of about 31 to 42 percent for the audit hours model, which is lower than reported in previous audit hours studies in U.S. and Australian settings (Bell et al. 2008; Schelleman and Knechel 2010) but similar to audit-fee models that use Belgian data (Dutillieux et al. 2009).

capture two different aspects of industry knowledge and may have a differential effect on audit hours and/or audit fees. This finding adds to the debate on the measurement of industry specialization (Minutti-Meza 2013; Audousset-Coulier et al. 2015). For audit offices that both have a high industry scale and enjoy a high market share, opposite effects occur simultaneously, which could explain the seemingly contradictory results found in the literature on industry specialization effects. The results for the control variables are generally consistent with those of previous studies.

[Insert TABLE 5 about here]

Table 6 investigates the effect of office industry scale on audit fees and billing rates. The results show that audit fees are negatively associated with office industry scale (*SCALE*: –0.408, *p*-value < 0.05), although the coefficient of *TOP3* in the fee model is insignificant (*TOP3*: –0.164, *p*-value > 0.10). Furthermore, the billing rates are unaffected by office industry scale (*SCALE*: –0.205, *p*-value > 0.10; *TOP3*: –0.008, *p*-value > 0.10). We thus find that the audit fee discount associated with scale, as also reported in Fung et al. (2012), is not driven by the division of fixed costs over more clients (which would result in lower average costs and lower billing rates).[21,22] This finding further also implies that efficiency gains are fully passed on to clients. Note that this conclusion is also supported by the insignificant test of equal regression coefficients (unreported) between the audit hours and the audit fee model (*SCALE*: *p*-value = 0.319; *TOP3*: *p*-value = 0.892).

[Insert TABLE 6 about here]

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[21] Note that, in the absence of data on these fixed costs, we cannot rule out the possibility that fixed costs are spread out over more clients but that these cost savings are not passed-on to clients.

[22] With respect to *DOM_LEADER*, we find that audit fees are higher (coeff: 0.387, *p*-value < 0.05) in line with the findings reported in Bae et al. (2016), who rely on South Korean data. We, however, do not find higher billing rates associated with *DOM_LEADER* (*p*-value > 0.10), while Bae et al. (2016) find a lower billing rate for dominant leaders. This difference is likely caused by the different types of firms (private versus public) and differences in the institutional environments between Belgium and South Korea.

Regression results: Test of Hypothesis 2

In Table 7, we report in panels A and B the results of our test of Hypothesis 2 using *SCALE* and *TOP3* as our measure of office industry scale, respectively. Our main variable of interest is *SCALE/TOP3_HIGHMP*, which captures the effect of office industry scale when auditor market power is high. We document a higher billing rate associated with office industry scale when market power is high (*SCALE_HIGHMP*: 0.380, p-value < 0.05 and *TOP3_HIGHMP*: 0.220, p-value < 0.01). This suggests that the audit fee discount (and hence efficiency pass-on) is smaller when the audit firm has market power, in line with Hypothesis 2. This finding is further supported by the significant Chi-square test of equal regression coefficients for both *TOP3_HIGHMP* and *SCALE_HIGHMP* (p-value < 0.05), which shows that the realized efficiency gain (*SCALE_HIGHMP*: –0.772, p-value < 0.01 and *TOP3_HIGHMP*: –0.531, p-value < 0.01) is not fully reflected in the decrease in audit fees (*SCALE_HIGHMP*: –0.410, p-value < 0.10 and *TOP3_HIGHMP*: –0.298, p-value < 0.01). Hence efficiency gains are only partially passed on when the audit firm's market power is high.

In contrast, we find no evidence that the billing rate is higher when market power is low (*SCALE_LOWMP*: 0.132, p-value > 0.10 and *TOP3_LOWMP*: –0.078, p-value > 0.10), which is also supported by our test of equal regression coefficients (p-value > 0.10). This finding shows that efficiency gains, when realized, are fully passed on to clients when the audit firm has low market power. Taken together, these results confirm our second hypothesis, as the extent of pass-on decreases from a full pass-on to a partial pass-on when the audit firm's market power is high.

An untabulated Wald test reveals that the coefficient for *TOP3_HIGHMP* is significantly different from *TOP3_LOWMP* in the audit hours model (p-value < 0.01). This suggests that efficiency gains are larger when the audit office has a sufficiently large scale and market power is high. While we did not ex ante hypothesize such an effect, this could indicate that audit firms seeking to differentiate themselves from their closest competitors focus more on their industry knowledge and organizational learning processes, allowing them to benefit more from economies of scale.[23] The Wald test, however, shows no significant difference between *SCALE_LOWMP* and *SCALE_HIGHMP* in the audit hours model (p-value > 0.10). Hence, we are hesitant to draw strong inferences.

[23] This result is also consistent with Fung et al. (2012), who report a similar finding: a significantly lower interaction effect of economies of scale and industry leadership on audit fees. Because they only analyzed audit fees, they interpreted this effect as

The results for the other control variables are generally in line with expectations. The billing rate is lower for larger (p-value < 0.10), profitable clients (p-value < 0.05), and those recently acquired through audit firm merger activity (p-value < 0.10). Interestingly, the results show the additional audit effort (p-value <0.05) associated with larger inventories or receivables is not reflected in the audit fee (p-value > 0.10), resulting in a lower billing rate (p-value < 0.05). Similarly, there is evidence of a fee premium during the busy season, although the effect is insignificant in the billing rate model using *TOP3*.

[Insert TABLE 7 about here]

Supplementary analysis: The association between industry scale and audit quality

Our results suggest that office industry scale leads to efficiency gains. However, a decrease in the time spent on engagements could be risky because performing fewer audit hours could imply that the minimum audit quality is no longer supplied. To test whether our office industry scale measures are associated with differences in audit quality, we estimate a model in which we explain absolute, positive and negative abnormal accruals as a function of office industry scale and of a number of control variables typically used in prior international (Reichelt and Wang 2010) and Belgian earnings-management studies (Dutillieux 2009).[24] We estimate performance-adjusted abnormal discretionary accruals using the population of all Belgian firms for each industry with at least 20 observations (i.e., out of sample) (Reichelt and Wang 2010; Simnett et al. 2016).[25] Due to a lack of data for estimating the level of

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industry specialists passing more of the efficiencies on to their client. The implicit assumption in their study is that the magnitude of the efficiency gain does not differ between industry specialists and non-specialists. Yet, our results with respect to *TOP3* suggest that efficiency gains themselves may actually increase, while the pass-on decreases.

[24] We also estimated abnormal working capital accruals. The untabulated results are qualitatively similar.

[25] Abnormal accruals are calculated as the portion of total accruals (calculated as net income from continuing operations minus operating cash flow) that are "unexpected," given the firm's characteristics. Hence, abnormal accruals are a proxy for the extent to which management uses accruals to adjust earnings upward (or downward). We initially start with a sample of the 15,733 firms required to appoint a statutory auditor in 2000. We delete observations with missing values for *LN_ASSETS* (– 229), industry codes (– 1,807), insufficient data for calculating total accruals (– 914), and insufficient prior-year data for constructing the control variables (– 1,627). After truncating scaled total accruals at the top and bottom 1 percent, the final sample consists of 10,934 firms.

earnings management, only 825 of the initial sample of 910 could be used.[26] Panel A in Table 8 displays the results using *SCALE* as the measure of office industry scale, while panel B displays the result of *TOP3*. The adjusted R^2 is about 7.2 percent, which is comparable to prior Belgian abnormal accrual studies (Dutillieux 2009). With respect to the variables of interest, the coefficients of our measures of office industry scale (*SCALE*: coeff: 0.0024, *p*-value > 0.10 and *TOP3*, coeff: 0.002, *p*-value > 0.10) are not significantly associated with the absolute, negative or positive discretionary accruals. Hence, efficiency gains due to office industry scale are not associated with a reduction in audit quality.

[Insert TABLE 8 about here]

7. Sensitivity analyses

Alternative measures of office industry scale

To test the robustness of our results, we use a scale measure by including a dummy equal to one for the four largest portfolio industries. Overall, the untabulated results are qualitatively similar to the main models.

Alternative measures of audit firm market power

We construct dummy variables based on different cutoffs of *DISTANCE*. Specifically, we develop different indicator variables based on a market-share distance to the closest competitor of 1 percent, 2 percent, 3 percent, and 4 percent. In line with the main analysis, we split *SCALE* and *TOP3* based on these dummies. The billing rate models shows a higher billing rate when using cutoffs of 2 percent, 3 percent and 4 percent, while this is not the case for a cutoff of 1 percent. In sum, these results suggest that the audit firm needs at least a 2 percent market share distance to enjoy market power vis-à-vis the client.

Client size

To test whether the results are driven by large or small private clients, we split the sample based on the median value of clients' total assets. The untabulated results show that the results are mainly driven by the large private clients as

[26] We have 873 observations with sufficient data to estimate absolute discretionary accruals, but the additional requirement of at least 20 observations per industry and the additional controls needed for the discretionary accrual models decreases the sample to 825.

the results for this subsample are similar to the main results. In contrast, we do not find efficiency gains associated with office industry scale for the small clients.

Client bargaining power

Testing the impact of client bargaining power (Casterella et al. 2004), we run a split sample analysis based on the median value of client sales in each office-industry.[27] The results suggest that client bargaining power dominates audit firm market power as the billing rate is only higher when the audit firm has market power and the client has low bargaining power. When the client's bargaining power is high, all realized efficiencies are passed on regardless of the market power of the auditor. This is evident in the insignificance of the test of equal coefficients for the variables *SCALE_HIGHMP* and *TOP3_HIGHMP* in the subsample of clients with high bargaining power. In the subsample of clients with low bargaining power, the opposite situation holds, as the test of equal coefficients for those two variables is significantly different from zero, which suggests a partial pass-on.

Sample

To confront the concern that client characteristics could be correlated with *SCALE/TOP3* we create a matched sample using a propensity score retrieved on all control variables. Results of the main analyses are confirmed. We find a significant negative coefficient for the *TOP3* variable in the audit hour regression, while we do not find a higher billing rate. We do however find higher billing rates when the audit firm's market power is high.

8. Conclusions and limitations

In this article, we examine whether office industry scale is associated with more efficient audits and whether the extent of pass-on of those efficiencies from the auditor to its client depends on the audit firm's market power. Our results indicate that office industry scale is negatively associated with audit hours, but does not significantly affect

[27] We could not use the proxy for bargaining power developed by Casterella et al. (2004), as measured by the natural log of total sales for client *i* divided by the natural logarithm of total sales for all clients audited by the auditor in the same 2-digit industry and office. The reason is that is that inspecting the split sample descriptives based on the median of *POWER* as in Casterella et al. (2004) reveals that *TOP3* accounts for 71.81 percent of observations in the low client bargaining power sample, but only 5.5 percent of observations in the high client bargaining power sample. This would significantly affect the validity of the results found.

the billing rate. This suggests that fee discounts associated with audit office industry scale documented in prior research (i.e., Fung et al. 2012) result from a decrease in audit hours and hence lower *variable costs*, rather than from the division of *fixed audit costs* over more clients. This result can be interesting to regulators as efficiency gains could increase consumer surplus. Note that we also document that office industry scale is negatively associated with both staff and partner hours. Furthermore, we also report results consistent with the argument that office-level efficiency gains are entirely passed on to clients when the audit firm's market power is low, but that the extent of efficiency pass-on decreases when audit firm market power is high. We thus offer a supply-side perspective on client-auditor bargaining power, in contrast to the demand-side perspective taken in other studies (Fung et al. 2012; Casterella et al. 2004). In addition, our results also show that market share-based and portfolio-based proxies of auditor industry expertise have differential effects on audit hours, and hence confirm that both types of measures most likely capture different aspects of industry knowledge. Finally, our audit quality analysis reveals that our measures of audit industry scale are not associated with discretionary accruals. Hence, the decrease in audit hours associated with office industry scale can be interpreted as real gains in efficiency because they are not negatively associated with audit quality.

Our study is subject to several limitations. First, the data relate to one fiscal year only, and our inferences may therefore not apply to other time periods, though the structure and characteristics of the Belgian audit market, and in particular its private client segment, have not changed substantially after the single year under study. Second, the results may not apply outside the Belgian institutional setting. Nevertheless, some prior studies outside of Belgium have documented a negative relationship between audit fees (but not audit hours) and market share-based measures of industry specialization (Casterella et al. 2004; Johnstone et al. 2004) or city-industry scale (Fung et al. 2012). Third, since industry knowledge and market power are not directly observable, we have to rely on proxies to capture them. It is possible that the proxies we use do not sufficiently capture market power and are subject to measurement error. Fourth, efficiency gains could result in lower prices for clients. In the long run, this could result in the most efficient firm gaining the highest market power and driving less efficient competitors out of the market. Market power and efficiency gains could therefore be endogenous. Fifth, we only study private companies and it is unclear whether our results would generalize to listed companies. Nonetheless, we are able to replicate results found in Bae et al. (2016) and Fung et al. (2012) which use publicly listed clients from different institutional environments providing some confidence about the generalizability of the results. Finally, we were unable to measure audit quality directly and had to rely on a proxy for earnings quality. Alternative measures of financial-statement quality could be used to investigate the link between efficiencies and industry scale.

References

Argote, L., and D. Epple. 1990. Learning curves in manufacturing. *Science* 247 (4945): 920–924.

Argote, L., and E. Miron-Spektor. 2011. Organizational learning: From experience to knowledge. *Organization Science* 22 (5): 1123–1137.

Armstrong, C. S., J. L. Blouin, and D. F. Larcker. 2012. The incentives for tax planning. *Journal of Accounting and Economics*, 53 (1), 391-411.

Audousset-Coulier, S., A. Jeny, and L. Jiang. 2015 The validity of auditor industry specialization measures. *Auditing: A Journal of Practice & Theory 35* (1): 139–161

Bae, G. S., S. U. Choi and J. H. Rho. 2016. Audit hours and unit audit price of industry specialist auditors: Evidence from Korea. *Contemporary Accounting Research* 33 (1): 314–340.

Ball, R., and L. Shivakumar. 2005. Earnings quality in UK private firms comparative loss recognition timeliness. *Journal of Accounting and Economics* 39 (1): 83–128.

Balsam, S., J. Krishnan, and J. Yang. 2003. Auditor industry specialization and audit quality. *Auditing: A Journal of Theory and Practice* 22 (2): 71–97.

Bell, T. B., R. Doogar, and I. Solomon. 2008. Audit labor usage and fees under business risk auditing. *Journal of Accounting Research* 46 (4): 729–760.

Besanko, D., U. Doraszelski, Y. Kryukov, and M. Satterthwaite. 2010. Learning-by-doing, organizational forgetting, and industry dynamics. *Econometrica* 78 (2): 453–508.

Bills, K. L., D.C. Jeter, and S.E. Stein. 2015. Auditor industry specialization and evidence of cost efficiencies in homogenous industries. *The Accounting Review,* 90(5), 1721-1754.

Bills, K.L. and N.M. Stephens. 2016. Spatial Competition at the Intersection of the Large and Small Audit Firm Markets. *Auditing: A Journal of Practice & Theory*, 35(1), 23-45.

Boh, W. F., S. A. Slaughter, and J. A. Espinosa. 2007. Learning from experience in software development: A multilevel analysis. *Management Science* 53 (8): 1315–1331.

Boone, T., R. Ganeshan, and R. Hicks. 2008. Learning and knowledge depreciation in professional services. *Management Science* 54 (7): 1231–1236.

Byard, D., Y. Li and Y. Yu. 2011. The effect of mandatory IFRS adoption on financial analysts' information environment. *Journal of accounting research* 49 (1): 69-96.

Cabral, L. M., and M. H. Riordan. 1994. The learning curve, market dominance, and predatory pricing. *Econometrica* 62 (5): 1115–1140.

Cahan, S. F., D. C. Jeter, and V. Naiker. 2011. Are all industry specialist auditors the same? *Auditing: A Journal of Practice & Theory* 30 (4): 191–222.

Casterella, J., J. R. Francis, B. Lewis, and P. Walker. 2004. Auditor industry specialization, client bargaining power, and audit pricing. *Auditing: A Journal of Practice and Theory* 23 (1): 123–140.

Chow, C. W., J. L. Ho, and S. C. Vera-Munoz. 2008. Exploring the extent and determinants of knowledge sharing in audit engagements. *Asia-Pacific Journal of Accounting and Economics* 15: 141–160.

Craswell, A., J. R. Francis, and S. L. Taylor. 1995. Auditor brand name reputations and industry specialization. *Journal of Accounting and Economics* 20 (3): 297–322.

Darr, E. D., L. Argote, and D. Epple. 1995. The acquisition, transfer, and depreciation of knowledge in service organizations: Productivity in franchises. *Academy of Management Science* 41 (11): 1750–1762.

Danos, P., J. W. Eichenseher, and D. L. Holt. 1989. Specialized knowledge and its communication in auditing. *Contemporary Accounting Research* 6 (1): 91–109.

Dasgupta, P., and J. Stiglitz. 1988. Learning-by-doing, market structure and industrial and trade policies. *Oxford Economic Papers* 40 (2): 246–268.

DeFond, M., J. R. Francis, and T. Wong. 2000. Auditor industry specialization and market segmentation: Evidence from Hong Kong. *Auditing: A Journal of Practice and Theory* 19 (1): 49–66.

Dunn, K., and B. Mayhew. 2004. Audit firm industry specialization and client disclosure quality. *Review of Accounting Studies* 9 (1): 35–58.

Dutillieux, W. 2009. Audit research opportunities in European institutional settings. Doctoral dissertation, KU Leuven.

Eichenseher, J. W., and P. Danos. 1981. The analysis of industry-specific auditor concentration: towards an explanatory model. *The Accounting Review* 56 (3): 479–492.

European Commission. 2015. NUTS - Nomenclature of territorial units for statistics: overview. European Commission. Available online at http://ec.europa.eu/eurostat/web/nuts/overview, retrieved August 29, 2016.

Ferguson, A., J. R. Francis, and D. J. Stokes. 2003. The effects of firm-wide and city-specific industry expertise on audit pricing. *The Accounting Review* 78 (2): 429–448.

Francis, J. R., K. Reichelt, and D. Wang. 2005. The pricing of national and city-specific reputations for industry expertise in the U.S. audit market. *The Accounting Review* 80 (4): 113–136.

Fresard, L. 2010. Financial strength and product market behavior: The real effects of corporate cash holdings. *The Journal of finance*, 65 (3): 1097-1122

Fung, S. Y. K., F. A. Gul, and J. Krishnan. 2012. City-level auditor industry specialization, economies of scale, and audit pricing. *The Accounting Review* 87 (4): 1281–1307.

Gul, F. A., S. Y. K Fung, and B. Jaggi. 2009. Earnings quality: Some evidence on the role of auditor tenure and auditors' industry expertise. *Journal of Accounting and Economics* 47 (3): 265–287.

Hammersley, J. 2006. Pattern identification and industry specialist auditors. *The Accounting Review* 81 (2): 309–336.

Hay, D., W. R. Knechel, and N. Wong. 2006. Audit fees: A meta-analysis of the effect of supply and demand attributes. *Contemporary Accounting Research* 23 (1): 141–191.

Johnstone, K. M., J. C. Bedard, and M. L. Ettredge. 2004. The effect of competitive bidding on engagement planning and pricing. *Contemporary Accounting Research* 21 (1): 25–53.

Knechel, W. R., A. Vanstraelen, and M. Zerni. 2015. Does the identity of engagement partners matter? An analysis of audit partner reporting decisions. *Contemporary Accounting Research* 32 (4): 1443-1478.

Krishnan, J. 2001. A comparison of auditors' self-reported industry expertise and alternative measures of industry specialization. *Asia-Pacific Journal of Accounting and Economic* 8 (1): 127–142.

Krishnan, G. V. 2003. Does Big 6 auditor industry expertise constrain earnings management? *Accounting Horizons* supplement, 1–16.

Liu, X., and D. A. Simunic. 2005. Profit sharing in an auditing oligopoly. *The Accounting Review* 80 (2): 677–702.

Malhotra, N., and T. Morris. 2009. Heterogeneity in professional service firms." *Journal of Management Studies* 46 (2): 895–922.

Mayhew, B. W., and M. Wilkins. 2003. Audit firm industry specialization as a differentiation strategy: Evidence from fees charged to firms going public. *Auditing: A Journal of Practice and Theory* 22 (2): 33–52.

Minutti-Meza, M. 2013. Does auditor industry specialization improve audit quality? *Journal of Accounting Research* 51 (4): 779–817.

Neal, T., and R. Riley. 2004. Auditor industry specialist research design. *Auditing: A Journal of Practice and Theory* 23 (2): 169–177.

Numan, W., and M. Willekens. 2012. An empirical test of spatial competition in the audit market. *Journal of Accounting and Economics* 53: 450–465.

O'Keefe, T. B., D. A. Simunic, and M. T. Stein. 1994. The production of audit services: Evidence from a major public accounting firm. *Journal of Accounting Research* 32 (2): 241–261.

Pisano, G. P., R. M. J. Bohmer, and A. C. Edmondson. 2001. Organizational differences in rates of learning: Evidence from the adoption of minimally invasive cardiac surgery. *Management Science* 47 (6): 752–768.

Reagans, R., L. Argote, and D. Brooks. 2005. Individual experience and experience working together: Predicting learning rates from knowing who knows what and knowing how to work together. *Management Science* 51 (6): 869–881.

Redmayne, N.B., M.E. Bradbury and S.F. Cahan. 2010. The effect of political visibility on audit effort and audit pricing. *Accounting & Finance* 50 (4): 921-939.

Reichelt, K., and D. Wang. 2010. National and office-specific measures of auditor industry expertise and effects on audit quality. *Journal of Accounting Research* 48 (3): 647–686.

Schaen, M., and S. Maijoor. 1997. The structure of the Belgian audit market: The effect of client concentration and capital market activity. *International Journal of Auditing* 1 (2): 151–162.

Schelleman, C., and W. R. Knechel. 2010. Short-term accruals and the pricing and production of audit services. *Auditing: A Journal of Practice and Theory* 29 (1): 221–250.

Simnett, R., E. Carson, and A. Vanstraelen. 2016. International Archival Auditing and Assurance Research: Trends, Methodological Issues, and Opportunities. *Auditing: A Journal of Practice and Theory* 35 (3): 1-32.

Stein, M. T., D. A. Simunic, and T. B. O'Keefe. 1994. Industry differences in the production of audit services. *Auditing: A Journal of Theory and Practice* 13 (1): 128–142.

Taylor, S. D. 2011. Does audit fee homogeneity exist? Premiums and discounts attributable to individual partners. *Auditing: A Journal of Practice and Theory* 30 (4): 249-272.

Taylor, M. 2000. The effects of industry specialization on auditors' inherent risk assessments and confidence judgments. *Contemporary Accounting Research* 17 (4): 693–712.

Vander Bauwhede, H., and M. Willekens. 2004. Evidence on (the lack of) audit quality differentiation in the private client segment of the Belgian audit market. *European Accounting Review* 13 (3): 501–522.

Vera-Munoz, S. C., J. L. Ho, and C. W. Chow. 2006. Enhancing knowledge sharing in public accounting firms. *Accounting Horizons* 20 (2): 133–155.

Weets, V., and M. Jegers. 1997. Are the 'Big Six' 'big' in Belgium? *European Accounting Review* 6 (4): 773–789.

Willekens, M., and C. Achmadi. 2003. Pricing and supplier concentration in the private client segment of the audit market: Market power or competition? *The International Journal of Accounting* 38 (1): 431–455.

Willekens, M., S. Dekeyser, L.Bruynseels, , and W. Numan 2017. Did the (alleged) lack of competition in the market for audit services lead to lower audit quality in the pre-crisis era? Working paper, KU Leuven.

TABLE 1

Variable definitions

	Variable definitions
Dependent variables	
LN_HOURS	The natural logarithm of total hours performed on the engagement
LN_PARTHOURS	The natural logarithm of total partner hours performed on the engagement
LN_STAHOURS	The natural logarithm of total staff hours performed on the engagement
LN_FEE	The natural logarithm of total audit fees (in thousand EUR)
BILLRATE	The natural logarithm of the total audit fee divided by total hours
Client specific control variables	
LN_ASSETS	The natural logarithm of total sales (in EUR)
LN_SALES	The natural logarithm of sales (in EUR)
RECINV	The ratio of receivables plus inventory divided by total assets
QUICK	The quick ratio
DEBT	The ratio of debt to total assets
ROA	Return on assets
BUSY	Dummy variable equal to one if the client has a December fiscal year end and zero otherwise
LOSS	Dummy variable equal to one if the client reports an after-tax negative net income and zero otherwise
PUBLIC	Dummy variable equal to one if the firm is publicly listed and zero otherwise
INITIAL	Dummy variable equal to one if the engagement is part of the first three-year mandate and zero otherwise
JOINT	Dummy variable equal to one if the audit is performed jointly with another audit firm and zero otherwise
ACQUIR	Dummy variable equal to one if the client originally appointed an audit firm that was subsequently acquired by our sample firm
LN_NAS	The natural logarithm of all other legal audit services performed by the auditor; this does not include non-audit services
SUBSIDIARIES	The natural logarithm of the number of subsidiaries
Industry specialist variable	
DOM_LEADER	Dummy equal to one if the audit firm is leader, i.e., has the highest market share in the industry-region, and has a market share distance of at least 10 percent with the closest competitor and zero otherwise
Office industry scale variables	
TOP3	Dummy variable equal to one for the audit office's (or audit firm's) highest three portfolio industries and zero otherwise
SCALE	The percentile rank of the number of clients of each office-industry
Competition variable	
DISTANCE	The absolute value of the difference in market share within the regional industry segment between the audit firm and its closest competitor in that industry market segment = min($\lvert MS_i - MS_n \rvert$) where *i* is a subscript indicating our sample firm, *n* is a subscript indicating all competing audit firms within the regional industry segment; MS = the market share of an audit firm within a regional industry segment
HIGHMP	Dummy equal to one if DISTANCE is larger than the p75-value of DISTANCE and zero otherwise

Audit quality analysis	
|DA|	Performance adjusted absolute discretionary accruals
CFO	Cash flow of operations
SALES_TURN	The ratio of sales to total assets
OR_GROWTH	The growth in operating revenue from 1999 to 2000 divided by operating revenue in 1999
LAGTAX	Indicator variable equal to one if the company paid taxes in the previous year and zero otherwise

TABLE 2
Sample selection

Engagements of the BIG4 firms under study for which we have actual audit hours available	**1,258**	
Less engagements for which total audit hours were unavailable	(62)	
Less engagements where not all the control variables were available	(122)	
Less engagements where audit fees were unavailable	(44)	
Less financial firms (SIC codes: 6000–6999)	(120)	
Less public firms	(7)	
Less industries with less than 5 clients at regional level	(8)	
Sample used to test audit-fee model		895
Starting sample of all firms that were required to appoint a statutory auditor in fiscal year 2000	**15,733**	
Less firms with missing values for LN_ASSETS	(229)	
Less firm with missing values for the auditor	(2,354)	
Less firms with missing SIC-code	(1,807)	
Sample used to calculate market share–based measures		11,343

TABLE 3
Descriptive statistics

	N	Mean	StdDev	Min	P25	Median	P75	Max
Panel A: Dependent variables								
Audit fee (in thousand EUR)	895	15.006	20.049	0.744	3.830	8.393	16.981	127.162
LN_FEE	895	9.048	1.056	6.612	8.251	9.035	9.740	11.753
Total hours	895	163.39	190.86	2.00	39.75	97.50	204.00	1000.50
LN_HOURS	895	4.451	1.268	0.693	3.683	4.580	5.318	6.908
Partner hours	895	9.520	15.259	0.000	1.500	4.000	11.000	111.000
LN_PARTHOURS	895	1.749	1.061	0.000	0.916	1.609	2.485	4.718
Staff hours	895	152.921	181.662	0.000	36.250	91.500	188.500	951.500
LN_STAHOURS	895	4.352	1.350	0.000	3.618	4.527	5.244	6.859
BILLRATE	895	4.647	0.8	3.17	4.241	4.539	4.879	9.036
Panel B: Office industry scale variables								
SCALE	895	0.780	0.259	0.010	0.650	0.880	0.970	1.000
TOP3	895	0.387	0.487	0.000	0.000	0.000	1.000	1.000
Panel C: Firm-specific control variables								
DOM_LEADER	895	0.064	0.244	0.000	0.000	0.000	0.000	1.000
LN_ASSETS	895	19.376	1.799	14.176	18.330	19.262	20.370	25.008
LN_SALES	895	19.370	1.951	13.152	18.375	19.447	20.595	23.877
RECINV	895	0.559	0.280	0.000	0.338	0.596	0.801	0.997
QUICK	895	2.246	8.108	0.021	0.688	1.043	1.456	118.138
DEBT	895	0.749	0.890	0.000	0.490	0.696	0.859	12.265
ROA	895	0.020	0.224	-1.317	-0.004	0.027	0.098	0.623
BUSY	895	0.745	0.436	0.000	0.000	1.000	1.000	1.000
LOSS	895	0.276	0.447	0.000	0.000	0.000	1.000	1.000
INITIAL	895	0.374	0.484	0.000	0.000	0.000	1.000	1.000
LN_NAS	895	0.283	1.873	0.000	0.000	0.000	0.000	13.013
SUBSIDIARIES	895	0.401	0.671	0.000	0.000	0.000	0.693	2.996
JOINT	895	0.057	0.232	0.000	0.000	0.000	0.000	1.000
ACQUIR	895	0.183	0.387	0.000	0.000	0.000	0.000	1.000
Panel D: Market power variables								
DISTANCE	895	0.034	0.095	0.000	0.003	0.013	0.038	0.857
HIGHMP	895	0.251	0.434	0.000	0.000	0.000	1.000	1.000

Notes: All continuous variables except *LN_NAS* are winsorized at the 1 percent level. Panel A reports the descriptive statistics of the dependent variables in our models. Panel B presents the descriptive statistics of the office industry scale variables. Panel C includes the descriptive statistics of the firm-level control variables included in the analysis. Panel D shows the proxy used to measure the competitiveness of the industry. Variable definitions can be found in Table 1.

TABLE 4
Correlations between variables (*N* = 895)

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1 *LN_FEE*		0.8401*	0.6867*	0.8274*	0.0726*	-0.0774*	-0.0611	0.0279	0.0533	0.5356*	0.6118*	0.0218	-0.1230*
2 *LN_HOURS*	0.7991*		0.7053*	0.9965*	-0.4073*	-0.0673*	-0.0443	0.0488	0.0691*	0.5740*	0.6440*	0.0496	-0.1361*
3 *LN_PARTHOURS*	0.6986*	0.6827*		0.6651*	-0.1159*	-0.0905*	-0.0724*	0.0363	0.0739*	0.4655*	0.4994*	0.0358	-0.0697*
4 *LN_STAHOURS*	0.7634*	0.9911*	0.6203*		-0.4206*	-0.0631	-0.0397	0.0492	0.0692*	0.5666*	0.6395*	0.0506	-0.1347*
5 *BILLRATE*	-0.0021	-0.5961*	-0.1978*	-0.6300*		-0.0145	-0.0399	-0.0377	-0.0124	-0.1540*	-0.1853*	-0.0733*	0.0632
6 *SCALE*	-0.0772*	-0.0651	-0.0712*	-0.0624	0.0048		0.7751*	0.0090	-0.1072*	-0.0997*	-0.1052*	0.2049*	0.0918*
7 *TOP3*	-0.0625	-0.0477	-0.0764*	-0.0481	-0.0080	0.5616*		0.0212	-0.1883*	0.0141	-0.0529	0.1028*	0.0534
8 *HIGHMP*	0.0438	0.0516	0.0504	0.0510	-0.0340	-0.0095	0.0212		0.4501*	0.0516	0.0776*	-0.0392	-0.0503
9 *DOM_LEADER*	0.0755*	0.0712*	0.0923*	0.0659*	-0.0186	-0.0538	-0.1883*	0.4501*		0.0258	0.0672*	0.0007	-0.0875*
10 *LN_ASSETS*	0.5511*	0.5182*	0.4615*	0.4890*	-0.1077*	-0.0786*	0.0170	0.0518	0.0533		0.7394*	-0.1225*	-0.1256*
11 *LN_SALES*	0.6131*	0.5932*	0.4636*	0.5682*	-0.1628*	-0.0841*	-0.0521	0.0864*	0.0874*	0.7063*		0.1264*	-0.1895*
12 *RECINV*	0.0275	0.0749*	0.0270	0.0760*	-0.0837*	0.1472*	0.0893*	-0.0323	0.0055	-0.1127*	0.1593*		0.1737*
13 *QUICK*	-0.1178*	-0.1502*	-0.0805*	-0.1481*	0.0867*	0.0380	0.0615	0.0585	-0.0394	-0.0766*	-0.2180*	0.0289	
14 *DEBT*	-0.0575	-0.0633	-0.0290	-0.0649	0.0244	0.0181	-0.0095	0.0431	0.0623	-0.1884*	-0.1012*	0.0477	-0.1300*
15 *ROA*	0.0424	0.0720*	0.0608	0.0706*	-0.0647	0.0154	0.0367	-0.0336	-0.0225	0.1725*	0.1611*	0.0451	0.0945*
16 *BUSY*	0.0836*	0.0427	0.0287	0.0413	0.0424	-0.0531	0.0323	-0.0691*	-0.1415*	0.0663*	0.0373	0.0110	-0.0061
17 *LOSS*	0.0112	-0.0025	-0.0022	-0.0058	0.0155	0.0086	-0.0384	0.0052	0.0335	-0.1054*	-0.0723*	-0.0593	-0.0750*
18 *INITIAL*	-0.0281	-0.0546	-0.0360	-0.0564	0.0572	-0.0140	-0.0214	-0.0171	-0.0221	-0.0406	-0.0659*	-0.0860*	-0.0080
19 *LN_NAS*	0.0193	0.0410	0.0389	0.0401	-0.0451	-0.0538	-0.0114	0.0169	0.0234	0.1387*	0.0236	-0.0739*	0.0973*
20 *SUBSIDIARIES*	0.2567*	0.2207*	0.2648*	0.2061*	-0.0156	0.0188	0.0123	0.0505	0.0501	0.3788*	0.2589*	-0.2044*	-0.0548
21 *JOINT*	0.0057	-0.0073	0.0729*	-0.0208	0.0388	0.0355	0.0721*	0.0353	0.0741*	0.1101*	0.0589	0.0056	-0.0247
22 *ACQUIR*	-0.2444*	-0.1596*	-0.1094*	-0.1505*	-0.0681*	0.0388	0.0925	0.0717*	-0.0644	-0.1490*	-0.1393*	-0.0299	0.0441

TABLE 4 (continued)

	14	15	16	17	18	19	20	21	22
1 *LN_FEE*	0.0397	0.0238	0.0872*	0.0062	-0.0306	0.0106	0.2098*	0.0067	-0.2495*
2 *LN_HOURS*	0.0415	0.0363	0.0550	-0.0019	-0.0385	0.0350	0.2325*	0.0157	-0.1972*
3 *LN_PARTHOURS*	-0.0059	0.0541	0.0432	-0.0176	-0.0509	0.0355	0.2308*	0.0677*	-0.1091*
4 *LN_STAHOURS*	0.0415	0.0338	0.0518	-0.0003	-0.0379	0.0326	0.2249*	0.0131	-0.1987*
5 *BILLRATE*	-0.0459	-0.0323	0.0562	0.0216	0.0077	-0.0386	-0.0408	0.0041	-0.0869*
6 *SCALE*	0.0262	0.0184	-0.0354	-0.0194	-0.0496	-0.0594	-0.0256	0.0287	0.0463
7 *TOP3*	0.0044	0.0049	0.0323	-0.0384	-0.0214	-0.0116	0.0106	0.0721*	0.0925*
8 *HIGHMP*	0.0242	0.0025	-0.0691*	0.0052	-0.0171	0.0168	0.0323	0.0353	0.0717*
9 *DOM_LEADER*	0.0548	-0.0083	-0.1415*	0.0335	-0.0221	0.0232	0.0383	0.0741*	-0.0644
10 *LN_ASSETS*	-0.0142	0.0210	0.0658*	-0.0960*	-0.0430	0.1104*	0.3629*	0.1117*	-0.1360*
11 *LN_SALES*	0.0982*	0.0818*	0.0316	-0.0793*	-0.0693*	0.0313	0.2629*	0.0659*	-0.1289*
12 *RECINV*	0.1134*	0.0330	0.0056	-0.0590	-0.0826*	-0.0715*	-0.2003*	0.0105	-0.0285
13 *QUICK*	-0.5537*	0.2929*	0.0048	-0.2398*	-0.0213	-0.0379	-0.1192*	-0.0271	0.1047*
14 *DEBT*		-0.3915*	-0.0002	0.3055*	0.0402	-0.0937*	-0.0906*	0.0094	-0.0509
15 *ROA*	-0.5424*		-0.0080	-0.7742*	-0.0907*	0.0029	0.0448	-0.0595	0.0331
16 *BUSY*	-0.0123	0.0332		-0.0349	-0.0777*	0.0011	0.0676*	0.0220	-0.0678*
17 *LOSS*	0.2356*	-0.5531*	-0.0349		0.1061*	-0.0766*	-0.0602	0.0315	-0.0404
18 *INITIAL*	0.0608	-0.1004*	-0.0777*	0.1061*		-0.0068	-0.0772*	0.0788*	-0.0739*
19 *LN_NAS*	-0.0459	0.0101	0.0014	-0.0765*	-0.0068		0.0309	0.0277	-0.0716*
20 *SUBSIDIARIES*	-0.0773*	0.0615	0.0469	-0.0699*	-0.0599	0.0219		0.0606	0.0362
21 *JOINT*	0.0006	-0.0755*	0.0220	0.0315	0.0788*	0.0277	0.0900*		-0.0666*
22 *ACQUIR*	-0.0339	0.0406	-0.0678*	-0.0404	-0.0739*	-0.0716*	0.0448	-0.0666*	

Notes: The correlations are calculated for the audit-fee sample of 895 engagements. Pearson correlations are reported below the diagonal, while Spearman correlations are reported above the diagonal. Variables significant at the 5 percent level are indicated with an asterisk. All continuous variables except *LN_NAS* are winsorized at the 1 percent level. Variable definitions can be found in Table 1.

TABLE 5
Audit hours models

Dependent variable	Model using *SCALE* as office industry scale measure									Model using *TOP3* as office industry scale measure								
	LN_HOURS			***LN_PARTHOURS***			***LN_STAHOURS***			***LN_HOURS***			***LN_PARTHOURS***			***LN_STAHOURS***		
	Coeff.		z-stat	Coeff		z-stat	Coeff		z-stat	Coeff		z-stat	Coeff		z-stat	Coeff		z-stat
	(1)		(2)	(3)		(4)	(5)		(6)	(7)		(8)	(9)		(10)	(11)		(12)
Intercept	-2.873	***	-5.06	-2.536	***	-4.32	-3.166	***	-5.02	-3.090	***	-5.08	-2.654	***	-4.37	-3.390	***	-5.01
SCALE	-0.558	**	-2.41	-0.155		-0.58	-0.581	**	-2.30									
TOP3										-0.155	*	-1.68	-0.252	**	-2.39	-0.155	*	-1.84
HIGHMP	-0.230	*	-1.77	-0.089		-0.50	-0.269	**	-1.98	-0.225	*	-1.74	-0.083		-0.52	-0.265	*	-1.93
DOM_LEADER	0.387	***	2.89	0.551	***	4.08	0.381	***	2.63	0.340	***	2.60	0.540	***	4.06	0.333	**	2.35
LN_ASSETS	0.170	***	5.34	0.153	***	4.35	0.166	***	4.99	0.172	***	5.23	0.156	***	4.35	0.168	***	4.90
LN_SALES	0.230	***	7.96	0.111	***	3.70	0.239	***	8.20	0.232	***	8.05	0.112	***	3.87	0.242	***	8.28
RECINV	0.246	**	2.19	0.227		1.50	0.246	**	1.98	0.228	**	2.02	0.214		1.40	0.228	*	1.80
QUICK	-0.076	*	-1.88	-0.018		-0.58	-0.084	*	-1.76	-0.076	*	-1.83	-0.017		-0.56	-0.084	*	-1.71
DEBT	-0.168		-1.01	-0.164		-1.11	-0.191		-1.11	-0.153		-0.90	-0.160		-1.06	-0.175		-0.99
ROA	-0.045		-0.19	-0.094		-0.67	-0.036		-0.15	-0.040		-0.17	-0.078		-0.55	-0.032		-0.13
BUSY	-0.024		-0.31	-0.037		-0.41	-0.032		-0.37	-0.015		-0.20	-0.029		-0.32	-0.023		-0.27
LOSS	0.132		0.99	0.085		0.98	0.125		0.87	0.127		0.95	0.083		0.94	0.120		0.83
INITIAL	-0.026		-0.34	0.035		0.55	-0.033		-0.42	-0.027		-0.36	0.035		0.55	-0.034		-0.44
JOINT	-0.423	**	-2.27	0.106		0.84	-0.516	**	-2.28	-0.403	**	-2.11	0.139		1.07	-0.495	**	-2.15
ACQUIR	-0.129	*	-1.73	0.057		0.70	-0.142		-1.60	-0.142	**	-2.03	0.070		0.97	-0.157	*	-1.84
LN_NAS	0.012		0.80	-0.001		-0.07	0.015		0.87	0.013		0.87	0.000		0.00	0.015		0.93
SUBSIDIARIES	0.107		1.40	0.196	***	3.92	0.102		1.22	0.097		1.32	0.190	***	3.83	0.092		1.14
Number of observations	895			895			895			895			895			895		
Adjusted R^2	0.420			0.310			0.387			0.419			0.315			0.385		
Office fixed effects	Included			Included			Included			Included			Included			Included		
Industry fixed effects	Included			Included			Included			included			included			Included		

Notes: This table presents the results of a seemingly unrelated regression of firm-specific control variables and the scale measure *TOP3* and *SCALE* on the natural logarithm of total hours, partner hours, and staff hours. All continuous variables except *LN_NAS* are winsorized at the 1 percent level. Standard errors are clustered around 2-digit SIC codes, and office and industry fixed effects are included but not reported for the sake of brevity. *, **, and *** represent significance levels of 10 percent, 5 percent, and 1 percent, respectively. Variable definitions can be found in Table 1.

TABLE 6

Audit fee and billing rate models

Dependent variable	Model using *SCALE* as office industry scale measure						Model using *TOP3* as office industry scale measure					
	LN_FEE			***BILLRATE***			***LN_FEE***			***BILLRATE***		
	Coeff.. (1)		*z*-stat (2)	Coeff. (3)		*t*-stat (4)	Coeff. (5)		*z*-stat (6)	Coeff. (7)		*t*-stat (8)
Intercept	2.740	***	5.24	5.783	***	17.86	2.567	***	4.89	5.844	***	17.68
SCALE	-0.408	**	-2.58	0.205		1.24						
TOP3							-0.164		-1.53	-0.008		-0.13
HIGHMP	-0.043		-0.47	0.176	*	1.99	-0.039		-0.44	0.176	*	1.99
DOM_LEADER	0.387	**	2.72	-0.006		-0.05	0.353	**	2.54	0.012		0.11
LN_ASSETS	0.132	***	3.53	-0.032	*	-1.74	0.134	***	3.50	-0.032	*	-1.78
LN_SALES	0.218	***	6.14	-0.027		-1.43	0.220	***	6.16	-0.028		-1.48
RECINV	-0.052		-0.33	-0.258	**	-2.04	-0.067		-0.43	-0.255	*	-1.99
QUICK	0.003		0.12	0.081	*	1.79	0.003		0.14	0.081	*	1.78
DEBT	-0.088		-0.51	0.082		0.70	-0.077		-0.44	0.076		0.64
ROA	-0.311	*	-1.89	-0.294	**	-2.11	-0.304	*	-1.84	-0.292	**	-2.11
BUSY	0.092		1.50	0.116	*	1.73	0.100		1.63	0.115	*	1.70
LOSS	0.085		1.10	-0.061		-0.63	0.081		1.03	-0.059		-0.61
INITIAL	0.041		0.61	0.072		0.98	0.040		0.59	0.072		1.00
JOINT	-0.292	*	-1.77	0.203		1.35	-0.271		-1.63	0.204		1.31
ACQUIR	-0.270	***	-3.86	-0.153	*	-1.98	-0.276	***	-4.19	-0.143	*	-1.95
LN_NAS	0.006		0.40	-0.009		-1.09	0.007		0.45	-0.009		-1.06
SUBSIDIARIES	0.142	***	3.48	0.035		0.47	0.134	***	3.30	0.038		0.52
Number of observations	895			895			895			895		
Adjusted R^2	0.488			0.088			0.488			0.087		
Office fixed effects	Included			Included			Included			Included		
Industry fixed effects	Included			Included			included			Included		

Notes: This table presents the results of a seemingly unrelated regression (ordinary least square regression) of firm-specific control variables and the scale measure *TOP3* and *SCALE* on the natural logarithm of audit fees (billing rate). All continuous variables except *LN_NAS* are winsorized at the 1 percent level. Standard errors are clustered around 2-digit SIC codes, and office and industry fixed effects are included but not reported for the sake of brevity. *, **, and *** represent significance levels of 10 percent, 5 percent, and 1 percent, respectively. Variable definitions can be found in Table 1.

TABLE 7

Panel A: models with *SCALE* split based on market power

	Model using *SCALE* as office industry scale measure										
Dependent variable	***LN_HOURS***			***LN_FEE***			Test of equal regression coefficients		***BILLRATE***		
	Coeff.. (1)		*z*-stat (2)	Coeff. (3)		*z*-stat (4)	*p*-value (5)		Coeff. (6)		*t*-stat (7)
Intercept	-2.925	***	-5.35	2.739	***	5.28			5.825	***	18.02
SCALE_LOWMP	-0.469	*	-1.74	-0.408	**	-2.24	0.714		0.132		0.72
SCALE_HIGHMP	-0.772	***	-2.71	-0.410	*	-1.74	0.031	**	0.380	**	2.02
HIGHMP	0.009		0.04	-0.041		-0.16	0.749		-0.019		-0.11
DOM_LEADER	0.378	***	3.30	0.387	***	2.71	0.932		0.002		0.02
LN_ASSETS	0.171	***	5.32	0.132	***	3.54	0.038	**	-0.033	*	-1.77
LN_SALES	0.229	***	7.90	0.218	***	6.19	0.592		-0.026		-1.41
RECINV	0.248	**	2.22	-0.052		-0.33	0.019	**	-0.260	**	-2.08
QUICK	-0.077	*	-1.92	0.003		0.12	0.056	*	0.082	*	1.81
DEBT	-0.171		-1.03	-0.088		-0.51	0.475		0.084		0.73
ROA	-0.047		-0.20	-0.311	*	-1.89	0.021	**	-0.293	**	-2.11
BUSY	-0.024		-0.31	0.092		1.50	0.056	*	0.116	*	1.73
LOSS	0.128		0.96	0.085		1.09	0.625		-0.058		-0.60
INITIAL	-0.023		-0.32	0.041		0.61	0.316		0.070		0.97
JOINT	-0.424	**	-2.27	-0.292	*	-1.77	0.325		0.204		1.35
ACQUIR	-0.128	*	-1.71	-0.270	***	-3.86	0.044	**	-0.154	*	-1.99
LN_NAS	0.013		0.89	0.006		0.40	0.417		-0.010		-1.19
SUBSIDIARIES	0.107		1.40	0.142	***	3.48	0.603		0.035		0.47
Number of observations	895			895					895		
Adjusted R^2	0.420			0.488					0.088		
Office fixed effects	Included			Included					Included		
Industry fixed effects	Included			Included					included		

TABLE 7 (continued)
Panel B: models with *TOP3* split based on market power

	Model using TOP3 as office industry scale measure										
Dependent variable	***LN_HOURS***			***LN_FEE***			Test of equal regression coefficients		***BILLRATE***		
	Coeff. (1)		*z*-stat (2)	Coeff. (3)		*z*-stat (4)	*p*-value (5)		Coeff. (6)		*t*-stat (7)
Intercept	-3.163	***	-5.44	2.541	***	4.92			5.889	***	17.96
TOP3_LOWMP	-0.040		-0.40	-0.123		-0.99	0.213		-0.078		-1.16
TOP3_HIGHMP	-0.531	***	-7.80	-0.298	***	-3.13/	0.003	***	0.220	***	2.80
HIGHMP	0.022		0.25	0.050		0.44	0.725		0.026		0.32
DOM_LEADER	0.263	***	2.97	0.326	**	2.42	0.556		0.059		0.52
LN_ASSETS	0.173	***	5.08	0.134	***	3.46	0.031	**	-0.033	*	-1.83
LN_SALES	0.231	***	7.78	0.220	***	6.09	0.556		-0.027		-1.48
RECINV	0.227	**	2.03	-0.067		-0.43	0.024	**	-0.254	*	-1.99
QUICK	-0.075	*	-1.89	0.004		0.15	0.056	*	0.081	*	1.81
DEBT	-0.154		-0.94	-0.078		-0.45	0.510		0.077		0.66
ROA	-0.049		-0.20	-0.307	*	-1.85	0.024	**	-0.286	**	-2.08
BUSY	-0.014		-0.18	0.100		1.64	0.063	*	0.114		1.68
LOSS	0.124		0.93	0.080		1.02	0.631		-0.058		-0.58
INITIAL	-0.028		-0.39	0.040		0.59	0.285		0.073		1.02
JOINT	-0.392	**	-2.02	-0.267		-1.61	0.377		0.198		1.25
ACQUIR	-0.127	*	-1.73	-0.270	***	-4.00	0.036	**	-0.152	**	-2.05
LN_NAS	0.019		1.45	0.009		0.60	0.216		-0.013		-1.61
SUBSIDIARIES	0.095		1.31	0.133	***	3.34	0.565		0.039		0.54
Number of observations	895			895					895		
Adjusted R^2	0.420			0.488					0.087		
Office fixed effects	Included			Included					Included		
Industry fixed effects	Included			Included					included		

Notes: This table presents the results of a seemingly unrelated regression (ordinary least square regression) of firm-specific control variables and the scale measures *SCALE* (in panel A) and *TOP3* (in panel B) split based on the audit firms market power on the natural logarithm of total hours and audit fees (billing rate). All continuous variables except *LN_NAS* are winsorized at the 1 percent level. The fifth column represents the *p*-value of a test of equal regression coefficients across equations. Standard errors are clustered around 2-digit SIC codes, and office and industry fixed effects are included but not reported for the sake of brevity. *, **, and *** represent significance levels of 10 percent, 5 percent, and 1 percent, respectively. Variable definitions can be found in Table 1.

TABLE 8

Panel A: Audit quality analysis using *SCALE*

Dependent variable	**|*DA*|**			**|*DA*| if *DA*<0**			**|*DA*| if *DA*>0**		
	Coeff.		*t*-stat	Coeff.		*t*-stat	Coeff.		*t*-stat
Intercept	0.261	***	2.90	-0.084		-0.98	0.448	***	4.64
SCALE	0.024		0.68	0.047		1.43	0.021		0.63
HIGHMP	0.049	*	1.78	0.026		0.99	0.024		0.91
DOM_LEADER	-0.043		-1.18	0.036		0.73	-0.032		-1.06
LN_ASSETS	0.009		1.15	-0.010		-0.94	0.025	***	3.23
LN_SALES	-0.016	*	-1.90	0.016		1.41	-0.021	***	-2.70
CFO	0.053		1.08	0.586	***	11.52	-0.542	***	-10.01
LEVERAGE	-0.069	**	-1.97	-0.057	*	-1.76	0.017		0.54
LOSS	0.001		0.03	0.028	*	1.72	-0.011		-0.71
CURRENT	-0.002		-1.27	-0.000		-0.09	-0.004	**	-2.34
ROA	-0.094		-1.51	-0.473	***	-7.83	0.479	***	6.04
SALES_TURN	-0.001		-0.17	-0.024	**	-2.41	0.002		0.47
OR_GROWTH	0.015		0.92	0.058	***	2.97	0.022		1.23
LAGTAX	-0.048	***	-3.29	0.020		1.60	-0.055	***	-3.90
INITIAL	0.005		0.38	0.007		0.50	0.009		0.61
N	825			447			378		
Adjusted R^2	0.072			0.583			0.628		
Office fixed effects	Included			Included			Included		
Industry fixed effects	Included			Included			Included		

TABLE 8 (continued)

Panel B: Audit quality analysis using *TOP3*

Dependent variable	**|*DA*|**			**|*DA*| if *DA*<0**			**|*DA*| if *DA*>0**		
	Coeff.		*t*-stat	Coeff.		*t*-stat	Coeff.		*t*-stat
Intercept	0.264	***	2.95	-0.076		-0.89	0.447	***	4.66
TOP3	0.002		0.09	0.007		0.49	0.024		1.54
HIGHMP	0.050	*	1.78	0.027		1.04	0.020		0.77
DOM_LEADER	-0.041		-1.13	0.038		0.77	-0.025		-0.87
LN_ASSETS	0.009		1.13	-0.011		-0.99	0.024	***	3.20
LN_SALES	-0.016	*	-1.91	0.016		1.43	-0.021	***	-2.66
CFO	0.055		1.10	0.588	***	11.57	-0.545	***	-10.20
LEVERAGE	-0.068	*	-1.95	-0.055	*	-1.69	0.017		0.54
LOSS	0.001		0.04	0.028	*	1.75	-0.011		-0.74
CURRENT	-0.002		-1.27	-0.000		-0.08	-0.003	**	-2.23
ROA	-0.094		-1.51	-0.473	***	-7.76	0.475	***	5.99
SALES_TURN	-0.001		-0.17	-0.024	**	-2.44	0.002		0.45
OR_GROWTH	0.015		0.93	0.058	***	2.98	0.024		1.37
LAGTAX	-0.048	***	-3.26	0.021		1.68	-0.055	***	-3.91
INITIAL	0.005		0.38	0.006		0.47	0.009		0.61
N	825			447			378		
Adjusted R^2	0.072			0.582			0.630		
Office fixed effects	Included			Included			Included		
Industry fixed effects	Included			Included			Included		

Notes: This table represents the results of the discretionary abnormal accrual analysis within the audit firm under study. All continuous variables are winsorized at the 1 percent level. *, **, and *** represent significance levels of 10 percent, 5 percent, and 1 percent, respectively. Office and industry fixed effects are included. Variable definitions can be found in Table 1.