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The effects of non-Big 4 mergers on audit efficiency and audit market competition[☆]

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ABSTRACT

This study examines whether recent mergers between small and midsize accounting firms influence competition by increasing the number of firms that can compete with larger rivals in the U.S. public company audit market. I find that in-market mergers generate efficiencies that are reflected in a post-merger reduction in audit hours but not in reduced audit quality. For both in-market and out-of-market mergers, clients switching to post-merger firms are more likely to be accelerated filers and are significantly larger in terms of several proxies for size and complexity. Lastly, I find that an increase in market-level merger activity is associated with lower profitability of Big 4 firms operating in the same market but only in the smaller client segment. These findings suggest that recent mergers have actually *increased* competition in some segments of the audit market despite already high concentration and concerns about a lack of sufficient competition.

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1. Introduction

Economic theory generally predicts that the degree of competition in a market relates positively to the number of suppliers. When market concentration is high, sellers' pricing decisions are interdependent, increasing the likelihood that firms will coordinate with one another to maximize collective profits. Following this reasoning, regulators and other stakeholders are frequently concerned that mergers, by decreasing the number of suppliers, may reduce competition. However, some

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mergers, even in highly concentrated markets, may actually increase competition. For example, when much of the market is controlled by a few firms with market power, then mergers between the remaining fringe firms may improve efficiency or allow merged firms to enter new markets, effectively increasing the number of firms that can compete with larger rivals. In this study, I examine a recent wave of mergers between small and midsize U.S. audit firms. These firms compete in the U.S. public company audit market where four large firms (i.e., the Big 4) dominate and many smaller firms fight over a fraction of the market. I hypothesize that non-Big 4 mergers generate efficiencies and improve the ability of merged firms to compete with the Big 4. As a result, I predict that mergers lead the Big 4 to accept lower economic profits in the years following a merger.¹ I investigate these questions using a proprietary database of audit hours, realization rates, and inspection results collected by the PCAOB.

This study is motivated by the ongoing debate regarding a lack of competition in the U.S. public company audit market following the emergence of the Big 4 (Danos and Eichenseher, 1986; GAO, 2003; 2008; European Commission, 2010). After a series of mergers from 1987 to 1998 and the demise of Arthur Andersen in 2002, the Big 4 came to dominate the market, and many public companies are thus limited in their choice of auditors because smaller audit firms cannot efficiently serve larger or more complex clients. For example, in a survey of Fortune 1000 companies, 60 percent of respondents viewed competition in their audit market as insufficient (GAO, 2008). Although the consolidation of the largest firms ended with the dissolution of Arthur Andersen in 2002, non-Big 4 firms have vigorously pursued M&A in subsequent years (Sinkin and Putney, 2017). Despite the recent merger activity and the potential implications for competition in the U.S. public company audit market, the impact of non-Big 4 mergers on the market is not well understood.

The incentives of merging firms depend on the market's attributes and structure. On the one hand, various stakeholders, including academic researchers, often assume that the U.S. public company audit market is an oligopoly (GAO, 2003; 2008; Numan and Willekens, 2012); therefore, one possibility is that recent mergers are motivated by the desire to create market power (Williamson, 1968; Scherer and Ross, 1990). In a Cournot oligopoly, equilibrium prices relate inversely to the number of sellers, and mergers can lead to higher prices because they eliminate direct competition between merging firms (Shapiro, 1995). Mergers in a Bertrand oligopoly may result in higher prices if they involve differentiated products that are substitutes (Deneckere and Davidson, 1985). Importantly, the anticompetitive incentives relating to mergers are not limited to large firms: Farrel and Shapiro (1990) show that *any* merger in a Cournot oligopoly that does not create efficiencies will raise prices. On the other hand, classic oligopoly models may represent a simplistic view of the audit market because they ignore the effects of the competitive fringe: the collection of smaller price-taking firms that, despite their relative disadvantages, can significantly influence the behavior of larger rivals (Carlton and Perloff, 2005). I argue that at least some segments of the U.S. public company audit market can be characterized as a dominant firm oligopoly and that recent mergers are more likely to be motivated by competitive incentives, such as efficiency and the desire to enter new markets.

A dominant firm oligopoly is characterized by a single firm or jointly acting group of firms that have a significant market share and some degree of market power and any number of competitors that are price takers, each with a small share of the market.² The dominant firms have some competitive advantage, such as lower costs or a superior product and therefore have an incentive to exploit their advantage by restricting output or raising prices. However, these dominant firms will take fringe competitors into account, and the resulting equilibrium depends on the relative costs of the fringe and the barriers to entry: larger cost advantages and high barriers will allow dominant firms to charge more (Carlton and Perloff, 2005). Mergers can erode dominant firms' market power because they can increase the efficiency or scope of merging firms. From this perspective, recent non-Big 4 mergers may be more accurately classified as *entry* because they allow merging firms to overcome barriers to segments of the market dominated by the Big 4.

To investigate the effects of non-Big 4 mergers on audit efficiency and audit market competition, I obtain proprietary data on realization rates, audit hours, and inspection results collected by the PCAOB as part of its inspections. These data offer significant advantages relative to publicly available data because they more directly measure profitability, production costs, and audit quality. By analyzing mergers at the auditor-office level, my analysis distinguishes between two types of mergers based on whether the predecessor firms operated in the same geographic area: I define in-market mergers as those involving two offices in the same MSA at the time of the merger. When firms do not operate in the same geographic market, I label these as out-of-market mergers.

I focus on audit efficiency around in-market mergers because the literature suggests they are more likely to both create market power and efficiencies (Sapienza, 2002); however, I also investigate out-of-market mergers in all tests. To analyze the effects of mergers on audit efficiency, I examine post-merger changes in audit hours for a sample of companies that engage merging firms in the years immediately surrounding a merger. I find an approximately 16 percent post-merger reduction in total audit hours for clients of in-market merging firms, though these estimates likely underestimate the efficiency effect

¹ Prior research argues that the U.S. public company audit market consists of multiple segments (Palmrose, 1986; Francis and Simon, 1987) and that small and midsize audit firms are unlikely to compete with the Big 4 to audit the largest companies. If merged firms do not represent a substitute for the Big 4 for audits of the largest companies, then the impact of mergers may vary across segments. To investigate this possibility, I partition the sample into two segments according client size and examine the impact of mergers on competition in each. I discuss these tests in Section 5.2.

² In the most basic characterization of this market structure there is a single "dominant" firm with market power; however, a group of firms may act collectively as the dominant firm through explicit or tacit collusion (Scherer and Ross, 1990; Carlton and Perloff, 2005). Hereafter, I use "dominant firms" to refer to the larger firms that act collectively to exercise market power while recognizing this distinction; any firms not in this group comprise the noncooperative fringe.

because I also find that merged firms attract larger clients that likely require greater auditor hours. A deeper investigation of labor mix reveals a greater reduction in partner hours compared to nonpartner hours, consistent with merged firms leveraging a larger labor pool to more efficiently allocate expertise. My investigation of audit efficiency over time suggests that synergies are not realized in the first year following the merger but that they emerge later and persist throughout the post-merger period. Lastly, I find no evidence that out-of-market mergers are associated with reductions in audit hours, suggesting they are motivated by factors other than efficiency (e.g., to enter new geographic markets).

To rule out the explanation that results reflect lower effort, I examine post-merger changes in audit quality. Because mergers also influence firms' client portfolios, the interpretation of most publicly available proxies for audit quality is not straightforward in this setting. For example, if merged firms attract bigger clients, then observed changes in output-based measures, such as restatements and discretionary accruals, may be driven by higher financial reporting quality due to changes in client mix. To overcome this issue, I measure audit quality with PCAOB-identified audit deficiencies because this represents an assessment of audit *process* quality, which differs from client characteristics such as financial reporting quality. I also consider a range of output-based proxies and find no indication that mergers lead to lower quality. In fact, my findings imply that engagements involving post-merger firms have lower deficiency rates and are less likely to experience a restatement. I find no significant associations when examining both signed and unsigned discretionary accruals as well as the propensity to issue going concern opinions. Taken together with the results from audit hour regressions, the findings suggest that merging audit firms are delivering at least the same level of quality (if not higher) using fewer inputs to production, which is consistent with the definition of audit efficiency offered by [Knechel and Sharma \(2012\)](#).

To investigate the effects of mergers on audit market competition, I test whether mergers exert pressure on larger rivals by examining changes in Big 4 realization rates. These tests reveal that an increase in market-level mergers is associated with lower future profits for Big 4 firms operating in the same geographic market for both in-market and out-of-market mergers. After partitioning the market based on client size, I find the negative association between mergers and profitability is limited to the smaller client segment, implying that merged firms do not compete with the Big 4 for larger clients. Next, I examine changes to the auditor's portfolio of clients in the years immediately surrounding a merger. For both in-market and out-of-market mergers, I show that clients switching to post-merger firms are more likely to be accelerated filers and are significantly larger and more complex. I observe no such changes among switches to a matched sample of similar nonmerging firms over the same period.

This study makes several contributions. First, the findings contribute to the understanding of the effects from the increasing number of mergers among non-Big 4 U.S. audit firms over the past two decades, an important trend in the audit market that has received little attention from academics. I am among the first researchers to investigate this trend.³ I use proprietary data from the PCAOB to examine measures that are typically unobservable to researchers such as audit hours, labor mix, realization rates, and PCAOB inspection findings with client identities. I show that recent mergers between non-Big 4 auditors have likely increased competition in some segments of the U.S. public company audit market.⁴ These findings speak to claims that growth may allow some small auditors to compete more efficiently with larger rivals ([GAO, 2008](#); [European Commission, 2010](#)) and complement the literature identifying factors contributing to more competition in highly concentrated audit markets ([Bills and Stephens, 2016](#); [Keune et al., 2016](#)).

Second, I contribute to the literature on audit market structure. I show that certain segments of the U.S. public company audit market operate as a dominant firm oligopoly with a competitive fringe. These findings are inconsistent with studies suggesting that auditors charge competitive fees, regardless of the number of competitors (e.g., [Doogar and Easley, 1998](#); [Ferguson et al., 2020](#)). However, these findings also do not support the argument that concentration will unambiguously lead to higher prices due to the competitive fringe. The failure to account for variation in market power and the effects of a fringe may have contributed to the conflicting results among prior studies examining the relationship between concentration and prices (e.g., [DeFond and Zhang, 2014](#); [Eshleman and Lawson, 2017](#)).

Third, I provide evidence of non-Big 4 U.S. merger-related effects that complements (and sometimes contrasts with) prior studies in other settings that may not generalize to the U.S. audit market. For instance, [Sullivan \(2002\)](#) shows that clients were more likely to switch to merged firms in the aftermath of Big N mergers in the 1980s and 1990s and interprets this as evidence of cost reductions that benefited clients. Other studies examine audit fees in the aftermath of Big N mergers and find conflicting results ([Iyer and Iyer, 1996](#); [Ivancevich and Zardkoohi, 2000](#); [McMeeking et al., 2007](#)). My results also differ from those in a recent study of Chinese audit firm mergers; [Gong et al. \(2016\)](#) find evidence of post-merger audit fee increases despite reductions in audit hours, which suggests an anticompetitive outcome (e.g., [Sullivan, 2002](#)). In contrast, I provide evidence that U.S. non-Big 4 mergers have resulted in lower audit fees and brought new competition to a segment of the market dominated by the Big 4. These differences raise questions about whether findings from Chinese mergers are likely to generalize to the U.S. setting due to structural changes in the Chinese audit market. For example, the sample period in [Gong](#)

³ In a concurrent paper, [Christensen et al. \(2020\)](#) examine some audit quality effects from these mergers with audit firm-level PCAOB inspection findings, accruals, and restatements from public data sources. I provide a more complete comparison in Section 6.1.

⁴ Although I restrict my analysis to the U.S. public company audit market, recent mergers also likely altered competition in the private company audit, nonaudit service, and auditor labor markets. While realization rates indirectly reflect some of the effects from other markets through their impact on the costs of audit inputs, my findings may not generalize to these markets.

et al. (2016) coincides with an explicit policy of state support for the largest audit firms, as well as an effort to bring Chinese accounting and auditing standards in line with international ones (Piotroski and Wong, 2012; Gong et al., 2016).

This paper proceeds as follows: I discuss prior research and hypothesis development in Section 2, research design in Section 3, sample composition and descriptive information in Section 4, the main hypothesis tests in Section 5, additional analyses in Section 6, and concluding remarks in Section 7.

2. Prior literature and hypothesis development

2.1. Audit market structure

Various stakeholders, including academics, have described the U.S. public company audit market as an oligopoly, alleging that insufficient competition has led to higher fees, lower quality, or both (e.g., GAO, 2003; 2008; Eshleman and Lawson, 2017). However, basic oligopoly models ignore the potential effects of the competitive fringe, that is, relatively higher-cost firms that operate in the same relevant market. To the extent such a fringe exists, theory predicts that changes to its composition can substantially affect the ability of larger firms to exercise market power. For example, Worcester (1957) argues that, over time, the dominant firm equilibrium will break down into a competitive outcome, due to the threat of entry, and thus the expansion of the fringe.

A dominant firm oligopoly is characterized by a single firm or jointly acting group of firms that serve the majority of the market and a group of smaller firms that supply the remainder. Large firms have market power due to some competitive advantage; for example, they may have lower costs or offer a superior product (Carlton and Perloff, 2005, p.112). Whether large firms can sustain market power over the long run depends on their relative cost advantages and barriers to entry. All else equal, higher barriers, fewer competitors, and greater differences in production costs will allow larger firms to set higher prices than those that would prevail under a competitive equilibrium (Carlton and Perloff, 2005). Research examining the market for coconut oil (Buschena and Perloff, 1991) and Uruguayan banks (Spiller and Favaro, 1984) has documented this market structure in both commodity goods and service industries.

There are several reasons to believe that at least some portion of the U.S. public company audit market functions as a dominant firm oligopoly. First, there is widespread perception that larger public companies do not have sufficient choice in audit firms, and survey evidence suggests significant barriers prevent smaller auditors from auditing large public companies (GAO 2003; 2008). These barriers include reputation, capital constraints, and a lack of staffing capacity, technical expertise, and geographic reach. Thus, dominant firms' comparative advantage, and the source of their market power may result from lower costs or a differentiated product, and entry barriers may restrict the ability of smaller firms from entering the market. Prior research suggests the U.S. public company audit market may consist of multiple segments based on client size (Palmrose, 1986; Francis and Simon, 1987). Entry barriers are likely to be higher in the large client segment because the Big 4 have a greater comparative advantage there. Higher barriers in this segment may reduce entry from smaller firms.

2.2. Audit production efficiency

Theories on the motivations for horizontal mergers (i.e., mergers between firms that operate in the same relevant market) can be divided into two broad categories: efficiency theories, whereby a merger reduces costs for the merged firm, and anticompetitive theories, whereby a merger reduces competition and allows the merged firm to charge higher prices (Sullivan, 2002).⁵ Efficiency theories predict that mergers will generate marginal cost reductions and, in a competitive environment, that cost savings will be passed on to customers in the form of lower prices. Conversely, anticompetitive theories predict higher prices due to increased market power. Importantly, efficiency and market power incentives are not mutually exclusive: mergers can simultaneously lead to marginal cost reductions and higher prices, which presents significant limitations to analyses based solely on prices (in this case, audit fees).

The industrial organization literature suggests mergers may generate efficiencies through improvements in management, production organization, technology, and economies of scale and scope (Williamson, 1968; Scherer and Ross, 1990). Efficiency gains lower the consolidated firm's marginal costs relative to pre-merger firms. Evidence of merger-related efficiency gains exists in both the manufacturing and service industries. For example, studies have documented synergies in mergers among suppliers in the energy, retail, electronic equipment, and healthcare sectors (Fee and Thomas, 2004) as well as the airline (Kim and Singal, 1993) and banking industries (Houston et al., 2001; Sapienza, 2002; Focarelli and Panetta, 2003).

Specific to audit firms, mergers can achieve economies of scale by spreading certain fixed costs, such as investments in audit technology and human capital (i.e., training and recruiting) over a greater number of engagements (GAO, 2008; Gong et al., 2016). For example, consolidated firms can support more areas of specialization (e.g., industry specialization, transaction-specific expertise, etc.) and can better utilize individuals with technical expertise, due to a larger client base (Sullivan, 2002). Consistent with this logic, the literature suggests that industry specialists benefit from "economies of expertise" and pass (at least a portion of) cost savings on to clients in the form of lower fees (Pearson and Trompeter, 1994;

⁵ Williamson (1968) notes that mergers can generate synergies even when motivated by factors other than efficiency and market power (e.g., taxes). These can result from displacement of ineffective management, technological developments, shifts in demand, or a combination of these.

Mayhew and Wilkins, 2003; Fung et al., 2012). Additionally, mergers between firms in complementary locations allow auditors to better serve larger clients, enter new markets, and fill gaps in geographic coverage (GAO, 2003). Finally, mergers between firms in the same market may eliminate inefficient overlapping functions (Sapienza, 2002).⁶

The literature on audit firm M&A does not provide a strong foundation for predicting the efficiency effects of recent non-Big 4 mergers for several reasons. First, most related studies suffer from an inherent data limitation because inputs to the audit production process are generally unobservable to researchers. The literature has thus typically relied on price-based proxies for efficiency, which have an ambiguous interpretation or rely on significant assumptions about unobserved factors to infer efficiencies. For example, Ivancevich and Zardkoohi (2000) collect aggregate audit firm-level data to investigate the 1989 mergers creating Ernst & Young and Deloitte & Touche. The authors show lower firm-level revenue per dollar of audited assets for merged firms relative to nonmerged firms and interpret this as evidence of efficiency. In contrast, McMeeking et al. (2007) examine the U.K. audit market and find evidence that clients of merged firms are likely to pay higher audit fees than clients of nonmerging firms; however, the authors infer higher prices are due to product differentiation rather than increased market power. An important caveat of these studies is that the literature (e.g., DeFond and Zhang, 2014; Doogar et al., 2015) notes that audit fees capture a wide range of unobservable factors, including market power, production costs, litigation risk, and business risk, which are also likely to be influenced by mergers. The inability of researchers to disentangle these factors is therefore a likely source of conflicting results within this literature.

Second, the literature on audit firm M&A examines firms that face significantly different incentives compared to U.S. non-Big 4 auditors. For example, several studies investigate the effects of Big N mergers, which drastically altered market structure and are more likely to generate market power compared to non-Big 4 mergers.⁷ Similarly, Gong et al. (2016) examine a small sample of Chinese audit firm mergers from 2005 to 2009 and find evidence of reductions in audit hours; however, these results may not generalize outside of this sample, due to unique characteristics of the Chinese audit market during this period. For example, the China Securities Regulatory Commission (CRC) implemented major regulatory changes in 2007 (Piotroski and Wong, 2012), which likely changed auditors' incentives as well as the audit production process.⁸

In summary, prior results on audit firm mergers do not provide strong inferences for predicting the effects of non-Big 4 mergers, due to the unique characteristics of each market. Accordingly, I base my directional prediction for H1 on the attributes of merging firms. Compared to prior literature, the mergers in this study involve significantly smaller auditors that are less likely to produce anticompetitive outcomes. Lastly, if the U.S. audit market is characterized as a dominant firm oligopoly, then non-Big 4 mergers represent mergers between firms that are either currently on the fringe or outside of the relevant market.⁹ Thus, merging firms are likely to have even greater efficiency incentives because lower costs are one potential source of larger firms' market power. Regardless of the source of efficiency gains, I expect them to be reflected in the most significant input to the audit process: labor hours.¹⁰ I focus on total audit hours for the tests of H1 because this measure captures labor inputs at all levels and is comparable across firms; however, I also consider partner and nonpartner hours because the impact of mergers may not be uniform across labor levels. For example, if mergers allow firms to more efficiently allocate expertise then I expect to find larger reductions in partner hours. Although audit hours reflect changes instituted by the post-merger firm, such as pricing and labor allocation decisions, it is important to consider that these measures are also influenced by changes in the firm's client portfolio. For example, if mergers enable firms to attract larger and more complex clients, then post-merger engagements are likely to require more labor hours and greater expertise. Failing to control for these factors is likely to understate the efficiency of mergers. Because I expect the efficiency effects to outweigh anticompetitive and other confounding factors, I make a directional prediction for H1 with respect to audit hours for clients of merged firms.

H1. In-market mergers result in efficiency gains that are reflected in lower audit hours for clients of the merged firm, relative to clients of the predecessor firm.

2.3. Audit market competition

Audit firms compete along several dimensions. For example, they vie for clients in the public company audit market, the private company audit market, and the market for nonaudit services; the same firms also compete in the auditor labor market. Although mergers can alter competition in all of these markets, prior research treats them as distinct, each with its own idiosyncratic structure (Simunic 1984; Chaney et al. 2004; Hoopes et al. 2018). As such, the impact of non-Big 4 mergers likely differs across markets. This study investigates the impact of mergers on competition in the market for audit services. I focus on the U.S. public company audit market and, in particular, the portion of the audit market served by the Big 4. I base

⁶ I employ total audit hours as the primary measure of audit efficiency for the tests of H1, which are not likely to reflect cost savings due to eliminating redundancies or eliminating duplicate overhead functions of merging firms. However, I consider these factors in my supplemental analysis of audit fees: by controlling for total audit hours, any efficiencies beyond reduced staff or partner hours for a particular audit would be reflected in the variable of interest. I describe these tests in greater detail in Section 6.3.

⁷ Theoretical models predict that anticompetitive incentives are proportional to size of consolidating firms (Farrel and Shapiro, 1990).

⁸ Section 5.1 elaborates on these changes.

⁹ Merging firms may operate outside of the relevant market because they operate in different geographic markets or because they lack the size or scope necessary to audit larger public companies.

¹⁰ This reasoning is based on Knechel and Sharma's (2012) definition of audit efficiency as "whether the audit could be conducted with fewer resources and still obtain an effective outcome." The definition assumes no decrease in quality. I explicitly test this assumption in Section 6.1.

theoretical predictions on models of a dominant firm oligopoly, assuming that the Big 4 act collectively as the dominant firm and the remaining firms represent the noncooperative fringe. In supplemental tests, I separately examine the impact of mergers in the small and large client segments of the market because research suggests that the U.S. public company audit market consists of multiple segments (Palmrose 1986; Francis and Simon, 1987).

Dominant firm oligopoly models assume that dominant firms possess market power due to lower costs or a superior product; however, their ability to profitably raise prices may be constrained by the competitive fringe. Profit maximizing dominant firms will set prices (or output) to the point where marginal cost equals marginal revenue but first must determine their own residual demand curve: the difference between the market demand curve and competitive fringe's supply curve (Carlton and Perloff, 2005). In other words, dominant firms must account for the portion of market demand that will be met by the fringe when setting prices. At higher prices, for example, the fringe will be able to serve more of the market, *ceteris paribus*. Thus, equilibrium prices increase with the size of dominant firms' cost advantages as well as the barriers to entry (Carlton and Perloff, 2005).

Mergers between non-Big 4 firms can alter this equation in several ways. First, H1 predicts that mergers will generate efficiencies, such as economies of scale, which reduce merged firms' production costs. Second, mergers between firms with complementary geographic locations or expertise may increase scope, allowing the merged firm to audit larger or more complex clients. For example, if audits are a differentiated product, then some non-Big 4 firms may offer a closer substitute for a Big 4 audit. Mergers may allow these firms to enter new markets by acquiring smaller firms located in other cities. Anecdotal evidence suggests that entry is a common motivator for the recent mergers, especially those involving larger regional firms (Accounting Today, 2016). Thus, mergers may increase the output of the fringe by increasing the number of firms that can audit larger companies.

In response to increased competition from the fringe, I expect dominant firms to lower prices and accept smaller profits. I test this hypothesis by examining changes in realization rates for clients of the Big 4 following mergers between smaller firms operating in the same geographic market. Realization rates are likely to better measure competition, compared to audit fees, because they are the primary measure auditors use to assess profitability and because they incorporate important unobservable factors, such as billable overhead and the costs of labor inputs and labor mix.¹¹ Formally stated, H2 is as follows.

H2. The number of mergers in a market is negatively associated with the profitability of Big 4 audit engagements.

3. Research design

3.1. Research design: tests of H1

To investigate the effects of mergers on audit efficiency, I examine post-merger changes in production inputs. Consistent with the literature, I use auditor labor hours as the main proxy for the factors of production (Caramanis and Lennox, 2008; Gong et al., 2016). Labor hours represent the primary input to the audit production process. As such, I expect more efficient audits to deliver the same level of quality while using fewer inputs (Knechel and Sharma, 2012). I base multivariate regression models of Sapienza's (2002) study of small bank mergers; however, I alter the design to accommodate three important limitations imposed by the sample. First, I can only observe auditors' public company clients because the PCAOB does not oversee the audits of privately held companies. Although there is significant heterogeneity among non-Big 4 auditors, smaller firms typically do not audit more than a few public companies. Second, most clients appear in the sample, at most, once in every three years because the PCAOB only collects data on audit hours in the year of inspection and most auditors in the sample are subject to inspection triennially. Third, the frequency of auditor switches, IPOs, de-listings, and bankruptcies in the non-Big 4 market reduces the number and length of continuing engagements (as well as further reducing the number of times a client appears in the sample). Due to these limitations, I drop restrictive sample constraints imposed by Sapienza's (2002) study on bank mergers.¹² The resulting model resembles that of DeFond and Lennox (2011), who study of small auditor exits from the audit market. The basic specification of my regression models is as follows:

$$\text{Audit Efficiency} = \beta_0 + \beta_1 \text{In-Market Merger Indicator} + \beta_2 \text{Post In-Market Merger Indicator} + \beta_3 \text{Out-of-Market Merger Indicator} + \beta_4 \text{Post Out-of-Market Merger Indicator} + \text{Controls} + \epsilon, \quad (1)$$

where *Audit Efficiency* is represented by one of the following audit hours-based proxies: the natural log of total audit hours, partner hours, or nonpartner hours.¹³ The independent variables of interest for the tests of H1 are indicator variables defined

¹¹ Although this study does not directly examine competition in the auditor labor market, mergers may affect audit firms' ability to attract and retain staff, pay lower wages, and leverage auditor expertise (Sullivan 2002; Naidu et al., 2018). To the extent that mergers do influence these factors, they will be reflected in realization rates but not audit fees. Regardless, I also investigate the impact of mergers on audit fees in supplemental tests described in Section 6.5.

¹² Sapienza (2002) leverages a complete panel of quarterly interest rate data from 1989 to 1995 and examines borrower-client relationships that are relatively sticky from period to period. Due to these characteristics, the identification strategy restricts the sample to continuing borrowers and uses a (borrower) fixed-effects model. Thus, the models estimate the treatment effect using the borrowing firm as a control for itself. I instead control for differences between clients of pre- and post-merger auditors by including the *In-Market Merger Indicator* variable as well as a robust set of control variables for the determinants of audit fees and audit hours.

¹³ For the main analysis, I cluster standard errors by client. In untabulated tests, I re-estimate all models based on Equation (1) with standard errors clustered by audit firm and find that this decision does not alter any inferences.

as follows. When there is a merger between two firms that previously operated in the same MSA, I consider all overlapping offices to have experienced an in-market merger. *In-Market Merger Indicator* is defined at the auditor office level and equals one for all client-years (both before and after the merger) engaging an auditor office that is involved in an in-market merger; this variable resembles the main effect in a difference-in-differences design in that it controls for time-invariant differences between clients that engage merging and nonmerging auditors. The main test variable for tests of **H1**, *Post In-Market Merger Indicator*, equals one for client-years audited by the consolidated firm's office of an in-market merger for fiscal years beginning after the merger date. The coefficient on this variable captures changes in audit efficiency for clients of consolidated firms relative to pre-merger firms, due to the presence of *In-Market Merger Indicator* in the same regression model. Because I also hypothesize that mergers allow firms to attract larger and more complex clients, the coefficient on *Post In-Market Merger Indicator* may reflect both production efficiencies and changes in client portfolios; however, the confounding effect of client mix may bias the coefficients against finding reduced hours.

I create analogous indicator variables for mergers involving offices that do not operate in the same MSA at the time of the merger to investigate out-of-market mergers. I restrict these designations to the target firm's geographic market, due to the considerable size differences between target and acquiring firms. As a result of these size differences, I do not expect symmetric post-merger effects between acquirers' and targets' geographic markets. *Out-of-Market Merger Indicator* is defined at the auditor office level and equals one for all client-years that engage either the target (before) or consolidated firm (after) an out-of-market merger. *Post Out-of-Market Merger Indicator* equals one for client-years audited by the consolidated firm's office for fiscal years beginning after the merger date.

The variable classifications can be demonstrated by the following examples. Marcum LLP acquired WilsonMorgan LLP on July 2, 2013, and both had offices in the Los Angeles-Long Beach-Anaheim MSA. In this case, *In-Market Merger Indicator* is coded 1 for all Los Angeles clients of either firm. *Post In-Market Merger Indicator* is equal to one for any of Marcum's Los Angeles clients with fiscal years beginning on or after July 2, 2013. As an example of an out-of-market merger, Moss Adams LLP acquired Epstein Weber & Conover PLC, a single office firm located in the Phoenix-Mesa-Chandler MSA on January 1, 2007; Moss Adams did not have a Phoenix office at that time. In this case, *Out-of-Market Merger Indicator* is equal to one for all Phoenix clients of Epstein Weber & Conover before the merger or Moss Adams after the merger. *Post Out-of-Market Merger Indicator* equals one for Moss Adams's Phoenix clients with fiscal years beginning on or after January 1, 2007.

In all models, I control for several characteristics that capture auditors' incentives to provide high quality and ability to generate market power; these include auditor size (*Auditor Size*), office size (*Office Size*), audit market concentration (*Concentration*), and the auditor's market share of total non-Big 4 audit fees (*Market Share*).¹⁴ Remaining control variables are based on the determinants of auditors' production costs identified by the literature (Simunic, 1980; Hay et al., 2006). I include year, industry, and MSA fixed effects in the base model. As an additional specification, I employ audit office (merging pair) fixed effects models. The MSA effects are subsumed by audit office fixed effects in these specifications; *In-Market Merger Indicator* and *Out-of-Market Merger Indicator* also drop out of these models because they are collinear with the merging pair indicators.

3.2. Research design: tests of H2

H2 investigates the effects of mergers on audit market competition by examining whether mergers are associated with changes in the profitability of Big 4 firms operating in the same geographic market. To conduct these tests, I utilize data on realization rates provided by the PCAOB. Realization rates are the primary metric auditors use to assess the profitability of individual engagements and are a function of labor hours, billing rates at each respective labor level, and the actual audit fees charged to the client (Bedard and Johnstone, 2010).¹⁵ Consistent with the literature, I normalize realization rates by audit firm-year to account for differences in calculating billing rates across firms and over time (Ciconte and Kitto, 2021).¹⁶

In contrast to tests of **H1**, I exclude all engagements involving non-Big 4 audit firms for several reasons. First, data on realization rates are unavailable for many of the engagements outside of the top six audit firms, due to the data limitations described in Section 3.1. Second, models of a dominant firm oligopoly assume that small firms are price-takers and that only the

¹⁴ As noted by Sapienza (2002), it is important to include these variables to control for changes in concentration, market share, and size that are unrelated to mergers, even though these variables are correlated with the variable of interest. In an untabulated analysis, I observe that *Post In-Market Merger Indicator* is significantly ($p < 0.01$) correlated with *Auditor Size* (0.196), *Market Share* (0.093), and *Concentration* (0.088). I also re-estimate all equations based on Equation (1) without these variables and find consistent results in terms of sign and significance for the variables of interest.

¹⁵ Specifically, audit fees are divided by the "standard fee," which is computed by multiplying labor hours by their respective billing rates. Billing rates are designed to reflect the variable costs and allocated fixed costs for each labor level.

¹⁶ An examination of the distributions of raw realization rates suggests that the four firms in my sample have similar but not identical methods for calculating realization (i.e., employ different billing rates). Three firms do not exhibit statistically significant differences in raw realization rates, while the fourth firm has a higher mean value but similar standard deviation. To remove this confounding factor, I normalize realization rates by firm-year. Specifically, I subtract raw realization rates by the mean realization rate among all engagements in the same year for the same firm and then divide by the standard deviation of realization rates among all engagements in the same year for the same firm. Because this procedure could also remove some variation of interest if, for example, mergers impact Big 4 firms' ability to allocate labor through changes to their client portfolios, I also employ a level-normalized measure in supplemental tests and find that inferences are unchanged. Unlike the main dependent variable, the level-normalized measure does not divide by the standard deviation of realization. I elaborate on these tests in Section 6.5.

largest firms can exert market power. Therefore, I focus my tests of H2 on engagements involving Big 4 audit firms. Specifically, I estimate the following OLS regression model:

$$\text{Realization} = \beta_0 + \beta_1 \text{Ln}(\text{Number of In-Market Mergers}) + \beta_2 \text{Ln}(\text{Number of Out-of-Market Mergers}) + \text{Controls} + \varepsilon. \quad (2)$$

The variables of interest, $\text{Ln}(\text{Number of In-Market Mergers})$ and $\text{Ln}(\text{Number of Out-of-Market Mergers})$, reflect the total number of in-market or out-of-market mergers in the client's geographic market from the beginning of the sample period until the beginning of the client's current fiscal year. For example, if the first in-market merger in a given MSA occurs in 2010, and the second and last occurs in 2012, I record zero in-market mergers for all fiscal years before 2011, one in-market merger for fiscal years 2011–2012, and two in-market mergers for all fiscal years after 2012. Because the total number of mergers is skewed across geographic markets, I logarithmically transform these variables. Consistent with the tests of H1, I control for the auditor's office size (*Office Size*), market concentration (*Concentration of Big 4 Audit Fees*), and market share (*Market Share of Big 4 Audit Fees*); however, I omit the control for auditor size because the sample is restricted to Big 4 firms that are similar in size.¹⁷ Remaining control variables are consistent with those included in Equation (1). I include industry and MSA fixed effects in the base model. As an additional specification, I estimate Equation (2) with client fixed effects to examine the extent to which results relate to client mix or within-client changes in realization.

4. Sample composition and descriptive information

4.1. Audit firm M&A sample

I obtain a list of mergers from Audit Analytics, which identifies mergers by reviewing PCAOB registration forms and other public information, including audit firm press releases and trade journals. To account for audit firm name changes and firms that engage in multiple mergers, I use the PCAOB's unique identifier (registration number) to track audit firms over time. The PCAOB requires firms to submit certain filings when seeking to succeed the registration of a predecessor firm (i.e., Form 4) and when changing names (while otherwise remaining the same legal entity, i.e., Form 3). Firms also must file an annual report (i.e., Form 2), which, among other items, includes disclosures about mergers and name changes that occurred during the previous year. Unlike Audit Analytics' unique identifier (*auditor_fkey*), PCAOB registration numbers rarely change over the course of these events because it is generally more costly and time consuming to apply for a new registration number than it is to keep an existing one.¹⁸ Thus, PCAOB registration numbers allow me to identify merging firms that operate under different names than at the time of their mergers (e.g., adding or subtracting a partner's name from the firm title).

Starting with all mergers from 2004 to 2016, I remove mergers involving the six largest audit firms because the PCAOB does not collect data on audit hours for the entire sample period for these firms.¹⁹ Furthermore, these firms are much larger in terms of size and likely face different incentives to merge.²⁰ Next I remove all mergers involving foreign audit firms and those without sufficient information to verify the date of the merger and the location of the firm offices. I further restrict the sample to mergers involving two firms that are subject to PCAOB inspection at the time of the merger to confine the analysis to firms competing in the public company audit market and therefore subject to the same regulatory regime. Underlying theory on horizontal mergers assumes that merging firms operate in the same relevant market, which may not be true for firms that, by definition, are not participating in the public company audit market. Additionally, data on audit fees, hours, and control variables are only observable for SEC-issuer clients. After imposing these restrictions, the final sample consists of 191 mergers. From this list, I classify mergers into two groups based on auditors' geographic market at the time of the merger: in-market mergers involve two firms that operate in the same MSA at the time of the merger, and out-of-market mergers involve firms that do not operate in the same MSA. For mergers involving firms with multiple offices, I allow the designation to vary across markets. Table 1 Panel A presents a breakdown of the number of mergers by year and type (e.g., in-market versus out-of-market). Column (1) lists the number of mergers involving two PCAOB-inspected firms, measured at the audit firm level. Columns (2) and (3) are measured at the audit office level and present the number of in-market and out-of-market mergers, respectively.

¹⁷ As noted in Section 3.1, it is important to control for these factors that are also correlated with the variable of interest. In an untabulated analysis, I re-estimate all models based on Equation (2) without these variables and find consistent results in terms of sign and significance for the variables of interest.

¹⁸ In contrast, Audit Analytics issues a new *auditor_fkey* whenever a firm alters its name (e.g., adding or subtracting a partner's name or initial from the firm title), which is quite common among small audit firms and especially among those merging. As a result, only considering *auditor_fkeys* from the date of the merger will misidentify some merging and nonmerging firms that change names multiple times. For instance, a researcher would misclassify pre-merger (post-merger) firms as nonmerging firms if the pre-merger (post-merger) firm operated under a different name than it did at the time of the merger. Failing to adjust for name changes also introduces measurement error in fixed effects variables and results in multiple indicator variables being assigned to observations audited by the same legal entity. I use the PCAOB registration number of the post-merger firm to define fixed effects for merging pairs.

¹⁹ The top six firms include the Big 4 firms plus BDO and Grant Thornton.

²⁰ In robustness tests, I exclude all annually inspected audit firms (i.e., those with more than 100 issuer clients) to rule out the explanation that results are driven by the largest non-Big 4 firms. Results are consistent in terms of sign and significance using this alternative sample.

Table 1
Mergers and client-level observations by year and classification.

Mergers by Year			
Year	(1)	(2)	(3)
	Mergers Involving Firms Subject to PCAOB Inspection (Firm Level)	In-Market Mergers (Office Level)	Out-of-Market Mergers (Office Level)
2004	10	7	6
2005	14	11	5
2006	12	11	3
2007	13	12	8
2008	17	9	15
2009	18	16	22
2010	18	11	15
2011	13	9	14
2012	15	11	15
2013	16	13	17
2014	15	8	23
2015	17	18	16
2016	13	6	18
Total	191	142	177

Table 1 displays the number of mergers by year and type. Column (1) lists the number of mergers between two firms subject to PCAOB inspection, measured at the audit firm level. In order to identify firms that are subject to PCAOB inspection, I check whether the PCAOB has issued an inspection report for the firm. To be sure that I capture audit firms that exited the market or were acquired prior to their first inspection report, I also check whether the firm audits any public companies during the sample period. Columns (2) and (3) list the number of in-market and out-of-market mergers, respectively, measured at the auditor office level. I define in-market (out-of-market) mergers as mergers involving two audit firms that share (do not share) the same geographic market at the time of the merger. For out-of-market mergers, I only consider the market of the acquired firm. For merger involving firm(s) with multiple offices, I allow the designation of in-market and out-of-market to vary across markets.

4.2. Audit engagement sample and descriptive information

To investigate the impact of mergers on audit production efficiency and audit market competition, I obtain data on audit labor hours, inspection deficiencies, and engagement profitability from the PCAOB, which are collected as part of its inspections. Prior to an inspection, the PCAOB requests information about all of the firm's SEC-issuer clients and the personnel performing those audits (CAQ, 2012). Total audit hours, including hours broken down by partner, engagement quality review (EQR) partner, and professional staff (excluding partner hours) as well as realization rates are included in this information.

Databases containing audit hours and realization rates suffer from two main limitations stemming from the years in which they are collected by the PCAOB. For U.S. non-top six auditors (as measured by market share) data are collected starting in 2004 but only in the year the audit firm is subject to inspection. Because most mergers involve triennially inspected auditors (i.e., those with fewer than 100 issuer clients), most clients will appear in the non-top six sample, at most, once in every three years. These data are contained in the PCAOB's Exhibit B database. In contrast, these data are collected annually for each of the six largest firms but only beginning in 2008 and make up the Annual Data Request database (Gipper et al., 2021, 2022). Thus, my design must account for an incomplete panel of data for engagements involving non-top six auditors and a shorter sample period for those involving top firms.

Table 2 describes the sample composition for the main hypothesis tests and related analyses. For the tests of H1, I collect data on audit hours for all engagements with identifying information (e.g., CIK number and fiscal year-end) audited by domestic non-top six firms from 2004 to 2016 from the PCAOB's Exhibit B database. I do not include the six largest auditors, because of the lack of data on audit hours prior to 2008 and because including clients of the Big 4 in the control group is likely to introduce selection bias. I begin my analysis in 2004 for two reasons. First, I cannot obtain data on audit hours prior to the implementation of the PCAOB's inspection program, which precludes all fiscal years prior to 2004.²¹ Second, the passage of Sarbanes-Oxley significantly altered the incentives of smaller auditors (DeFond and Lennox, 2011). Therefore, excluding these years ensures that all firms are facing the same regulatory regime and incentives to merge. I exclude fiscal years ending after December 31, 2016, to allow for the revelation of misstatements in audit quality tests. The total number of engagements meeting these criteria is 19,928. From this list, I remove 2777 audits of non-operating companies (e.g., shell companies, benefit plan audits, and 11-K filers) and 4562 engagements missing data on total audit hours, leaving 12,589 observations in the sample of engagements with data on total audit hours. Next I merge these data to the intersection of Audit Analytics and Compustat on the client's SEC Central Index Key (CIK), losing 5087 observations without a match or missing the data necessary to compute control variables in Equation (1). I also remove 344 observations where the merger occurred during the client's current or immediately preceding fiscal year as well as post-merger years that occurred more

²¹ In an untabulated analysis, I analyzed mergers that occurred prior to the beginning of my sample in 2004. I identified just 20 total mergers between two firms with at least one SEC client, including only four in-market mergers, which mitigates concerns that the merger data are left-censored.

Table 2 Panel A

Sample composition.

(1)	Total engagements listed in PCAOB's Exhibit B database from 2004 to 2016 with identifying information	19,928
	Less: observations missing total audit hours	(2777)
	Less: non-operating companies (e.g., benefit plan audits, shell companies, mutual funds, etc.)	(4562)
	Final Sample of Engagements with Audit Hours Data	12,589
	Less: client firm-years missing data necessary to compute control variables for main tests of H1, as well as those missing the data necessary to compute control variables	(5087)
	Less: engagements involving merging firms that occurred more than 5 years after the date of the merger, as well as clients audited by a firm that merged during the client's current or immediately preceding fiscal year	(344)
	Total sample available for main tests of H1 (Table 4 Panel A)*	7158
(1)	Total sample available for main tests of H1	7158
	Less: engagements in main sample for test of H1 that are not selected for inspection	(4685)
	Less: engagements without necessary data in Compustat/Audit Analytics to compute control variables for inspection deficiency regression models	(474)
(2)	Total sample available for PCAOB-Identified Inspection Deficiency Tests (Table 6 Panel A)	1999
(1)	Total sample available for tests of H1	7158
	Less: engagements without necessary data in Compustat/Audit Analytics to compute control variables for restatement regression models	(1760)
(3)	Total sample available for Restatement Tests (Table 6 Panel B)	5398
(4)	Total engagements listed in PCAOB's Annual Data Request database from 2008 to 2016 with identifying information	37,686
	Less: engagements involving Non-Big 4 audit firms	(5840)
	Less: engagements missing realization rate	(1382)
	Less: engagements without necessary data in Compustat/Audit Analytics to compute control variables for tests of H2	(7607)
	Final Sample Available for Main Tests of H2 (Table 5 Panel A)**	22,857

Table 2 Panel A displays the sample composition for the main hypothesis tests and related tables. Subtotal (1) represents the final sample for the main tests of H1 reported in Table 4 Panel A. A breakdown of these observations by year according to whether the client engages a pre-merger, post-merger, or nonmerging firm is presented in Table 2 Panel B. Descriptive statistics for this sample are reported in Table 3 Panel A. This sample also appears in audit fee tests presented in Table 8. Subtotal (2) represents the total sample available for PCAOB-identified inspection deficiency tests reported in Table 6 Panel A. Subtotal (3) represents the total sample available for restatement tests reported in Table 6 Panel B. Subtotal (4) represents the final sample for the main tests of H2 reported in Table 5 Panel A. A breakdown of these observations by year according to whether the engagement occurs in a pre-merger market, post-merger market, or in a market that does not experience a merger at any time during the sample is presented in Table 2 Panel C. Descriptive statistics for this sample are reported in Table 3 Panel B.

Table 2 Panel B

Client-Level Observations by year for tests of H1.

Year	(1)	(2)	(3)
	Clients of Pre-Merger Firms	Clients of Post-Merger Firms	Clients of Nonmerging Firms
2004	44	0	185
2005	34	3	200
2006	105	10	575
2007	47	13	335
2008	100	19	619
2009	105	46	638
2010	52	44	403
2011	44	60	463
2012	39	74	553
2013	16	71	500
2014	29	108	548
2015	30	79	567
2016	0	39	361
Total	645	566	5947
Unique Clients	422	377	2728
Unique Audit Firms	264	95	502

Table 2 Panel B displays a breakdown of the 7158 engagements that make up the main tests of H1 according to whether the client engages a pre-merger, post-merger, or nonmerging audit firm. Observations in Column (1) are audited by a merging firm prior to the merger (including both in-market and out-of-market mergers). Observations in Column (2) are audited by a merging firm after to the merger (including both in-market and out-of-market mergers). Observations in Column (3) are audited by a nonmerging audit firm. The number of unique clients and audit firms reflect the observations that ultimately make it into the sample after screening out the observations described in Table 2 Panel A.

Table 2 Panel C

Client-Level Observations by year for tests of H2.

Year	(1)	(2)	(3)
	Clients in Pre-Merger Markets	Clients in Post-Merger Markets	Clients in Nonmerging Markets
2008	793	1309	608
2009	503	1535	573
2010	372	1651	567
2011	347	1672	521

Table 2 Panel C (continued)

Year	(1)	(2)	(3)
	Clients in Pre-Merger Markets	Clients in Post-Merger Markets	Clients in Nonmerging Markets
2012	237	1765	522
2013	156	1798	488
2014	88	1912	495
2015	65	1965	491
2016	39	1924	461
Total	2600	15,531	4726
Unique Clients	951	3186	906
Unique Audit Firms	4	4	4

Table 2 Panel C displays a breakdown of the 22,857 engagements that make up the main tests of **H2** according to whether the observation occurs in a pre-merger market, post-merger market, or in a market that does not experience a merger at any time during the sample. Observations in Column (1) include engagements located in an MSA that experiences at least one merger, and before the date of the first merger. Observations in Column (2) include engagements located in an MSA that experiences at least one merger, and after the date of the first merger. Observations in Column (3) include engagements located in an MSA that does not experience a merger at any point in the sample. The number of unique clients and audit firms reflect the observations that ultimately make it into the sample after screening out the observations described in **Table 2** Panel B.

than five years after the mergers date to mitigate the impact of confounding factors, yielding a final sample of 7158 observations for main tests of **H1**.²²

To clarify the composition of the sample, I present a breakdown of these 7158 observations by year, according to whether the client engages a pre-merger, post-merger, or nonmerging audit firm in **Table 2** Panel B.²³ There are zero clients of post-merger (pre-merger) firms in 2004 (2016) by construction because I remove engagements that experience a merger in the current or immediately preceding year for the main tests of **H1**; however, I include these observations in supplemental tests described in Section 6.4 and inferences remain unchanged. I also present descriptive statistics for this sample in **Table 3** Panel A. Although all observations appearing in audit quality tests are included in the 7158 observations that comprise the sample of the main tests of **H1**, the smaller sample sizes for audit quality tests reflect missing control variables or, in the case of inspection deficiencies, the fact that not all engagements are selected for inspection.

For tests of **H2**, I begin with the 37,686 engagements with identifying information from the PCAOB's Annual Data Request (ADR) database from 2008 to 2016, and I remove 5840 engagements involving non-Big 4 auditors. I limit the analysis to the clients of the Big 4 because I do not have a complete panel of data for smaller auditors and because theory predicts that only the largest firms can command market power. Next I remove 1382 observations that are missing data on realization rates and a further 7607 observations that do not have a match in both Compustat and Audit Analytics as well as those that do have a match but are missing data necessary to calculate control variables in Equation (2). This results in a final sample of 22,857 observations for the main tests of **H2**.

To clarify the makeup of the sample for the main tests of **H2**, I tabulate number of engagements by year, according to whether the client is located in a market before it experiences a merger, after it experiences a merger, or in a market that does not experience a merger in **Table 2** Panel C. I also present descriptive statistics for this sample in **Table 3** Panel B.

5. Main analyses

This section discusses the results for my main tests of **H1** and **H2**, which are presented in **Tables 4** and **5**, respectively. I do not tabulate the coefficient estimates for control variables for brevity; however, I present the full specifications for each model in **Online Appendix Tables OA1** and **OA2** and note that the sign and significance of the coefficients on control variables are consistent with prior research.

5.1. Tests of **H1**: audit production efficiency

Table 4 displays the main results for the tests of **H1**. I estimate Equation (1) with $\ln(\text{Total Hours})$ as the dependent variable in Panel A. I am primarily interested in the coefficient on *Post In-Market Merger Indicator*, which represents the change in audit hours for post-merger years relative to pre-merger years. The coefficient on this variable is negative and statistically significant (-0.168 , $t = -3.627$) in Column (1), providing initial evidence that consolidated firms can conduct audits using fewer labor hours than can pre-merger firms. In Column (2), the coefficient on *Post Out-of-Market Merger Indicator* is not statistically significant, implying no post-merger change in audit hours for out-of-market mergers. The results remain consistent in Column (3) when I estimate regressions with both variables in the same model: the coefficient on *Post In-Market Merger Indicator* is negative and statistically significant (-0.162 , $t = -3.491$), while the coefficient on *Post Out-of-Market Merger*

²² I exclude these years to remove transitory effects unrelated to mergers (e.g., lowballing) and because I do not expect synergies immediately after merging. However, I reintroduce these years when I evaluate changes in efficiency and audit fees over time in Section 6.4. In an untabulated analysis, I also find that inferences from audit quality tests are unaffected by this decision.

²³ In cases where a consolidated firm is subsequently acquired, I use the earlier merger date to identify post-merger years.

Table 3

Descriptive statistics.

Panel A: Audit Production Efficiency Tests						
Variable	N	Mean	Stud Dev	25th Pct.	Median	75th Pct.
Acquisition Indicator	7158	0.16	0.37	0.00	0.00	0.00
Assets	7158	352.57	795.45	5.71	33.15	297.15
Audit Fees	7158	186.55	228.19	65.00	122.00	229.00
Audit Firm Size	7158	48.74	47.45	12.00	32.00	65.00
Book-to-Market Ratio	7158	2.13	5.07	0.09	0.49	1.57
Business Segments	7158	2.45	2.68	1.00	2.00	2.00
Busy Season Indicator	7158	0.72	0.45	0.00	1.00	1.00
ΔCash Sales	6084	0.18	3.38	−0.45	−0.04	0.28
Concentration	7158	0.32	0.20	0.22	0.25	0.31
ΔEmployees	6438	0.01	0.09	−0.00	0.00	0.01
Foreign Income Indicator	7158	0.09	0.29	0.00	0.00	0.00
Firm Age	7158	14.19	10.37	6.00	12.00	20.00
Going Concern Indicator	7158	0.28	0.45	0.00	0.00	1.00
ΔInventory	6850	0.00	0.06	−0.00	0.00	0.00
In-Market Merger Indicator	7158	0.13	0.34	0.00	0.00	0.00
Inventory & Accounts Receivable	7158	0.35	0.29	0.06	0.31	0.62
Lease Indicator	7158	0.51	0.50	0.00	1.00	1.00
Leverage	7158	3.20	13.33	0.34	0.77	0.93
Litigation	7158	0.20	0.40	0.00	0.00	0.00
Loss Indicator	7158	0.54	0.50	0.00	1.00	1.00
Market Share	7158	0.22	0.30	0.03	0.08	0.24
Net Issue Indicator	7158	0.53	0.50	0.00	1.00	1.00
Non-Big 4 Market Leader	7158	0.20	0.40	0.00	0.00	0.00
Nonpartner Hours	7158	870.86	883.81	278.00	596.00	1150.00
Office Size	7158	160.74	122.76	63.88	135.01	222.43
Out-of-Market Merger Indicator	7158	0.04	0.19	0.00	0.00	0.00
Operating Cash Flows	7134	−0.65	2.50	−0.27	0.00	0.04
Part I Finding Indicator	2473	0.36	0.48	0.00	0.00	1.00
Partner Hours	7067	189.77	2460.50	51.00	94.00	157.00
Post In-Market Merger Indicator	7158	0.06	0.24	0.00	0.00	0.00
Post Out-of-Market Merger Indicator	7158	0.02	0.13	0.00	0.00	0.00
ΔReceivables	6852	0.01	0.12	−0.02	0.00	0.05
Report Lag	7158	83.60	25.90	70.00	83.00	91.00
Restatement Indicator	7158	0.11	0.31	0.00	0.00	0.00
ΔReturn on Assets	6395	0.26	11.49	−0.08	−0.00	0.05
Sales Growth	6185	0.44	2.25	−0.10	0.04	0.25
Second Tier Indicator	7158	0.15	0.36	0.00	0.00	0.00
Soft Assets	7158	0.62	0.32	0.36	0.71	0.92
Total Hours	7158	995.98	968.17	345.00	700.00	1314.00
Soft Assets	7158	0.62	0.32	0.36	0.71	0.92

Panel B: Audit Market Competition Tests						
Variable	N	Mean	Stud Dev	25th Pct.	Median	75th Pct.
Assets	22,857	8400.40	23,683.59	406.34	1543.29	5287.34
Book-to-Market Ratio	22,857	0.88	0.98	0.26	0.56	1.08
Business Segments	22,857	5.18	5.50	2.00	2.00	8.00
Busy Season Indicator	22,857	0.78	0.42	1.00	1.00	1.00
Foreign Income Indicator	22,857	0.49	0.50	0.00	0.00	1.00
Firm Age	22,857	23.83	16.62	12.00	19.00	31.00
Going Concern Indicator	22,857	0.02	0.15	0.00	0.00	0.00
Concentration of Big 4 Audit Fees	22,857	0.29	0.11	0.23	0.26	0.30
Inventory & Accounts Receivable	22,857	0.23	0.21	0.07	0.18	0.33
Net Issue Indicator	22,857	0.47	0.50	0.00	0.00	1.00
Leverage	22,857	0.58	0.28	0.39	0.57	0.75
Loss Indicator	22,857	0.29	0.46	0.00	0.00	1.00
Market Share of Big 4 Audit Fees	22,857	0.28	0.15	0.18	0.25	0.35
Number of In-Market Mergers	22,857	2.72	5.58	0.00	0.00	2.00
Number of Out-of-Market Mergers	22,857	1.61	2.93	0.00	0.00	2.00
Office Size	22,857	1990.67	1166.15	1100.26	1828.88	2548.57
Realization	22,857	43.28	20.89	28.62	37.00	52.00
Report Lag	22,857	60.75	11.29	54.00	59.00	68.00
Restatement Indicator	22,857	0.11	0.31	0.00	0.00	0.00
Soft Assets	22,857	0.59	0.28	0.36	0.62	0.83

Table 3 Panel A presents the descriptive statistics for key variables in tests related to H1. The composition of each sample is described in Table 2 Panel A. Table 2 Panel B lists a breakdown of these observations by year and according whether the client engages a pre-merger, post-merger, or nonmerging audit firm. All variables displayed in the table are presented in their raw form. Variable definitions are listed in Appendix A.

Table 3 Panel B presents the descriptive statistics for key variables in tests related to H2. The composition of each sample is described in Table 2 Panel A. Table 2 Panel C lists a breakdown of these observations by year and according whether the observation occurs in a pre-merger market, post-merger market, or in a market that does not experience a merger at any time during the sample. All variables displayed in the table are presented in their raw form. Variable definitions are listed in Appendix A.

Table 4
Main tests of H1 – audit production efficiency.

Panel A: Total Hours						
	(1)	(2)	(3)	(4)	(5)	(6)
	<i>Ln(Total Hours)</i>	<i>Ln(Total Hours)</i>	<i>Ln(Total Hours)</i>	<i>Ln(Total Hours)</i>	<i>Ln(Total Hours)</i>	<i>Ln(Total Hours)</i>
<i>In-Market Merger Indicator</i>	0.114*** (3.851)		0.082** (2.499)			
<i>Post In-Market Merger Indicator</i>	-0.168*** (-3.627)		-0.162*** (-3.491)	-0.107** (-2.129)		-0.108** (-2.145)
<i>Out-of-Market Merger Indicator</i>		0.067*** (2.701)	0.059** (2.119)			
<i>Post Out-of-Market Merger Indicator</i>		0.029 (0.605)	0.021 (0.430)		-0.016 (-0.328)	-0.024 (-0.503)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	MSA, Industry, Year	MSA, Industry, Year	MSA, Industry, Year	Audit Office, Industry, Year	Audit Office, Industry, Year	Audit Office, Industry, Year
Observations	7158	7158	7158	7158	7158	7158
Adjusted R-Squared	0.70	0.70	0.70	0.76	0.76	0.76
Panel B: Partner Hours						
	(1)	(2)	(3)	(4)	(5)	(6)
	<i>Ln(Partner Hours)</i>	<i>Ln(Partner Hours)</i>	<i>Ln(Partner Hours)</i>	<i>Ln(Partner Hours)</i>	<i>Ln(Partner Hours)</i>	<i>Ln(Partner Hours)</i>
<i>In-Market Merger Indicator</i>	0.090** (2.242)		0.088** (2.195)			
<i>Post In-Market Merger Indicator</i>	-0.192*** (-3.310)		-0.190*** (-3.277)	-0.205*** (-3.677)		-0.204*** (-3.657)
<i>Out-of-Market Merger Indicator</i>		0.077 (1.212)	0.074 (1.170)			
<i>Post Out-of-Market Merger Indicator</i>		-0.041 (-0.472)	-0.05 (-0.577)		0.036 (0.634)	0.021 (0.366)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	MSA, Industry, Year	MSA, Industry, Year	MSA, Industry, Year	Audit Office, Industry, Year	Audit Office, Industry, Year	Audit Office, Industry, Year
Observations	7067	7067	7067	7067	7067	7067
Adjusted R-Squared	0.43	0.43	0.43	0.53	0.53	0.53
Panel C: Nonpartner Hours						
	(1)	(2)	(3)	(4)	(5)	(6)
	<i>Ln(Nonpartner Hours)</i>	<i>Ln(Nonpartner Hours)</i>	<i>Ln(Nonpartner Hours)</i>	<i>Ln(Nonpartner Hours)</i>	<i>Ln(Nonpartner Hours)</i>	<i>Ln(Nonpartner Hours)</i>
<i>In-Market Merger Indicator</i>	0.102*** (3.258)		0.080** (2.422)			
<i>Post In-Market Merger Indicator</i>	-0.144*** (-2.725)		-0.137*** (-2.599)	-0.125** (-2.331)		-0.123** (-2.282)
<i>Out-of-Market Merger Indicator</i>		0.053** (2.135)	0.043 (1.607)			
<i>Post Out-of-Market Merger Indicator</i>		0.035 (0.719)	0.031 (0.639)		0.016 (0.245)	0.014 (0.212)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	MSA, Industry, Year	MSA, Industry, Year	MSA, Industry, Year	Audit Office, Industry, Year	Audit Office, Industry, Year	Audit Office, Industry, Year
Observations	7067	7067	7067	7067	7067	7067
Adjusted R-Squared	0.64	0.64	0.64	0.68	0.68	0.68

Table 4 reports the results of OLS regressions estimating Equation (1) with *Ln(Total Hours)* as the dependent variable in Panel A, *Ln(Partner Hours)* as the dependent variable in Panel B, and *Ln(Nonpartner Hours)* as the dependent variable in Panel C. I do not report the coefficients on control variables for brevity; however, I present full specifications in Table OA1 of the Online Appendix. All variable definitions are listed in Appendix A. Regressions in Columns (1)–(3) include year, industry, and MSA fixed effects. Regressions in Columns (4)–(6) include audit office (merging pair), industry, and year fixed effects. I assign audit office (merging pair) fixed effects according to the PCAOB registration number of the merged firm. All standard errors are clustered by firm (client). * p-values reported here are computed using two-tailed tests: *p < 0.10, **p < 0.05, ***p < 0.01.

Indicator is insignificant. Although the results in Columns (1)–(3) initially support H1, it is worth noting that the coefficients on *In-Market Merger Indicator* and *Out-of-Market Merger Indicator* are positive and significant in each model, which suggests that clients of merging audit firms (both before and after the merger) are more complex and therefore require greater effort. These findings also emphasize the fact that the coefficient on *Post In-Market Merger Indicator* likely understates the impact of mergers on audit efficiency due to changes in client mix. To provide additional evidence for tests of H1, I relax the implicit assumption that clients of in-market (out-of-market) merging firms are homogenous by replacing *In-Market Merger Indicator*

Table 5
Main tests of H2 – audit market competition.

Panel A: Full Sample						
	(1)	(2)	(3)	(4)	(5)	(6)
	Realization	Realization	Realization	Realization	Realization	Realization
<i>Ln(Number of In-Market Mergers)</i>	-0.101*** (-4.689)		-0.084*** (-3.501)	-0.062*** (-3.030)		-0.061*** (-2.684)
<i>Ln(Number of Out-of-Market Mergers)</i>		-0.085*** (-3.703)	-0.035 (-1.400)		-0.036* (-1.734)	-0.003 (-0.139)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	MSA, Industry	MSA, Industry	MSA, Industry	Client	Client	Client
Observations	22,857	22,857	22,857	22,503	22,503	22,503
Adjusted R-Squared	0.15	0.15	0.15	0.66	0.66	0.66
Panel B: Small Client Segment						
	(1)	(2)	(3)	(4)	(5)	(6)
	Realization	Realization	Realization	Realization	Realization	Realization
<i>Ln(Number of In-Market Mergers)</i>	-0.156*** (-5.087)		-0.139*** (-4.015)	-0.118*** (-3.777)		-0.108*** (-3.053)
<i>Ln(Number of Out-of-Market Mergers)</i>		-0.115*** (-3.602)	-0.034 (-0.948)		-0.080*** (-2.687)	-0.024 (-0.695)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	MSA, Industry	MSA, Industry	MSA, Industry	Client	Client	Client
Observations	11,371	11,371	11,371	11,110	11,110	11,110
Adjusted R-Squared	0.15	0.15	0.15	0.66	0.66	0.66
Panel C: Large Client Segment						
	(1)	(2)	(3)	(4)	(5)	(6)
	Realization	Realization	Realization	Realization	Realization	Realization
<i>Ln(Number of In-Market Mergers)</i>	-0.033 (-1.106)		-0.021 (-0.636)	0.012 (0.409)		-0.002 (-0.064)
<i>Ln(Number of Out-of-Market Mergers)</i>		-0.038 (-1.156)	-0.025 (-0.719)		0.030 (0.962)	0.031 (0.931)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	MSA, Industry	MSA, Industry	MSA, Industry	Client	Client	Client
Observations	11,486	11,486	11,486	11,393	11,393	11,393
Adjusted R-Squared	0.16	0.16	0.16	0.69	0.69	0.69

Table 5 reports the results of OLS regressions estimating Equation (2) with *Realization* as the dependent variable in the full sample in Panel A, the small client sample in Panel B, and the large client sample in Panel C. To define market segments, I partition the H2 sample by assigning each observation into one of two groups based on median client assets by MSA. Engagements below (above) the median are assigned to the small (large) client segment. The dependent variable (*Realization*) is normalized by audit firm and year to account for variation across firms and over time. I do not report the coefficients on control variables for brevity; however, I present full specifications in Table OA2 of the Online Appendix. All variable definitions are listed in Appendix A. Regressions in Columns (1)–(3) include MSA and industry fixed effects. Regressions in Columns (4)–(6) include firm (client) fixed effects. All standard errors are clustered by firm (client).

* p-values reported here are computed using two-tailed tests: *p < 0.10, **p < 0.05, ***p < 0.01.

and *Out-of-Market Merger Indicator* with audit office (merging pair) fixed effects specifications in Columns (4)–(6).²⁴ The coefficient on *Post In-Market Merger Indicator* remains negative and significant in both specifications (-0.107, t = -2.129; -0.108, t = -2.145), while the coefficient on *Post Out-of-Market Merger Indicator* is insignificant.

I investigate post-merger changes in labor mix in Panels B and C of Table 4. In Panel B, the dependent variable is *Ln(Partner Hours)*. The coefficient on *Post In-Market Merger Indicator* is negative and significant in all four specifications, implying that mergers lead to a reduction in partner hours. In Panel C, the dependent variable is *Ln(Nonpartner Hours)*. The coefficient on *Post In-Market Merger Indicator* is smaller in magnitude but still negative and statistically significant, which is consistent with a post-merger decrease in professional staff hours. Overall the analysis of labor mix suggests that in-market mergers are associated with a decline in audit hours at all labor levels, with the greatest reductions occurring at the partner level. These findings are consistent with a post-merger increase in efficiency, allowing merged firms to provide the same level of quality using fewer inputs. In terms of economic magnitude, the results in Table 4 imply that, relative to pre-merger years, in-market mergers lead to a 17.4 percent ($1 - e^{-0.192}$) and a 13.3 percent ($1 - e^{-0.144}$) reduction in partner and nonpartner hours, respectively. I find no evidence of a reduction in labor hours at any level among out-of-market mergers.

²⁴ As an additional robustness test (described in Section 6.7), I employ a difference-in-differences design with a matched control group of nonmerging firms following the methodology of Gong et al. (2016). The results from these tests suggest the findings in Table 4 are unlikely to be driven by endogenous differences between clients of merging and nonmerging firms.

The results in Table 4 also highlight two significant empirical differences from similar tests in a recent study of Chinese mergers (Table 3 of Gong et al., 2016). First, the adjusted R-squared values are roughly two times higher in the U.S. sample, implying there are fundamental differences in the factors that determine auditors' inputs to production and that proxies for audit risk account for more of the variation in audit hours in the U.S. setting. Second, the post-merger reduction in audit hours documented by Gong et al. (2016) is largely driven by a 68 percent reduction in hours across both the treatment and control groups. This finding suggests there may be important structural shifts in how audits are conducted in China during the sample period examined by Gong et al. (2016). For example, Piotroski and Wong (2012) note that the CRC introduced reforms in 2007 to bring Chinese accounting and auditing standards in line with international standards. These changes are an important confounding factor because they are likely to affect the audit production process, auditors' incentives to merger, and clients' incentives to demand high quality auditors.²⁵ The regulatory changes that occurred during the sample period of Gong et al. (2016) also highlight an important feature of the sample period in this study: my analysis is based on firms facing the same regulatory regime. Thus, recent non-Big 4 mergers are more likely to be driven by an organic response to market structure rather than a drastic realignment of auditor incentives.

Collectively, the results in Table 4 provide preliminary support for H1 and suggest that in-market mergers lead to a reduction in labor inputs at all levels, though the reduction is greatest for audit partners. Although it may, at first, be surprising to see a larger reduction in partner hours, it is perhaps less so when considering the size of some smaller triennially inspected audit firms. For example, when a single office consists of just a few audit partners, senior members of the engagement team are more likely to take on tasks typically assigned to junior staff. Therefore, a likely explanation of these results is that mergers allow audit firms to more efficiently allocate expertise.²⁶ Moreover, I find no evidence of a reduction in audit hours following out-of-market mergers when there are more likely to be frictions (e.g., the cost of travel) that constrain a more efficient allocation of labor.

5.2. Tests of H2: audit market competition

Table 5 presents the main results for tests of H2. I estimate Equation (2) in the full sample in Panel A. In Column (1), the coefficient on $\ln(\text{Number of In-Market Mergers})$ is negative and significant (-0.101 , $t = -4.689$), suggesting that in-market mergers are associated with lower profitability among Big 4 engagements in the years following a merger. I observe a similar effect for out-of-market mergers in Column (2): the coefficient on $\ln(\text{Number of Out-of-Market Mergers})$ is negative and significant (-0.085 , $t = -3.703$). When both variables are included in the same model in Column (3), only the coefficient on $\ln(\text{Number of In-Market Mergers})$ is negative and significant (-0.084 , $t = -3.501$). These findings suggest that in-market mergers exert greater competitive pressure on the Big 4 than do out-of-market mergers, although the strong correlation between these variables (0.725 , $p < 0.01$) impedes disentangling the relative effects of each type of merger. In Columns (4)–(6), I re-estimate the model after replacing MSA and industry fixed effects with client fixed effects to examine whether the results are driven by changes in client mix or within-client changes in profitability. The results resemble those reported in Columns (1)–(3) in terms of sign and statistical significance, although the coefficients are smaller. For example, the coefficient on $\ln(\text{Number of In-Market Mergers})$ is negative and significant both before (-0.062 , $t = -3.030$) and after (-0.061 , $t = -2.684$) controlling for the number of out-of-market mergers, and the coefficient on $\ln(\text{Number of Out-of-Market Mergers})$ is significant only before (-0.036 , $t = -1.734$) controlling for the number of in-market mergers. Thus, the results from client fixed effect models imply that, although the overall impact of mergers is mostly driven by within-client changes, at least some variation in profitability is attributable to changes in client mix.

Although the results in Table 5 Panel A provide initial evidence that non-Big 4 mergers exert competitive pressure on the Big 4, it is important to consider whether the impact is uniform across all market segments, given the multitiered structure of the U.S. public company audit market. To investigate this possibility, I partition the sample into two groups based on client size in Panels B and C of Table 5. Specifically, I calculate the median value of client assets for each MSA and assign engagements above (below) the median to the larger (smaller) client segment. Results for the smaller client segment, presented in Panel B, are similar in sign and significance to those in the full sample. The coefficient on $\ln(\text{Number of In-Market Mergers})$ is negative and significant before and after controlling for the number of out-of-market mergers and the coefficient on $\ln(\text{Number of Out-of-Market Mergers})$ is only significant before controlling for in-market mergers. However, the size of the coefficient suggests a greater impact in this segment of the market. In terms of magnitude, the coefficients on $\ln(\text{Number of In-Market Mergers})$ in Columns (1) and (3) suggest that a 1 percent increase in market-level merger activity leads to a roughly 10.4–14.4 percent reduction in the future profitability of smaller Big 4 engagements. As in the full sample, the coefficients on the variables of interest remain statistically significant but slightly smaller after replacing MSA and industry fixed effects with client fixed

²⁵ For example, the CRC required auditors to adopt a risk-based audit approach, which is in line with U.S. and international auditing standards. Research on audit production assumes that the client-level control variables capture audit risk, which influences auditors' decisions regarding inputs to production (e.g., Simunic, 1980; Hay et al., 2006).

²⁶ Examining the efficiency of labor allocation requires data on audit personnel utilization or other similar measures. Although the PCAOB collects data on partner utilization for the six largest audit firms (Gipper et al., 2021, 2022), I am not aware of nor do I have access to any similar information that PCAOB may be collecting for smaller annually and triennially inspected audit firms. Without access to utilization rates or similar measures, I cannot directly test audit firms' labor allocation efficiency. However, discussions with practitioners confirmed these accounts. As an example, one former auditor stated that access to a senior manager would allow some engagements to shift away work from the partner, who bills at a higher rate.

effects in Columns (4)–(6). Panel C presents the Results for the large client segment. The coefficients on $\ln(\text{Number of In-Market Mergers})$ and $\ln(\text{Number of Out-of-Market Mergers})$ are statistically insignificant in all specifications, implying that mergers do not affect the profitability of the Big 4 in this segment of the market.²⁷

Collectively, the results in Table 5 support H2, implying that non-Big 4 mergers exert competitive pressure on local Big 4 offices; however, these findings are subject to caveats. A cross-sectional analysis reveals the impact of mergers is limited to the smaller client segment, implying that the impact of mergers is not uniform within the U.S. public company audit market and that merged firms do not compete with the Big 4 for the largest audit clients. Additionally, my analysis examines competition in the public company audit market; mergers may also alter competition in other the private company audit market, the nonaudit service market, and the auditor labor market. While realization rates may indirectly incorporate some of these effects through their impact on the cost of audit inputs, my results cannot speak directly to the impact of mergers on competition in other markets. Regardless of these qualifications, the results do speak to a large and economically significant market. Collectively, they suggest that at least some segments of the U.S. public company audit market may be characterized as a dominant firm oligopoly. They also suggest that mergers allow smaller firms to overcome entry barriers to some segments of the audit market, bringing new competition to markets dominated by a few large firms.

6. Additional analyses

This section discusses additional tests (both tabulated and untabulated) that supplement the main analyses, investigate alternative explanations, and examine the sensitivity to various design choices.

6.1. Do post-merger reductions in labor hours reflect lower quality?

As previously noted, my analysis of labor hours assumes that audit quality remains constant, regardless of the reduction in audit inputs predicted by H1. To rule out the explanation that the results in Table 4 reflect lower effort, I investigate post-merger changes in audit quality by replacing the dependent variable in Equation (1) with several proxies for audit quality: PCAOB-identified audit deficiencies, restatements, discretionary accruals, and going concern opinions. I employ PCAOB-identified audit deficiencies as my primary measure of quality because this is a direct measure of the audit process compared to output-based proxies, which are a joint product of the company's financial reporting quality (Aobdia, 2019). Therefore, the measure is unlikely to be influenced by changes in client portfolios that also result from mergers. When inspectors determine that the auditor has violated auditing standards and conclude that evidence is insufficient to support the audit opinion, the PCAOB discloses a deficiency in Part I of the audit firm's inspection report (CAQ, 2012). Although the public version of the inspection report conceals issuers' identities, I can link deficiencies to individual engagements by using the PCAOB's proprietary database. This feature allows me to control for client-level characteristics in regression models, which is impossible using only publicly available data. Although inspection deficiencies have several distinct advantages as a measure of audit quality, one disadvantage is that the sample may not represent the wider population because the PCAOB employs a risk-based approach to selecting engagements for inspection (Aobdia, 2019). Therefore, I also consider accounting restatements, discretionary accruals, and the propensity to issue going concern opinions in supplementary tests. For each of these variables, I base models and their respective control variables on the literature (DeFond et al., 2002; Ashbaugh et al., 2003; Kothari et al., 2005; Lobo and Zhao, 2013; Aobdia, 2019).

Table 6 Panel A presents the results audit deficiency models. In Column (1), the coefficient on *Post In-Market Merger Indicator* is negative and significant (-0.712 , $t = -2.596$), which is inconsistent with lower quality. The marginal effect implies that, conditional on being selected for inspection, audits performed by post-merger firms are approximately 16 percent less likely to contain a deficiency. I find no evidence of change in deficiency rates among out-of-market mergers in Column (2). I observe similar results when I include in-market and out-of-market variables in the same model in Column (3) and when I include audit office (merging pair) fixed effects in Columns (4)–(6). I also find similar results for regressions estimating the likelihood of a restatement in Table 6 Panel B. The coefficient on *Post In-Market Merger Indicator* is negative and statistically significant in each specification. In terms of magnitude, the marginal effect (-0.059) in Columns (1) and (3) implies that restatements are approximately 6 percent less likely among clients of post-merger firms.²⁸ Although the results imply higher quality, I am cautious about attributing effects to mergers because supplemental tests in Section 6.2 suggest mergers also influence firms' client portfolios. Thus, the negative coefficients on *Post In-Market Merger Indicator* could reflect the fact that merged firms attract larger and more sophisticated clients that are less likely to misstate. I find no evidence of a post-merger reduction in the likelihood of a restatement among out-of-market mergers in any of the specifications. I tabulate the results

²⁷ The contrasting results imply that the large and small client segments have different market structures. For instance, one possibility is that the large client segment functions as a classic Cournot oligopoly (and that merged firms are not able to enter this market). A second possibility is that competition in the large client segments more closely reflects Bertrand-style competition. For instance, Big 4 firms might aggressively bid for prominent clients while behaving more like a dominant oligopoly for smaller clients. Different forms of competition between the small and large client segments might explain some of the differences in prior findings (e.g., Gerakos and Syverson, 2015; Ferguson et al., 2020).

²⁸ In untabulated tests, I re-estimate models after limiting restatements to those that harm the client's financial statements. The coefficient on *Post In-Market Merger Indicator* is slightly stronger in terms of sign and significance to those reported Table 5; however, I report all types of restatements for the main analysis because higher quality audits should reduce the likelihood of restatements, regardless of their impact on the client's financial position.

Table 6
Audit efficiency and audit quality.

Panel A: Inspection Deficiencies												
	(1)		(2)		(3)		(4)		(5)		(6)	
	Part I Finding Indicator		Part I Finding Indicator		Part I Finding Indicator		Part I Finding Indicator		Part I Finding Indicator		Part I Finding Indicator	
	Coeff. (t-stat)	Marginal effect	Coeff. (t-stat)	Marginal effect	Coeff. (t-stat)	Marginal effect	Coeff. (t-stat)	Marginal effect	Coeff. (t-stat)	Marginal effect	Coeff. (t-stat)	Marginal effect
<i>In-Market Merger Indicator</i>	0.142 (0.709)	0.032			0.147 (0.733)	0.033						
<i>Post In-Market Merger Indicator</i>	-0.712*** (-2.596)	-0.160			-0.722*** (-2.625)	-0.162	-0.664** (-2.347)	-0.141			-0.668** (-2.357)	-0.142
<i>Out-of-Market Merger Indicator</i>			-0.388 (-0.861)	-0.087	-0.415 (-0.923)	-0.093						
<i>Post Out-of-Market Merger Indicator</i>			0.274 (0.383)	0.062	0.240 (0.325)	0.054			-0.213 (-0.414)	-0.046	-0.262 (-0.500)	-0.056
Controls	Yes		Yes		Yes		Yes		Yes		Yes	
Fixed Effects	MSA, Industry, Year		MSA, Industry, Year		MSA, Industry, Year		Audit Office, Industry, Year		Audit Office, Industry, Year		Audit Office, Industry, Year	
Observations	1999		1999		1999		1676		1676		1676	
Pseudo R-Squared	0.12		0.11		0.12		0.18		0.18		0.18	
Panel B: Restatements												
	(1)		(2)		(3)		(4)		(5)		(6)	
	Restatement Indicator		Restatement Indicator		Restatement Indicator		Restatement Indicator		Restatement Indicator		Restatement Indicator	
	Coeff. (t-stat)	Marginal effect	Coeff. (t-stat)	Marginal effect	Coeff. (t-stat)	Marginal effect	Coeff. (t-stat)	Marginal effect	Coeff. (t-stat)	Marginal effect	Coeff. (t-stat)	Marginal effect
<i>In-Market Merger Indicator</i>	0.032 (0.195)	0.003			0.030 (0.180)	0.003						
<i>Post In-Market Merger Indicator</i>	-0.656** (-2.021)	-0.059			-0.655** (-2.019)	-0.059	-0.779** (-2.277)	-0.064			-0.775** (-2.270)	-0.064
<i>Out-of-Market Merger Indicator</i>			0.264 (0.797)	0.024	0.265 (0.792)	0.024						
<i>Post Out-of-Market Merger Indicator</i>			-0.296 (-0.570)	-0.027	-0.324 (-0.623)	-0.029			0.156 (0.371)	0.013	0.112 (0.266)	0.009
Controls	Yes		Yes		Yes		Yes		Yes		Yes	
Fixed Effects	MSA, Industry, Year		MSA, Industry, Year		MSA, Industry, Year		Audit Office, Industry, Year		Audit Office, Industry, Year		Audit Office, Industry, Year	
Observations	5398		5398		5398		5034		5034		5034	
Pseudo R-Squared	0.11		0.11		0.11		0.16		0.16		0.16	

Table 6 reports the results of logistic regressions estimating Equation (1) with *Part I Finding Indicator* as the dependent variable in Panel A and *Restatement Indicator* as the dependent variable in Panel B. I do not report the coefficients on control variables for brevity; however, I present full specifications in Table OA3 of the Online Appendix. Marginal effects at the mean are reported next to coefficients for the variables of interest. All variable definitions are listed in Appendix A. Regressions in Columns (1)–(3) include year, industry, and MSA fixed effects. Regressions in Columns (4)–(6) include audit office (merging pair), industry, and year fixed effects. I assign audit office (merging pair) fixed effects according to the PCAOB registration number of the merged firm. All standard errors are clustered by firm (client).

* p-values reported here are computed using two-tailed tests: *p < 0.10, **p < 0.05, ***p < 0.01.

for the going concern and discretionary accruals models in the Online Appendix Tables OA4 and OA5, respectively, and find no evidence that either in-market mergers or out-of-market mergers are associated with either measure.²⁹

I also perform several untabulated analyses that suggest that the quality results are robust to various research design choices. First, I re-estimate all logistic regression models (PCAOB-identified deficiency, restatement, and going concern analyses) after dropping MSA fixed effects and find that the results are not influenced by observations dropped due to collinearity. Second, I document that results are consistent after excluding all annually inspected audit firms (i.e., those with more than 100 public company audit clients). Third, I find similar results when I re-estimate audit quality models after including the first year following the merger, implying that the results are not likely to be driven by higher deficiency rates in initial audit engagements (Gipper et al., 2021). Collectively, the results from audit quality tests are inconsistent with the notion that post-merger reductions in audit hours reflect lower quality; in fact, they suggest in-market mergers may actually

²⁹ I consider multiple measures of discretionary accruals for these tests. In Table OA5, the dependent variable is the modified Jones model augmented with firm and year fixed effects and a correction for serial correlation following Kothari et al. (2015). In an untabulated analysis, I also consider both signed and unsigned measures of the performance-matched modified Jones model and the modified Jones model adjusted for performance (Kothari et al., 2005), and all inferences remain the same.

improve quality on some dimensions.³⁰ Considered with the results in Table 4, these findings suggest that in-market mergers generate efficiencies. Specifically, efficiencies are reflected in post-merger auditors requiring fewer inputs to provide the same, if not higher, audit quality.

6.2. Do mergers affect the ability of audit firms to attract larger and more complex clients?

I hypothesize that one way mergers increase competition is by enabling audit firms to compete for larger and more complex clients. To investigate this possibility, I examine changes to firms' portfolios of clients surrounding mergers. A direct comparison of client portfolios before and after the merger is problematic because the auditor-client relationship is sticky (DeAngelo, 1981) and because audit firms' capacity constraints mean that one cannot infer whether switches away from merging firms are driven by former clients or by the auditor's desire to attract different types of clients. As such, I focus my analysis on the sample of clients that switch to merging firms in the years immediately before and after a merger. I also construct a control group of clients that switched to similar nonmerging audit firms during the same period to provide a basis for comparison. To ensure that merging and nonmerging firms are similar, I match each pre-merger auditor to a nonmerging firm located in the same MSA based on nearest neighbor matching in terms of market share of audit fees in the year before the merger. Next I identify all clients that switch to one of these firms during the five years before and after the merger and compare client characteristics between the pre-merger and post-merger periods by performing t-tests for differences in means across various proxies for size and complexity.³¹ If mergers allow firms to compete for larger and more complex clients, then I expect merged firms (but not nonmerging ones) to exhibit an increase in the number of switches and changes in client characteristics in the post-merger period.

Table 7 presents the results for these tests. I observe an increase in the number of clients switching to merged firms following both in-market (373 versus 334) and out-of-market mergers (174 versus 111) in Panel A. Moreover, a comparison of client characteristics suggests that post-merger firms are more likely to compete in the segment of the audit market dominated by the Big 4. Among in-market mergers, accelerated filers comprise 9% (19%) of clients switching to pre-merger (post-merger) audit firms, approximately a 10 percentage point or 211 percent increase. I observe a larger increase for out-of-market mergers: accelerated filers switching to pre-merger (post-merger) audit firms comprise 9% (28%) of new clients, which represents approximately a 19 percentage point or 311 percent increase. For both types of mergers, new clients are also significantly larger (*Assets*, *Market Value of Equity*), more complex (*Intangible Assets Indicator*, *Foreign Income Indicator*), and less financially distressed (*Net Debt Issue Indicator*, *Prior Year Going Concern Indicator*, *Loss Indicator*) based on at least two proxies for each construct. Interestingly, I also observe that clients switching to consolidated out-of-market firms are significantly more likely to purchase nonaudit services (*Nonaudit Fee Indicator*), suggesting that merged firms may be able to differentiate on service mix. I find no evidence of increases in the number of switches or the likelihood of attracting larger or more complex clients for either of the control groups in Panel B, implying that similar nonmerging firms do not experience comparable changes in client composition.³² Collectively, the results in Table 7 are consistent with both in-market and out-of-market mergers increasing the number of firms that compete for the audits of larger public companies.

6.3. Do mergers reduce competition in the non-big 4 segment of the market?

Although the findings in Table 5 suggest that non-Big 4 mergers have increased competition in at least some segments of the market served by the Big 4, the results may not generalize to the entire U.S. public company audit market, given its multitiered structure. One possibility is that mergers increase competition among Big 4 firms while reducing competition among other firms. For example, mergers could create market power within the non-Big 4 segment by eliminating direct competition between rivals. To examine this possibility, I investigate post-merger changes in audit fees for clients of merging firms. I do not use realization rates for this analysis because this information is missing for many engagements in the Exhibit B dataset, and, for observations with necessary data, there is significant heterogeneity in the methods by which firms calculate realization. Accordingly, I perform the analysis by estimating Equation (2) with the $\ln(\text{Audit Fees})$ as the dependent variable and include $\ln(\text{Total Hours})$ as an independent variable to control for auditors' inputs to production. If mergers reduce competition in the non-Big 4 segment of the market, then I expect a positive coefficient on the variables of interest.

³⁰ I note three main differences between these findings and similar tests of Christensen et al. (2020). First, I use audit deficiency measures that are more directly tied to audit quality. By leveraging PCAOB data, I can identify which engagements are selected for inspection and control for engagement characteristics. In contrast, Christensen et al. (2020) can only observe inspection results at the audit firm level and report a post-merger increase in deficiencies per inspection. Second, my findings are validated over more measures that capture more dimensions of audit quality. In addition to inspection deficiency results, I find no evidence of lower quality using restatements, discretionary accruals, and the propensity to issue going concern opinions, while Christensen et al. (2020) find only weak evidence of a post-merger increase in discretionary accruals and inconclusive effects using restatements. Third, I examine a more inclusive sample of mergers involving all public company auditors outside of the top six firms and differentiate between in-market and out-of-market mergers. In contrast, Christensen et al. (2020) restrict their sample to mergers involving smaller, triennially inspected firms and make no distinction based on the location of merging firms.

³¹ This design resembles Lennox and Pittman's (2011) pre-versus post-analysis surrounding a change from mandatory to voluntary audits for private companies in the United Kingdom. In Table 4, the authors compare changes in credit ratings for companies that continued to be audited to those of companies that ceased to be audited.

³² The statistically significant differences for *Intangible Assets Indicator*, *Loss Indicator* and *Net Equity Indicator* suggest that clients in the post-merger period are actually less complex for similar nonmerging firms.

Table 7
Changes to client portfolio.

Panel A: Client Switches to Merging Audit Firms												
Variable	In-Market Mergers						Out-of-Market Mergers					
	(1)		(2)		(3)		(4)		(5)		(6)	
	Pre-Merger		Post-Merger		Difference		Pre-Merger		Post-Merger		Difference	
	N	Mean	N	Mean	Mean Diff	t-stat	N	Mean	N	Mean	Mean Diff	t-stat
<i>Accelerated Filer Indicator</i>	334	0.09	373	0.19	0.10***	3.63	111	0.09	174	0.28	0.19***	3.88
<i>Assets</i>	334	97.24	373	205.39	108.15***	3.85	111	112.38	174	430.54	318.16***	5.16
<i>Market Value of Equity</i>	321	51.99	361	90.18	38.19***	3.91	106	55.27	171	79.21	23.94**	2.07
<i>Firm Age</i>	334	13.28	373	13.55	0.27	0.31	111	9.04	174	12.34	3.30***	2.75
<i>Intangible Assets Indicator</i>	334	0.51	373	0.58	0.08**	2.02	111	0.39	174	0.54	0.15**	2.54
<i>Foreign Income Indicator</i>	334	0.07	373	0.13	0.05**	2.36	111	0.09	174	0.05	-0.04	-1.49
<i>Prior Year Going Concern Indicator</i>	293	0.37	347	0.24	-0.13***	-3.61	83	0.33	160	0.14	-0.19***	-3.59
<i>Net Debt Issue Indicator</i>	334	0.36	373	0.28	-0.08**	-2.30	111	0.38	174	0.33	-0.05	-0.78
<i>Net Equity Issue Indicator</i>	334	0.29	373	0.30	0.01	0.37	111	0.23	174	0.24	0.02	0.31
<i>Loss Indicator</i>	334	0.67	373	0.64	-0.03	-1.00	111	0.68	174	0.43	-0.25***	-4.30
<i>Nonaudit Fee Indicator</i>	334	0.58	373	0.61	0.04	0.98	111	0.53	174	0.77	0.24***	4.33

Panel B: Clients Switches to Matched Control Group of Nonmerging Audit Firms												
Variable	Control Group for In-Market Mergers						Control Group for Out-of-Market Mergers					
	(1)		(2)		(3)		(4)		(5)		(6)	
	Pre-Merger Period		Post-Merger Period		Difference		Pre-Merger Period		Post-Merger Period		Difference	
	N	Mean	N	Mean	Mean Diff	t-stat	N	Mean	N	Mean	Mean Diff	t-stat
<i>Accelerated Filer Indicator</i>	108	0.04	87	0.06	0.02	0.67	58	0.03	38	0.00	-0.03	-1.15
<i>Assets</i>	108	54.32	87	73.34	19.03	0.67	58	52.93	38	8.95	-43.98	-0.86
<i>Market Value of Equity</i>	103	44.37	79	64.29	19.92	1.51	56	20.83	37	35.16	14.33	1.01
<i>Firm Age</i>	108	8.98	87	7.84	-1.14	-0.95	58	9.90	38	7.16	-2.74	-1.42
<i>Intangible Assets Indicator</i>	108	0.45	87	0.30	-0.16**	-2.23	58	0.22	38	0.32	0.09	1.00
<i>Foreign Income Indicator</i>	108	0.05	87	0.06	0.01	0.35	58	0.07	38	0.00	-0.07	-1.66
<i>Prior Year Going Concern Indicator</i>	65	0.48	48	0.48	0.00	0.02	42	0.60	20	0.60	0.01	0.04
<i>Net Debt Issue Indicator</i>	108	0.37	87	0.33	-0.04	-0.54	58	0.33	38	0.32	-0.01	-0.12
<i>Net Equity Issue Indicator</i>	108	0.21	87	0.25	0.04	0.66	58	0.40	38	0.21	-0.19*	-1.92
<i>Loss Indicator</i>	108	0.66	87	0.77	0.11*	1.72	58	0.76	38	0.92	0.16**	2.06
<i>Nonaudit Fee Indicator</i>	108	0.41	87	0.45	0.04	0.57	58	0.60	38	0.53	-0.08	-0.74

Table 7 reports descriptive statistics for the characteristics of clients switching to merging audit firms and a matched control group of nonmerging audit firms in the five years before and after the merger. To form the control group, I begin by matching each pre-merger audit firm to its nearest neighbor in terms on market share of MSA audit fees. Next, I identify all client switches to matched firms in the five years before and after the date of the merger. Client switches in the five years before (after) the merger are assigned to the pre-merger (post-merger) period. Panel A reports descriptive statistics for clients of in-market mergers in Columns (1)–(3) and clients of out-of-market mergers in Columns (4)–(6). Panel B reports descriptive statistics for the control group for in-market mergers in Columns (1)–(3) and the control group for out-of-market mergers in Columns (4)–(6). In both panels, Columns (1) and (4) present descriptive statistics for switches in the pre-merger period, Columns (2) and (5) present descriptive statistics for switches in the post-merger period, and Columns (3) and (6) present t-tests for differences in means between the pre-merger and post-merger periods. All Variable definitions are listed in Appendix A. Observations in Table 7 may not appear in the main tests of H1 if they are missing data to compute control variables.

* p-values reported here are computed using two-tailed tests: *p < 0.10, **p < 0.05, ***p < 0.01.

Conversely, a negative coefficient would suggest that mergers generate efficiencies beyond reductions in labor inputs (because I control for total audit hours), for example, by reducing overhead costs. However, I am cautious about drawing conclusions on the sources of efficiencies based on these results because, unlike realization rate models, audit fee models do not account for variation in labor mix and audit firms' cost structures.

The results for these tests are presented in Table 8. Before considering the variables of interest, note that the adjusted R-squared values are significantly higher compared to similar tests of Gong et al. (2016), echoing concerns raised in Section 5.1 regarding structural differences between the U.S. and Chinese audit markets.³³ In Columns (1) and (2), the coefficient on the *Post In-Market Merger Indicator* is negative and statistically significant in Columns (1) and (3) (-0.124, t = -3.422; -0.131, t = -3.714), providing initial evidence of fee reductions both before and after controlling for in-market mergers. I find no evidence that *Post Out-of-Market Merger Indicator* is associated with audit fees, which is consistent with the findings in Table 4 and implies that out-of-market mergers do not generate synergies. In Columns (4) through (6), I present results for audit office (merging pair) fixed effects models and find similar results. In terms of economic

³³ For example, the adjusted R-squared ranges from 0.80 to 0.85, and the coefficient on *HOURS TOT* from 0.517 to 0.524 in Table 8. In similar tests reported in Table 7 of Gong et al. (2016), the adjusted R-squared ranges from 0.566 to 0.572, and the coefficient on audit hours is 0.051.

Table 8
Audit fees for clients of merging audit firms.

	(1)	(2)	(3)	(4)	(5)	(6)
	<i>Ln(Audit Fees)</i>	<i>Ln(Audit Fees)</i>	<i>Ln(Audit Fees)</i>	<i>Ln(Audit Fees)</i>	<i>Ln(Audit Fees)</i>	<i>Ln(Audit Fees)</i>
<i>In-Market Merger Indicator</i>	0.072*** -2.697		0.070*** (2.653)			
<i>Post In-Market Merger Indicator</i>	-0.124*** (-3.422)		-0.131*** (-3.714)	-0.081** (-2.530)		-0.065* (-1.827)
<i>Out-of-Market Merger Indicator</i>		0.003 (0.083)	0.000 (0.007)			
<i>Post Out-of-Market Merger Indicator</i>		-0.019 (-0.399)	-0.025 (-0.509)		-0.039 (-1.076)	-0.046 (-1.239)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	MSA, Industry, Year	MSA, Industry, Year	MSA, Industry, Year	Audit Office, Industry, Year	Audit Office, Industry, Year	Audit Office, Industry, Year
Observations	7158	7158	7158	7158	7158	7158
Adjusted R-Squared	0.80	0.80	0.81	0.85	0.85	0.85

Table 8 reports the results of OLS regressions estimating Equation (1) with *Ln(Audit Fees)* as the dependent variable. I do not report the coefficients on control variables for brevity; however, I present full specifications in Table OA6 of the Online Appendix. All variable definitions are listed in Appendix A. Regressions in Columns (1)–(3) include year, industry, and MSA fixed effects. Regressions in Columns (4)–(6) include audit office (merging pair), industry, and year fixed effects. I assign audit office (merging pair) fixed effects according to the PCAOB registration number of the merged firm. All standard errors are clustered by firm (client).

* p-values reported here are computed using two-tailed tests: *p < 0.10, **p < 0.05, ***p < 0.01.

magnitude, the coefficients in Table 8 indicate that in-market mergers lead to a roughly 6.3 percent to 12.3 percent reduction in audit fees, relative to pre-merger years. Because the potential to generate market power is likely to vary across mergers, I re-perform the analysis in Table 8 after interacting post-merger indicators with three variables that capture potential sources of market power: the auditor's market share of non-Big 4 audit fees (*Market Share*) and indicator variables for second tier firms (*Second Tier*) and non-Big 4 market leadership (*Non-Big 4 Market Leader*). The coefficient on *Post In-Market Merger Indicator* remains similar in magnitude and statistically significant at conventional levels, while the interaction terms are all statistically insignificant implying similar results for mergers that are more likely to alter market structure. Overall the results in Table 8 suggest that at least a portion of efficiencies documented in tests of H1 are passed on to clients in the form of lower prices and that non-Big 4 mergers have increased competition in the small client segment of the market.

6.4. Audit efficiency over time

As an additional robustness tests, I examine audit efficiency over time by investigating year-to-year changes in total audit hours and fees in the years immediately surrounding mergers. I focus this analysis on in-market mergers because I find no evidence of efficiencies among out-of-market mergers in either audit hour or audit fee regressions presented in Tables 4 and 8, respectively. In contrast to the main tests of H1, I include client-years that experience a merger in either the current or immediately preceding fiscal year and alter Equation (1) by replacing *Post In-Market Merger Indicator* with separate indicator variables for each of the 10 years surrounding the merger (with year *t-1* serving as the baseline).

To illustrate changes in efficiency over time, I plot each coefficient for audit hour and audit fee regressions in Fig. 1. The whiskers surrounding each point display the 95 percent confidence interval for the coefficient. In Fig. 1, none of the coefficients for year *t-5* through *t+1* are statistically significant, implying that neither efficiencies nor fee reductions are realized either before or immediately after the merger. The fact that the coefficient for year *t+1* is insignificant is not surprising, given that I cannot observe the length of time between fee negotiations and the date of the merger. In contrast, the coefficients for both *Ln(Total Hours)* and *Ln(Audit Fees)* are negative and statistically significant for all years *t+2* through *t+4*, suggesting that efficiencies are realized two to four years after the merger and remain relatively consistent over this period. Interestingly, the magnitude of the coefficient for *Ln(Audit Fees)* is slightly smaller than that of *Ln(Total Hours)*, which suggests that some but not all of the cost reductions are passed on to clients.

6.5. Alternative measures of engagement profitability

For the main tests of H2, I estimate Equation (2) with *Realization* as the dependent variable, which reflects the engagement's realization rate normalized by audit firm-year to account for differences in the calculation of billing rates across firms and over time. The decision to normalize variance was driven by a higher mean and standard deviation of realization rates for one of the firms in the sample. Although normalizing the variance of realization corrects for this issue, it could remove some variation in realization that is relevant to the research question. For example, mergers could indirectly influence Big 4 firms' staffing capacity at certain labor levels through their impact on client retention, which, in turn, could affect the ability to

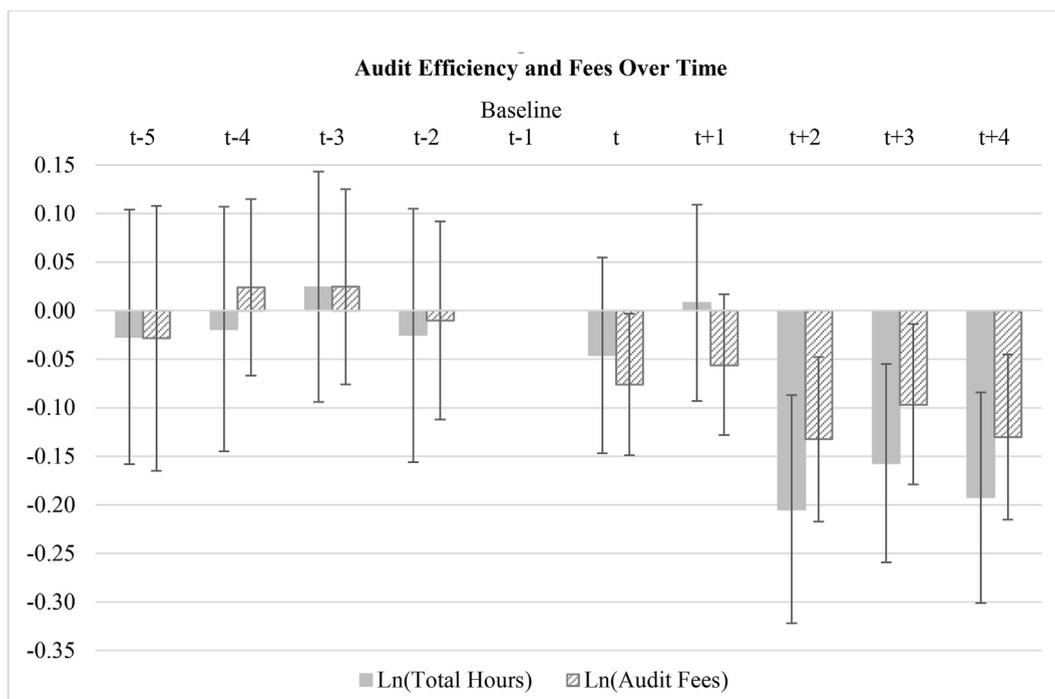


Fig. 1. Plots OLS coefficient estimates and 95 percent confidence intervals from regressions estimated with $\ln(\text{Total Hours})$ and $\ln(\text{Audit Fees})$ as the dependent variable. The regressions take the form of Equation (1) altered by replacing the *Post In-Market Merger Indicator* with separate indicator variables for each of the ten years surrounding the merger (omitting year $t-1$ to avoid perfect collinearity). The models include MSA, industry, and year fixed effects as well as audit- and client-specific control variables (see notes to Tables 4 and 8 for details).

recoup standard fees for engagements requiring specific levels of expertise. To examine this possibility, I re-estimate Equation (2) with a level-normalized measure of *Realization*. Specifically, I subtract raw realization rates by the mean realization rate for engagements in the same firm-year but do not divide by the standard deviation. As an additional robustness tests, I also re-estimate Equation (2) using audit fees instead of realization rates for the dependent variable to examine the impact of mergers on audit pricing. Although realization rates incorporates pricing by construction, the measure could reflect a mixture of fee cuts and reductions in the billing of standard fees (e.g., not billing the client when the engagement requires additional hours or higher ranked labor).

The results of these tests suggest the findings are robust to using the alternative measures of engagement profitability. I find the same pattern of results in terms of sign and statistical significance for regressions estimated with the variable only level normalized but not variance normalized in Table OA7, implying that the results for tests of H2 are insensitive to normalizing the variance of realization rates. Although the magnitudes of coefficients are larger compared to those in Table 5, this distinction reflects the fact that the dependent variable is not scaled by the standard deviation of realization. I also find qualitatively similar results for audit fee regressions presented in Table OA8. The coefficients on $\ln(\text{Number of In-Market Mergers})$ and $\ln(\text{Number of Out-of-Market Mergers})$ are statistically significant at conventional levels in all specifications of the full and small client samples but are smaller in terms of magnitude. For example, the coefficient on $\ln(\text{Number of In-Market Mergers})$ implies that a 1 percent increase in market-level merger activity leads to a roughly 6.2 percent to 7.3 percent reduction in the future audit fees for engagements in the small client segment (compared to 10.4 percent to 14.4 percent in Table 5 Panel B). As in the main analysis, I find no evidence that $\ln(\text{Number of In-Market Mergers})$ and $\ln(\text{Number of Out-of-Market Mergers})$ are associated with audit fees in the large client segment. When viewed along with the main analysis, these results imply the lower profitability is likely a mixture of both fee cuts and reductions in billing; however, I am cautious about inferring relative magnitudes due to the difficulty of disentangling these factors empirically because audit fee models do not fully account for labor mix.

6.6. Generalizability

A significant advantage of this study is that I can observe audit hours, realization rates, and the engagement-level results of PCAOB inspections, which are generally unobservable to researchers. However, one potential limitation is that I do not have a complete panel, due to the nature of the data collection process, which raises concern that the sample may not represent the wider population of public companies. Although this constraint is more likely to introduce noise rather than directional bias, I reproduce the descriptive statistics reported in Table 3 using only publicly available data in

Table OA9 of the Online Appendix to mitigate these concerns.³⁴ A comparison of the descriptive statistics suggests that the sample based on proprietary data exhibits similar characteristics to a sample based only on publicly available data.

I also perform several additional untabulated tests to further mitigate concerns about generalizability. First, I re-perform audit quality and audit fee tests on samples using only publicly available data (i.e., without excluding observations that do not appear in PCAOB databases). I find no evidence to suggest that findings from the PCAOB sample do not generalize to the wider population for any of the tests presented in the paper. For restatement tests, I continue to find that *Post In-Market Merger Indicator* is negatively associated with the likelihood of a restatement while the coefficient on *Post Out-of-Market Merger Indicator* is not statistically significant in the sample based on publicly available data. I also find no evidence that either in-market or out-of-market mergers are associated with going concern opinions or discretionary accruals, which is consistent with the results for the sample based on PCAOB data. Lastly, I continue to find that the coefficient on *Post In-Market Merger Indicator* is negatively associated with fees as in Table 8; however, the explanatory power is slightly lower, reflecting the fact that I cannot control for audit hours in models estimated based on publicly available data.

6.7. Endogenous differences between clients of merging and nonmerging audit firms

The positive coefficients on *In-Market Merger Indicator* in Table 4 suggest that clients engaging merging auditors (both before and after the merger) are more complex and therefore demand additional audit hours. To ensure that these results are not driven by endogenous differences between merging and nonmerging firms, I employ a matched sample with a difference-in-differences design following Gong et al. (2016).³⁵ Specifically, I match all clients of merging firms to their nearest neighbor (in terms of assets) within the same industry-year in the first year before the merger. I require all firms to appear in the sample at least once before and after the merger. If the control group provides a reasonable basis for comparison, then I expect an insignificant coefficient on the main effect variable and a negative coefficient on the interaction term for these tests.

I do not tabulate the results of this analysis for brevity; however, I find no evidence to suggest the findings in Table 4 are driven by unobserved differences between clients of merging and nonmerging firms. The coefficient on the interaction term is negative and statistically significant for regressions estimating total audit hours (-0.158 , $t = -2.007$), partner hours (-0.212 , $t = -2.152$), and nonpartner hours (-0.182 , $t = -2.046$), and resemble in magnitude those reported in Table 4. Importantly, the coefficients on the main effects are not statistically significant in any of the specifications, implying no distinguishable differences between the treatment and control groups in the pre-merger period or between the control group in the pre- and post-merger periods. Overall the results of this additional analysis suggest that the main results of the tests of H1 (Table 4) are not likely to be caused by unobserved differences between clients of merging and nonmerging firms.

7. Conclusion

This study investigates the effects of the recent wave of mergers between small and midsize U.S. audit firms on audit efficiency and audit market competition. I find evidence that mergers between firms sharing the same geographic market generate efficiencies that are reflected in a post-merger reduction in audit hours but not quality. Furthermore, an analysis of audit fees suggests that merged firms pass at least a portion of cost savings on to their clients in the form of lower prices. Although I find no evidence of changes in audit hours or fees among out-of-market mergers, I find that both in-market and out-of-market mergers are associated with lower profitability among Big 4 firms operating in the same geographic market. In cross-sectional tests, I find the effects of non-Big 4 mergers are limited to the small client segment of the audit market. Finally, I examine the impact of mergers on auditor switches and find evidence that both in-market and out-of-market mergers allow merged firms to attract larger and more complex clients. Collectively, these findings suggest that both kinds of mergers have increased competition in at least some segment segments of the U.S. audit market dominated by the Big 4.

This study makes several contributions. First, my results illuminate an important trend in the audit market that has received little attention from academics. Despite the increasing volume of merger activity, I am aware of only one study (Christensen et al., 2020) that examines this phenomenon and none that explicitly investigates the effects on competition and market structure. The findings inform regulators and other stakeholders concerned with emerging risks, including a perceived lack of competition in the public company audit market. I show that, despite high levels of concentration, recent mergers between non-Big 4 auditors have likely increased competition in some segments of the market. These findings speak directly to claims that growth may allow some small auditors to better compete with larger rivals (GAO, 2008; European Commission, 2010) and complement the literature by identifying factors contributing to more competitive outcomes in

³⁴ This data constraint is unlikely to produce a directional bias because the PCAOB collects data on audit hours for all SEC-issuer engagements in the year the audit firm is subject to inspection. Thus, my samples should be comparable to those based only on publicly available data, unless there is a systematic bias in observations that are missing data on audit hours and realization rates.

³⁵ These regressions take the following form: $Audit\ Efficiency = \beta_0 + \beta_1 TREATMENT + \beta_2 POST + \beta_3 (TREATMENT * POST) + Controls + \epsilon$. Due to the small sample size for these tests, I define industries according to the Fama-French 12-industry classifications to limit sample attrition.

highly concentrated markets (Bills and Stephens, 2016; Keune et al., 2016). The results contribute to the audit firm M&A literature by showing that recent non-Big 4 mergers have generated efficiencies, and brought new competition to some segments of the U.S public company audit market. Lastly, this study contributes more broadly to the literature on audit market structure by showing that some segments of audit market function as a dominant firm oligopoly with a competitive fringe. The literature has largely ignored the potential impact of the fringe on dominant firms' pricing decisions, instead focusing on competition among the Big 4 (e.g., Doogar and Easley, 1998; Numan and Willekens, 2012; Gerakos and Syverson, 2015). This is a potentially serious omission, given that economic theory predicts that fringe firms can have a significant impact on dominant firms' behavior.

Online Appendix. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jacceco.2023.101618>.

Appendix A. Variable Definitions

Dependent Variables

<i>Ln(Audit Fees)</i>	The natural log of audit fees (<i>audit_fees</i>). Data source: Audit Analytics.
<i>Part I Finding Indicator</i>	An indicator variable equal to one if the inspection resulted in a Part I finding. Data source: PCAOB.
<i>Ln(Total Hours)</i>	The natural log of total audit hours, including both partner and other staff hours. Data source: PCAOB.
<i>Ln(Partner Hours)</i>	The natural log of total partner hours. Data source: PCAOB.
<i>Ln(Nonpartner Hours)</i>	The natural log of nonpartner hours (other professional staff). Data source: PCAOB.
<i>Realization</i>	The engagement's billing realization rate assigned by the audit firm. Realization rates are calculated by dividing audit fees by the "standard fee," where the standard fee is a function of labor hours at each labor level multiplied by the respective billing rates. Realization rates are normalized by audit firm-year to correct for variation in billing rates across firms and over time. Data source: PCAOB.
<i>Restatement</i>	An indicator variable equal to 1 if the client's financial statements were restated and 0 otherwise. I use the following Audit Analytics variables to identify restatements: <i>res_accounting</i> , <i>res_fraud</i> , <i>res_cler_err</i> , <i>res_sec_invest</i> . Data source: Audit Analytics.

Variables of Interest

<i>In-Market Merger Indicator</i>	An indicator variable, defined at the auditor-office level, equal to one for all client-years (both before and after the merger) engaging an auditor that merges with another firm that operates in the same MSA prior to the merger. Data source: auditor office locations obtained from Audit Analytics.
<i>Out-of-Market Merger Indicator</i>	An indicator variable, defined at the auditor-office level, equal to one for all client-years (in the target firm's MSA) engaging an auditor that merges with another firm that <i>does not</i> operate in the same MSA prior to the merger. Data source: auditor office locations obtained from Audit Analytics.
<i>Post In-Market Merger Indicator</i>	An indicator variable equal to one when (1) <i>In-Market Merger Indicator</i> is equal to 1 and (2) the client's fiscal year begins after the merger date. Data source: auditor office locations obtained from Audit Analytics.
<i>Post Out-of-Market Merger Indicator</i>	An indicator variable equal to one when (1) <i>Out-of-Market Merger Indicator</i> is equal to 1 and (2) the client's fiscal year begins after the merger date. Data source: auditor office locations obtained from Audit Analytics.
<i>Ln(Number of In-Market Mergers)</i>	The natural log of one plus the number of in-market mergers that have occurred in a company's MSA from 2004 through fiscal year t-1. Data source: auditor office locations obtained from Audit Analytics.
<i>Ln(Number of Out-of-Market Mergers)</i>	The natural log of one plus the number of out-of-market mergers that have occurred in a company's MSA from 2004 through fiscal year t-1. Data source: auditor office locations obtained from Audit Analytics.

Other Variables

<i>Acquisition Indicator</i>	An indicator variable equal to 1 if the client reports cash outflows due to acquisition of a company (<i>aqc</i>) in the current year and 0 otherwise. Data source: Compustat.
<i>Accelerated Filer Indicator</i>	An indicator variable equal to one if the company is an accelerated filer, determined by whether the auditor provided an attestation of management's assessment of internal control over financial reporting under Section 404(b) (<i>ic_is_effective</i>). Data source: Audit Analytics.
<i>Ln(Assets)</i>	The natural log of total assets (<i>at</i>). Data source: Compustat.
<i>Auditor Size</i>	The natural log of the total number of clients by auditor-year, according to Audit Analytics' opinion file. Data source: Audit Analytics.
<i>Book-to-Market Ratio</i>	Book value of assets divided by market value of assets: (<i>prcc_f * csho</i>)/(<i>at + lt</i>). Data source: Compustat.
<i>Business Segments</i>	The square root of the number of business segments as reported in the Compustat Segment History file. Data source: Compustat.
<i>Busy Season Indicator</i>	An indicator variable equal to 1 if the client's fiscal year (<i>fyr</i>) ends in December and 0 otherwise. Data source: Audit Analytics.
<i>Operating Cash Flows</i>	Operating cash flows (<i>oancf</i>) in year t divided by assets (<i>at</i>) in year t-1. Data source: Compustat.

Δ Cash Sales	Change in the value of <i>Cash Sales</i> from year t-1 to year t. Data source: Compustat.
Δ Employees	Change in employees (<i>emp</i>) from year t-1 to year t. Data source: Compustat.
Δ Inventory	Change in inventory (<i>invnt</i>) from year t-1 to year t, scaled by assets (<i>at</i>) in year t. Data source: Compustat.
Δ Leverage	Change in leverage (<i>lt</i>) from year t-1 to year t, scaled by assets (<i>at</i>) in year t. Data source: Compustat.
Δ Receivables	Change in receivables (<i>rect</i>) from year t-1 to year t, scaled by assets (<i>at</i>) in year t. Data source: Compustat.
Δ Return on Assets	Change in <i>Return on Assets</i> from year t-1 to year t. Data source: Compustat.
Cash Sales	Sales (<i>sale</i>) in year t minus change in receivables (<i>rect</i>) from year t-1 to year t, divided by assets (<i>at</i>) in year t. Data source: Compustat.
$\ln(\text{Firm Age})$	The natural log of the number of years since the company first appears in Compustat. Data source: Compustat.
Foreign Income Indicator	An indicator variable equal to 1 if the client has foreign exchange income or loss (<i>pifo</i>) and 0 otherwise. Data source: Compustat.
Going Concern Indicator	An indicator variable equal to 1 if the client received a going concern opinion (<i>going_concern</i>) in the current year and 0 otherwise. Data source: Audit Analytics.
Prior Year Going Concern Indicator	An indicator variable equal to 1 if the client received a going concern opinion (<i>going_concern</i>) in the prior year and 0 otherwise. Data source: Audit Analytics.
Geographic Segments	The square root of the number of geographic segments as reported in the Compustat Segment History file. Data source: Compustat.
Concentration	The Herfindahl index, calculated as the sum of squared market share for all auditors operating in an MSA. Higher values representing higher concentration, calculated annually using audit fees (<i>audit_fees</i>). For tests of H1 (H2), I calculate market shares based on all engagements involving non-Big 4 (Big 4) auditors in a given MSA-year. Data source: Audit Analytics.
Intangible Assets Indicator	An indicator variable equal to one if the company reports research and development expense (<i>xrd</i>) or advertising expense (<i>xad</i>). Data source: Compustat.
Inventory & Accounts Receivable	Inventory (<i>invnt</i>) plus receivables (<i>rect</i>) in year t, scaled by assets (<i>at</i>) in year t. Data source: Compustat.
Net Issue Indicator	An indicator variable if either <i>Net Debt Issue Indicator</i> or <i>Net Equity Issue Indicator</i> equals one and 0 otherwise. Data source: Compustat.
Net Debt Issue Indicator	An indicator variable equal to one if net debt issuance is greater than 1 percent: $(dltt + dlc - dltt_{t-1} - dlc_{t-1})/at_{t-1} > 0.01$. Data source: Compustat.
Net Equity Issue Indicator	An indicator variable equal to one if net equity issuance is greater than 1%: $(sstk - prstk)/at_{t-1} > 0.01$. Data source: Compustat.
Non-Big 4 Market Leader	An indicator variable equal to one for the highest ranked non-Big 4 auditor in terms of market share. Calculated annually by MSA. Data source: Audit Analytics.
Lease Indicator	An indicator variable equal to one if the company reports a lease obligation (<i>mrct</i> > 0). Data source: Compustat.
Leverage	Total liabilities (<i>ib</i>), divided by total assets (<i>at</i>) in year t. Data source: Compustat.
Liquidity	Current assets (<i>act</i>), divided by current liabilities (<i>lct</i>) in year t. Data source: Compustat.
Loss Indicator	An indicator variable equal to 1 if net income (<i>ni</i>) is negative and 0 otherwise. Data source: Compustat.
Market Share	The auditor's market share of total audit fees (<i>audit_fees</i>). Calculated annually by MSA. For tests of H1 (H2), I calculate market shares based on all engagements involving non-Big 4 (Big 4) auditors in a given MSA-year. Data source: Audit Analytics.
$\ln(\text{Nonaudit Fees})$	The natural log of 1 plus the total amount of nonaudit fees (<i>non_audit_fees</i>) paid to the auditor. Data source: Audit Analytics.
$\ln(\text{Report Lag})$	The natural log of 1 plus the number of days between the client's fiscal year end and the auditor's signature date (<i>sig_date_of_op_s</i>). Data source: Audit Analytics.
Second Tier	An indicator variable equal to one for engagements audited by RSM McGladrey and Crowe and 0 otherwise. Data source: Audit Analytics.
Market Share	The auditor's market share of total audit fees (<i>audit_fees</i>). Calculated annually by MSA. Data source: Audit Analytics.
Market Value of Equity	Market value of equity (<i>prcc_f * csho</i>). Data source: Compustat.
Property Plant & Equipment	Property, plant, and equipment (<i>ppent</i>) in year t, divided by assets (<i>at</i>) in year t-1. Data source: Compustat.
Nonaudit Fee Indicator	An indicator variable equal to 1 if the company purchases nonaudit fees and zero otherwise (<i>non_audit_fees</i>). Data source: Audit Analytics.
Return on Assets	Earnings before extraordinary items (<i>ib</i>) in year t, divided by assets (<i>at</i>) in year t-1. Data source: Compustat.
Sales Growth	Change in sales (<i>sale</i>) from year t-1 to year t, divided by sales in year t-1. Data source: Compustat.
Soft Assets	Total assets (<i>at</i>) minus property, plant, and equipment (<i>ppent</i>) and cash (<i>che</i>), divided by total assets (<i>at</i>). Data source: Compustat.
Office Size	The auditor's average audit fees (<i>audit_fees</i>) within an MSA. Data source: Audit Analytics.

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