

Proprietary Information Spillovers and Auditor Choice

Daniel Aobdia

daniel.aobdia.2013@anderson.ucla.edu

UCLA Anderson School of Management

Los Angeles, CA, 90095

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Abstract

Using exogenous shocks to the auditing industry, including large auditor mergers and the collapse of Arthur Andersen, I document a reluctance of rivals to engage the same auditor due to information spillover concerns. This reluctance is more evident in concentrated industries where barriers to mobility, proxied by differentiation and capital expenditure levels, are low. More secretive manufacturing firms are also more reluctant to share their auditor with a rival. I also find weak evidence that the concern for information spillovers is lessened when rivals are dissimilar in terms of sales or when they are headquartered in the same state, where other conduits for information spillover, including employee turnover, are present. Last, I find some evidence that auditors extract rents from clients concerned about information spillovers.

1. Introduction

A firm with a supplier who also services rival firms runs the risk of information spillovers. Providing suppliers with access to proprietary information is often necessary for suppliers to fulfill their role. Either by design or inadvertently the supplier may become a conduit through which a rival sharing the same supplier may obtain that information. Concerns about the safety of proprietary information could be sufficient to affect supplier choice decisions. A well-known case was the reluctance of Bell Operating Companies to continue with AT&T as an equipment supplier once deregulation allowed AT&T to become a direct competitor (Hughes and Kao 2001). Semiconductor materials and equipment manufacturers were reputed to be reluctant to share information with members of the Semiconductor Manufacturing Technology Consortium (SEMATECH) fearing revelation of proprietary information to competitors (Grindley et al. 1994). The merger of Ernst & Whinney, Coca-Cola's auditor, with Arthur Young, PepsiCo's auditor, led the combined Ernst & Young to resign from the PepsiCo's account (WSJ, February 26 1990). In anticipation of another merger of auditors, Frederick Zuckerman, Chrysler's treasurer, remarked: *"It'd be very awkward to have the same auditor for two large firms [...] Clients may feel uncomfortable knowing that their corporate secrets are lying just a few files away from papers of their arch rivals"* (Reuters, July 10 1989). However, formal empirical research on the reluctance of rival firms to share suppliers due to concerns about information spillovers beyond such anecdotes has been slow to emerge, possibly because information spillovers usually do not leave any paper trails (Krugman 1991b).

In this study, I examine the reluctance of same-industry rival firms to share auditors. The audit setting is particularly suitable to my study given that all publicly traded firms are required to be audited. Auditors have access to a wide range of proprietary information to assess the

accuracy of their clients' financial reports. In addition, the number of auditors able to service major industry competitors is very limited, making it likely that concerns for spillovers would be considered when making auditor choice decisions. The recent historical evolution of the auditing industry also provides natural experiments that allow me to infer causality. Specifically, I exploit the collapse of Arthur Andersen, at the time one of the Big Five public accounting firms, and the auditing industry consolidation trend over the past 25 years with three large audit firm mergers to infer causality should these events prompt auditor switching decisions consistent with an objective of avoiding information spillovers.

Contributing to a tension in auditor choice decisions is the prospect that economies of industry specialization by auditors, as documented in previous studies, may outweigh concerns of such spillovers. I use this tension to advantage in cross-sectional analyses. In particular, other features of my study include consideration of other conduits for information spillovers such as employee turnover, cross-sectional variation in predisposition of manufacturing clients toward secrecy, potential barriers to imitation within the industry¹ and rent extraction by auditors from clients concerned about spillovers in reaction to a forced change of auditors. A novelty unique to mandated audits is the ease of forming baseline likelihoods of major rivals randomly choosing an auditor from the distribution of audit firms across other less similar members of the same industry classification.

Theoretical studies of negative externalities in the form of information spillovers from sharing a common supplier include Demski, Lewis, Yao, and Yildirim (1999), Hughes and Kao (2001), Baccara (2007), and Bönnte and Wiethaus (2008). Demski, et al. consider client

¹ Barriers to imitation are also widely called mobility barriers within the Industrial Organization literature. They correspond to the ease or difficulty of changing positions from one strategic group to another within the same industry

information leakage across divisions of a professional firm and incentive mechanisms for efficiently dealing with such spillovers. Hughes and Kao consider the alternative of a vertically integrated firm, facing downstream competition, to spin off an upstream supplier in order to preclude transmission of rival's proprietary information and preserve upstream sales to those rivals. In Baccara's model, a firm chooses between outsourcing production, thereby exposing it to leakage to competitors, and in-house production at the loss of some efficiency. Bönte and Wiethaus consider a choice between increasing the efficiency of a supplier by providing technical knowledge and risking transmission of that knowledge to competitors serviced by the same supplier. The ubiquitous aspect in each case is a tension between information spillovers from sharing a common supplier with rival firms and experiencing some form of inefficiency. Such a tension is clearly present in an auditing setting where the loss of gains to industry specialization constitutes the potential source of inefficiency.

Indeed, a large portion of the theoretical and empirical auditing literature confirms the prospect that gains to industry specialization by auditors is a significant factor in auditor choice decisions. Signaling models by Titman and Trueman (1986) and Datar, Feltham and Hughes (1991) depict the relevance of audit quality to value in initial public offerings; predictions tested empirically by Balvers, McDonald and Miller (1988), Beatty (1989), and Feltham, Hughes and Simunic (1991). Other studies including Lim and Tan (2007) and Krishnan (2003) find that the use of industry specialists is associated with higher audit quality. Relevant to the leverage that industry specialization might have on audit fees, Craswell, Francis, and Taylor (1995) document that industry specialist auditors charge significant premiums in the Australian market.

Additional considerations that could influence this tension within the cross-section of industries include differences in the intensity of product market competition and in the nature of

the knowledge transmitted. Caves and Porter (1977) and Porter (1979) introduce the concept of strategic groups within given industries and the concept of barriers to mobility for firms to compete from one strategic group to another. Peteraf (1993) empirically confirms for the airline industry that rivalry is greater across strategic groups than within groups. These papers indicate that the costs of sharing the same auditor can be reduced when barriers to mobility are high. Notwithstanding product market competition considerations, the tension also depends on the appropriability of the knowledge potentially transmitted. In particular, innovative knowledge often cannot be protected only with property rights (Rajan and Zingales 2001). Levin, Klevorick, Nelson and Winter (1987), Cohen, Nelson and Walsh (2000) and Cohen (2010) explore different appropriation mechanisms besides patent protection in the context of product and process innovations and document that secrecy matters for many manufacturing firms, with large inter-industry variations.

My results provide consistent evidence that in general the top three rivals by sales in each industry are reluctant to share the same auditor. The reluctance is enhanced by the absence of barriers to mobility, the absence of other conduits for information spillovers, and greater concern for secrecy by manufacturing firms. Regarding the collapse of Arthur Andersen, the evidence indicates that when forced to choose a new auditor, the top three rivals were less than half as likely to do so relative to other firms in the same industry. Similarly, my results in the other experiment involving mergers indicate that top rivals switched auditors following mergers placing them with the same auditor almost twice as frequently as a control group where no top rival was brought in by the merger. I also find evidence that auditors were able to charge higher

fees after the collapse of Arthur Andersen in industries where the supply of larger audit firms was tight beforehand².

Several policy implications follow from these results. The ability of audit firms to extract greater rents following Arthur Andersen's collapse suggests that the short supply of major audit firms provides those firms with hold-up power that might influence whether regulators would allow them to fail should further scandals arise. In turn, this influence, combined with a potentially captive client base, might lead to a moral hazard that lowers audit quality. The present limited supply of major audit firms also tends to undermine the recent intent of the Public Company Oversight Board in exploring mandatory rotation (see PCAOB release 2011-006 in August 2011) since this may induce greater exposure of firms to information spillovers that would otherwise occur with less frequency. Such a change in the tension between information spillovers and industry specialization could result in rivals sharing the same audit firm seeking to restrict auditor access to proprietary information, thereby resulting in lower audit quality in servicing the public interest. It also would strengthen the bargaining power of audit firms, again, contributing to audit firms' hold-up power.

My results complement Asker and Ljungqvist (2010), who provide empirical evidence that rival firms display reluctance to share the same underwriter. Similar to the roles of Arthur Andersen's collapse and major firm mergers in my research design, Asker and Ljungqvist rely on reactions to exogenous shocks to the securities underwriting industry to infer causality in documenting the reluctance of rivals to share underwriters. The underwriting industry is similar to the auditing industry in the nature of the due diligence that they each perform. They differ in

² I cannot use auditor mergers in the fee analysis because all auditor mergers took place before 1999 whereas companies began reporting the amount of auditing fees paid only after 2000.

the one-shot nature of underwriting compared to the repeated nature of audits and auditor relations, and in a broader access to proprietary information by the auditor. Consequently the auditing relationship arguably makes for a greater sensitivity to information spillovers³.

Closer to the context of my study, Kwon (1996) finds a negative association between the level of client industry concentration and a measure of the level of auditor dominance within an industry, consistent with firms in concentrated industries being reluctant to share the same auditor⁴. Distinctive features of my study include the use of the natural experiments related to Arthur Andersen's collapse and mergers among large firms to infer causality, indicants of barriers to mobility that might lessen information spillover concerns, and a survey of firms relying on secrecy as a measure of sensitivity to competitors gaining access to proprietary information on innovations, which allows me to directly tie rivals' reluctance to share the same auditor to information spillover concerns.

The remainder of this paper is structured as follows. Section 2 introduces the main motivation and hypothesis development. Section 3 develops the data and proxy variables construction. Main empirical results are presented in Section 4. I also present an analysis of audit pricing in Section 5. Section 6 concludes.

³ Additional distinctive features of my study compared to Asker and Ljungqvist include an assessment in auditor choice of the role of product market competition and of the appropriability of the knowledge transferred. In particular, I directly tie concerns for information spillovers with auditor choice by finding that manufacturing firms in more secretive industries are more reluctant to share the same auditor

⁴ Kwon's results are subject to two important caveats. First, the number of firms within each industry could be an omitted variable as it is related to both industry concentration ratio and the assumed proxies for auditor dominance. Second, as indicated in section 3, it might be harder to detect true direct rivals within industries with more companies, usually less concentrated, than within industries with fewer companies, usually more concentrated, when looking at the entire industry distribution. I abstract from these concerns by looking at the top three competitors within each industry.

2. Motivation and hypothesis development

Auditors have access to a wide range of proprietary financial information from their clients, implying that firms should be concerned about their auditors' other clientele. In a salient example, Andersen Consulting, the consulting arm of Arthur Andersen at the time, was suspected of transferring proprietary information from Yamaha to Harley Davidson (O'Shea and Madigan 1998). However, prior auditing literature has also documented the benefits of industry specialization in terms of audit quality with industry specialist auditors being able to charge significant premiums⁵. In addition, given the repeated game nature of the auditing client relationship, evidenced by low auditor switching rates, it is possible that auditors have taken appropriate action in order to limit the risks of information spillovers, at least for their clients who are concerned about them. Last, some industries might include firms interested in sharing the same auditor as their rivals in order to benefit from information spillovers.

Therefore, it remains an empirical question to detect companies' reluctance to share their auditor with competitors due to information spillovers reasons. I state my first hypothesis as follows:

H1: Same industry rivals are more likely to choose different auditors

During the course of a typical audit engagement, auditors have access to detailed company financial information. This information can include terms of trade to main customers in

⁵ Note that a higher aggregate fee premium is also consistent with a spillover related explanation where auditors price their spillover capabilities. For example, Francis et al. (2005) document that audit fees are higher for nationally top ranked auditors only when they are also the city-leader. Their result is consistent with auditors pricing their office-level spillover capabilities, consistent with the theoretical predictions of Baccara (2007). Overall, it is unclear, notwithstanding the pricing of information spillovers, whether aggregate audit fees should be higher for expert auditors compared to non-expert auditors given that expertise can translate into a higher hourly billing rate, but overall into a decreased number of hours for the auditor to complete the audit.

order to verify accounts receivables, suppliers' terms in order to verify accounts payable, product or product line profit and loss information, country-level profit and loss information and plant level cost information. Auditors also conduct plant visits, for example to verify inventory levels, and can have access to plant specific information. In particular, auditing of raw materials and work-in-process inventories, usually located at the heart of the plant, might put auditors in contact with potentially sensitive factory process information. During the course of their conversations with company management, auditors might come in contact with additional information related to company strategy, including merger and acquisition plans, product development or marketing plans. Overall, the information acquired is much more detailed than publicly disclosed company financial statements and could be used by a rival to advantage in product market competition. Accordingly, the rivals most able to make good use of this information should be relatively similar to the company. In the empirical tests I define similarity using industry concentration and comparability of rivals' sales. Consequently, I state the first part of the second hypothesis as follows:

H2a: More similar rivals are more likely to choose different auditors

In addition, the information should be less valuable when the rival cannot quickly imitate the product or customer strategy of the company. In particular, barriers to mobility can influence auditor choice, as they may prevent the information transferred by the auditor from one rival in one strategic group to be used by another rival in another strategic group. This indicates that rivals may be less reluctant to share the same auditor when barriers to mobility are high. Barriers to mobility include industry differentiation and capital expenditures (Saloner et al. 2001, Gilbert 1989, Caves and Porter 1977, Sutton 1991). Capital expenditures can act as a barrier to mobility

because large capital expenditures need to be planned in advance and take time and effort to replicate. Consequently, I state the second part of the hypothesis as follows:

H2b: Same industry rivals are more likely to choose different auditors when industry differentiation is low or capital expenditure requirements are low

Next, given the extent of auditors access to their clients' proprietary information, companies that use secrecy as a mechanism to appropriate the profit from their product and process innovations should be more concerned about sharing their auditor with their rivals. In particular, Cohen et al. (2000) and Cohen (2010) outline the importance of secrecy for manufacturing firms to protect the profit from their own product or process innovations and document large inter-industry variations in the degree of protections afforded by patents and secrecy. I state the third part of the second hypothesis as follows:

H2c: Same industry rivals are more likely to choose different auditors when secrecy as a means to appropriate the profits from product and process innovations is important within the industry

There are other conduits for information spillovers besides a shared auditor. Examples of information spillovers in general include Mattel's litigation with MGA regarding ownership of the Bratz dolls (WSJ, Jan 12 2011); the inventor of the dolls developed the concept while working at Mattel before moving to MGA. Rajan and Zingales (2001) mention that Fairchild semiconductor management left the firm with proprietary information about the microprocessor in order to found Intel corp. Renault recently wrongfully laid off three key employees because

the company believed that they had sold economic information about its electric car program⁶ (WSJ, March 19 2011). These examples illustrate that firm employees in contact with firm's proprietary information can act as a conduit for information spillovers. In both cases of Mattel with MGA and Fairchild with Intel, the companies were headquartered in the same area. In particular, two companies sharing the same geographic location have access to the same labor pool and to the same intermediate goods suppliers (Jaffe et al. 1993). This leads to increased probability of information spillovers compared to two companies not sharing the same geographic location. Alcacer and Chung (2007) provide evidence that firms seeking information spillovers locate in the same areas as their rivals, while firms avoiding information spillovers locate in different areas. Consequently, two firms sharing the same geographic location should be less concerned about information spillovers coming from a shared auditor as many alternative information spillover conduits are available⁷. I state my third hypothesis as follows:

H3: Rivals headquartered in the same location are more likely to have a shared auditor than rivals headquartered in different locations

Last, auditors should be able to extract rents in industries where rivals are reluctant to share the same auditor due to information spillover concerns. The situation should be noticeable in periods of tightening auditing supply, including at the time of the collapse of Arthur Andersen. In particular, rivals in industries avoiding sharing the same auditor where supply was already tight prior to the Arthur Andersen collapse should have experienced a higher increase in fees

⁶ The managers turned out not to have sold any information. However, this incident documents that companies are concerned about the potential spillover of information to competitors, including information of a pure financial nature

⁷ Note that a mitigating factor to this hypothesis is that the probability of information spillovers could be increased when two firms are covered by the same auditor office in comparison to two firms being covered by two different offices of the same auditor. Consequently two firms that are located in the same area due to historical reasons but that are still concerned about information spillovers would tend to choose a different auditor more often than two firms located in different areas. This mitigating factor could explain the relatively weak results I find regarding shared states and probability of rivals sharing the same auditor

after the collapse than rivals in industries where there was slack in auditing supply or in industries with lowered concerns for information spillover. I state my fourth hypothesis as follows:

H4: Audit fees increased more after the collapse of Arthur Andersen in industries where the concern for information spillover was higher and auditing supply was scarcer

3. Data Construction

3.1 Defining Rivals

I obtain auditor and industry information from Compustat, having eliminated firms listed on Canadian exchanges (I keep firms where Compustat currency code is in USD), ADRs (adr ratio empty in Compustat), subsidiaries (stko variable equal to 1 or 2 in Compustat) and companies headquartered outside of the United States (using the loc variable in Compustat)⁸. The aim is to identify companies that have the highest probability of being true product market rivals, where information spillovers through a shared auditor are possible, and where auditor choices are independent. For example, a parent is not a competitor to its subsidiary operating in the same industry. The parent-subsidiary choice of auditor is also unlikely to be independent. The Compustat data spans the period from 1985, first year where the NAICS codes become widely available in the database, to 2009.

⁸ I kept companies headquartered in jurisdictions listed as tax havens as per the OECD definition (GAO report December 2008). In any case the results are not sensitive to inclusion of firms headquartered in foreign countries in the sample.

Rivals are then defined as the three firms with highest total revenues within a given NAICS six digit code, as specified by the Compustat primary code. The choice of NAICS codes over several alternatives, including SIC codes is driven by several considerations. First, SIC codes have been replaced with NAICS codes starting from 1987. This means that more recent industries are poorly depicted by SIC codes. Also, Krishnan and Press (2003) document that NAICS codes lead to more cohesive industries than SIC codes. Last, historical SIC codes are not widely available in the Compustat database prior to 1987. The use of GIC codes, despite its potential superiority (Bhojraj et al. 2003) is problematic for this study as GIC data is not available prior to 1994 in Compustat. However, two of the three large audit mergers occurred prior to 1990 (both mergers of Ernst and Young and of Deloitte and Touche took place in 1989). The main advantage of using the most granular level of NAICS codes as compared to SIC codes or less granular levels of NAICS codes is that the probability of identifying true product market competitors is increased. For example, the code 311930 only includes Coke and Pepsi as primary competitors. The drawback of using higher levels of granularity is the exclusion of several industries in some of the tests where the number of competitors is limited and where a control group within the same industry code is required⁹.

I focus on the top players, defined by their sales level¹⁰, within each industry code in order to maximize the power of my tests. This focus is comparable to the one in Asker and Ljunqvist (2010) and is due to several reasons. First, due to their larger sizes, top industry players are more likely to have overlapping business lines, customers and geographies, making

⁹ Results are robust to using top two competitors instead of top three competitors and to the use of different industry classifications, including NAICS at the four digit code level and SIC at the four digit code level, when enough cross-sectional variation is available for the tests

¹⁰ I deem sales level to be more appropriate than other measures of size, including assets and market size, as I want to focus on current size and do not want to introduce in the proxy other confounding considerations such as the level of supply chain integration or future market opportunities.

them true product market rivals. For example, the top three competitors in the NAICS code 721120 (gaming) for 2009 include Las Vegas Sands, MGM Resorts and Caesar Entertainment. A quick analysis of these companies' 10-Ks shows that they operate in the same cities with competing casinos in their main markets of Las Vegas, Atlantic City and Macau, and target the same customer base. On the other hand, non-top three competitors include Trump Entertainment, a company only with properties in Atlantic City, NJ, and Monarch, a casino located in Reno, NV. These two casinos cannot be considered direct product market rivals.

Second, top industry players are also more likely to be concerned about sharing financial proprietary information with competitors given that they are likely to be more complex than smaller competitors, with presence in different markets, geographies and customer types, and might have more information to hide as a result¹¹. Last, only large firms, given the amount of auditing fees involved, can put some pressure on their auditor so that the auditor does not get hired by a rival¹².

3.2 Empirical proxies

Several empirical proxies are used in order to test the above hypotheses. Proxies for rivals' similarity (H2a) include:

Herfindahl, the industry Herfindahl index, calculated at the NAICS six digit code. I posit that more concentrated industries are more likely to have better defined rivals.

¹¹ Given the wide flexibility granted to firms in terms of segment reporting and the possibility to alter segment reporting to the firm's benefit (Fields et al. 2001), more complex firms have increased opportunities to conceal their profits areas when reporting their financial statements compared to simpler firms.

¹² It is interesting to note that some firms may actually have an interest in sharing the same auditor with their rivals in order to benefit from information spillovers, indicating a potential asymmetry of interests across rivals. Focusing on the top 3 players removes this constraint as larger firms are more likely to be leaders in their industry who can put sufficient pressure on their auditors so that the auditors do not get hired by a rival.

CCR3, the top three firms concentration ratio, defined as the combined sales of the top three players divided by the total sales within the industry. I use *CCR3* as an alternative to *Herfindahl* for the industry concentration ratio, as the Herfindahl index tends to be highly correlated with other explanatory variables. Finding consistent results using *CCR3* as an alternative variable would decrease concerns about multicollinearity.

Deltasale, which measures whether the top three competitors within a given industry are similar in sales or not. I calculate *Deltasale* as the standard deviation of sales among the top three players within an industry, normalized by the average sales of these three companies. A lower value of *Deltasale* indicates more similarity of the top three players sizes while a higher value indicates more heterogeneity in the top three players sizes.

Proxies for industry differentiation and capital expenditures (H2b) include:

Logindcapex, defined as the log of the weighted average of capital expenditures in an industry, weighted by each company market share defined by sales, as in Li (2010). I take the log to reduce the skew in the variable. The variable measures typical capital expenditures needed in the industry and proxies for the ease of imitation within the industry.

Indpricecostmargin, defined as in Karuna (2007) and Li (2010). The variable is equal to industry aggregate sales divided by industry aggregate operating costs and is a measure of industry differentiation, with higher values indicating higher industry differentiation and lower values indicating higher substitutability.

The major proxy for the importance placed on secrecy (H2c) is *Secrecy Mfg*. The variable is equal to the average of the secrecy variables for product innovations and for process innovations taken from the Carnegie Mellon survey results as reported by Cohen et al. (2000) in

Table 1 and Table 2. Cohen et al. surveyed in 1994¹³ 1,478 manufacturing firms conducting research and development and reported results for 34 sub-industry groups within the manufacturing group. I match these sub-industry groups with the NAICS codes and attribute the results of the survey at the sub-industry group level to each matched NAICS code. *Secrecy Mfg* measures the mean percentage of product and process innovations for which secrecy is considered effective by the companies within the sub-industry group that replied to the survey. *Secrecy Mfg* is set to zero for non-manufacturing firms given that no data is available. In order to control for the absence of results for non-manufacturing firms, I also introduce the dummy variable *Dummy Mfg* that takes the value one for manufacturing firms and zero otherwise.

The major proxy for rivals in the same location (H3) is *Shared State*, an indicator variable that takes the value one when at least two of the three top competitors have their headquarters in the same state. Company state headquarters information is from Compustat.

I also use *Meanindage* as a control, with the variable calculated as the average age of firms within a given industry, with the age being calculated from the first day the company becomes available in Compustat. *Meanindage* is a proxy for industry maturity. The direction of *Meanindage* is unclear as more mature industries have better defined competitors but younger industries might have stronger information spillover concerns.

¹³ There might be a potential concern that a single data point in 1994 is not representative enough for the overall sample which spans over 25 years. However, secrecy is likely to be relatively sticky over time. In addition, there is no reason to believe that there would be any bias caused by the use of this variable. At worst there could be too much noise in the estimation of the variable, in which case results would become statistically insignificant. Overall, results are unchanged when excluding this variable from the empirical specifications, as evidenced by columns two and three of Table 3. In addition, the Arthur Andersen collapse test in Table 5 provides direction for causality for this variable.

4. Empirical Results

4.1 Association based results

Sample construction

The analysis focuses on the actual probability that the three top competitors share the same auditor. I compare this probability to the probability that three firms chosen at random within the industry share the same auditor. In particular, I calculate the benchmark probability distribution by excluding the top three firms in the industry. In order to have meaningful comparisons, I focus on industries with at least six companies, with three companies being the top three players and where at least three other companies are available in order to calculate the benchmark probabilities. I also focus on industries where the proxies defined in section 3.2 are properly defined. Last, I focus on firms where the top three competitors are being covered by top tier auditors, as most large firms use the services of top tier auditors. Top tier auditors include the Big 8 auditors, which ultimately became the Big 4. This leaves a sample of 4,278 industry years.

I use the distribution of the non-top three firms in order to calculate the benchmark probabilities. More details are given in Appendix A with a specific example provided. First, for each auditor i , I calculate its market share p_i as the number of firms covered by auditor i divided by the total number of firms within the given industry, excluding the top three players in the calculation. $p_i, i=1, n$ denotes the assumed true distribution from which firms are sampled from. Second, assuming further that three firms are drawn from this distribution, with replacement, I then assess the benchmark distribution using the multinomial distribution. The purpose of the benchmark distribution is to compute the benchmark probabilities that none of the three sampled firms, two out of three or three out of three sampled firms share the same auditor. The

benchmark distribution is given as follows. The probability that all three randomly chosen firms share the same auditor is given by $\sum_{i=1}^n p_i^3$. The probability that exactly two out of three randomly chosen firms share the same auditor is given by $3\sum_{i=1}^n p_i^2 - 3\sum_{i=1}^n p_i^3$. The probability that none of the firms share the same auditor is equal to one less the sum of the probabilities defined above.

Third, I also define the probability that at least two out of three chosen firms (i.e.

$3\sum_{i=1}^n p_i^2 - 2\sum_{i=1}^n p_i^3$) share the same auditor, as the benchmark probability. The variable

Benchmarkprobability is then used in a fourth step to calculate *Diff*, which measures the deviation from the benchmark probability of the actual outcome that at least two out of the top three firms in an industry share the same auditor. In other words, *Diff* is equal to an indicator variable that takes the value one when at least two out of the top three firms in an industry share the same auditor, less *Benchmarkprobability*. The purpose of *Diff* is to measure the deviation from the benchmark of the actual probability of two firms or more sharing the same auditor within the same industry. I regress *Diff* over the variables identified in section 3 in order to test for the hypotheses elaborated in section 2¹⁴.

Table 1 Panel A presents summary statistics for the variables defined above¹⁵. Note that *Diff* has a negative mean of (0.123), consistent with the top three players sharing their auditor less than the benchmark probability. Table 1 Panel B presents correlations among the variables,

¹⁴ Note that another potential research design could be to regress over several control variables an indicator variable taking the value one when two or more firms within an industry share the same auditor, and add *Benchmarkprobability* as an additional control on the right hand side of the regression. However, besides the fact that I am interested here in explaining the difference between the actual and benchmark probabilities, another issue is that *Benchmarkprobability* is measured with noise. The OLS coefficients would therefore be biased due to the downward bias of the *Benchmarkprobability* OLS coefficient. On the other hand, adding noise in the dependent variable does not bias the results of the regression.

¹⁵ Given that the *Secrecy Mfg* variable is set to zero to more than half of the sample, I also include summary statistics for the secrecy variable restricted to the manufacturing sample of 1,797 firms

with numbers in bold for correlations significant at the 5% level or better. *Herfindahl* is highly correlated with *Deltasale* whereas *CCR3* is less correlated with *Deltasale* than *Herfindahl*.

Results

In order to test H1, I employ a chi-square test in comparing the benchmark distribution to the actual distribution of industries where none of the three firms share the same auditor, two out of three firms share the same auditor and three out of three firms share the same auditor. Results are presented in Table 2. I conduct this test every year because the stability of the client-auditor relationship makes the results sticky over time. The distribution of actual probabilities is skewed towards firms sharing their auditors less often than for the distribution of benchmark probabilities. The chi-square statistics are significant at the 5% level and better in all years and the differences are sizeable. For example, the actual probability for the top three competitors to all share the same auditor is of 6.2% when averaging the results across all the sample years, compared to a benchmark probability of 13.9%. The benchmark distribution as presented in Table 2 dominates the actual distribution in the sense of the monotone likelihood ratio property (MLRP) for every year in the sample, indicating strong dominance results consistently across the sample.

I test H2 and H3 by regressing *Diff* over the empirical proxies defined in section 3.2. Univariate results can already be found in Table 1 panel B in the correlations table. *Diff* is negatively correlated with *Herfindahl* and *CCR3*, indicating that companies are more reluctant to share the same auditor in concentrated industries. These results are consistent with Kwon (1996). *Diff* is also positively correlated with the capital expenditures variable (*Logindcapex*) and with the shared state variable (*Shared State*), consistent with both H2b and H3. I also find that *Diff* is

negatively correlated with *Secrecy Mfg*, consistent with H2c. However, *Diff* is negatively correlated to *Deltasale*, perhaps because of the high correlation between *Deltasale* and *Herfindahl*.

I present multivariate results of the tests of H2 and H3 in Table 3 using OLS. Given that the panel data covers 25 years and given the relative stability over time of auditor client relationships and industry characteristics, I cluster standard errors at the industry level to alleviate any concern of overstated t-statistics. I begin with a regression of *Diff* without any control, to confirm the results of Table 2. In this regression, the constant is equal to the average of the *Diff* variable. The constant is significantly negative, indicating that top three players are sharing their auditor less often than the benchmark probability¹⁶. The next two columns introduce additional control variables. Overall, the results are consistent with H2a. As expected, the coefficients on *Herfindahl* or *CCR3* are significantly negative. The coefficient on *Deltasale* loads significantly in the regression with *Herfindahl* as a control, but not in the regression including *CCR3* as a control, providing weak evidence that companies share their auditor more when they are more different in terms of size. The results on H2b are stronger and consistent with the hypothesis. The coefficient on *Logindcapex* is significantly positive, indicating that firms in industries with large capital investments are less reluctant to share the same auditor. The coefficient for *Indpricecostmargin* is also significantly positive, indicating that industry differentiation plays some role in auditor choice. These results are consistent with less reluctance to share the same auditor when intra-industry barriers to mobility are high due to high capital expenditure requirements or to increased industry differentiation. The results are valid regardless of whether *Herfindahl* or *CCR3* were used as the industry concentration variable. The results are

¹⁶ Note that the constant loses its initial meaning in the following regressions including controls, given that the mean of most independent variables is not equal to zero

also consistent with H3. The *Shared State* variable loads positively, significant at 1%. I then introduce *Secrecy Mfg* in the third and fourth columns in order to test H2c. The variable is negative but loads insignificantly, with a p-value of 10.8%. Other variables signs and statistical significances remain unchanged.

Next, I partition the sample between manufacturing firms and non-manufacturing firms. The results are broadly unchanged for the non-manufacturing sample. For the manufacturing sample, I find that the *Secrecy mfg* variable loads negatively, significant at 5% or better, providing evidence that rivals in more secretive industries are less likely to share their auditors. I also find that the coefficient on *Indpricemargin* and *Shared State* are insignificant. In untabulated tests, I find that the coefficient for *Indpricemargin* is not significantly different between the manufacturing and non-manufacturing samples, indicating that my tests may be suffering from a power issue in the analyses when partitioning the original sample. On the other hand, the coefficient on *Shared State* in the manufacturing sample is significantly smaller from the non-manufacturing sample (difference significant at 1%), indicating that manufacturing firms are still reluctant to share their auditors with their rivals even when their headquarters are located within the same state. One interpretation could be that the location of the plants, not captured by the *Shared State* variable, matters more for those firms than the location of the headquarters.

I assess the economic significance of the results on H2 and H3 from the second OLS regression, except for the *Secrecy Mfg* variable, assessed from the eighth specification (manufacturing sample) due to lack of significance in the second regression. The results are economically significant. For example, an increase of one standard deviation for *Herfindahl* (see Table 1 for standard deviations) reduces the propensity of firms to share the same auditor by 13.9%. An increase of one standard deviation of *Logindcapex* and *Indpricemargin* increases

the propensity of firms to share the same auditor by 5.8% and 2.8%, respectively. Sharing the same state increases the propensity of firms to share the same auditor by 8.9%. An increase of one standard deviation of *Secrecy Mfg* decreases the propensity of manufacturing firms to share the same auditor by 4.7%.

4.2 Auditor switches sample

Description of the analysis

I conduct similar analyses focusing only on the subsample of firms that switch auditors. In normal situations, a sample of firms switching auditors might suffer from a selection bias, as the switching decision is endogenous. However, it is still worthwhile to test H1 as firms still have to make a decision regarding their future auditor conditional on a switch occurring. The collapse of Arthur Andersen in 2002 also provides an exogenous shock to the industry. Arthur Andersen's former clients had no choice but to switch auditors. I identify 940 auditor switches by top three firms within the sample, including 232 coming from the collapse of Arthur Andersen. The benchmark probability cannot be calculated as before. The benchmark probabilities are calculated as the market share of the remaining auditors who cover other top three rivals. I exclude the auditor from which the firm is switching from in the calculation of the benchmark probability. A concrete example is provided in Appendix B. Specifically, if auditor i is the auditor from which the top three player is switching from, the benchmark probability is

given by $\frac{\sum_{j \neq i}^n p_j \cdot 1_{j, \text{Top3}}}{1 - p_i}$ where the indicator variable $1_{j, \text{top3}}$ takes the value 1 if auditor j covers one

of the industry top three players. Similar to the association based results, I focus on switches to top tier auditors as most top three players are covered by top tier auditors.

Results

I compare the actual probability that a top three player switches to an auditor covering one of its top three rivals to the benchmark probability defined above. Test results of H1 are presented in Table 4. Consistent with H1, the actual probability of a top player sharing the same auditor as its rival is significantly lower than the benchmark probability. This is true for both the Arthur Andersen sample and the remainder of the sample. The numbers are economically significant with the actual probability being half of the benchmark probability. This indicates that switching top industry players are reluctant to share the same auditor with their rivals.

I test H2 and H3 in a similar fashion to Table 3, using an OLS specification with the dependent variable *Diff* equal to the deviation from the benchmark probability of the switching firm switching to an auditor covering its rival or not¹⁷. The results are presented in Table 5. In the first column, I confirm the results of Table 4 by regressing the variable *Diff* without any control variable. The constant is significantly negative and corresponds to the difference between the actual probability and the benchmark probability presented in Table 4. I then introduce control variables in the second and third columns¹⁸. Most of the results are consistent compared to Table 3 and confirm my initial results. *Herfindahl* and *CCR3* load negatively, while *Deltasale* loads positively in the second column and *Logindcapex* loads positively in both columns. *Secrecy Mfg* loads negatively, providing stronger results than in Table 3. The coefficient on *Indpricecostmargin* remains positive but is insignificant, while the coefficient on *Shared State* is insignificant or negative with marginal significance, both contrary to expectations.

¹⁷ *Diff* is equal to the difference between an indicator variable that takes the value one when the switching firm switches to an auditor covering its rival and the benchmark probability

¹⁸ Note that the constant loses its meaning in those specifications as the mean of the independent variables is not equal to zero

I then partition the sample between the switching firms outside of the Arthur Andersen collapse and the firms that had to switch auditors due to the collapse of Arthur Andersen. The results are broadly unchanged compared to the first three columns, with statistical significance sometimes reduced, possibly due to the smaller sample sizes.

4.3 Auditor mergers sample

Description of the analysis

I use auditor mergers as a source of exogenous shocks to the client auditor allocation. This allows testing for a causal relationship between rivals being concerned about sharing the same auditor and auditor choice. There were only three large auditor mergers in the past 25 years¹⁹. However, each auditor had a large clientele. Consequently, in several industries, rivals covered by different auditors would have ended up being covered by the same auditor after the merger, unless they switched auditors. On the other hand, rivals in other industries ended up not being impacted by the merger. The potential spillover risk of sharing auditors with a rival increased for overlapping rivals, keeping the benefits of auditor specialization relatively constant, while this risk did not change for non-overlapping rivals. This setup provides a natural control to compare the probability of switching of rivals where an overlap occurred to firms where no overlap occurred²⁰.

I define rivals as top three players within each industry and only consider firms covered by the auditors that were involved in the merger, by looking at the auditor-client allocation one

¹⁹ Ernst & Whinney merged with Arthur Young in October 1989, Deloitte, Haskins and Sells merged with Touche Ross in December 1989, and Price Waterhouse merged with Coopers Lybrand in July 1998

²⁰ I also confirmed that there was no ruling by the Department of Justice (DOJ) or Federal Trade Commission (FTC) that compelled the newly merged auditor to divest some of its clients due to a dominant position of the merged auditor in specific industries. Such a ruling could have biased the specifications towards me finding the results

year prior to the merger. I then analyze whether clients had switched auditors one year after the merger occurred, depending on whether the other auditor involved in the auditor merger covered a top three rival to the company or not. I restrict the sample to industries with three players or more, where the NAICS codes are well defined at the six-digit level. These restrictions yield a final sample of 623 firms, including 112 overlapping firms and 64 switches.

Results

First, in order to test H1, I compare the probability of switching for overlapping rivals compared to non-overlapping rivals in Table 6 panel A, where rivals are defined as top three within an industry. I conduct analyses at the company level, where each datapoint is a company, and create an indicator variable, *switch*, that indicates whether the company switched auditors after the merger compared to before the merger. I also create another indicator variable, *Overlap top3 players*, that indicates whether the other auditor involved in the merger covered a top three rival to the company or not. I find evidence that overlapping rivals are much more likely to switch auditors than non-overlapping rivals, with the probability increasing from 8.8% to 17.0%. The differences are statistically significant at the 1% level using a Chi-Square test of differences, and also large, with the probability of switching almost doubling depending on whether the other auditor involved in the merger covers a top three rival or not.

I introduce additional controls in Table 6 panel B²¹. Switching auditors can be a costly decision as the new auditor may not fully acquainted with the firms' operations. The new auditor also needs to move up the learning curve with its new client. Even though the chosen auditor may decide not to include any extra start-up cost in the initial engagement pricing, the increased

²¹ The first column of panel B confirms that the results in panel A are robust to the use of a logit specification

activity by the new auditor in order to move up the learning curve could still consume increased time and managerial resources at the client firm, yielding non negligible switching costs for the client firms. Consequently, I posit that client firms are less likely to switch auditors when switching costs increase. I proxy for switching costs by including a dummy for a relationship longer than 5 years, *Long Relationship*, and interact this dummy with whether there is an overlap with a rival or not²². Results in the second column of Table 6 panel B are weakly consistent with my predictions. The coefficient on *Overlap top3 players* loads significantly, indicating that firms with a short auditor relationship are more likely to switch auditors when an overlap with a rival occurs. On the other hand, the sum of *Overlap top3 players* and the interaction of *Overlap top3 players* and the long relationship dummy (*Long Relationship*) is insignificant²³. However, the interaction coefficient does not load significantly in the regression.

In columns 3 and 4 of Table 6 panel B I also introduce the additional controls defined in section 3.2. The results on the *Overlap top3 players* variable are still robust to inclusion of these control variables. To test rivals similarity, industry differentiation, capital expenditures, secrecy (H2) and shared headquarters location (H3), I also interact these control variables with *Overlap top3 players* in column 5. Results are weak, possibly because the total number of switches is too limited, especially for the overlapping sample where only 19 switches are available²⁴. Most of the interaction coefficients are insignificant. Only the coefficient on the interaction with *Indpricecostmargin* loads negatively, indicating that, consistent with H2b, companies in more differentiated industries are less likely to switch auditors when client overlaps occur. Due to

²² The 5 years cutoff date is based on the results of Levinthal and Fichman (1988), who estimate a hazard model of auditor switching and show that the hazard initially increases until a 5 year relationship is reached and then decreases subsequently.

²³ Even though the sum of both coefficients is still positive, untabulated tests show that the p-value for the sum of both coefficients is at 0.39.

²⁴ The limited number of actual switches precludes any further analysis where the sample would be partitioned even further to companies where switching costs are lower or higher.

potential non-linearity concerns in the logit specifications, especially regarding the interaction coefficients, I also confirmed the analysis using OLS. The results are presented on the right of Table 6 Panel B and are consistent with the logit specifications, with a negative coefficient on the interaction of *Indpricecostmargin* and no other coefficient loading significantly in the specifications.

Overall, the merger test provided causal evidence in favor of same industry rivals avoiding to share the same auditor (H1) and additional evidence in favor of industry differentiation as a mitigating factor to H1 (H2b). The main interest of the merger test is that it does not involve the calculation of any benchmark probability.

5. Auditor pricing and the collapse of Arthur Andersen

5.1 Description of the analysis

In this section I investigate whether auditors are able to extract rents from the reluctance of their clients to share the same auditor. I use the collapse of Arthur Andersen as an exogenous shock to the auditing supply and posit that the supply tightened more in some industries than in others²⁵. In particular, I predict that audit fees increased more after the collapse of Arthur Andersen in industries where the concern for information spillover was higher and auditing supply was scarcer, as the tightening of the audit supply gave increased opportunities to the auditors for rent extraction (H4).

²⁵ I am unable to use auditor mergers as an exogenous shock because companies started reporting audit fee data from 2000, whereas all the auditor mergers took place before 1999

There are three groups of firms that could be considered in the analysis. I present an illustrative example of these groups in Figure 1 with two industries and three remaining auditors. Group 1 contains firms covered by Arthur Andersen prior to the collapse of the auditing firm. Any comparison of fees for these firms prior and after the collapse would be meaningless, as these firms had to switch of auditor. Many confounding factors could explain any result on fee changes, including fees lowballing prior or after the collapse of the Arthur Andersen, and including potential compensation for increased risk by the new auditor from taking a former Arthur Andersen client. Consequently, I have no prediction regarding the first group and exclude it from the analyses. Group 2 contains firms that are covered by auditors who started covering in the same industry firms previously covered by Arthur Andersen. Again, any analysis of the fees here could be subject to several confounding factors that could explain the results. Evidence of fees increase could not only be explained by rent extraction from the auditor, but also by compensation for increased risk taking by the auditor within a given industry. Consequently, I exclude this group from the analyses. Group 3, the group of focus, contains firms that were covered by auditors other than Arthur Andersen prior to the collapse of the auditing firms and whose auditors did not end up covering firms previously covered by Arthur Andersen within the same industry. For this group of firms, I predict that fees increased for firms in industries where supply was tight prior to the collapse of Arthur Andersen, in comparison with industries where supply was less tight. Note that it would be difficult to reconcile positive results with any other alternative explanation besides rent extraction from the auditor due to the reluctance of rival firms to share the same auditor²⁶.

²⁶ In untabulated tests, I confirm that results are also robust for the expanded samples including group 2 and group 3 and all firms (group 1 and group 2 and group 3). However, results are easier to interpret when restricting the sample to group 3. Results are also robust to restricting the sample to years 2001 and 2004, in the spirit of a pure difference

5.2 Data and sample construction

I use the Compustat audit fee database, which includes audit fee data from 2000 to 2006. I only keep firms covered by auditors that did not end up covering firms in the same industry previously covered by Arthur Andersen. The industry is defined at the NAICS 6 digit codes, consistent with prior tests. Depending on the specifications, I focus on either the top three players, the top five players and the top ten players. The reason I change the sample and do not remain fully consistent with my prior analysis of the top three players in earlier sections is that there was a sufficient number of Big 4 auditors to audit top three firms without any overlap. It therefore makes sense to expand the number of firms in an industry to allow the constraint on auditors to play a role in rent extraction.

I use several proxies for tightness of supply. The first proxy, applied to the top three, takes the value one when prior to the collapse of Arthur Andersen the top three players were covered by three different top tier auditors, and zero otherwise. The second proxy, applied to the top five, takes the value one when prior to the collapse of Arthur Andersen the top five players within one industry were covered by all five top tier auditors, and zero otherwise. The third proxy, applied to the top ten, takes the value one when prior to the collapse of Arthur Andersen the top ten players within one industry were covered by all five top tier auditors, and zero otherwise. The fourth proxy is equal to the number of top tier auditors covering the top three players within an industry prior to the collapse of Arthur Andersen, divided by three. The fifth and sixth proxies are similar to the fourth, except that they apply to the top five players and top

in differences test comparing fees before the collapse and after. Last there is no reason to expect any selection bias in Group 3 that would go towards me finding the results.

ten players within an industry. For example, the sixth proxy is equal to the number of top tier auditors covering the top ten players within an industry, divided by five.

5.3 Results

Table 7 regresses the natural logarithm of the audit fees on the proxy variable, an interaction between the proxy variable and the years after Arthur Andersen collapse, and several control variables. I predict that the interaction variable should load positively, indicating an increase of the fees after the collapse of Arthur Andersen for firms in industries where supply was tighter prior to the collapse. I also include several control variables, defined the same way as in Francis et al. (2005). *Lta* is the log of assets, *Lseg* is the log of business segments as reported in the Compustat Segments database, *Cata* is the ratio of current assets to total assets, *Quick* is the ratio of current assets less inventories to current liabilities, *De* is the ratio of long term debt to total assets, *Roi* is the ratio of earnings before interest and taxes to total assets, *Foreign* is the proportion of income from foreign operations (defined as $pifo/(pifo+pidom)$ from Compustat), *Opinion* takes the value one when the audit report is not unqualified (auop code other than 1 in Compustat), *Ye* takes the value one when the year end is not December 31st, and *Loss* takes the value one when net income is negative for a given year. I further winsorize at the 1% and 99% percentiles *Logauditfee*, *Lta*, *Cata*, *Quick*, *De*, *Roi* and *Foreign*. In order to control for fixed effects, I also include year dummies, Fama French industry group dummies, and dummies for the number of firms within each industry. Overall, the statistical significance of the regressions, evidenced by the high R-square values and the control variables signs and statistical significances, are consistent with Francis et al. (2005) results. I also cluster standard deviations at the company level as most variables in the regression are relatively stable over time for each company.

The results in Table 7 are consistent with my initial hypothesis. Most proxies for industry tightness load positively in the interaction term, indicating an increase of fees after the collapse of Arthur Andersen for industries where auditing supply was tight prior to the collapse of Arthur Andersen (H4). Results are significant at the 1% level when using the top ten as the primary sample and at the 5% level when using the top five. The results go in the predicted direction but are statistically insignificant when using proxies based on the top three players, possibly because these proxies are not strong enough to capture tightness of industry supply, or because due to their larger size the top three players in each industry still have enough negotiation power to avoid any major fee increase from the auditor.

In terms of economic significance, the average log of audit fee for the top ten in the sample is 6.308, or a total fee of \$549,000. If I use the results from the third column of Table 7, the log would increase to 6.404, or a total fee of \$604,000, an economically significant difference.

6. Conclusion

In this paper, I presented evidence that top rivals are reluctant to share the same auditor, due to information spillover concerns. I document that the probability of all top three rivals sharing the same auditor being is only slightly below 50% of the benchmark probability. The use of exogenous shocks to the auditing industry, including auditors mergers and the collapse of Arthur Andersen, make a case for spillovers as a causal factor in auditor choice. The observed patterns occur more in industries where top leaders are more similar to each other, in manufacturing industries where secrecy matters, less in industries where differentiation is higher

or capital expenditures are higher and less where top players are headquartered in the same state. Last, using Arthur Andersen collapse, I presented evidence that the auditors are able to extract rents from this behavior from their client firms.

The results suggest that the auditing industry might be even less competitive than initially envisioned. Given the reduction of the number of auditors to the Big 4, and the lack of entry in the industry, those results have important policy implications. In particular, my results contribute to the recent debate on mandatory auditor rotation for client firms and suggest that mandatory auditor rotation might increase the reluctance of firms to share proprietary information with their auditors in case they have to share the same auditor with their rivals.

This paper is the first one to show a causal relationship between companies concern of information spillovers and auditor choice. Several interesting research questions remain to be answered, in particular documenting actual information spillovers coming from a shared auditor and studying market implications of the reluctance of rival firms to share the same auditor.

Appendix A: Calculation of Benchmark Probabilities - Association Based

Appendix A proposes the following example to detail the computation of the benchmark distribution and the variable *Diff*. The figure represents a current client-auditor allocation for a given industry.

A	B	C	D
1		2	
		3	
4	5	6	8
11	12	7	9
		10	13

In this example, there are four auditors, A, B, C and D, and 13 firms composing the industry. Each firm is denominated by its rank in sales, with firm 1 being the firm with the largest sales and 13 the firm with the lowest sales.

First, I assume that the distribution of the non-top three firms is the true distribution from which firms are chosen randomly. There are ten non-top three firms in the industry. Consequently, the

distribution is given by: $P_A = \frac{2}{10} = .2$, $P_B = \frac{2}{10} = .2$, $P_C = \frac{3}{10} = .3$, $P_D = \frac{3}{10} = .3$

I then sample randomly three firms from this distribution, with replacement. The probability that two firms out of the three share the same auditor is given by:

$$P_2 = 3 \times (0.2^2 + 0.2^2 + 0.3^2 + 0.3^2) - 3 \times (0.2^3 + 0.2^3 + 0.3^3 + 0.3^3) = 0.57$$

The probability that three firms out of the three share the same auditor is given by:

$$P_3 = 0.2^3 + 0.2^3 + 0.3^3 + 0.3^3 = 0.07$$

Consequently the probability that none of the three firms share the same auditor is given by:

$$P_0 = 1 - P_1 - P_2 = 1 - 0.57 - 0.07 = 0.36$$

The benchmark probability, the probability that at least two firms share the same auditor is given

by: $P_{\text{benchmark}} = P_2 + P_3 = 0.57 + 0.07 = 0.64$

The variable Diff is equal to: $\text{Diff} = 1 - 0.64 = 0.36$ because firms 2 and 3 share the same auditor, auditor C. In case no top three firm shares the same auditor I would have $\text{Diff} = 0 - 0.64 = -0.64$

Appendix B: Calculation of Benchmark Probabilities – Auditor Switches

Appendix B proposes the following example to detail the computation of the benchmark distribution and the variable *Diff*. The figure represents a client-auditor allocation for a given industry. Client 1 is the client that is assumed to switch auditors.

A	B	C	D
1	2	3	4
10	5	6	9
	7	8	12
	11		

In this example, there are four auditors, A, B, C and D, and 12 firms composing the industry. Each firm is denominated by its rank in sales, with firm 1 being the firm with the largest sales and 12 the firm with the lowest sales.

There are 10 firms covered by auditors B, C and D. Consequently, conditional on not choosing auditor A, the probabilities of choosing auditors B, C and D are given by $P_B = \frac{4}{10} = .4$,

$$P_C = \frac{3}{10} = .3, P_D = \frac{3}{10} = .3$$

Auditors B and C cover firms 2 and 3, assumed to be firm 1's direct rivals. Consequently, the benchmark probability is given by $P_{Benchmark} = 0.4 + 0.3 = 0.7$

If firm 1 switches to auditors B or C, then the variable *Diff* is given by: $Diff = 1 - 0.7 = 0.3$

If firm 1 switches to auditor D, then the variable *Diff* is given by: $Diff = 0 - 0.7 = -0.7$

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Table 1: Descriptive Statistics and correlations for overall sample

Table 1 Panel A presents descriptive statistics and Table 1 Panel B presents correlations among variables, with Spearman above the diagonal and Pearson below and significance at the 5% level or better in bold. There are 4,278 industry years in the sample. *Diff* equals one less the benchmark probability when at least two top three players share the same auditor, and zero less the benchmark probability otherwise. *Herfindahl* is the industry Herfindahl index. *CCR3* is the concentration ratio for the top three firms in each industry as defined by sales. *Logindcapex* is equal to the log of the mean industry capital expenditures. *Indpricecostmargin* is equal to industry sales divided by industry operating costs and is a measure of industry differentiation. *Deltasale* equals the standard deviation of the sale of the two three players divided by the mean of the top three players sales and is a measure of firm similarity. *Meanindage* is equal to the industry average of the number of years firms are in the Compustat database. *Shared State* is a dummy variable equal to one when at least two of the three top firms are headquartered in the same state. *Dummy Mfg* takes the value one when firms are classified as manufacturing firms. *Secrecy* is the average of the secrecy product and secrecy variables as in Cohen et al. (2000) Table 1 and Table 2. The variable is only defined for manufacturing firms. *Secrecy Mfg* equals secrecy when firms are manufacturing firms and zero otherwise.

Panel A: Descriptive statistics

Variable	N	Mean	SD	p25	p50	p75
Diff	4,278	(0.123)	0.514	(0.625)	0.144	0.336
Herfindahl	4,278	0.276	0.165	0.165	0.234	0.342
CCR3	4,278	0.715	0.171	0.606	0.732	0.848
Logindcapex	4,278	4.382	1.860	3.179	4.378	5.677
Indpricecostmargin	4,278	1.153	0.483	1.049	1.089	1.154
Deltasale	4,278	0.625	0.375	0.339	0.555	0.858
Meanindage	4,278	13.595	6.341	9.003	12.445	17.041
Shared State	4,278	0.294	0.456	-	-	1.000
Dummy Mfg	4,278	0.420	0.494	-	-	1.000
Secrecy Mfg	4,278	20.990	25.181	-	-	45.420
Secrecy	1,797	49.968	7.821	43.455	50.105	57.190

Panel B: Correlations (Spearman above diagonal, Pearson below)

Variable	Diff	Herfindahl	CCR3	Log indcapex	indprice costmgn	Delta sale	Mean Indage	Shared State	Dummy Mfg	Secrecy Mfg
Diff		(0.212)	(0.230)	0.075	(0.009)	(0.057)	(0.033)	0.100	(0.032)	(0.044)
Herfindahl	(0.119)		0.953	0.154	0.068	0.746	0.050	(0.033)	0.133	0.103
CCR3	(0.164)	0.821		0.128	0.054	0.565	0.075	(0.021)	0.109	0.087
Logindcapex	0.080	0.201	0.111		0.241	0.209	0.333	0.045	(0.028)	0.008
Indpricecostmargin	0.016	0.123	0.079	(0.162)		0.096	0.042	0.068	(0.057)	(0.034)
Deltasale	(0.048)	0.833	0.556	0.222	0.097		(0.034)	(0.046)	0.139	0.104
Meanindage	0.004	0.021	0.059	0.346	(0.055)	(0.042)		(0.099)	0.275	0.280
Shared State	0.087	(0.047)	(0.017)	0.031	(0.030)	(0.051)	(0.119)		(0.007)	(0.006)
Dummy Mfg	(0.038)	0.114	0.116	(0.015)	(0.104)	0.130	0.258	(0.007)		0.953
Secrecy Mfg	(0.042)	0.092	0.098	0.009	(0.099)	0.105	0.269	(0.008)	0.980	

Table 2: Probability of top three firms sharing the same auditor by NAICS

Table 2 presents the distribution of the probabilities that no firms out of the top three players, two firms out of the top three players, and three firms out of the top three players share the same auditor, in comparison to the benchmark probability that three randomly chosen firms within the industry, excluding the top three players, share the same auditor. Calculations are performed on a yearly basis, with a chi-square test of differences and p-value. MLRP satisfied indicates whether the benchmark distribution as presented in the table dominates the actual distribution as presented in the table in the sense of the monotone likelihood ratio property (MLRP).

Year	Number Industries	Actual Probabilities - Top 3 Sharing			Benchmark Probabilities - Top 3 Sharing			Test of differences		MLRP Satisfied
		None	Two	Three	None	Two	Three	Chi Sq	p-value	
1985	145	52.4%	46.9%	0.7%	38.0%	51.6%	10.4%	21.673	0.000	Yes
1986	150	54.0%	44.0%	2.0%	38.5%	51.0%	10.5%	21.195	0.000	Yes
1987	169	52.7%	43.8%	3.6%	37.5%	51.9%	10.6%	20.320	0.000	Yes
1988	158	55.1%	41.8%	3.2%	38.8%	51.1%	10.1%	21.008	0.000	Yes
1989	166	53.0%	43.4%	3.6%	33.0%	54.9%	12.1%	33.993	0.000	Yes
1990	174	47.1%	47.1%	5.7%	32.7%	55.4%	11.9%	18.817	0.000	Yes
1991	173	50.9%	44.5%	4.6%	33.1%	55.6%	11.3%	27.119	0.000	Yes
1992	193	49.2%	47.7%	3.1%	32.2%	55.7%	12.1%	32.369	0.000	Yes
1993	193	48.7%	48.7%	2.6%	33.4%	55.2%	11.4%	28.277	0.000	Yes
1994	213	44.1%	52.1%	3.8%	32.6%	55.4%	12.1%	21.375	0.000	Yes
1995	237	47.7%	47.7%	4.6%	32.2%	55.6%	12.3%	31.664	0.000	Yes
1996	237	45.6%	49.4%	5.1%	32.6%	55.1%	12.2%	23.509	0.000	Yes
1997	224	36.6%	56.7%	6.7%	33.0%	55.1%	11.9%	6.088	0.048	Yes
1998	219	37.9%	54.8%	7.3%	27.9%	58.3%	13.9%	15.131	0.001	Yes
1999	206	39.3%	51.5%	9.2%	27.5%	58.8%	13.7%	15.435	0.000	Yes
2000	188	43.6%	48.4%	8.0%	27.9%	57.6%	14.4%	24.759	0.000	Yes
2001	170	44.7%	45.3%	10.0%	29.4%	57.7%	12.9%	19.258	0.000	Yes
2002	166	30.7%	56.6%	12.7%	21.8%	61.2%	17.0%	8.528	0.014	Yes
2003	156	30.1%	60.9%	9.0%	22.2%	60.5%	17.3%	10.681	0.005	Yes
2004	147	29.3%	60.5%	10.2%	21.5%	61.1%	17.5%	8.622	0.013	Yes
2005	139	27.3%	63.3%	9.4%	21.4%	61.4%	17.2%	7.289	0.026	Yes
2006	123	26.0%	65.0%	8.9%	20.9%	60.5%	18.6%	8.196	0.017	Yes
2007	115	28.7%	63.5%	7.8%	22.6%	60.6%	16.8%	7.544	0.023	Yes
2008	111	32.4%	61.3%	6.3%	21.3%	59.8%	18.9%	15.755	0.000	Yes
2009	106	<u>24.5%</u>	<u>68.9%</u>	<u>6.6%</u>	<u>20.3%</u>	<u>60.1%</u>	<u>19.6%</u>	11.440	0.003	Yes
Average		41.3%	52.5%	6.2%	29.3%	56.8%	13.9%			

Table 3: Drivers of probability of top three firms sharing the same auditor by NAICS

Table 3 presents an OLS analysis where the dependent variable, *Diff*, is equal to the difference between the actual probability that at least two top three firms share the same auditor and the benchmark probability. Control variables have been defined in Table 1. Standard deviations are clustered at the industry level. Coefficient values are presented above and the t-statistic below. The results are presented for the full sample, the sample including non-manufacturing firms only and the sample including manufacturing firms only. Significance levels are * 10%, ** 5% and *** 1%.

Dep. Variable: Diff	Predicted Sign	Full Sample						Non Mfg Sample		Manufacturing Sample	
		No Controls	Herfindahl	CCR3	Secrecy Herfindahl	Secrecy CCR3		Herfindahl	CCR3	Herfindahl	CCR3
Herfindahl	-		(0.840) *** (5.091)		(0.846) *** (5.104)			(0.853) *** (3.812)		(0.946) *** (3.923)	
CCR3	-			(0.602) *** (5.683)		(0.604) *** (5.734)			(0.625) *** (4.624)		(0.629) *** (3.881)
Logindcapex	+		0.031 *** 2.949	0.027 *** 2.678	0.031 *** 3.102	0.029 *** 2.851		0.029 ** 2.384	0.027 ** 2.334	0.039 ** 2.226	0.035 * 1.963
Indpricecostmargin	+		0.057 *** 3.366	0.049 *** 2.830	0.057 *** 3.334	0.049 *** 2.840		0.054 *** 2.774	0.046 ** 2.440	0.292 0.931	0.252 0.744
Deltasale	+		0.208 *** 2.854	0.056 1.181	0.206 *** 2.828	0.051 1.080		0.218 ** 2.219	0.076 1.212	0.196 * 1.883	(0.001) (0.016)
Mean Industry age	?		(0.001) (0.290)	- (0.126)	- (0.065)	- 0.036		(0.003) (0.754)	(0.003) (0.704)	0.002 0.365	0.002 0.492
Shared State	+		0.089 *** 2.749	0.094 *** 2.859	0.089 *** 2.763	0.094 *** 2.869		0.156 *** 3.653	0.158 *** 3.640	(0.011) (0.232)	- 0.006
Dummy Mfg	?				0.206 1.471	0.208 1.520					
Secrecy Mfg	-				(0.004) (1.612)	(0.004) (1.612)				(0.006) ** (2.135)	(0.006) ** (2.181)
Constant		(0.123) *** (7.092)	(0.237) *** (4.292)	0.073 0.924	(0.238) *** (4.281)	0.071 0.909		(0.218) *** (3.082)	0.095 0.928	(0.223) (0.663)	0.142 0.398
N		4,278	4,278	4,278	4,278	4,278		2,481	2,481	1,797	1,797
Number Clusters		359	359	359	359	359		211	211	148	148
Adjusted R-square		-	0.040	0.045	0.042	0.047		0.049	0.058	0.044	0.042
F-statistic		-	7.724 ***	8.143 ***	6.272 ***	7.135 ***		5.695 ***	6.754 ***	4.456 ***	4.097 ***

Table 4: Auditor Switches

Table 4 presents a comparison to the benchmark probability of the actual probability that a client firm switches to an auditor covering a rival firm, conditional on the firm switching. The benchmark probability is calculated as the market share of the auditors covering other top three players, divided by one minus the market share of the auditor covering the switching top three player. A chi square tests for the equality of the probability numbers.

	Sample		
	All Switches	Arthur Andersen	Non Arthur Andersen
Actual Probability	34.1%	34.1%	34.2%
Benchmark Probability	68.7%	70.7%	68.1%
Chi Square Value	523.545	149.993	375.354
P-value	<.0001	<.0001	<.0001
Number Firms	940	232	708

Table 5: Auditor Switches

Table 5 uses an OLS specification with the dependent variable, *Diff*, equal to the actual probability of the switching top three firm sharing his new auditor with another top three firm, less the benchmark probability. Coefficient values are presented above and the t-statistic below. Results are presented for the overall sample of switching firms, for the sample of switching firms excluding Arthur Andersen, and for the sample of switching firms from Arthur Andersen collapse. Control variables have been defined in Table 1. Significance levels are * 10%, ** 5% and *** 1%.

Dep. Variable: Diff	Predicted Sign	Overall Sample			Excluding Arthur Andersen			Arthur Andersen Collapse		
		(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Herfindahl	-		(1.407) *** (9.381)			(1.373) *** (8.288)			(1.565) *** (4.447)	
CCR3	-			(0.995) *** (8.161)			(0.958) *** (6.802)			(1.060) *** (4.318)
Logindcapex	+		0.030 *** 3.002	0.036 *** 3.501		0.022 * 1.916	0.029 ** 2.462		0.067 *** 2.989	0.070 *** 3.132
Indpricecostmargin	+		0.043 1.511	0.042 1.478		0.093 1.269	0.091 1.227		0.047 1.397	0.047 1.418
Deltasale	+		0.404 *** 4.920	(0.043) (0.865)		0.353 *** 3.891	(0.081) (1.439)		0.577 *** 2.969	0.052 0.510
Mean Industry age	?		(0.005) * (1.946)	(0.006) *** (2.650)		(0.004) (1.414)	(0.006) ** (2.034)		(0.006) (1.186)	(0.008) * (1.659)
Shared State	+		- (0.004)	(0.068) * (1.903)		0.021 0.497	(0.052) (1.269)		(0.060) (0.745)	(0.117) (1.515)
Dummy Mfg	?		0.389 ** 2.535	0.492 *** 3.174		0.364 ** 2.068	0.451 ** 2.533		0.598 * 1.874	0.745 ** 2.332
Secrecy Mfg	-		(0.006) ** (2.096)	(0.008) *** (2.592)		(0.006) * (1.747)	(0.008) ** (2.120)		(0.010) (1.617)	(0.012) * (1.923)
Constant		(0.346) *** (19.570)	(0.171) *** (2.761)	0.435 *** 4.154	(0.339) *** (16.820)	(0.173) * (1.746)	0.408 *** 2.892	(0.366) *** (9.987)	(0.405) *** (3.076)	0.249 1.142
N		940	940	940	708	708	708	232	232	232
Adjusted R-square		-	0.150	0.132	-	0.147	0.122	-	0.169	0.166
F-statistic		-	21.716 ***	18.817 ***	-	16.271 ***	13.244 ***	-	6.889 ***	6.728 ***

Table 6: Auditor Mergers

Table 6 panel A presents a comparison of the switching rate of firms when auditors merge depending on whether the merger brings an overlapping rival or not. Panel B presents a logit specification where the dependent variable equals one when the firm switches auditors, and zero otherwise. The *Overlap top3 players* variable takes the value one when the other auditor involved in the auditor merger covers another top three player within the same industry, as defined by the NAICS six digits code. Long relationship is a dummy variable equal to one when the client-auditor relationship is above five years. Other variables have been defined in Table 1. Interaction coefficients are for the overlap variable and the other variables of interest. Significance levels are * 10%, ** 5% and *** 1%.

Panel A

	Company level		
	<u>No Switch</u>	<u>Switch</u>	<u>Total</u>
No Overlap	466 91.2%	45 8.8%	511 100.0%
Overlap top 3 players	93 83.0%	19 17.0%	112 100.0%
Total	559 89.7%	64 10.3%	623 100.0%
	<u>Statistic</u>	<u>p-value</u>	
Chi Square Statistic	6.633	0.010	

Panel B

	Logit					OLS
	(1)	(2)	(3)	(4)	(5)	(1)
Overlap top3 players	0.749 ** 2.530	0.824 ** 2.228	0.717 ** 2.327	0.721 ** 2.338	9.413 *** 2.631	1.037 *** 3.658
Long Relationship		(0.899) *** (2.795)	(0.811) *** (2.624)	(0.821) *** (2.660)	(0.683) * (1.878)	(0.050) * (1.710)
Overlap x Long Relationship		(0.368) (0.569)			(0.666) (0.877)	(0.104) (1.493)
Herfindahl			2.313 1.382		2.967 1.542	0.209 1.508
Overlap x Herfindahl					(2.845) (0.591)	(0.192) (0.442)
CCR3				1.438 1.356		
Logindcapex			(0.094) (1.423)	(0.099) (1.531)	(0.072) (0.988)	(0.009) (1.297)
Overlap x Logindcapex					0.316 1.404	0.038 1.645
Indpricecostmargin			0.100 0.758	0.105 0.818	0.113 0.725	0.017 ** 2.369
Overlap x Indpricecostmargin					(8.266) ** (2.340)	(0.874) *** (3.193)
Delta Sale			(0.540) (0.620)	0.263 0.648	(0.547) (0.547)	(0.023) (0.317)
Overlap x Delta Sale					0.442 0.176	(0.004) (0.016)
Meanindage			0.007 0.298	0.008 0.344	(0.008) (0.257)	- (0.112)
Overlap x Meanindage					0.069 1.124	0.008 1.230
Sharedstate			(0.631) * (1.817)	(0.612) * (1.770)	(0.809) * (1.864)	(0.050) * (1.734)
Overlap x Sharedstate					0.035 0.041	(0.021) (0.288)
Dummy Mfg			(0.626) (0.477)	(0.720) (0.537)	(0.426) (0.270)	(0.040) (0.328)
Overlap x Dummy Mfg					(1.543) (0.513)	(0.239) (0.958)
Secrecy Mfg			0.004 0.167	0.006 0.236	0.004 0.141	- 0.163
Overlap x Secrecy Mfg					0.005 0.088	0.001 0.286
Constant	(2.338) *** (14.974)	(1.899) *** (9.371)	(2.077) *** (4.631)	(2.983) *** (3.422)	(2.365) *** (4.524)	0.092 ** 2.202
N	623	623	623	623	623	623
R-square	0.014	0.048	0.092	0.092	0.123	0.067
Chi square	5.892 **	19.705 ***	37.918 ***	37.848 ***	50.588 ***	
F statistic						3.333 ***

Table 7: Audit Fee Analysis

Table 7 presents an analysis where the dependent variable is equal to the natural logarithm of audit fees. The audit fee data is from the Compustat audit fee database, covers years from 2000 to 2006, and is winsorized at the 1st and 99th percentiles. Control variables include *Lta*, the log of assets, *Cata*, the ratio of current assets to total assets, *Quick*, the ratio of current assets less inventories to current liabilities, *De*, the ratio of long term debt to total assets, *Roi*, the ratio of earnings before interest and taxes to total assets and *Foreign*, the proportion of income from foreign operations. All prior control variables are winsorized at the 1st and 99th percentiles. Control variables also include *Lseg*, the log of business segments, *Opinion*, an indicator variable equal to one when the audit report is not unqualified, *Non Dec dummy*, an indicator variable equal to one when the year end is not December 31st, and *Loss*, an indicator variable that equals one when net income is negative for the given year. In the first column, the proxy variable equals one when three top tier auditors were covering the top three industry firms prior to Arthur Andersen collapse. In column two, the proxy equals one when all the five top tier auditors were covering the top 5 firms. In column three the proxy equals one when all five top tier auditors were covering the top ten firms. In the fourth column, the proxy is equal to the number of top tier auditors covering the top three players prior to the collapse of Arthur Andersen, divided by three. Column five and sixth use the number of top tier auditors covering the top five players and top ten players, divided by five. The proxies are interacted with a dummy for after the collapse of Arthur Andersen in 2002. The specifications control for year fixed effects, number of companies within each industry fixed effects, and for fixed effects for the Fama French industry groups. The coefficients are given above and the t-statistic below. Standard deviations are clustered at the company level. Significance levels are * 10%, ** 5% and *** 1%.

	Top 3 Discrete Proxy	Top 5 Discrete Proxy	Top 10 Discrete Proxy	Top 3 Continuous Proxy	Top 5 Continuous Proxy	Top 10 Continuous Proxy
Proxy	0.009 0.215	(0.554) * (1.940)	(0.225) *** (5.816)	0.010 0.126	(0.029) (0.277)	(0.206) ** (2.573)
Interaction after AA collapse	0.065 1.557	0.373 ** 2.326	0.096 *** 2.702	0.074 0.999	0.180 ** 2.094	0.164 *** 2.805
Control Variables						
Lta	0.546 *** 31.290	0.550 *** 39.225	0.551 *** 51.767	0.546 *** 31.138	0.549 *** 38.775	0.550 *** 50.986
Lseg	0.079 ** 2.091	0.077 ** 2.389	0.084 *** 2.935	0.079 ** 2.109	0.078 ** 2.423	0.086 *** 3.017
Cata	0.636 *** 5.153	0.634 *** 6.459	0.598 *** 7.545	0.637 *** 5.152	0.637 *** 6.465	0.597 *** 7.457
Quick	(0.059) *** (9.845)	(0.056) *** (10.236)	(0.057) *** (10.505)	(0.059) *** (9.816)	(0.056) *** (10.163)	(0.059) *** (10.534)
De	0.010 0.109	0.021 0.269	0.010 0.151	0.012 0.124	0.028 0.357	0.010 0.156
Roi	(0.210) *** (3.716)	(0.220) *** (4.940)	(0.208) *** (5.711)	(0.210) *** (3.695)	(0.221) *** (5.037)	(0.203) *** (5.584)
Foreign	0.220 *** 7.841	0.229 *** 8.685	0.233 *** 9.629	0.220 *** 7.815	0.231 *** 8.803	0.233 *** 9.621
Opinion	0.096 *** 4.110	0.109 *** 5.337	0.120 *** 6.752	0.097 *** 4.139	0.106 *** 5.222	0.121 *** 6.771
Non Dec dummy	(0.160) *** (3.963)	(0.145) *** (4.327)	(0.123) *** (4.489)	(0.160) *** (3.963)	(0.143) *** (4.281)	(0.120) *** (4.359)
Loss dummy	0.157 *** 4.790	0.162 *** 6.031	0.191 *** 8.505	0.157 *** 4.788	0.162 *** 6.024	0.191 *** 8.514
Constant	1.978 *** 9.510	1.931 *** 10.328	1.933 *** 11.395	1.981 *** 9.490	1.976 *** 10.286	2.014 *** 11.523
Number firm dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry group dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	5,215	6,768	8,799	5,215	6,768	8,799
Number clusters	1,349	1,731	2,247	1,349	1,731	2,247
Sample used	Top 3	Top 5	Top 10	Top 3	Top 5	Top 10
Adjusted R-square	0.794	0.803	0.808	0.794	0.803	0.807
F-statistic	145.818 ***	177.841 ***	225.405 ***	145.969 ***	178.146 ***	225.412 ***

Figure 1 presents an illustrative example of the group definition for the analysis of fees related to the Arthur Andersen collapse. There are two industries, X and Y. Arthur Andersen initially covers firms X1 and firm Y1. Firm X1 moves to auditor A after the collapse, while firm Y1 moves to Auditor B after the Arthur Andersen collapse. These two firms are part of group 1. Group 2 includes firms where their auditor took for client one of the Arthur Andersen firm within their industry. Group 3 includes all other firms.

