Does market power encourage audit compliance? Theory and Evidence

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Abstract

Efficient allocation of capital requires both competition and accurate information on firm performance. However, producing credible financial information is not costless, nor is the independent verification of its accuracy. Firms in more competitive industries may try to avoid these costs and misrepresent their financial performance to investors, a practice known as earnings management. This paper develops a game theoretic model, that captures the potential relationship between industry competition, compliance with accounting regulations and the quality of independent audits. The theoretical model shows that whether compliance and audit quality increases or decreases with competition, depends on two offsetting considerations: (1) the product market effect, where firms in more competitive industries, with narrow profits margins may evade regulation in order to increase their profits; and (2) the audit market effect, where firms facing more competition may wish to increase their demand for a quality audit in order to signal the reliability of their financial statements and access capital markets at a lower cost. By estimating the structural parameters of this model using a Full Information Maximum Likelihood approach we find that firms in industries with greater competition have both lower levels of compliance, and employ lower quality audits, suggesting the product market effect is dominant. These results both help settle the academic debate on the role competition plays in firms' compliance with accounting regulations as well as serve as a guide to policymakers seeking to increase enforcement.

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1 Introduction

In order to ensure the accuracy of their financial statements, publicly traded firms are expected to comply with Generally Accepted Accounting Principles (GAAP) and Security and Exchange (SEC) regulations. In addition to internal compliance, firms must be audited by external accounting firms. Compliance with these regulations is critical to ensuring that investors can rely on information on firms' performance and allocate capital to its most efficient uses. Thus, it is important to understand the forces that incentivizes compliance with accounting regulations.

Economic intuition and reasoning suggest that compliance with any regulation is typically influenced by market forces (among other things such as government and third party oversight). For example, in a very competitive product market with small profit margins, firms may be more willing to try to evade regulations and limit the quality of an external audit if it enables them to increase their profits. We refer to this as the product market effect. However, while this result has been studied within the context of some general regulation (for example, in Branco and Villas-Boas (2015)) the causal link between competitive forces and a firm's decision to comply with accounting regulations is not well understood. One reason Branco and Villas-boas (2012)'s result may not be generalizable to the accounting industry is that the accuracy of financial statements is also critical to firms being able to access capital markets. If the need to borrow at lower costs increases with competition, this audit market effect, may offset the product market effect. As of yet the literature has yet to model both of these factors adequately. Additionally, empirical studies offer conflicting results on the role of competition plays in compliance and audit quality. The goal of this paper is to provide both theoretical guidance and empirical evidence that can help settle this debate as well as assist policymakers on which industries may produce less accurate financial statements.

Empirically, the evidence on the relationship between compliance and competition is somewhat mixed. The degree of compliance with accounting regulations is often framed in terms of firms manipulating earnings in order to meet analyst projects, a practice known as earnings management. Datta et al. (2013), Melrose (2015) and Karuna, Christo; Subramanyam, K R, Tian (2012) all find that earnings management is more likely to occur in more competitive markets. In examining the banking sector in particular Bushman et al. (2014) also finds less timely accounting recognition when the sector become more competitive. In contrast Marciukaityte and Park (2009) find that earnings management is less likely to occur in more competitive markets. Thus, there is no well-established finding regarding this relationship.

Without a strong theory of the relationship between compliance with accounting regulations and competition it is hard to understand, interpret and reconcile these empirical results. However, establishing the theoretical link is complicated by firms ability to choose their own external auditor, and thus the quality of their earnings. DeFond and Zhang (2014a) suggest that the demand for audit quality is driven primarily from the value that an outside audit brings to the credibility of a firm's financial statements (although the authors do not link the demand for audit quality with the level of competition). This choice in turn influences whether they will be found to be in compliance with accounting regulations, and any theoretical model also needs to recognize the endogenous choice of audit quality.

To date however the link between compliance and audit quality has not been established. Becker and DeFond (1998) and Frances et al. (1999) explicitly explore this relationship and find a correlation between lower audit quality and greater earnings management. Krishnan (2003) similarly finds less earnings management among firms that have auditors who are industry experts. In contrast however, in the European Market, Maijoor and Vanstraelen (2006) finds that Big X auditors are not related to higher quality earnings, suggesting the relationship between strict compliance with GAAP and audit quality is not settled. Further, there are few studies that examine if the observed correlation between audit quality and compliance has an external driver, such as competition. In one of the few papers, that examine the relationship between audit quality and competition Knechel et al. (2008) uses a Finish data and finds that firms in more competitive industries choose lower quality auditors.

While much of the existing literature is solely empirical, in this paper we argue that a theoretical model that incorporates the audit quality choice is critical to understanding and interpreting any empirical finding. For example, a theoretical model can assist in explaining whether an empirical finding that compliance falls with competition, is a result of the competitive pressures or the choice of a quality external auditor. Thus, in order to understand the empirical results clearly, one needs a theoretical model that links managerial decisions regarding compliance *and their audit quality choices* to the market structure in a way that can be "taken to the data." However, to date there is no theoretical model that studies how market structure affects compliance with accounting regulations that also accounts for the firm's endogenous audit quality decision.[1]

One of the main contributions of this paper is filling the gap in the theoretical literature. To do so, we develop a model in which firms are Cournot oligopolists who endogenously choose their level of compliance, the quality of their auditor, and their quantities to maximize profits or market share. Firms benefit from an audit because the additional credibility it gives financial statements allows firms easier access to capital. Further, these benefits may potentially increase in the quality of an audit, because presumably this sends a strong, credible, signal to investors. However, while high quality audits bring many benefits, they are also costly because they require firms to invest in expensive compliance measures. Furthermore, high quality audits make it more difficult for firms to engage in practices such as earnings management. Thus, firms must balance these trade-offs when choosing both their level of compliance and their audit quality, while taking into account the conditions in their product market.

We study the n-player Cournot-Nash equilibrium of this game. Theoretically, we find that the likelihood of non-compliance (such as earnings management) may increase or decrease with competition depending on two effects: the product market effect and the audit market effect. The product market effect identifies the impact of competition and other demand characteristics in the client firm's product market on the equilibrium level of compliance and equilibrium audit quality. As competition increases we find that the marginal benefit of complying decreases. Thus, the product market effect implies that compliance will always decrease with competition (even after accounting for the audit quality choice). The audit market effect focuses on the demand and supply of audit quality, and this effect may cause compliance to increase or decrease with competition. Specifically, if the benefits to a high quality audit increase with competition, then a firm in a more competitive industry will demand a higher quality audit. Since higher quality audits may potentially reduce the

[1]For more general regulations (such as compliance with environmental regulations, or consumer safety standards), the theoretical relationship between competition and regulatory compliance is complicated. For example, while Branco and Villas-Boas (2015) find that more competition leads to less compliance with regulation, Forian and Friehe (2015) find that corporate crimes are less likely to occur with increased competition. The discrepancy in these theoretical results arises because each of these authors make different assumptions regarding market structure and the type of regulation. Specifically, in Villas-Boas, firms are Cournot oligopolists who compete over market share for products that are perfect substitutes and the regulation does not directly affect consumer's in their product market. In contrast, Florian and Frehe consider a horizontally differentiated market and the regulation they focus on does affect their consumer's (e.g. product safety regulations).

incentives for non-compliance, the audit market effect causes compliance to increase with competition. If the audit market effect dominates then compliance will increase with competition otherwise it will decrease.

Theoretically, our model is closest to Hvide (2008) who studies the audit market decisions of firms and their auditors. His model examines the conditions under which an auditor will be more or less likely to be lenient when auditing a firm. In a duopoly he finds that firms with low compliance choose a lenient auditor, while firms with high levels of compliance choose a strict auditor. While his model is useful, there are two key draw backs. First, in his model, compliance is taken to be exogenous (i.e. a "type" determined by nature). Hence, it cannot be used to empirically study how compliance varies with competition. Second, his model only focuses on a duopoly. However, as we have shown, the competition in the product market affects compliance, which in turn affects audit quality. Hence, it is difficult to apply these results to data where most firms operate in oligopolistic markets.

In addition to a theoretical model of compliance and audity quality, an additional contribution of this study is to estimate the model structurally using a Full Information Maximum Likelihood (FIML) approach such that the equilibrium outcomes of the model explain observed proxies of profits, earnings management and audit quality among publicly traded U.S. companies. By estimating the structural parameters of the model, in contrast to a reduced form approach, we are able to use theory as a guide to interpreting our results, and better understand the sources of how competition influences audit quality and compliance.

Our results indicate that both compliance and audit quality fall with competition. We find compliance drops sharply when the number of competitors increases in an industry and the benefits to compliance fall. Thus it appears that the product market effect is the dominant concern when it comes to complying with accounting regulations. Further, our results suggest that audit quality also falls with compliance, suggesting that the benefits to having a high quality third-party review of financial statements and being able to signal to capital markets more reliable financial statements, declines with competition.

Following the introduction, Section 2 presents the model, equilibrium results and comparative statics. Section 3 presents the data we use to estimate the model and Section 4 discusses estimation strategy. Section 5 provides our empirical results and Section 6 concludes. All derivations are in the Appendix.

2 The Model

Consider a market with $N \geq 2$ oligopolistic firms that each produce q_i units of a product, where total market quantity $Q = \sum_{i=1}^{N} q_i$. The cost of producing each unit is c, and there are no fixed costs. Firms sell products to consumers with quasilinear utility function $U(\mathbf{q}, q_0; \mathbf{a}) = u(\mathbf{q}, \mathbf{a}) + q_0$ where good 0 is the numéraire, with $p_0 = 1$. We assume that U has the Bowley form

$$U(\mathbf{q}, q_0; \mathbf{a}) = \sum_{i=1}^{N} q_i - \frac{\beta}{2}\left(\sum_i q_i^2 + 2\sum_i \sum_{i \neq j} q_i q_j\right) + q_0.$$

Maximizing this utility function with respect to a standard budget constraint yields the linear inverse demand,

$$P = \alpha - \beta q_i - \delta q_{-i}$$

where q_{-i} is the sum of all the firms quantities other than firm i. We assume $\delta \in (0, \beta]$. As $\delta \to 0$ products are not substitutes, $\delta \to \beta$ implies that in the limit products are prefect substitutes.

Each firm in this market can choose their level of compliance with audit rules by choosing $\gamma_i \in (0, 1]$. The cost of complying is given by $k(\gamma_i)$, where $k(.)$ is increasing and strictly convex in γ. The idea behind γ is that it represents the firm's level of compliance with GAAP, where the stricter the adherence to GAAP the more accurately the firms financial statements reflect its underlying financial performance. Thus, we assume that higher levels of γ are more likely to reveal the firm's true economics, whereas lower levels overstate the firm's underlying economics. Alternatively, γ may represent the probability that firm does not engage in earnings management. Regardless, a fully compliant firm will set $\gamma = 1$, and a non-compliant firm chooses $\gamma = 0$. Independent of any audit occurring, a firm can be fined f per unit of non-compliance (perhaps by the SEC).

Since all firms must obtain an external audit, the effectiveness of either complying or not complying with audit rules depends on the quality of an audit (which is also supposed to confirm that the firm is accurately reflecting its underlying economics. Let $a \in [0, 1]$ represent the quality of an audit, which is the probability with which an audit is successful (success includes determining whether the firm has complied with GAAP rules). The cost (supply of audit) at quality level a is given by

$$g(a_i) = \frac{g^2}{2}$$

The firm's demand for an audit quality level a is driven by the (marginal) benefits for audit quality. This benefit function consists of three components; a fixed, variable, and compliance effect.

$$\underbrace{T(a_i)}_{\text{fixed}} + \underbrace{B(a_i, \gamma_i)}_{\text{variable}} \tag{1}$$

We assume that,

$$\frac{\partial T}{\partial a} > 0,$$

and that,

$$\frac{\partial B}{\partial a} > 0, \frac{\partial^2 B}{\partial a \partial \gamma} \geq 0, .$$

The justification for each of the previous functions and their derivatives are driven by the literature. Specifically, with regard to the derivatives of T and B with respect to a, DeFond and Zhang (2014b) and Fama (1980) argue that firms benefit from an audit since it adds value to its financial statements and enables it to raise capital more effectively. Thus, we should expect a higher quality audit to be more beneficial. Further, the marginal benefit may be higher (or lower) for a firm that has complied more (higher γ). Hence, the cross partial of B with respect to a and γ may not be 0.

The timing of the game is as follows,

Stage 1 Firms choose γ_i given the costs and fines (compliance stage)

Stage 2 Firms choose their quantity q_i.

Stage 3 Firms then choose their audit quality a_i

Stage 4 The game ends (all penalties, payoffs are realized).

With this framework, we may write down the profit function of firm i,

$$\pi_i = q_i \left(P_i - (1 - \gamma_i) f\right) + a_i T - \gamma_i b + \gamma_i B a - g(a_i) - k(\gamma_i) \tag{2}$$

To ensure that we have interior solutions we make the following assumptions. Proofs related to these assumptions are relegated to the appendix.

Assumption 1 *Demand is sufficiently strong; that is, $\alpha - c > f$.*

Second we assume that g is sufficiently large so that we have an interior solution for $a_i \in (0, 1]$.

Assumption 2 *The parameters T, B, and g possess the following relationships.*

1. $T > |B|$
2. $g > T + B$.

Third, in order to assume that γ_i is interior, we assume

Assumption 3

$$\frac{2\beta(\alpha - c)^2}{(2\beta - \delta)^2} < k - \frac{B^2}{g},$$

Note that this last assumption implies that $gk - B^2 > 0$ since $(\alpha - c) > 0$.

Assuming sequential rationality, and subgame perfection, we solve the model by backward induction. To allow us to estimate them model structurally we assume that the audit benefit function 1 takes the following form,

$$a_i T - \gamma_i b + \gamma_i a_i B - g(a_i) - k(\gamma_i). \tag{3}$$

However, it should be noted that this functional form does not alter our theoretical results.

Solving backwards the FOC for a_i is,

$$T + \gamma_i B - g a_i = 0.$$

Thus, with similar constraints $a_i \in (0, 1)$. Hence,

$$a_i^* = \frac{T + \gamma_i B}{g}$$

Therefore, each firms choice of audit quality is a function of its own GAAP compliance level γ_i.Substituting this into the expression for profits above, we obtain,

$$\pi_i = q_i \left(P_i - (1 - \gamma_i) f\right) - \overline{k}(\gamma_i),$$

where,

$$\overline{k}(\gamma_i) = k(\gamma_i) + \gamma_i b - \frac{(T+\gamma B)^2}{2g}$$

and let,

$$m(\gamma_i) = f(1-\gamma_i).$$

The solution to this system of equations for all N firms yields,

$$q_i^* = \frac{(\alpha - c)(2\beta - \delta) - m(\gamma_i)(2\beta + \delta(N-2)) + \delta \sum_{\forall j \neq i} m(\gamma_j)}{(2\beta + \delta(N-1))(2\beta - \delta)}$$

and profits of firm i are,

$$\beta(q^*)^2 - \overline{k}(\gamma_i)$$

Using calculations similar to before, in a symmetric equilibrium the optimal γ_i solves,

$$2\beta f \left(\frac{\alpha - c - (1-\gamma) f}{2\beta + \delta(N-1)} \right) \left(\frac{2\beta + \delta(N-2)}{(2\beta + \delta(N-1))(2\beta - \delta)} \right) = \overline{k}'(\gamma)$$

Recall, $k(\gamma) = \frac{k\gamma^2}{2}$, we have the solution

$$\gamma^* = \frac{b - \frac{BT}{g} + \frac{f(n-1)^2(-\alpha+c+f)}{n^2(2\beta+\delta(n-1))} + \frac{f(n-1)(-\alpha+c+f)}{n^2(2\beta-\delta)} + \frac{2\beta f(-\alpha+c+f)}{n(2\beta+\delta(n-1))^2}}{\frac{B^2}{g} + \frac{2\beta f^2(2\beta+\delta(n-2))}{(2\beta-\delta)(2\beta+\delta(n-1))^2} - k} \tag{4}$$

Using this γ^*, we now define the symmetric Cournot equilibrium.

Lemma 1 *At a symmetric equilibrium, the quantity, compliance, profits, and audit quality are,*

$$a^* = \frac{T + \gamma^* B}{g}$$

$$\gamma^*$$

$$q^* = \frac{\alpha - c - (1-\gamma^*) f}{2\beta + \delta(N-1)}$$

$$\pi^* = \beta(q_i^*)^2 - \overline{k}(\gamma_i^*)$$

At the symmetric equilibrium specified in Lemma 1, we now offer some key comparative static results for the case where $T'(N) = B'(N) = 0$. That is, where the demand for audit quality is not affected by the level of competition in the product market.

Proposition 1 *The equilibrium level of compliance and audit quality demand has the following comparative static properties with respect to the two competition parameters.*

- *Compliance with audit rules γ^* is always decreasing in N, and is decreasing in δ for some $\delta < \overline{\delta}$ and increasing in δ for $\delta > \overline{\delta}$.*
- *Demand for audit quality a^*:*
  - *If $B > 0$, then $sign|\frac{\partial a^*}{\partial N}| = sign|\frac{\partial \gamma^*}{\partial N}|$, and $sign|\frac{\partial a^*}{\partial \delta}| = sign|\frac{\partial \delta^*}{\partial N}|$.*
  - *If $B < 0$, then the comparative statics are reversed. That is, $sign|\frac{\partial a^*}{\partial N}| = -sign|\frac{\partial \gamma^*}{\partial N}|$, and $sign|\frac{\partial a^*}{\partial \delta}| = -sign|\frac{\partial \delta^*}{\partial N}|$.*

In other words compliance is always decreasing in N, but may increase or decrease in N depending on the level of product differentiation within an industry (characterized by δ).

The previous case considered the situation where $\delta \neq \beta$, however, to date there is no precise measure of horizontal differentiation. Hence, we also explore a model that sets $\delta = \beta$s

2.1 Model 2: Market effects on audit quality

Equation 1 assumes that the marginal benefits are independent of the level of competition in the product market. However, all these effects could be modulated by N. For example, the marginal benefit of a higher quality audit may go up in a highly competitive industry since that firm may be able to raise capital more easily. That is, each of these marginal benefit may vary with respect to competition. To allow for this we now assume the following.

Assumption 4

$$\frac{\partial^2 T}{\partial a \partial N} \geq 0, \text{ and } \frac{\partial^2 B}{\partial a \partial N} \geq 0$$

To allows us to structurally estimate the model we also assume that,

$$T = \tau + tlog(N)$$

$$B = \hat{B}\log(N),$$

where τ, t, and B are all strictly positive.

Suppose $\beta = \delta$ and assumption 4 is satisfied, then the comparative statics of a^* and γ^* are characterized in the following proposition.

Proposition 2 *The equilibrium level of compliance and audit quality demand has the following comparative static properties with respect to the two competition parameters.*

- *Compliance with audit rules γ^* is decreasing in N if either t or B is sufficiently small. Otherwise, if t or B is sufficiently large, compliance may be increasing in N.*
- *Demand for audit quality a^* possesses the following property, $sign|\frac{\partial a^*}{\partial N}| = sign|\frac{\partial \gamma^*}{\partial N}|$.*

2.2 Model summary

Effectively, our theoretical results offer two (not necessarily contradictory models). In model 1, $T'(N) = B'(N) = 0$, but $\delta \neq \beta$. In model 2, $T'(N) = B'(N) \neq 0$ but we allow $\delta = \beta$ (no horizontal differentiation). In both these models compliance may increase or decrease with N. However, we estimate only model 2 since there is no generally accepted measure of horizontal differentiation.

3 Data Description

We take a structural approach to estimating the relationship between audit quality, compliance and competition using firm level of data of publicly traded U.S. firms. To bridge the gap between the theoretical model and our empirical estimation requires compiling measures associated with (1) competition and market power, (2) the key endogenous variables of compliance, audit quality and profits, and (3) covariates that can account for heterogeniety between clients. We use COMPUSTAT's North American Annual file as our main data source, and we start with a universe of all firms with data from 1998 to 2014. Similar to Datta et al. (2013) we require all firms in our sample to be public companies that trade on the NASDAQ, NYSE or the American stock exchange.

Table 1: Descriptive Statistics by Level of Competition

	High Competition		Low Competition		All Firms	
Variable	Mean	Stdev.	Mean	Stdev.	Mean	Stdev.
Competition Measures						
N	559.957	178.263	105.313	44.492	332.931	261.867
β	6.184	2.168	6.721	2.623	6.452	2.421
Outcomes						
DACC	0.207	0.679	0.054	0.381	0.131	0.556
Big X	0.816	0.387	0.842	0.365	0.829	0.376
Net Income ($millions)	78.638	584.863	92.522	603.254	85.571	594.151
Additional Covariates						
Market Value	6.179	2.006	6.428	1.997	6.303	2.005
Market to Book	0.681	1.258	0.618	1.205	0.649	1.232
Stdev Sales	0.206	1.772	0.563	29.720	0.384	21.039
Leverage	0.118	0.158	0.217	0.174	0.167	0.173
Assets Growth	0.147	0.412	0.078	0.281	0.112	0.354
Z-Score	-49.341	316.149	19.645	69.038	-14.893	231.536

3.1 Market Competition

The theoretical model has two measures of the competitive landscape, N, the level of competition and β, the average market power in the industry. To define the industry for each firm we use the thirty Fama-French industry classifications based on the SIC. We take N as simply the firm count in each industry year-cell. We then take the view that β approximates the own price elasticity, and assume firms are using optimal markup pricing. For each client we construct the markup μ_{ijt} for a client, i, in industry, j at year, t, as $\mu_{ijt} = \frac{sales_{ijt} - cogs_{ijt} - sga_{ijt}}{sales_{ijt}}$, where $sales_{ijt}$, $cogs_{ijt}$, and sga_{ijt}, are the corresponding revenue, cost of goods sold and selling and general administrative expenses variables in COMPUSTAT. Given that our model assumes homogeneous values for β we average μ_{ijt} over each industry-year cell and set $\beta_{jt} = \frac{I}{\sum_i \mu_{ijt}}$.

Table 1 presents the descriptive statistics for each variable in our data set for clients in high competition industries (N greater than the median) and low competition industries (N less than the median). Highly competitive industries average more than 500 clients and have a β of 6.2, while the low competition industries average about 100 clients, with a β of 6.7. [2]

3.2 Compliance, audit quality and profits

The main outcomes of our model include client compliance, γ, the quality of audit provided by the auditor, a, and profits, π. Unfortunately, as DeFond and Zhang (2014a) document, the literature has yet to settle on preferred measures of compliance and audit quality and there exists pros and cons for a variety of proxies. A second difficulty we confront is that errors in financial statements may be a result of a purposeful lack of compliance on the part of the client, or more benign mistakes by the client that were not caught due to the poor quality of an audit. To overcome this obstacle we focus on one of the most commonly used proxies associated with earnings management driven by the client, abnormal discretionary accruals, and the most commonly used proxy for the quality of the audit, whether the auditor is a Big X member.

[2] While one might expect greater market power, β for low competition industries, the fact that our descriptive results indicate the reverse indicates that β and N are indeed measuring different aspects of the competitive landscape.

We measure compliance as the degree that clients shift expenses from one period to the next using discretionary accruals that are abnormally higher than industry norms ($DACC$). While inherently unobservable, a common approach developed by Jones (1991), which we employ, is to measure $DACC$ by running a regression for each industry-year cell of the form:

$$\frac{TA_{it}}{A_{it-1}} = \alpha_1 \frac{1}{A_{it-1}} + (\frac{\Delta REV_{it}}{A_{it-1}} - \frac{\Delta AR_{it}}{A_{it-1}}) + \alpha_3 \frac{PPE_{it}}{A_{it-1}} + \alpha_4 \frac{NI_{it-1}}{A_{it-1}} + \epsilon_{it} \tag{5}$$

where TA is total accruals, A is assets, REV is revenue, AR is accounts receivables, PPE is plant property and equipment, and NI is net income. All of these variables are available from COMPUSTAT. The residual of this regression ϵ_{it} provides the difference between a client i's accruals at time t, and the size of accruals that would be predicted to occur during the industry for the year. We take the absolute value of ϵ_{it} as our measure of the degree that management may be trying to manipulate earnings. In our sample of firms, discretionary accruals are four times as large in high competition industries in comparison to low competition ones, suggesting this practice is more frequent in more competitive industries.

Our measure of audit quality is simply whether the client has hired an accounting firm that is part of the dominant, so called "Big X" group of auditors. The theoretical underpinnings of the claim that the Big X auditors produce higher quality audits dates back to DeAngelo (1981), who suggest auditors with more clients to lose are more likely to ensure their reputation is not tarnished by producing a poor audit. Jones 1991, and Nelson 2002 find that the Big X firms produce higher quality earnings reports and Blokdijk et al. (2006) find that the Big X auditors allocate resources differently during an audit and produce a higher quality product. Thus, there is significant empirical evidence that employing Big X auditors do result in higher quality earnings. Approximately 83% of clients in our sample were audited by Big X auditors, slightly higher for clients facing a lot of competition.

The last outcome from the model that we will include in our empirical specification, is profits. We use annual net income from each client normalized by the assets. As one may expect, firms in more highly competitive industries have lower profits.

3.3 Client Characteristics

Our final set of variables are meant to capture heterogeneity among the characteristics of firms and auditors. First, we measure client growth using growth of assets and potential future growth of a company using the market value to book value ratio. We also control for the size of the client using the log of market capitalization. Clients in highly competitive industries tend to have higher growth rates and a slightly higher market-to-book ratios.

Next, we measure riskiness of firms with three variables. First, we measure the volatility of sales, which we construct as the standard deviation of sales over the prior three years normalized by prior year's assets. We also calculate the Altman's z-score based upon Ming and Watts (1996) updated coefficients as a measure of the riskiness of the client. Our last measure of risk, is the leverage ratio, calculated as long-term debt divided by assets. While the standard deviation of sales and leverage indicate that low competition clients tend to be more risky, the z-score indicates the opposite.

Our final step to constructing our data set is to ensure our results are not overly influenced by a few outliers. Many of the financial ratios such, as market-to-book, leverage and the z-score have extreme outliers. To ensure these do not influence our results, we windsorize our data by removing all observations with variables below the 5 percentile and above the 95th percentile.[3] Our final sample has about 40,000 client year observations.

4 Estimation Strategy

We take a structural approach to estimating the parameters of our theoretical model. To accomplish this we must: (1) relate the equilibrium values of $\gamma*$, $a*$ and $\pi*$ to observable proxies, (2) develop a method for incorporating client and auditor heterogeneity, and (3) a means to maximize the associated likelihood function.

To illustrate our approach the index i denotes the client, j the industry and t the year, and we gather equilibrium values, $a*_{ijt}$, $\gamma*_{ijt}$ and $\pi*_{ijt}$ into a vector Y^*_{ijt}. The set of corresponding observable proxies for these variables are given by the vector $\tilde{Y}_{ijt}$. As mentioned in the prior section we measure earnings management using abnormal

[3] We have also run a specification windsorizing at the 1st and 99th percentile, with similar results.

discretionary accruals, but since γ represents compliance we take the negative of $DACC$ as our proxy.[4] The associated proxies for π and a are real net income and Big X membership. We relate Y^*_{ijt} to $\tilde{Y}_{ijt}$ in the following way.

$$\tilde{Y}_{ijt} = Y^*(\theta, Z_{jt}) + X_{ijt}\phi + \epsilon_{ijt} \tag{6}$$

where X_{ijt} is a matrix of the client specific covariates the prior section discusses, ϕ is the associated vector of coefficients, Z_{jt} is the vector of industry characteristics, N_{jt} and β_{jt}, and ϵ_{ijt} is a white noise disturbance term. The remaining set of parameters from our theoretical model that can be separately identified include $\alpha - c$, f,k, b, τ, t, and and B, are gathered in the vector θ. Note, that g cannot be separately identified and thus we normalize it to unity, nor can we distinguish between α and c. For a given θ, and Z_{jt} the equilibrium values $Y^*(\theta, Z_{jt})$ can be identified using equations (2), (3), and (4) that characterize the model solution. Our key assumption, as shown in equation (6), is that expected values of our proxies are positively associated with equilibrium values from our model, given a set of observed attributes, X.

In the case of audit quality, our associated proxy Big X membership is a binary variable, and we must slightly modify our approach. We use a logit framework with a latent variable interpretation our specification is as follows:

$$\hat{a}_{ijt} = a^*(\theta, Z_{jt}) + X_{ijt}\phi + \epsilon_{ijt} \tag{7}$$

$$Pr(\tilde{a}_{ijt} = 1) = \Phi(\hat{a}_{ijt}) \tag{8}$$

where $a^*(\theta, Z_{jt})$ is the model prediction of audit quality, and $\hat{a}_{ijt}$ is a latent variable generated by the model's prediction of audit quality, client covariates and the white noise error term. Clients choose a Big X auditor with probability $\Phi(\hat{a}_{ijt})$, where $\Phi(.)$ is the cdf for the logit distribution.

Equations (6) - (7) can be estimated using Full Information Maximum Liklihood (FIML), where the likelihood of observing the full set of proxies is given by:

$$L(\theta, \phi) = \Pi_{ijt}\Psi(\epsilon)\Pi_{ijt}\Phi(\hat{a_{ijt}})^{\tilde{a_{ijt}}}(1 - \Phi(\hat{a_{ijt}}))^{1-\tilde{a_{ijt}}} \tag{9}$$

Across the entire data set we maximize the following likelihood function with respect

[4] In addition, after taking the negative of $DACC$, we add the minimum value, such that our final measure of compliance is always positive.

to the model's parameters:

$$L \max_{\theta,\phi} = \prod_{ijt} L(\theta,\phi)_{ijt} \tag{10}$$

We use a standard gradient based solver subject to Assumptions 1 - 3 provided in the appendix which ensures an interior solution. We also ensure we reach a global maximum by running the solver over 160 randomly selected starting points. Finally, given the complexity of the constraint structure we report bootstrapped standard errors, and 90% confidence intervals that are generated by sampling our data with replacement X times.

5 Results

Table 2: Estimation Results: Structural Parameters

	Baseline (1)	Year Fixed Effects (2)	Pre-Sox (3)	Post-Sox (4)	Exclude Regulated (5)
$\alpha - c$	0.0198	0.5792	0.1669	0.0141	0.0087
	(0.0139)	(0.2562)	(0.2270)	(0.3945)	(0.0643)
f	0.0099	0.2897	0.0840	0.0070	0.0044
	(0.0064)	(0.1227)	(0.1048)	(0.2035)	(0.0319)
k	0.0004	0.4035	0.0361	0.0002	0.0001
	(0.0010)	(0.3531)	(0.3186)	(0.3999)	(0.0559)
b	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0001)	(0.0000)	(0.0001)	(0.0000)
τ	1.0143	0.9428	0.8483	1.0160	1.0255
	(0.0327)	(0.0455)	(0.0918)	(0.1060)	(0.0442)
t	-0.0089	-0.0098	-0.0104	-0.0090	-0.0158
	(0.0019)	(0.0021)	(0.0050)	(0.0081)	(0.0017)
$\hat{B}$	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Year Fixed Effects	No	Yes	Yes	Yes	Yes

Note: Standard errors are in parentheses.

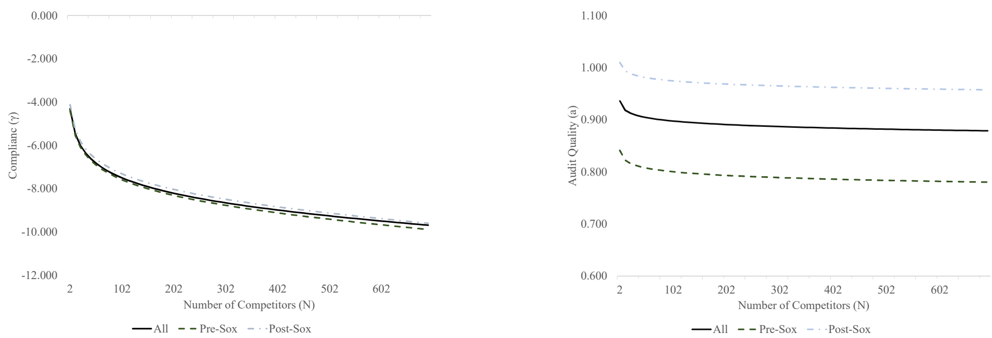
Estimates of the structural parameters can be found in Table 2. Column (1) provides results for the full sample. In the remaining columns we provide several robustness checks. In column (2) we see if our results are robust to the inclusion of year fixed effects. In 2002, in response to several accounting scandals, Congress enacted the Sarbanes-Oxley (SOX) Act which greatly increased the effort and cost of regulatory compliance and audits. To see how this law may have influenced our results, Column (3) presents the results prior to the 2002 passage of SO. Column (4) displays our results for the sample occurring after the full implementation of SOX in 2009. Note the intervening period, after the passage, but before full implementation is excluded from both columns (3) and (4). Since the degree and complexity of regulation specific to a given industry may influence how compliance and audit quality is effect by compeitiont, the last column, Column (5), excludes the two most regulated industries, the finanical sector and utilities.

Many of our raw estimates need further analysis to thoroughly understand, while other point estimates shed light on the relationship between competition, compliance and audit quality on their own. First, our estimate that $b = 0$ and $k > 0$ suggest that the any costs of compliance, or perhaps any reduction of benefits to earnings management is non-linear. Second, we find consistent evidence that $B = 0$. This suggests there is little interaction in the choice between compliance level and audit quality. In other words the benefits to choosing a higher quality audit, which is often access to the financial markets, does not depend on the level of earnings management the firm is engaged in. Also, robust to our various specifications is the finding that $t < 0$, suggesting the benefits to signaling more reliable financial statements through a high quality audit, is highest for firms in the least competitive industries. This benefit appears to dwindle as the number of competitors increases. Finally, we find that the value of f is consistently half the value of $\alpha - c$. We find that the firm increasing its level of γ to its maximum could potentially increase its contribution margin by 50%.

The estimated parameters are also best viewed in terms of their overall implication for the relation between competition and audit quality and compliance. Figure **??** presents the equilibrium values for γ and a varying the number of competitors N. In order to develop these estimates we use the parameters estimated with the fixed effects (Column 2 of Table 2) which includes the whole sample. The figure also presents the results for the pre-Sox (Column 3) and the post-Sox period (Column 4).

We find that throughout our estimates both compliance and audit quality decline with competition. Our parameter estimates also imply that compliance with audit regulations quickly falls with greater competition at a rapid rate. For example, for our full sample specification, the drop in compliance from two competitors to 102, is more than 300%. The level of compliance drops an additional 75% when the number of competitors increases from 102 to 202. Given the sharp decline in compliance with

Figure 1: Compliance and Audit Quality as a function of Competition



Panel A Compliance

Panel B Audit Quality

competition we present γ in Figure 1 with a natural log scale.

The drop in audit quality is much subtler. In contrast to the decline in compliance with greater competition, the fall in audit quality between two and 102 competitors is a little less than 4.1% and falls just a further additional 4.8% for industries with an additional one hundred competitors. This suggests that the benefits, of employing a high quality auditor seems to fall in industries with greater competition.

Figure 1 also presents some interesting implications for the impact of SOX. Each figure presents results for the pre- and post Sarbanes-Oxley periods as previously defined. For industries with just two firms compliance increases by about 27% between the pre- and post-SOX periods, and for firms in the most competitive industries the increase was about 28%. Thus it appears that earnings management has decreased for firms in all industries in the post-SOX period, although we caution the reader that more study is likely needed to assign the degree that these changes are related to SOX or other factors occurring during this period. We also find that audit quality increases significantly in the post-SOX period. Relative to pre-Sox, audit quality increased by 20% for a duopoly and almost 23% for firms in the most competitive industries. Despite there being only four Big X auditors in the post-Sox period to choose from, versus five in the pre-Sox period, more firms were choosing the higher quality auditors in the post-Sox period.

Table 3 presents the results for the additional covariates included in our specifications. We also present results for the same set of specifications as in Table 2. We find, as expected, that larger firms, as measured by log market capitalization, have higher profits. These larger firms also afford greater levels of compliance and higher audit quality, and thus market capitalizations has positive effects on both. Faster growing firms, as measured by asset growth and those firms with high growth potential, as measured by the log market to book value, also have higher profits. These firms though are associated with the lower audit quality and compliance. This may because firms with the greatest opportunities for future earnings growth are reluctant to use their resources for financial statement compliance and top-tier auditors.

One of measures of firm audit and financial risk, the standard deviation of sales, is not significant across any of the three equations. Leverage however is associated with lower profits. The need to take on debt might be associated with poor financial performance. We however also find that greater leverage is associated with higher audit quality and higher levels of compliance. Press and Weintrop (1990) show that greater leverage might be associated with a higher likelihood of violating debt covenants This may increase pressure from creditors, to have a higher quality third party auditor and more accurate financial statements for oversight. A higher z-score, is positively associated with greater profits as one might expect, but somewhat surprisingly negatively associated with compliance and audit quality. This could again be because firms with the lowest risk of bankruptcy are under the least scrutiny and pressure to have a high quality auditors.

6 Conclusion

Ensuring both competitive product markets and the reliability of firms' financial information have long been twin goals of policymakers. However, to date we have little evidence on whether these goals are in conflict. Empirical evidence has been mixed as to whether or not firms in more competitive industries have fewer incentives to comply with accounting regulations and manipulate earnings. Additionally, few studies have examined the relationship between audit quality and competition. This paper contributes to the literature by both developing a theoretical model of the joint compliance and audit quality decision, as well as estimating its structural parameters to determine how competition influences these choices.

Table 3: Results for Additional Covariates

	Baseline (1)	Year Fixed Effects (2)	Pre-Sox (3)	Post-Sox (4)	Exclude Regulated (5)
Profits (π)					
Constant	-0.5093	-0.4367	-0.3220	-0.5271	-0.4734
	(0.0293)	(0.0439)	(0.0728)	(0.0554)	(0.0000)
Asset Growth	0.0314	0.0297	0.0296	-0.0330	0.0423
	(0.0099)	(0.0077)	(0.0123)	(0.0082)	(0.0000)
Z-score	0.0005	0.0005	0.0009	0.0004	0.0005
	(0.0000)	(0.0000)	(0.0002)	(0.0001)	(0.0000)
Log Market to Book Value	0.0157	0.0155	0.0297	0.0118	-0.0010
	(0.0038)	(0.0023)	(0.0076)	(0.0026)	(0.0000)
Log Market Value	0.0111	0.0110	0.0012	0.0153	0.0110
	(0.0008)	(0.0011)	(0.0019)	(0.0010)	(0.0000)
Stdev Sales	-0.0002	-0.0002	0.0119	0.0000	-0.0002
	(0.0007)	(0.0008)	(0.0156)	(0.0014)	(0.0000)
Leverage	-0.0788	-0.0753	-0.0654	-0.0683	-0.0624
	(0.0064)	(0.0057)	(0.0171)	(0.0074)	(0.0000)
Audit Quality (a)					
Constant	-3.0492	-2.2123	-1.6351	-5.0841	-2.2253
	(0.0620)	(0.1017)	(0.1565)	(0.2138)	(0.0000)
Asset Growth	-0.4537	-0.6082	-0.5588	-0.3356	-0.6189
	(0.0415)	(0.0576)	(0.0996)	(0.1865)	(0.0000)
Z-score	-0.0001	-0.0007	-0.0016	-0.0008	-0.0006
	(0.0001)	(0.0001)	(0.0004)	(0.0016)	(0.0000)
Log Market to Book Value	-0.1829	-0.2449	-0.2416	-0.2612	-0.2273
	(0.0142)	(0.0151)	(0.0270)	(0.1046)	(0.0000)
Log Market Value	0.6464	0.8725	0.7479	0.9057	0.8608
	(0.0090)	(0.0115)	(0.0247)	(0.0165)	(0.0000)
Stdev Sales	0.0000	0.0004	0.0362	-0.2796	0.0003
	(0.0020)	(0.0665)	(0.0736)	(0.3517)	(0.0000)
Leverage	1.8907	1.4715	1.2894	1.4928	1.4208
	(0.1036)	(0.1001)	(0.2263)	(0.1989)	(0.0000)
Compliance (γ)					
Constant	46.6905	46.7841	6.6107	24.9714	46.7879
	(0.0123)	(0.0134)	(0.0135)	(0.1151)	(0.0000)
Asset Growth	-0.1773	-0.1923	-0.0459	-0.2281	-0.1959
	(0.0570)	(0.0531)	(0.0133)	(0.0821)	(0.0000)
Z-score	0.0001	0.0001	0.0001	0.0001	0.0001
	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0000)
Log Market to Book Value	-0.0095	-0.0123	-0.0051	-0.0059	-0.0137
	(0.0034)	(0.0038)	(0.0011)	(0.0527)	(0.0000)
Log Market Value	0.0104	0.0153	0.0018	0.0103	0.0153
	(0.0021)	(0.0027)	(0.0007)	(0.0044)	(0.0000)
Stdev Sales	-0.0013	-0.0012	-0.0301	0.0008	-0.0012
	(0.0068)	(0.0094)	(0.0434)	(0.0250)	(0.0000)
Leverage	0.0686	0.0336	0.0153	0.0996	0.0215
	(0.0153)	(0.0150)	(0.0067)	(0.0492)	(0.0000)

Our theoretically model suggests that compliance and audit market quality may either rise or fall with greater competition. On the one hand, if the product market effect is dominant, compliance may decrease, as firms facing more competitors have less to gain by complying with accounting regulations when profits are limited. Alternatively, compliance may increase, if the audit market effect is dominant and the benefits of signaling to investors greater financial statement reliability, and obtaining better credit terms, increases with competition. Finally, which effect dominants may differ for compliance and audit quality, but empirically, we find that the product market effect is dominant for both. A final major finding of our work is that both compliance and, to a lesser extent, audit quality, has increased significantly after the passage of the Sarbanes-Oxly legislation.

Our results indicate that policymakers should be aware that greater competition comes with a cost. Less concentrated industries are likely to produce less accurate financial statements with lower quality oversight from poor quality auditors. Thus the government may wish to focus its own monitoring efforts on the most concentrated industries.

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A Theory Appendix

A.1 Assumption 1

The derivative of profits with respect to a_i is,

$$T + \gamma_i B - g a_i.$$

Therefore, a sufficient condition to ensure that $a^* > 0$ is that $T > |B|$. To ensure that $a^* < 1$, at $a = 1$ we need

$$g > T + B.$$

A.2 Assumptions regarding $\overline{k}$

$\overline{k} = \frac{k\gamma^2}{2} + \gamma b - \frac{(T+\gamma B)^2}{g}$. These costs need to be strictly convex and increasing in γ (including at $\gamma = 0, 1$.

$$\overline{k}'(\gamma) = k\gamma + b - \frac{(T + \gamma B)B}{g}$$

which at $\gamma = 0$ is $b - (TB)/g > 0$ or $bg - TB > 0$. Next convexity implies,

$$\overline{k}''(\gamma) = k - \frac{B^2}{g} > 0.$$

A.3 Assumption 3

The first order condition for γ_i is,

$$2\beta f \frac{(2\beta + \delta(N-2))}{(2\beta + \delta(N-1))^2 (2\beta - \delta)^2} \left[(\alpha - c)(2\beta - \delta) - m(\gamma_i)(2\beta + \delta(N-2)) + \delta \sum_{\forall j \neq i} m(\gamma_j) \right] - \overline{k}'(\gamma_i) = 0.$$

And, the second order condition is,

$$2\beta f^2 \frac{(2\beta + \delta(N-2))^2}{(2\beta + \delta(N-1))^2 (2\beta - \delta)^2} (\beta + \delta(N-2)) < k - \frac{B^2}{g}$$

Note that

$$\frac{(2\beta + \delta(N-2))^2}{(2\beta + \delta(N-1))^2} < 1.$$

Hence, replacing f with $(\alpha - c)$ (and the terms with N by 1), it follows that if

$$\frac{2\beta(\alpha - c)^2}{(2\beta - \delta)^2} < k - \frac{B^2}{g},$$

then the SOC is satisfied. This condition is stronger than the SOC. Further, note that the previous condition (and the SOC itself) implies that $kg > B^2$.

Next, $\forall j \neq i$, at $\gamma_i = 1$ we need the FOC to be negative (so that γ_i is interior). This condition is,

$$\frac{2\beta f(\alpha - c)(2\beta + \delta(N - 2))}{(2\beta - \delta)(2\beta + \delta(N - 1))^2} < k - \frac{B^2}{g} + b - \frac{BT}{g}$$

Note that at $N = 1$, $(2\beta + \delta(N - 2)) = (2\beta - \delta)$ and since the LHS of the previous equation is increasing in N, we can write,

$$\frac{(2\beta + \delta(N - 2))}{(2\beta - \delta)(2\beta + \delta(N - 1))^2} \times \frac{(2\beta - \delta)}{(2\beta - \delta)} < \frac{(2\beta + \delta(N - 2))^2}{(2\beta + \delta(N - 1))^2(2\beta - \delta)^2} < 1.$$

Hence the expression for an interior solution

$$\frac{2\beta f(\alpha - c)(2\beta + \delta(N - 2))(2\beta - \delta)}{(2\beta - \delta)^2(2\beta + \delta(N - 1))^2} < \frac{2\beta(\alpha - c)^2(2\beta + \delta(N - 2)^2}{(2\beta - \delta)^2(2\beta + \delta(N - 1))^2}.$$

Finally, the requirement that $\overline{k}$ be increasing in γ everywhere including at $\gamma_i = 0$ requires $bg - BT > 0$. Hence the second condition (that the FOC be negative and $\gamma < 1$ is weaker than the SOC condition established above).