The Value of Auditing Services for Private Firms

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Abstract

We develop and estimate a dynamic structural model of the private-firm audit market to quantify audit value and assess audit mandates. Private firms jointly choose auditing and debt, balancing audit quality and fees against the certification and disciplinary effects of audits, while auditors compete on price and quality in an oligopolistic market. Using voluntary audit decisions of Chinese private firms, we find that Big 10 audits create value exceeding fees, whereas non-Big 10 audits generate little net value. Audits facilitate debt financing while deterring excessive leverage. Counterfactuals indicate that mandatory audits would impose small welfare losses on clients, with clients continuing to capture most of the surplus. However, mandates shift market share toward Big 10 firms, reduce clients' debt expansion due to higher audit quality, and increase auditor profits, particularly for Big 10 firms. These findings inform ongoing debates on private-firm audit mandates.

Keywords: Audit value; Private firms; Audit quality; Debt financing; Audit mandates
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1 Introduction

Audit requirements are a cornerstone of modern financial regulation. For public firms, mandatory audits are motivated by classic agency concerns: absent regulation, managers may take actions that harm dispersed shareholders, contributing to misreporting and corporate scandals (Hail, Tahoun, and Wang, 2018; Breuer, Le, and Vetter, 2023; Cheynel, Cianciaruso, and Zhou, 2024). The rationale for audit mandates is far less clear for private firms, where ownership is relatively concentrated and external reporting is often limited. In practice, most private firms choose not to obtain audits. At the same time, private firms are substantially more opaque and subject to weaker external monitoring than public firms. As a result, a firm's decision to forgo an audit may itself reflect underlying agency problems rather than their absence, raising the possibility that audit mandates could play a disciplining role even in closely held firms. Consistent with this tension, many jurisdictions either require audits for certain classes of private firms or periodically debate whether such mandates should be expanded, relaxed, or abolished.[1]

In this paper, we develop and estimate a structural model of the private-firm audit market to quantify the value of audit services and evaluate audit mandates. Two features of the setting motivate this approach. First, although prior research documents audit benefits in debt markets (e.g., Minnis, 2011), the value of audit quality to clients that do not voluntarily obtain audits is inherently unobserved. A structural framework allows us to recover clients' willingness to pay for audit quality from observed audit and debt financing choices, providing a basis for assessing the economic trade-offs of extending audit requirements to currently unaudited clients. Second, evaluating audit

[1] Many countries, like those in the European Union (EU) and non-EU countries like Australia, Brazil, Canada, New Zealand, and the United Kingdom (UK), require statutory audits for medium to large private companies or under certain conditions (e.g., Breuer et al., 2023). Some other jurisdictions, including India, Hong Kong, and Malaysia, require all companies to undergo audits in various forms.

mandates requires predicting how clients and auditors would behave under a regulatory regime that is not directly observed. By explicitly modeling forward-looking behavior on both sides of the market, the structural model delivers internally consistent counterfactual equilibria and enables welfare analysis of mandatory audits relative to a voluntary regime.

Our model describes the audit market as a dynamic oligopoly with heterogeneity on both sides. On the demand side, clients differ in profitability, size, leverage, and audit history, which jointly evolve over time and shape their demand for audit services and external financing. Each period, forward-looking clients choose whether to obtain an audit, which audit firm to hire, and whether to increase leverage, internalizing how current audit and debt financing decisions affect future states and payoffs. On the supply side, audit firms are heterogeneous along key economic dimensions. We distinguish between large and small audit firms with different cost structures. Audit firms compete dynamically on price and quality, maximize discounted profits, and account for client heterogeneity, competitors' strategies, and the effect of current offerings on future client relationships and market shares.

We estimate our model using a large sample of Chinese private firms. In our sample, 26.5% of private firms hire an auditor, and we observe a small but significant positive correlation between audit and debt choices: 58.6% of clients who choose to audit increase their debt, compared to 56.6% of those who do not audit. We estimate the model using maximum likelihood building on the Conditional Choice Probability (CCP) framework proposed by Hotz and Miller (1993). We extend the framework to solve optimal choices from both the demand and supply sides, following the approach in Cheynel and Zhou (2024), as discussed in Section 3.3. Our dynamic framework allows us to isolate the immediate effects of audits from their long-term consequences and to recover latent constructs such as differences in audit quality across audit firm sizes.

We first estimate the net audit quality, defined as the economic value of audit quality net of fees and scaled by clients' total assets. We report two measures. The first is the unconditional net audit quality, computed across all clients regardless of whether they obtain an audit. Big 10 audits provide a net audit quality representing 0.408% of clients' total assets, whereas non-Big 10 audits provide almost no value, economically close to zero, indicating that the value provided by non-Big 10 auditors is largely offset by fees.[2] The second measure is net audit quality conditional on audit adoption, which reflects endogenous selection into auditing under the voluntary regime. Under this conditional measure, Big 10 audits provide net audit quality represents 0.360% of clients' total assets, while non-Big 10 audits again provide net quality close to zero. The similarity between the unconditional and conditional estimates indicates that audits do not impose a net cost on the average client. Instead, the low rate of voluntary audit adoption reflects heterogeneity in client demands rather than audits being value-reducing on average.

We next examine the effects of audits when clients seek to increase their debt. On the one hand, we find that clients' voluntary choice to undergo an audit facilitates access to debt financing. This is consistent with voluntary audit serving as a signaling mechanism that enhances the credibility of their financial statements. On the other hand, we find that higher audit quality also limits clients' opportunities to over-leverage. This is consistent with more stringent audit procedures constraining excessive credit risk and empire building. Taken together, these forces imply that audits expand debt capacity while disciplining leverage choices.

Our final analyses evaluate the consequences of mandating audits, namely how a mandate would affect the audit market, auditors' fees and quality provision, clients' auditor and debt choices,

[2]Hereafter, we refer to large audit firms as Big 10 and small audit firms as non-Big 10 firms. The Big 10 in China include both international firms (PwC, Deloitte, EY, KPMG) and major domestic firms (BDO China Shu Lun Pan CPAs, RSM China, Grant Thornton China, Crowe Horwath China, Reanda Certified Public Accountants, and ShineWing Certified Public Accountants).

and overall welfare. We find that a mandate generates sizable shifts in audit market structure, with Big 10 firms expanding the most and absorbing a disproportionate share of newly audited clients. This shift reflects changes in competition driven by the influx of clients who would not voluntarily obtain audits. Due to their cost advantage, Big 10 auditors compete more aggressively for these clients, resulting in lower fees. In contrast, non–Big 10 auditors compete less aggressively, raising fees, as clients can no longer opt out of auditing altogether. Because of this shift toward Big 10 auditors, whose audits are of higher quality, a mandate increases the audit quality clients experience, especially for those who did not previously obtain audits.

Regarding clients' debt choices, we find that the overall probability that clients expand debt falls from 57% to 37%, which we attribute partly to the loss of the audit's signaling role. Under the voluntary regime, choosing an audit signals credibility to lenders, making audited clients more likely to increase debt. Under a mandate, this signaling effect is not present because all clients are audited. In addition, the shift of clients toward Big 10 auditors, who provide higher-quality audits, further reduces incentives to increase leverage.

These changes in client and auditor behavior affect welfare. We express welfare on an annualized basis as a percentage of total assets. For clients, average welfare under the voluntary regime is 0.603% of total assets, declining to 0.562% under the mandatory regime. The difference, 0.041% of total assets, is economically small: for the average client in our sample, with total assets of 302 million yuan, it amounts to about 0.12 million yuan per year. Turning to auditors, expected profits increase under the mandate for both Big 10 and non-Big 10 firms, with a much larger gain for Big 10 auditors. Big 10 expected profits rise from 0.009% to 0.055% of total assets, while non–Big 10 expected profits increase from 0.036% to 0.041%. Across both regimes, auditors capture only a small fraction of the surplus relative to clients, but mandatory audits shift some surplus

toward auditors and strengthen the market position of Big 10 firms.

Our paper relates to the extensive literature in economics and accounting on the value of certifying information (e.g. Ijiri, 1975; Townsend, 1979).[3] Prior studies show that voluntary audit decisions convey information to capital providers (e.g., Kausar, Shroff, and White, 2016; Esplin, Jamal, and Sunder, 2018; Breuer, Hombach, and Müller, 2020; Bao, Choi, Kang, and Lee, 2021).[4] However, these studies focus on specific benefits, such as lower interest rates, and leave open questions about the overall desirability of audits. For instance, firms without external financing needs may find audits less useful, and audits costs may exceed their benefits for some clients. We address this gap by estimating net audit quality, which is audit value relative to fees, using structural methods that account for endogenous auditor selection. We find that audits provide positive net value on average, even though only a small proportion of firms voluntarily adopt an audit, suggesting that heterogeneous client firm incentives drive adoption decisions. We also find that Big 10 audit firms offer higher net audit quality, contributing to the ongoing debate about whether big audit firms add value after accounting for their fees, controlling for clients' endogenous auditor selection (Lawrence, Minutti-Meza, and Zhang, 2011; DeFond, Erkens, and Zhang, 2017; Jiang, Wang, and Wang, 2019).

Our paper also extends prior research on the role of audits in debt financing by documenting a nuanced tradeoff that clients face when seeking to increase debt. Prior studies find that audits improve debt contract terms (Minnis, 2011; Lennox and Pittman, 2011; Badertscher, Kim, Kinney Jr, and Owens, 2023) and lower agency costs for riskier firms in need of new capital (Dedman,

[3]This literature builds on the works of Ijiri (1975), which distinguish between soft and hard information and explore how verification enhances credibility, and Townsend (1979), which show how costly state verification results in more efficient debt contracts.

[4]For example, voluntary audits help hedge funds attract investors (Bao et al., 2021), facilitate financing and investment (Kausar et al., 2016), benefit both internal and external stakeholders (Esplin et al., 2018), and enhance disclosure credibility (Breuer et al., 2020).

Kausar, and Lennox, 2014). Our evidence shows that the positive effect of an audit on debt primarily arises from audit choice being informative of client type, consistent with Lennox and Pittman (2011). However, our results also show that this effect is mitigated by higher audit quality, which disciplines clients' borrowing and constrains over-leverage.

Our structural approach enables us to conduct counterfactual analyses of mandatory audits and their effects on the audit market (Bourveau, Breuer, Koenraadt, and Stoumbos, 2021). While recent work examines how audit mandates affect industry-wide resource allocation (Breuer, 2021) and the audit labor market (Breuer et al., 2023), these studies do not quantify welfare implications, model auditors' strategic pricing responses, or examine effects on clients' debt choices. Our approach complements this work along several dimensions: we explicitly quantify welfare effects for both clients and auditors, capture how audit firms strategically adjust fees in response to a mandate, examine how the audit quality clients receive changes with their auditor choices, and document how mandates affect clients' debt expansion through changes in the signaling value of audits. Our findings highlight the importance of considering changes in audit market competition and client choices when analyzing audit mandates. As Big 10 auditors compete for new clients, they reduce fees and gain market share. As more clients choose Big 10 audits, audit mandates also reduce clients' debt expansion due to the disciplinary effects of higher audit quality.

Our results are based on the assumptions of our structural model and reflect the institutional environment of the Chinese setting. Nevertheless, they yield important insights into the economic trade-offs associated with audit mandates and offer a framework for researchers and policymakers in other jurisdictions to assess the potential impact of regulatory changes on audit demand and market outcomes. In this regard, our paper also contributes to nascent research analyzing audit outcomes using structural models (Gerakos and Syverson, 2015; Liang, 2015; Guo, Koch, and Zhu,

2017, 2022; Li, McNichols, and Raghunandan, 2018; Liu and Matsuno, 2026).[5] To our knowledge, our study is the first to use a structural approach to quantify the value of audits for private firms, which are crucial to the economy but whose voluntary audit choices are less understood (Minnis and Shroff, 2017; Knechel, Thomas, and Driskill, 2020; Lisowsky and Minnis, 2020; Bernard and Sutherland, 2025; Liu and Tong, 2025).

2 Model

To assess the value of audit services to clients, we develop a dynamic model that captures the interaction between clients and audit firms. In this model, clients simultaneously decide whether to engage audit services and increase their debt levels, while audit firms compete to offer these services in exchange for audit fees.

2.1 Period Utilities

Audit Services

We first present the profits of audit firms in each period t. We draw on prior literature on audits in Chinese settings and adopt the standard classification of Big 10 and non-Big 10 audit firms. All Big 10 audit firms are collectively treated as a single auditor identity, while all non-Big 10 audit firms are grouped together under a separate auditor identity. These auditors move first and offer to their client i audit services of quality q_{ik} against an audit fee p_{ik}, where i and k respectively indicate the identity of the client and the auditor.

[5] Gerakos and Syverson (2015) and Liang (2015) study mandatory audit firm rotation in a static models; Guo et al. (2017) and Guo et al. (2022) examine joint audits and audit industry specialization using static discrete choice models; Li et al. (2018) present a static model incorporating decisions of both clients and auditors.

Let π_{ik} be the period profit that audit firm k receives when client i chooses to pursue an audit and selects audit firm j:

$$\pi_{ik} = \begin{cases} p_{ik} - \frac{c_{ik}}{2} q_{ik}^2 & \text{if } k = j \\ 0 & \text{if } k \neq j \end{cases}, \tag{1}$$

where p_{ik} is the audit fee charged by auditor k for client i and q_{ik} is the quality of audit services offered to client i by auditor k.

When audit firm k is selected, the audit quality q_{ik} it offers comes at a marginal cost, which is influenced by the parameter c_{ik}. A Big 10 audit firm might benefit from expertise and bear a lower marginal cost given the same audit quality. Alternatively, Big 10 audit firms might not offer tailored solutions to private client firms, and their marginal costs could be higher. In equilibrium, audit quality and fees vary across auditors as well as clients due to the heterogeneity of audit firms and demand for audit services from clients.

Client's Period Utility

In each period t, client i simultaneously chooses (i) whether to hire an audit firm to certify its financial statements or not $j_{it} \in \{0, b, nb\}$, where $j_{it} = 0$ corresponds to no audit and $j_{it} = b$ ($j_{it} = nb$) indicates one of the Big 10 audit firms (non-Big 10 audit firms), and (ii) whether to increase debt $l_{it} \in \{0, 1\}$, where l_{it} equals one when the client increases total liabilities over the year, and zero otherwise. Clients make their choices after observing what the audit firms propose. In what follows, we suppress the subscripts i and t to save notations whenever doing so does not cause confusion.

The client's period utility combines their preferences for audit services and increasing debt:

$$u_{jl}(Size, Loss, NegEq, j_{-1}, p_j, q_j, \varepsilon_{jl}) \tag{2}$$

$$= \underbrace{\mathbb{1}\{j \neq 0\}(q_j - \theta p_j)}_{\text{Net audit quality}}$$
$$+ \underbrace{\mathbb{1}\{j = b\}\left(\lambda_0^b + \lambda_1^b Size + \lambda_2^b Loss + \lambda_3^b NegEq + \lambda_4^b \mathbb{1}\{j_{-1} = b\}\right)}_{\text{Matching with Big 10}}$$
$$+ \underbrace{\mathbb{1}\{j = nb\}\left(\lambda_0^{nb} + \lambda_1^{nb} Size + \lambda_2^{nb} Loss + \lambda_3^{nb} NegEq + \lambda_4^{nb} \mathbb{1}\{j_{-1} = nb\}\right)}_{\text{Matching with Non-Big 10}}$$
$$+ \underbrace{l\left(\nu_0 + \nu_1 Size + \nu_2 Loss + \nu_3 NegEq + \nu_4 \mathbb{1}\{j = b\} + \nu_5 \mathbb{1}\{j = nb\} + \delta q_j\right)}_{\text{Increasing Debt}} + \underbrace{\varepsilon_{jl}}_{\text{Random error}} \tag{3}$$

The first component, *net audit quality*, measures the audit quality to the client, net of audit fee, for selecting an audit firm, i.e., $j \neq 0$. This term is measured in utility units and equals $q_j - \theta p_j$, where q_j and p_j are, respectively, audit quality and audit fee offered by audit firm j. It does not take into account clients' heterogeneity in their preferences for audit services and thus only captures vertical product differentiation. It differs across audit firms and clients. The parameter θ corresponds to the sensitivity of the client's utility to audit fees and should be positive as we expect a downward-sloping demand curve.[6]

The second and third components include the value of matching with a Big 10 or a non-Big 10. This matching value is incremental to the first component. On the one hand, there is supporting evidence that the investing community regards Big 10 audit firms as more reputable than non-Big 10 ($\lambda_0^b > \lambda_0^{nb}$). On the other hand, the audit procedures of Big 10s might not necessarily be well adapted to private client firms' needs ($\lambda_0^b < \lambda_0^{nb}$). For example, Big 10s often offer standardized audit procedures, which private client firms might find too stringent, whereas non-Big 10 audit firms might be closer to their clients' needs and tailor better solutions to respond to their business

[6] It is important to estimate θ so the model-generated price elasticity is close to that observed in the data.

problems.

We also allow the value of matching with an audit firm to vary with client and auditor characteristics. Small, highly levered (i.e., those with negative equity), and loss firms may need the additional reputation of a Big 10 audit firm.[7] In this case, $\lambda_1^b < \lambda_1^{nb}$, $\lambda_2^b > \lambda_2^{nb}$, and $\lambda_3^b > \lambda_3^{nb}$. Alternatively, these firms may prefer non-Big 10 auditors because their auditing procedures are less stringent. In this case, $\lambda_1^b > \lambda_1^{nb}$, $\lambda_2^b < \lambda_2^{nb}$, and $\lambda_3^b < \lambda_3^{nb}$. We capture the value of renewing audit services by including past audit choices $\mathbb{1}\{j_{-1} = b\}$ and $\mathbb{1}\{j_{-1} = nb\}$ and expect the parameters on these variables to be positive ($\lambda_4^b > 0$ and $\lambda_4^{nb} > 0$) because clients in need of audit services in the previous period often prefer to hire the same audit firm in the current period.

The final component corresponds to the value of increasing debt. The value of increasing debt depends on the client's characteristics. Smaller clients might need to expand and finance their business opportunities by increasing debt. In contrast, larger clients might rely less on debt financing to pursue their business operations. More leveraged firms might be less inclined to increase their debt exposure further. Finally, less profitable clients might need more debt to keep their businesses afloat, and profitable ones might need more debt to chase successful investment opportunities. The parameters ν_1, ν_2, and ν_3 determine the incremental effect of each client's characteristic. The parameter ν_0 measures the preference of increasing debt not attributable to the client's characteristics.

We capture the effect of audits on debt choices through the parameters ν_4 and ν_5. Prior research indicates that private firms voluntarily choosing an audit often experience a lower cost of

[7] Minnis (2011) documents that clients with negative equity (i.e., total liabilities exceeding total assets) are more likely to hire an audit firm than those without. Moreover, after controlling for negative equity, Minnis (2011) finds that leverage does not have any incremental effect on clients' audit choices. Thus, following Minnis (2011), we capture leverage using negative equity ($NegEq$), an indicator variable that equals one when the client's total liability exceeds total assets.

debt (Minnis, 2011). The audit provides prospective lenders with assurance that the financial statements are reliable, thereby reducing the perceived risk of lending to the firm through certification procedures. The audit should help secure debt, suggesting $\nu_4 > 0$ and $\nu_5 > 0$. Nevertheless, when clients opt for an audit, a rigorous audit process can help detect financial risks and promote prudent financial management. This implies that higher audit quality can incentivize clients to exercise caution in increasing leverage. This disciplinary effect strengthens the credibility of the audit in the eyes of lenders by establishing safeguards that limit excessive risk-taking. As audit quality promotes financial stability and effective risk management (Choi, Doogar, and Ganguly, 2004; Gul, Kim, and Qiu, 2010; DeFond and Zhang, 2014), higher audit quality can decrease the likelihood of firms taking on additional debt, implying $\delta < 0$.

Finally, the random error ε_{jl} is not observed by the econometrician and follows a type I extreme value distribution, as is common in discrete choice models. These error terms capture the reasons for clients' debt decisions and audit firm/no-audit choices in a particular period that are not explicitly modeled. For instance, the value of audit services might be due to pressure from stakeholders or consumers or a safeguard put in place to monitor the management leadership. Interrupting audit services might stem from a disagreement between the client and their auditors. Taking new debt might be associated with new business ventures or economic conditions.

State Variables and their Law of Motion

We distinguish between two types of state variables. The first type includes the state variables observed by the econometrician and audit firms: the vector $\mathbf{s} \equiv (Size, Loss, NegEq, j_{-1})$ contains the clients' characteristics (i.e., *Size*, *Loss*, and *NegEq*) and $j_{-1} \in \{0, b, nb\}$. The value of j_{-1} is either no audit firm in the prior year if $j_{-1} = 0$, or the audit firm chosen in the previous period,

which is either a Big 10 audit firm if $j_{-1} = b$ or a non-Big 10 audit firm if $j_{-1} = nb$. The second type of state variables $(\varepsilon_{jl} \forall j,l)'$ are observed by the client but not by the audit firms or the econometrician.

To describe the law of motion of the different variables, we use the prime notation to denote future states. The law of motion for *Loss*, *Size*, and *NegEq* are random and characterized by a Markov transition density $f(Loss', Size', NegEq' | Loss, Size, NegEq, l)$. We allow the current year's client's debt choice to influence the law of motion because increasing debt should have an impact on the leverage ratio and, in turn, firm size and loss of the following year. Following prior studies, we assume that $\varepsilon_{j,l}$ is independent across (j,l) and time t.

Expected Profits and Utilities

Audit Firm

Given (1), the audit firm k's expected profit $\bar{\pi}_k(\mathbf{s},\mathbf{p},\mathbf{q}) \equiv \mathbb{E}(\pi_k|\mathbf{s},\mathbf{p},\mathbf{q})$ equals

$$\bar{\pi}_k(\mathbf{p},\mathbf{q},\mathbf{s}) = \left(d_{k,0}(\mathbf{p},\mathbf{q},\mathbf{s}) + d_{k,1}(\mathbf{p},\mathbf{q},\mathbf{s})\right)\left(p_k - \frac{c_k}{2}q_k^2\right),$$

where $\mathbf{p} \equiv (p_b(\mathbf{s}), p_{nb}(\mathbf{s}))'$ is a vector of the audit fees offered by audit firms b and nb, respectively, conditional on state $\mathbf{s}$; $\mathbf{q} \equiv (q_b(\mathbf{s}), q_{nb}(\mathbf{s}))'$ is a vector of the audit service value offered by audit firms b and nb, respectively, conditional on state $\mathbf{s}$; and $d_{k,0}(.)$ and $d_{k,1}(.)$ denote the *probability* that audit firm k is chosen and the client does not increase or increases debt, respectively. Assuming type I extreme value distribution for ε_{jl}, the probability of the client choosing j and l before

observing ε_{jl} equals

$$d_{j,l}(\mathbf{s}) = \frac{e^{v_{jl}(\mathbf{s},p_j,q_j)}}{\sum_{k,l}\left(e^{v_{k,l}(\mathbf{s},p_k,q_k)}\right)}, \tag{4}$$

and it can be directly estimated from the data by computing the empirical frequency of each choice for a given s.

Audit firm k maximizes the sum of expected discounted future profits, W_k, by simultaneously choosing p_k and q_k given the pairs of audit fee and quality chosen by competing audit firms, $\mathbf{p}_{-k}$ and $\mathbf{q}_{-k}$, given state $\mathbf{s}$.[8] The state variables for the audit firms are the same as those for the clients except that clients additionally observe ε_{jm}. The Bellman equation is

$$W_k(\mathbf{s};\mathbf{p}_{-k},\mathbf{q}_{-k}) = \max_{(p_k,q_k)}\left\{\bar{\pi}_k(\mathbf{p},\mathbf{q},\mathbf{s}) + \beta\sum_{j,l}\left\{d_{j,l}(\mathbf{p},\mathbf{q},\mathbf{s})\mathbb{E}\left[W_k(\mathbf{s}';\mathbf{p}'_{-k},\mathbf{q}'_{-k})|j,l,\mathbf{s}\right]\right\}\right\}.$$

Audit firm k's audit fee and quality offers satisfy the first-order conditions:

$$\frac{\partial W_k(\mathbf{s};\mathbf{p}_{-k},\mathbf{q}_{-k})}{\partial q_k} = \frac{\partial \bar{\pi}_k}{\partial q_k} + \beta\sum_{j,l}\left\{\frac{\partial d_{j,l}}{\partial q_k}\underbrace{\mathbb{E}\left[W_k(\mathbf{s}';\mathbf{p}'_{-k},\mathbf{q}'_{-k})|j,l,\mathbf{s}\right]}_{>0}\right\},$$

$$\frac{\partial W_k(\mathbf{s};\mathbf{p}_{-k},\mathbf{q}_{-k})}{\partial p_k} = \frac{\partial \bar{\pi}_k}{\partial p_k} + \beta\sum_{j,l}\left\{\frac{\partial d_{j,l}}{\partial p_k}\underbrace{\mathbb{E}\left[W_k(\mathbf{s}';\mathbf{p}'_{-k},\mathbf{q}'_{-k})|j,l,\mathbf{s}\right]}_{>0}\right\}.$$

[8] Audit quality is recovered in our model taking into account audit competition. Audit competition has been documented to be an important driver of audit quality as in Pan, Shroff, and Zhang (2023).

Clients' Expected Utility

The client maximizes the sum of the discounted future utilities as follows:

$$v_{jl}(\mathbf{s}, p_j, q_j) = \bar{u}_{jl}(\mathbf{s}, p_j, q_j) + \beta \mathbb{E}_{s',\varepsilon'} \left[\max_{j',l'} \left\{ v_{j',l'}(s') + \varepsilon'_{j',l'} | j, l, s \right\} \right]. \tag{5}$$

The function $v_{jl}(\mathbf{s})$ is the *choice-specific value function*, and the expectation is taken over $\mathbf{s}'$, ε', given current state $\mathbf{s}$ and the client's choices j and l, with discount factor $\beta \in (0,1)$. We use $\bar{u}_{jl}(\mathbf{s})$ to refer to the current period utility excluding the error terms.

The audit and new debt decisions are determined by

$$(j^*, l^*) \in argmax_{j,l} \left\{ v_{jl}(\mathbf{s}, p_j, q_j) + \varepsilon_{jl} \right\}. \tag{6}$$

We now define the choice-specific value functions as follows

$$v_{jl}(\mathbf{s}, p_j, q_j) = \bar{u}_{jl}(\mathbf{s}, p_j, q_j) + \beta \mathbb{E}_{s'} \left[\underbrace{log \left(\sum_{j' \in \{0,b,nb\}} \left(e^{v_{j',0}(\mathbf{s}')} + e^{v_{j',1}(\mathbf{s}')} \right) \right) + \gamma}_{\equiv V(\mathbf{s}') \text{ Ex ante value function}} | j, l, \mathbf{s} \right], \tag{7}$$

where γ is Euler's constant.

The additional term $\mathbb{E}_{\mathbf{s}'}[V(\mathbf{s}')|j,l,\mathbf{s}]$ represents the expected future utility given the choice of (j,l) by the client and the current state $\mathbf{s}$. Clients account for the impact of their current decisions on future states $\mathbf{s}'$ and, in turn, $V(\mathbf{s}')$. The law of motion explicitly links the current choices and future states, driving clients' dynamic behavior.

3 Data and Estimation

3.1 Sample Selection

We obtain data on Chinese private companies and their audit firms from 2013 until 2018 from different sources. Our sample of private client firms comprises 1,807,392 firm-year observations obtained from the Red Shield Company, an entity associated with the State Administration for Industry and Commerce (SAIC) in China, which provided us with the data for academic research purposes. We then merge these private firm data with their audit firm information obtained from the Ministry of Finance (MOF) in China. We first exclude clients with only one observation during our sample period, resulting in the removal of 43,480 observations. Next, 586,805 observations are dropped due to missing firm characteristics or invalid audit fees (e.g., audit fees less than zero). Finally, we exclude 112,176 observations where total assets in the first year of our sample period are less than 10,000 yuan, the leverage value is negative, or lagged leverage is negative. We then winsorize the ratio of audit fees to total assets at the 1st and 99th percentiles for audited clients. Our final sample comprises 1,064,931 client firm-year observations. Table 1 summarizes the sample selection process and the associated statistics. A non-negligible proportion of these client firm-year observations, i.e., 11.08%, consists of repeated audits. Among these repeated audits, 68.70% have renewed non-Big 10 audits whereas 29.02% Big 10 audits.[9]

[9] In an untabulated table, 37.81% of unique client firms choose to hire an auditor, and among them, 18.79% choose to hire Big 10 auditors. Additionally, almost no client firms went public (with 0.25% observations). Few of the audit firms (25 of them) have received a government penalty. Given the low number of observations on going public or incurring a government penalty, we do not model these alternative reasons for choosing an audit.

3.2 Reduced-Form Evidence

Table 2 Panel A presents the summary statistics of the variables used in our analyses. Focusing on the client firm-year observations, clients tend to issue debt approximately 57.1% of the time during our sample period and hire an audit firm about 26.53% of the time. When they choose to be audited, they prefer a non-Big 10 audit firm 79.09% of the time.

There are significant cross-sectional differences in client characteristics. On average, clients possess total assets amounting to 302.990 million Chinese *yuan* with a large standard deviation of 940.509 million Chinese *yuan*, spanning small clients (10th percentile) with 2.245 million Chinese *yuan* of total assets and larger clients (90th percentile) with 638.834 million Chinese *yuan* of total assets. Leverage stands at a high average level of 60.6% with a median level of 59.3%, indicating that private firms have substantial liabilities and may rely more on debt financing. These summary descriptive statistics suggest that debtholders might require certified financial statements to extend more debt. The average (median) client's profitability for the full sample is about -1.1% (0.2%) of total assets with a standard deviation of 16.5%. About 43.9% of our client firm-year observations earn profits. The relatively low profit levels suggest that our sampled private firms, particularly those in the manufacturing sector (the most represented industry in our sample; see Table A.1 in the Appendix), may be investing in new technologies or manufacturing processes that have not yet yielded sustainable revenue streams. This situation could drive demand for financial statement verification.

In the subsample of client firm-year observations of clients hiring audit firms (Panel B), their average (median) profitability is higher by about -0.4% (0.5%) of total assets, with a standard deviation of 16.7%. The average audit fees are equivalent to 72,116.41 Chinese *yuan*, approximately

$10,302 if we take the conversion rate from Chinese *yuan* to US dollars to be roughly 7:1, consistent with prior research (Liu and Tong, 2025). The average Big 10 audit fees are 230,503 Chinese *yuan*, while the average non-Big 10 audit fees are 32,677 Chinese *yuan*.

The descriptive statistics suggest that Chinese private firms are relatively small and generate low levels of profits. Given the substantial cross-sectional variations, we incorporate in the CCP model, three variables (*Size*, *Loss*, and *NegEq*) to account for client heterogeneity. Clients' preferences for audit services often arise from the need to enhance the reliability of financial statements, providing reassurance to stakeholders, and facilitating access to additional debt financing. However, this certification may hold even greater significance in this context, as our summary statistics indicate that these private firms are likely in the earlier stages of their business life cycle, operate within fast-growing markets, and exhibit a strong appetite for expansion.

Table 2 Panel C illustrates the association between clients' audit and debt choices. Among clients without an auditor, 56.6% increase debt, compared to 58.6% among clients with an auditor. This small but positive correlation is consistent with audits facilitating debt financing.[10] In untabulated additional analyses, we confirm a robust positive correlation between clients engaging auditors and their choices in issuing debt, consistent with the usefulness of audits for clients' debt issuance.

3.3 Estimation and Identification

We adapt the CCP approach, developed by Hotz and Miller (1993), to estimate our model. The CCP approach exploits the one-to-one mapping between the CCPs and the value functions. We

[10]We do not observe the breakdown in liabilities between short- and long-term liabilities or different types of liabilities. We use the increase in total liabilities as a proxy for raising debt.

extend this estimation approach by considering the interaction between clients' and audit firms' choices following Cheynel and Zhou (2024), as discussed in the Appendix. We estimate the model via maximum likelihood estimation. The likelihood function consists of two parts: (i) clients' audit and debt choices conditional on the state variables **s** and audit fees **p** and (ii) the likelihood function for audit fees **p** conditional on the state variables **s**. Without loss of generality, the client's current-period utility of no audit and no additional debt is normalized to zero, so the utility of the remaining choices is defined relative to this baseline. We estimate the model parameters, denoted by the vector Θ', by maximizing the likelihood function:

$$L(\Theta|Data) = \prod_{i,t} \left(\prod_{j=0}^{2} \prod_{l=0}^{1} d_{i,t,j,l}(j_{it}, l_{it}; \mathbf{p}_{i,t}, \Theta)^{\mathbb{1}\{j_{it}=j\} \times \mathbb{1}\{l_{it}=l\}} \pi(\mathbf{p}_{i,t}; \Theta) \right),$$

where $d_{i,t,j,l}$ is the joint probability of auditor (j_{it}) and debt (l_{it}) choices for client i in year t; $\mathbf{p}_{i,t}$ represents the vector of audit fees faced by client i in year t; and $\pi(.)$ is the likelihood function of audit fees, assumed to follow a normal distribution.

Identification in our model relies on three complementary sources of variation: cross-sectional differences across firms, within-firm time-series variation, and equilibrium variation across auditor types generated by strategic interaction. Cross-sectional variation arises from persistent differences in client characteristics such as size, profitability, and leverage status, which generate systematic heterogeneity in audit and debt choices. Within-firm time-series variation comes from changes in these characteristics over time, as well as from switching, renewal, and termination of audit relationships. Finally, equilibrium variation reflects how Big 10 and non-Big 10 auditors adjust fees and quality in response to client states and competitive pressure, creating structured differences in the offers that clients face.

The law of motion for client characteristics and audit history is identified from observed one-period transitions and therefore exploits both cross-sectional and within-firm variation. Conditional choice probabilities for audit and debt decisions are identified from repeated observations of firms in the same state and from transitions between states. Given these objects, the continuation-value component of utility is deterministically pinned down as a function of current states and choices. As a result, dynamic incentives are identified from the time-series structure of the data but do not rely on unobserved expectations or excluded instruments. Once continuation values are fixed, remaining variation in relative choice frequencies across audit and debt options identifies the period-utility parameters.

Preferences for auditor types are identified from systematic substitution patterns across auditor choices. Cross-sectional variation in auditor selection across firms with different characteristics identifies how client fundamentals affect the relative attractiveness of Big 10, non-Big 10, and no audit options. Within-firm time-series variation identifies the incremental value of maintaining an audit relationship: conditional on current fundamentals, fees, and continuation values, observed renewal and switching behavior pins down the relationship-specific persistence parameters.

Our estimation also needs to identify missing fees. In our model, equilibrium audit fees charged by auditors vary with the state variables, making the relationship between the audit fees charged by the chosen audit firm and the state variables informative about the fees offered by non-chosen auditors (see equation (A.9) in the Appendix). Gerakos and Syverson (2015) propose a machine learning approach to impute missing audit fees of the non-selected audit firms by using the state variables as explanatory variables. We follow their approach and impute missing audit fees before estimating the model.

Another identification challenge is audit quality q, which is not directly observable. Our es-

timation recovers audit quality from equilibrium conditions. In our model, audit firms' optimal quality choices depend on competitive conditions and how quality affects clients' auditor choices. The formulae for audit quality chosen by audit firm j facing client i are derived in the Appendix (see equation (A.8)) and used in the estimation. In other words, audit quality is identified through equilibrium variation across auditor types and client states and through its distinct effect on debt choices. Importantly, audit quality is identified separately from audit fees. Fees affect auditor choice directly through price sensitivity, whereas quality affects both auditor choice and debt decisions. Conditional on audit adoption, variation in debt choices across auditor types and states is informative about quality but not about fees, which do not enter the debt utility directly. Moreover, equilibrium optimality conditions imply that fees and quality are jointly chosen but not proportional: convex quality costs and heterogeneous competitive pressure allow auditors to charge similar fees while offering different quality, or vice versa. These restrictions ensure that audit quality is not absorbed into price sensitivity or matching effects but is separately identified from both cross-sectional and time-series variation in the data.

Turning to the other parameters, the fee-sensitivity parameter θ is identified from substitution in auditor choice as relative fees vary across auditor types and client states. This variation is primarily cross-sectional, as different firms face systematically different fee schedules, but it also has a time-series component as firms grow, incur losses, or change leverage status and are re-priced by auditors. Differences in fees and market shares between Big 10 and non-Big 10 auditors across states imply different quality–cost trade-offs, which identify audit cost parameters c_k. Conditional on being audited, cross-sectional and within-firm variation in debt expansion across inferred quality levels identifies the effect of audit quality on leverage decisions δ.

4 Results

4.1 Model Fit

We first evaluate model fit by comparing the predicted probabilities to choose an audit and increasing debt to their empirical analogs.

Table 3 reports the comparison and demonstrates that the model captures well the audit and debt choices. First, the first two columns of Table 3 compare the empirical frequency of increasing debt (column (1)) with the model-predicted frequency of increasing debt (column (2)), averaged over the full sample. The two numbers are almost identical at 57%. Second, the last two columns compare the empirical frequency of choosing an audit (column (3)) with the model-predicted frequency of choosing an audit (column (4)), averaged over the full sample. Again, the two numbers are close, at around 26.5%.

4.2 Estimation Results

4.2.1 The Supply of Audit Services

We present the average audit fees (p) and audit quality (q) offered in equilibrium by Big 10 and non-Big 10 auditors in Table 4 Panel A.[11] The panel demonstrates significant differences in audit quality and fees between Big 10 and non-Big 10 audit firms. On average, the quality of Big 10 audits is higher than that of non-Big 10 audits. However, this higher quality comes at a greater cost for clients, with Big 10 firms charging audit fees equal to about 0.6% of clients' total assets, compared to 0.3% charged by non-Big 10 firms.

[11] Over 95% of private firm clients in our sample purchase only audit services. Among the remainder, we estimate that only around 1.6% of total observations purchased non-audit services prior to audit services from the same firm. Thus, our estimates of audit quality primarily reflect the value of audit services rather than bundled offerings.

Figure 1 plots the cross-sectional distributions of audit quality and fees for Big 10 and non-Big 10 audits. Consistent with Table 4 Panel A, the figure demonstrates that Big 10 auditors consistently deliver higher audit quality but also charge higher fees than non-Big 10 auditors. One notable result is that the cross-sectional variation in audit quality offered by the same auditor type is minimal. In contrast, audit fees vary more across clients. As discussed below, as clients' auditor choices are more sensitive to audit fees than to audit quality (i.e., $\theta = 2.774$), auditors compete for clients with audit fees. As such, audit fees vary with client characteristics more than audit quality do. The results also suggest that while audit fees are positively associated with audit quality, fees are a noisy proxy for audit quality.

To further understand the economic consequences of audit quality and fees *for audit firms*, Table 4 Panel B reports the cost parameter estimates for auditors' profit function. Both parameters are positive and statistically significant. Big 10 auditors have lower marginal costs for the same level of audit quality ($c_b = 0.123 < c_{nb} = 0.373$), consistent with economies of scale.

Table 4 Panel C presents the cross-sectional distribution of audit costs ($\frac{c_k}{2}q_k^2$) and profits (π_k) for both auditor types. We highlight two findings. First, despite having a higher cost parameter, non-Big 10 audit firms incur lower total audit costs (0.16% of clients' total assets) than Big 10 firms (0.47%). This occurs because non-Big 10 auditors offer substantially lower quality (Panel A: $q_{nb} =$ 0.92 vs. $q_b = 2.77$), and the quadratic cost function means that lower quality dramatically reduces total costs. There is little cross-sectional variation in audit costs within auditor type because audit quality varies little across clients, as shown in Figure 1.

Second, non-Big 10 audit firms earn higher average profits (0.17% of clients' total assets) than Big 10 firms (0.12%), despite charging lower fees. This reflects their lower total costs. However, audit profits exhibit greater cross-sectional heterogeneity among Big 10 firms (SD = 0.05%) than

non-Big 10 firms (SD = 0.02%), driven by greater fee variation across Big 10 clients.

4.2.2 Clients' Demand for Audit Services

This section presents results for clients' demand for audit services, focusing on the effects of audit engagements on clients' current period utility. We study intertemporal effects in Section 4.4, where we distinguish between myopic and forward-looking choices. Given that our benchmark is no audit and no increase in debt, we interpret all estimates relative to this benchmark.

Table 5 Panel A reports the parameter estimates for clients' period utility. We find that larger client firms incur greater current-period disutility from audits ($\lambda_1^b < 0$ and $\lambda_1^{nb} < 0$). Loss-making and highly levered client firms derive higher current-period utility from non-Big 10 audits but lower utility from Big 10 audits (i.e., $\lambda_2^b < 0 < \lambda_2^{nb}$ and $\lambda_3^b < 0 < \lambda_3^{nb}$). This finding suggests that less stringent procedures of non-Big 10 auditors are more appealing to these client firms.

Table 5 Panel B presents estimates of the value of audit services, defined as audit quality scaled by the price sensitivity parameter θ, net of audit fees: $Q - p$ where $Q \equiv q/\theta$. This scaling allows us to interpret values as percentage points of clients' total assets. We first compute the service value offered by each auditor type (Big 10 and non-Big 10) *regardless of clients' auditor choice*, reporting the average across all clients in our data. This approach captures the value of audit services for all clients, including those who do not choose an audit. Because we do not condition on clients' actual auditor choice, their idiosyncratic tastes (i.e., ε_{ijl} in equation (3)) are set to zero.

The first row of Table 5 Panel B shows that Big 10 audits generate significantly higher net audit quality, equivalent to 0.408% of total assets, while non-Big 10 audits provide net audit quality close to zero (0.000% of total assets). This finding suggests that, relative to the audit fee they charge, Big 10 audit firms deliver higher-quality services than non-Big 10 firms.

We also examine the value of audit services conditional on the auditor being the optimal choice for the client and reach a similar conclusion. Specifically, the second row of Table 5 Panel B shows a higher benefit to hiring a Big 10 audit firm relative to a non-Big 10, with net value of non-Big 10 audits again close to zero.

Why do some clients choose non-Big 10 audits if their net audit quality is close to zero? The net audit quality measure ($Q - p$) captures the direct value of audit quality net of fees but excludes two additional sources of value. First, as shown in Section 4.2.3, the certification effect ($\nu_4, \nu_5 > 0$) provides additional signaling value when clients seek to expand debt. Second, the matching value captures firm-specific preferences, such as flexibility in audit procedures, familiarity with the client's business, or lower switching costs from prior relationships. Thus, even when net audit quality is close to zero, clients may still benefit from non-Big 10 audits through the these channels.

In conjunction with the descriptive evidence that only 26.5% of clients choose an audit, the evidence indicates that many clients do not choose an audit for reasons unrelated to net audit value.

Validation of Estimated Audit Quality. Audit quality is not directly observed and is therefore recovered as a latent variable from equilibrium conditions. To assess the external validity of this measure, we examine whether the estimated audit quality is systematically related to ex post outcomes that are widely regarded as informative about audit quality and that do not enter the estimation. If the recovered variable captures meaningful dimensions of audit quality, it should align with established empirical regularities observed outside the model.

We focus on subsequent IPOs and bankruptcies because they summarize two distinct consequences of credible financial reporting. Access to public equity markets requires financial state-

ments that are sufficiently reliable to withstand scrutiny by outside investors, underwriters, and regulators, while bankruptcies reflect extreme realizations of financial distress that more intensive audits are expected to limit by constraining misreporting and revealing problems earlier. These outcomes are realized after the audit engagement and are not inputs into the estimation, making them well suited to evaluate whether the recovered measure behaves as an audit quality variable should.

We find that estimated audit quality q is positively correlated with subsequent IPO and negatively correlated with subsequent bankruptcy, both statistically significant at the 10% level.[12] We acknowledge that the IPO correlation may partly reflect selection: firms planning to go public may proactively choose higher-quality auditors. However, the negative correlation with subsequent bankruptcy, where reverse causality is less plausible, provides additional support. Together, these associations are consistent with our estimated q capturing economically meaningful differences in assurance intensity, though we interpret these as validation correlations rather than causal estimates.

4.2.3 Effects of Audits on Clients' Debt Choices

Table 6 Panel A reports parameter estimates for the component of clients' utility that relates to increasing debt. The estimation yields a positive current-period utility from increasing debt regardless of the clients' characteristics, as shown by $\nu_0 > 0$, consistent with private firms relying heavily on debt financing. This benefit of increasing debt is more significant for smaller firms ($\nu_1 < 0$), as they are often more cash-constrained and typically in the earlier stages of their life

[12] We define subsequent IPO (bankruptcy) as an indicator equal to one if the client experiences an IPO (bankruptcy) after the current observation year. Results are similar using indicators for whether the client ever experienced an IPO or bankruptcy.

cycle. Loss-making firms obtain a higher utility from increasing debt ($\nu_2 > 0$), consistent with greater external financing needs. Levered firms incur a disutility in raising debt ($\nu_3 < 0$), plausibly because additional leverage might put their business at risk of insolvency or bankruptcy.

We further examine the effects of audits on clients' debt choices in Table 6 Panel B. Audits affect debt through two channels that work in opposite directions. Obtaining an audit facilitates access to debt ($\nu_4 > 0$ and $\nu_5 > 0$), consistent with an audit signaling better credit quality to lenders. At the same time, higher audit quality constraints clients' debt expansion ($\delta < 0$), consistent with a disciplinary role that limits excessive leverage. Table 6 Panel B reports the net effect, expressed as a percentage of total assets. Whether clients hire a Big 10 or a non-Big 10 audit firm, an audit overall supports their debt decision: the net value is 0.082% of total assets for Big 10 and 0.026% for non-Big 10 audits. This indicates that the signaling effect dominates the disciplinary effect. Audit services certify financial statements to potential lenders while also constraining clients from taking on excessive risk.

4.3 Mandatory Audits

4.3.1 Counterfactual Setup

This section examines the effect of mandatory audits. To conduct this counterfactual analysis, we start with all firm-year observations in our sample and simulate their audit and debt choices, assuming that they are required to hire an audit firm. We also allow audit firms to charge different audit fees and provide different quality of audit services, anticipating changes in clients' demand for audits. Because all clients are mandated to have an audit, the signaling value of choosing to be audited, as distinct from not being audited, disappears. As such, we set ν_4 and ν_5 to zero for most

of our analyses and also investigate the sensitivity to this assumption. Note that we maintain the quality difference between auditor types ($q_b > q_{nb}$) and allow clients to choose based on net audit quality and matching preferences. The restriction applies only to the extensive margin (having an audit vs. not), not to the intensive margin (Big 10 vs. non-Big 10 choice), which may still convey information to lenders.

4.3.2 Market Structure and Client Choices

Table 7 Panel A presents the results. We observe a significant increase in the Big 10's market share under the mandatory audit regime, from 21% (column (4)) to 86% (column (2)).[13] Additionally, the probability for clients to expand debt decreases from 57% (column (3)) to 37% (column (1)).

Our counterfactual analysis assumes that no new audit firms enter the market. This assumption likely produces an upper bound on the effects of a mandate. Breuer et al. (2023) find that clients respond to mandatory compliance requirements by selecting auditors with low fees and low audit quality. If a new low-cost entrant were to emerge under a mandate, some clients would choose this option, dampening the shift toward Big 10 auditors. In the extreme, an entrant offering zero fees and zero quality would effectively replicate the no-audit option, returning us to the voluntary regime.

We investigate the sensitivity of our results to entry by assuming that a third auditor with the same cost parameter as non-Big 10 auditors enters the market. Table 8 presents these results. The inferences are consistent with those from Table 7: Big 10 market share increases while non-Big 10 market share decreases, driven by lower Big 10 fees and higher non-Big 10 fees. Audit quality

[13] Big 10 auditors in the Chinese private firm market serve clients across the size distribution. In our sample, the client size distribution at the lower end is similar between Big 10 and non-Big 10 auditors, with Big 10 firms auditing some of the smallest clients. This institutional feature of the Chinese private audit market makes our counterfactual exercises, which consider scenarios where clients switch between auditor types, empirically grounded.

shows minimal change, and the client's propensity to raise debt decreases.

4.3.3 Auditors' Competitive Response

We take several steps to understand why clients' choices change and the broader impact of audit mandates. We start by examining how audit firms adjust their services in response to the mandate.

Two economic forces are at play. First, clients who previously did not choose an audit must now select an auditor, incentivizing auditors to compete for these new clients. This effect is stronger for Big 10 auditors. Conditional on the same client characteristics, Big 10 audits are preferred due to a higher net audit value, as shown in Table 5 Panel B, implying that Big 10 auditors are more likely to win clients. A greater likelihood of winning further increases their incentive to compete.

Second, the increase in the number of clients due to the audit mandate can reduce audit market competition, driving up audit fees. This effect is stronger for non-Big 10 auditors. Under the voluntary regime, the net value of non-Big 10 audits is close to zero, equivalent to the value of the no-audit option. Non-Big 10 auditors must therefore compete for clients who might otherwise forgo an audit. This competitive pressure disappears under a mandate, as all clients must hire an auditor. As such, non-Big 10 auditors' incentive to compete decreases. The new equilibrium balances these two forces.

Table 7 Panel B compares audit services under the voluntary and mandatory regimes. Audit firms do not significantly change the quality of their services in an economically meaningful way. However, audit fees change materially. The panel examines changes in the quality of audit services and audit fees offered by audit firms (irrespective of clients' audit choice). The quality of non-Big 10 audit services accounts for approximately 0.33% of total assets under both regime. Similarly, Big 10 audit services are valued at approximately 1% of total assets in both regimes. In

contrast, we observe significant changes in audit fees: under the mandatory regime, Big 10 auditors reduce fees while non-Big 10 auditors increase them. These fee changes contribute to the increase in Big 10 market share and the decrease in non-Big 10 market share. The results suggest that Big 10 auditors compete more aggressively for clients newly mandated audits, whereas non-Big 10 auditors compete less aggressively.

4.3.4 Audit Quality Received by Clients

Our second set of analyses examines changes in audit quality resulting from changes in clients' auditor choices. Even if the quality of audit services offered by auditors (in Table 7 Panel B) remains largely unchanged between voluntary and mandatory regimes, the quality of services received by clients (in Table 9 Panel A) might change because clients make different auditor choices. For example, clients are more likely to choose a Big 10 auditor under the mandatory regime given that Big 10 auditors reduce their fees. Because Big 10 auditors offer higher-quality services, the audit quality clients experience should improve.

We investigate this possibility in Table 9 Panel A, differentiating whether clients obtained an audit in the prior year in the voluntary regime. We make this distinction because clients that did not obtain an audit in the prior year are *less* likely to choose an audit voluntarily and, therefore, are more affected by the mandate. The first column examines client firms that did not obtain an audit in the prior year under the voluntary regime; the second column examines those that did. We analyze three scenarios: (i) the voluntary regime, serving as a benchmark, (ii) the mandatory regime where clients choose auditors in the same way as under the voluntary regime (i.e., no client re-optimization with the signaling effect on debt expansion), and (iii) the mandatory regime where clients re-optimize in response to changes in audit services and the requirement to obtain an audit.

Examining changes in audit quality across the three scenarios in Table 9 Panel A reveals an increase in audit quality due to the mandate. Comparing the first two rows provides insights into the *direct* effect of the mandate. The only difference between the voluntary regime (first row) and the mandatory regime with no client re-optimization (second row) is that clients who previously opted out must now choose an auditor; the audit services offered and clients' audit choices remain unchanged. Because Big 10 audits offer higher net value to clients, those newly required to obtain an audit are more likely to select a Big 10 auditor, leading to an increase in the average audit quality clients receive.

Comparing the last two rows provides insights into the effect of client re-optimization. When clients re-optimize under the mandatory regime (third row), they prefer Big 10 audits even more because Big 10 auditors reduce their fees while non-Big 10 auditors increase theirs, with audit quality remaining similar across both regimes (Table 7 Panel B). As clients shift toward Big 10 auditors, audit quality further increases. These effects are stronger for clients who did not obtain an audit in the prior year, as the mandate forces them to switch from no audit to obtaining an audit, rather than simply continuing with a potentially different auditor.

Table 9 Panel B analyzes changes in audit quality experienced by each client as a function of their characteristics. The dependent variable is the difference in audit quality experienced by the client in the mandatory regime *relative to the voluntary regime*. Column (1) includes only indicators for clients' prior-year audit choices under the voluntary regime. Column (2) adds other client characteristics, including *Size*, *Loss*, and $NegEq$.

Two results from Table 9 Panel B are worth noting. First, clients who are more likely to switch to Big 10 auditors experience greater increases in audit quality. This pattern arises because Big 10 auditors offer higher-quality services than non-Big 10 auditors (Table 7) and are increasingly

preferred under the mandatory regime (Table 9 Panel A). Accordingly, clients who did not choose an audit in the prior year experience the largest increase in audit quality, followed by those who chose non-Big 10 auditors and then those who chose Big 10 auditors. Clients who previously had no audit or had a non-Big 10 auditor are more likely to switch to a Big 10 auditor under the mandate, driving their gains in audit quality. Second, changes in audit quality are not equally distributed across clients. In particular, larger clients and loss firms are less likely to experience an increase in audit quality.

4.3.5 Changes in Debt Choices

Our third set of analyses examines changes in clients' debt choices under mandatory audits, reported in Table 10. Because audit quality influences clients' debt choices (Table 6), the shift toward Big 10 auditors documented above should affect clients' borrowing behavior.

As in Table 9 Panel A, we distinguish clients by their prior-year audit choice under the voluntary regime and compare three scenarios: (i) the voluntary regime, (ii) the mandatory regime without re-optimization, and (iii) the mandatory regime with re-optimization.

Table 10 demonstrates an overall decrease in the likelihood of debt expansion when comparing the voluntary regime (first row) with the mandatory regime where clients re-optimize (third row). However, the pattern is more nuanced without client re-optimization. Clients who did not choose an audit in the prior year under the voluntary regime are *more likely* to increase debt under the mandatory regime when they make their audit and debt choices in the same way as under the voluntary regime (column (1), comparing the first and second rows). This occurs because clients are forced to have an audit, and having an audit facilitates debt increases (Table 6). Yet an important driver of such debt increases is the signaling effect of having an audit. Once all clients are required

to have an audit, this signaling effect ceases to exist. Therefore, as clients re-optimize their debt choices, they reduce their debt expansion under the mandatory regime.

4.3.6 Welfare Implications

Our final set of analyses addresses a natural question that follows from changes in audit and debt choices: how does clients' and auditors' welfare change following audit mandates? Although forcing clients to obtain an audit implies a decrease in their welfare, holding all else constant, re-optimization by auditors through changes in audit fees and by clients through changes in auditor choices can improve client welfare. The net effect on client welfare is therefore unclear.

Table 11 analyzes welfare changes due to audit mandates. Panel A compares average client welfare under mandatory audit with that under voluntary audit. To facilitate comparison, we express welfare on an *annualized* basis in terms of percentage points of total assets. Average welfare under mandatory audit is equivalent to 0.562% of total assets, lower than that under voluntary audit, which amounts to 0.603% of total assets. This decrease of 0.041% of total assets represents 0.12 million *yuan* for the average client in our data, which has total assets of 302 million *yuan*. Therefore, mandating audits imposes minimal losses on clients.

Panel B of Table 11 reports audit firms' expected profits under voluntary and mandatory regimes, showing that profits increase for both types of auditors. Across both settings, audit firms capture substantially less surplus than clients. However, mandatory audits benefit Big 10 firms more, increasing their expected profits from 0.009% to 0.055% of total assets. This surpasses the expected profits of non-Big 10 audit firms, which remain relatively stable, rising only from 0.036% to 0.041% of total assets.

4.3.7 Summary for Mandatory Audits

Overall, mandatory audits would significantly alter the audit landscape. Big 10 firms would expand their market dominance by reducing fees, making their higher-quality services more accessible. Clients would reduce debt expansion as the signaling value of audits disappears and higher audit quality disciplines leverage decisions.

From a welfare perspective, mandatory audits impose minimal costs on clients, approximately 0.04% of total assets, while increasing auditor profits, particularly for Big 10 firms. Our welfare analysis captures effects on clients and auditors, including the role of audits in debt financing. We do not model potential benefits to other parties such as investors or tax authorities. The small magnitude of client welfare losses suggests that audit mandates would not impose substantial burdens on private firms.

4.4 Additional Analyses: The Role of Forward-looking Clients

Our analyses presume that clients make forward-looking decisions. To isolate the importance of forward-looking behavior, we simulate myopic clients' audit and debt choices, holding constant the fees and audit quality supplied by auditors. A myopic client has a zero discount rate (i.e., $\beta = 0$). In this counterfactual, we assume that $\beta = 0.9$ in the baseline estimates corresponds with actual behavior in the data.

Table 12 Panel A presents the results. Myopic clients are less likely to choose an audit, consistent with audits providing long-term benefits. The probabilities of choosing a Big 10 and a non-Big 10 decrease by 2.7 and 2.5 percentage points, respectively, relative to forward-looking clients with $\beta = 0.9$. This pattern is consistent with audits ensuring the accuracy of financial

figures over time, reinforcing the positive value of prior audits documented in our current-period utility estimates. In contrast, we do not observe an economically significant change in the average probability of increasing debt.

We next examine why myopic clients' behavior differs. Because our counterfactual only changes clients' discount rate, any changes in choice probabilities are driven entirely by the loss of expected future utility. We therefore regress changes in choice probabilities (i.e., the choices by myopic clients relative to those by forward-looking clients) on the expected future utility associated with each choice:

$$\Delta \Pr\{a\} = \alpha_0 + \alpha_1 \left(\mathbb{E}_{s'} \left[V(s') | a \right] - \mathbb{E}_{s'} \left[V(s') | a_0 \right] \right) + \varepsilon, \tag{8}$$

where a denotes a specific action chosen by the client, namely $l = 1$, $j = b$, or $j = nb$; $\Delta \Pr\{a\}$ is the probability of action a under $\beta = 0$ relative to that under $\beta = 0.9$; and $\mathbb{E}_{s'}[V(s')|a] - \mathbb{E}_{s'}[V(s')|a_0]$ is the expected future utility associated with action a relative to the benchmark action a_0, which is either $l = 0$ (no debt increase) or $j = 0$ (no audit). We use differences in expected future utility as the explanatory variable because only these differences matter for clients' choices.[14]

Table 12 Panel B presents the results. Column (1) shows that clients with larger expected future utility from increasing debt (relative to not increasing it) is associated with a more significant decrease in the probability of issuing debt when myopic. The result also suggests that, although myopic clients' debt choices on average do not differ from those of forward-looking clients, cross-sectional differences exist. Columns (2) and (3) demonstrate that clients with larger expected future utilities from choosing a Big 10 or non-Big 10 auditor (relative to no audit) are associated with a

[14]The relation between probability changes and expected future utilities is not linear. Therefore, the linear regressions do not produce an R^2 of 100% and are meant to illustrate these relations transparently.

more significant decrease in the probability of choosing that auditor when myopic. These results confirm that audits provide long term benefits to clients.

5 Conclusion

Our study offers new insights into the value of audits and their role in shaping clients' debt financing decisions. While audit engagements generate higher-quality assurance that offsets audit fees, many clients do not opt for an audit, reflecting heterogeneity in demand for audit services. Our analysis also reveals important distinctions between Big 10 and non-Big 10 audit firms. Big 10 auditors deliver greater net value to clients, both through high-quality assurance services and by facilitating access to debt financing. Although Big 10 firms typically charge higher audit fees, these fees are justified by the provision of higher-quality audits.

The introduction of mandatory audit requirements alters clients' auditor and debt choices. First, clients shift their preference toward Big 10 audit firms, which reduce fees while maintaining consistent audit quality. Second, once audits become mandatory, clients can no longer signal credibility to lenders by choosing to be audited, as all clients are audited. The disciplinary role of audits becomes more pronounced under mandatory regimes, further constraining clients' debt expansion. Importantly, clients would not bear large cost increases if audits become mandatory. Our welfare analysis also suggests that clients continue to capture considerably more surplus from audit services than audit firms, both with and without mandatory audits.

We acknowledge that our sample of Chinese private firms may not be representative of all challenges private firms face globally, as clients outside China operate under different regulatory, cultural, and industry conditions (Lennox and Wu, 2022). Although our findings may not fully

generalize to other institutional settings, they provide valuable insights into China's dynamic private sector and its evolving financial reporting practices. Our framework can be applied to assess the effectiveness of audits in those contexts if similar data become available. China's relatively weak institutional environment may heighten demand for independent auditor verification, which could explain why audit quality remains unchanged under a hypothetical mandatory regime. Research in other contexts may find different results, and comparing outcomes across settings will provide valuable insights into how the industrial organization of auditing and the broader institutional environment shape the role of financial statement verification in capital markets.

Our study focuses on the interaction between audit and debt choices. Future research could explore additional mechanisms explaining the value of audits. For instance, audits may provide value beyond debt financing, such as in initial public offerings, in mitigating litigation risk, or in strengthening internal controls that reduce operational risks (Liu, 2024). Further investigation could quantify the broader value of audits and examine how audit quality and auditor reputation influence client outcomes in these contexts.

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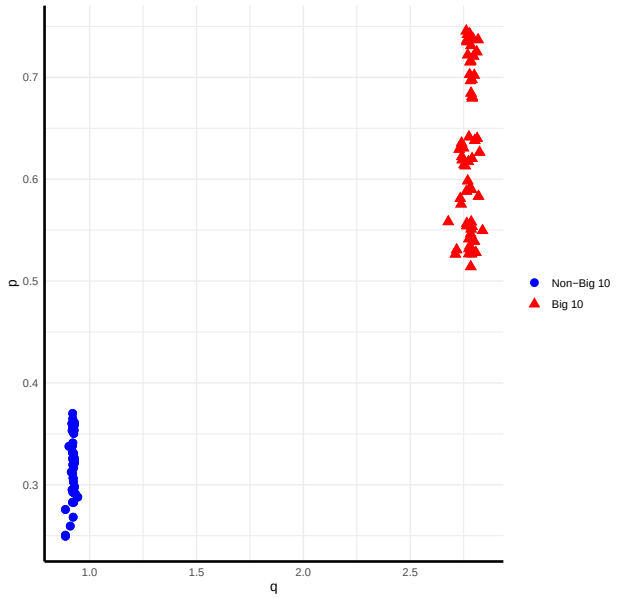


Figure 1: Audit Quality and Audit Fees

This figure presents the distribution of audit quality (q) and audit fee (p) offered by Big 10 audit firms (solid triangles) and non-Big 10 audit firms (solid dots). The horizontal axis represents audit quality (q). The vertical axis represents audit fees (p), expressed in percentage points of total assets.

Table 1: Sample Selection

Description	Number of Observations
Total observations	1,807,392
Drop clients with one observation	(43,480)
Drop observations with missing characteristics and invalid audit fees (e.g., audit fees less than zero)	(586,805)
Keep the first asset >10,000 and leverage > 0	(112,176)
Total sample	1,064,931

This table presents the sample selection.

Table 2: Summary Statistics

Panel A: All Private Firms

	Mean	Std. dev.	P10	P50	P90
Audit $(\mathbb{1}\{j_{it} = b, nb\})$	0.265	0.441	0.000	0.000	1.000
Debt $(\mathbb{1}\{l_{it} = 1\})$	0.571	0.495	0.000	1.000	1.000
ROA	-0.011	0.165	-0.095	0.002	0.099
Loss	0.561	0.496	0.000	1.000	1.000
Lev	0.643	0.606	0.075	0.593	1.033
Total Assets $(million)$	302.990	940.509	2.245	35.780	638.834
Size	3.000	1.414	1.000	3.000	5.000
NegEq	0.125	0.330	0.000	0.000	1.000

Panel B: Private Firms with Audits

	Mean	Std. dev.	P10	P50	P90
Audit Fee	72,116.410	242,990.566	2,000	8,000	155,000
Audit Fee $(p_{it}\mathbb{1}\{j_{it} = nb\})$	32,677.493	129,104.931	2,000	6,000	50,000
Audit Fee $(p_{it}\mathbb{1}\{j_{it} = b\})$	230,502.580	444,856.451	8,000	80,000	524,000
Debt $(\mathbb{1}\{l_{it} = 1\})$	0.586	0.493	0.000	1.000	1.000
ROA	-0.004	0.167	-0.089	0.005	0.114
Loss	0.611	0.488	0.000	1.000	1.000
Lev	0.623	0.585	0.074	0.573	1.005
Total Assets $(million)$	378.747	1,073.401	2.856	48.872	858.155
Size	3.189	1.418	1.000	3.000	5.000
NegEq	0.110	0.313	0.000	0.000	1.000

Panel C: Descriptive Association

Audit/Debt	$\mathbb{1}\{l_{it} = 0\}$	$\mathbb{1}\{l_{it} = 1\}$
$\mathbb{1}\{j_{it} = 0\}$	0.434	0.566
$\mathbb{1}\{j_{it} = b, nb\}$	0.414	0.586

This table presents descriptive statistics for variables used in the estimation. *Audit* $(\mathbb{1}\{j_{it} = b, nb\})$ is an indicator that equals one if the client hires an auditor, and zero otherwise. *Debt* $(\mathbb{1}\{l_{it} = 1\})$ is an indicator that equals one if the change in the client's liability is larger than zero, and zero otherwise. *ROA* is net profit divided by total assets. *Loss* is an indicator variable that equals one if the firm's net profit is negative and zero otherwise. *Lev* is total liability divided by total assets. The unit of total assets *Total Assets* $(million)$ is million Chinese *yuan*. *Size* is the quintile ranking of total assets. *NegEq* is an indicator that equals one when leverage is greater than one, and zero otherwise. *Audit Fee* $(p_{it}\mathbb{1}\{j_{it} = nb\})$ is the audit fee charged by the non-Big 10 audit firms. *Audit Fee* $(p_{it}\mathbb{1}\{j_{it} = b\})$ is the audit fee charged by the Big 10 audit firms. All continuous variables are winsorized at 1% and 99%. Panel A examines all private firms. Panel B reports the subsample of private firms with audits. Panel C presents the descriptive association between firms' debt choices and auditor hiring, namely the probability of debt increases (columns) conditional on clients' audit choices (rows).

Table 3: Model Fit

	Increase Debt (Data)	Increase Debt (Model)	Choose Audit (Data)	Choose Audit (Model)
Mean	0.571	0.572	0.265	0.266

This table evaluates model fit. The first two columns compare the empirical frequency of increasing debt (column (1)) with the model-predicted frequency of increasing debt (column (2)), averaged over the full sample. The last two columns compare the empirical frequency of choosing an audit (column (3)) with the model-predicted frequency of choosing an audit (column (4)), averaged over the full sample.

Table 4: Supply of Audit Services

Panel A: Equilibrium Fees and Quality Offers

	Big 10	Non-Big 10
q	2.772	0.922
p	0.591	0.332

Panel B: Parameter Estimates for Auditors' Profit Function

c_b	c_{nb}
0.123	0.373
(0.000)	(0.000)

Panel C: Summary Statistics of Audit Costs and Profits

	Mean	SD	25%	50%	75%
Audit Cost (Non-Big 10)	0.158	0.001	0.158	0.159	0.159
Audit Cost (Big 10)	0.474	0.006	0.471	0.475	0.478
Audit Profit (Non-Big 10)	0.173	0.020	0.162	0.171	0.192
Audit Profit (Big 10)	0.117	0.048	0.079	0.114	0.147

This table presents parameter estimates for the supply of audit services. Panel A presents the sample averages of audit quality (q) and audit fees (p) for Big 10 audit firms (column (1)) and non-Big 10 audit firms (column (2)), respectively. Panel B presents the parameter estimates of the current-period profit function for audit firm k, conditional on it being chosen by the client:

$$\pi_k = p_k - \frac{c_k}{2} q_k^2,$$

where p_k is the audit fee charged by audit firm k, scaled by total assets and expressed in percentage points, and q_k is the quality of audit firm k's services. Robust standard errors are below the coefficient estimates. Panel C presents the distribution of the cost and profit of audits for Big 10 and non-Big 10 audit firms. All values are expressed in percentage points of clients' total assets.

Table 5: Clients' Demand for Audit Services Without Debt Increases

Panel A: Parameter Estimates for Audit Choices

	Matching with Big Ten					Matching with Non-Big Ten				
θ	λ_0^b	λ_1^b	λ_2^b	λ_3^b	λ_4^b	λ_0^{nb}	λ_1^{nb}	λ_2^{nb}	λ_3^{nb}	λ_4^{nb}
2.774	-5.724	-0.374	-0.010	-0.336	5.652	-1.526	-0.195	0.160	0.250	0.927
(0.000)	(0.004)	(0.002)	(0.010)	(0.018)	(0.001)	(0.002)	(0.001)	(0.004)	(0.005)	(0.001)

Panel B: Value of Audit Services

	Big 10	Non-Big 10
$Q-p$ (offered by auditors)	0.408	0.000
$Q-p$ (conditional on realized auditor choice)	0.360	-0.006

Panel A of this table presents the parameter estimates characterizing clients' demand for audit services without debt increases ($l=0$). Client i's period utility combines their preferences for audit services and increasing debt (ignoring the time subscript t to economize on notations):

$$
\begin{aligned}
&u_{ijl}(Size_i, Loss_i, NegEq_i, j_{-1,i}, p_{ij}, q_{ij}, \varepsilon_{ijl}) \\
&= \underbrace{\mathbb{1}\{j \neq 0\}(q_{ij} - \theta p_{ij})}_{\text{Net audit quality}} \\
&\quad + \underbrace{\mathbb{1}\{j=b\}\left(\lambda_0^b + \lambda_1^b Size_i + \lambda_2^b Loss_i + \lambda_3^b NegEq_i + \lambda_4^b \mathbb{1}\{j_{-1}=b\}\right)}_{\text{Matching with Big 10}} \\
&\quad + \underbrace{\mathbb{1}\{j=nb\}\left(\lambda_0^{nb} + \lambda_1^{nb} Size_i + \lambda_2^{nb} Loss_i + \lambda_3^{nb} NegEq_i + \lambda_4^{nb} \mathbb{1}\{j_{-1}=nb\}\right)}_{\text{Matching with Non-Big 10}} \\
&\quad + \underbrace{l\left(\nu_0 + \nu_1 Size_i + \nu_2 Loss_i + \nu_3 NegEq_i + \nu_4 \mathbb{1}\{j=b\} + \nu_5 \mathbb{1}\{j=nb\} + \delta q_{ij}\right)}_{\text{Increasing Debt}} + \underbrace{\varepsilon_{ijl}}_{\text{Random error}} .
\end{aligned}
$$

Size is the quintile ranking of total assets; *Loss* is an indicator that equals one if the firm's net profit is negative and zero otherwise; *NegEq* is an indicator for whether total liabilities exceed total assets; $\mathbb{1}\{j_{-1}=b\}$ is an indicator for whether the client's prior audit choice is a Big 10 auditor; $\mathbb{1}\{j_{-1}=nb\}$ is an indicator for whether the client's prior audit choice is a non-Big 10 auditor. Panel B of this table presents the average estimated value of audit services. The first row reports the average $Q-p$ offered to clients, irrespective of their actual audit choice, where $Q \equiv q/\theta$. The second row reports the average $Q-p$ conditional on clients' actual audit choice.

Table 6: Clients' Demand for Audit Services With Debt Increases

Panel A: Parameter Estimates for Debt Increases

ν_0	ν_1	ν_2	ν_3	ν_4	ν_5	δ
0.274	-0.033	0.229	-0.093	0.461	0.149	-0.084
(0.001)	(0.000)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)

Panel B: The Effects of Audits on Debt Increases

	Big 10	Non-Big 10
$\frac{\delta q+\nu_{4,5}}{\theta}$	0.082	0.026

Panel A of this table presents the parameter estimates characterizing clients' utility from debt increases ($l=1$). Client i's period utility combines their preferences for audit services and increasing debt (ignoring the time subscript t to economize on notations):

$$
\begin{aligned}
& u_{ijl}(Size_i, Lossi, NegEq_i, j_{-1,i}, p_{ij}, q_{ij}, \varepsilon_{ijl}) \\
=& \underbrace{\mathbb{1}\{j\neq 0\}(q_{ij}-\theta p_{ij})}_{\text{Net audit quality}} \\
&+ \underbrace{\mathbb{1}\{j=b\}\left(\lambda_0^b+\lambda_1^b Size_i+\lambda_2^b Loss_i+\lambda_3^b NegEq_i+\lambda_4^b \mathbb{1}\{j_{-1}=b\}\right)}_{\text{Matching with Big 10}} \\
&+ \underbrace{\mathbb{1}\{j=nb\}\left(\lambda_0^{nb}+\lambda_1^{nb} Size_i+\lambda_2^{nb} Loss_i+\lambda_3^{nb} NegEq_i+\lambda_4^{nb} \mathbb{1}\{j_{-1}=nb\}\right)}_{\text{Matching with Non-Big 10}} \\
&+ \underbrace{l\left(\nu_0+\nu_1 Size_i+\nu_2 Loss_i+\nu_3 NegEq_i+\nu_4 \mathbb{1}\{j=b\}+\nu_5 \mathbb{1}\{j=nb\}+\delta q_{ij}\right)}_{\text{Increasing Debt}}+\underbrace{\varepsilon_{ijl}}_{\text{Random error}} \qquad \text{if } j\neq 0.
\end{aligned}
$$

Size is the quintile ranking of total assets; *Loss* is an indicator variable that equals one if the firm's net profit is negative and zero otherwise; *NegEq* is an indicator for whether total liabilities exceed total assets; $\mathbb{1}\{j_{-1}=b\}$ is an indicator for whether the client's prior audit choice is a Big 10 auditor; $\mathbb{1}\{j_{-1}=nb\}$ is an indicator for whether the client's prior audit choice is a non-Big 10 auditor. Panel B of this table presents the effects of audits on the current-period utility of increasing debt, namely $(\delta q+\nu_4)/\theta$ for Big 10 audits and $(\delta q+\nu_5)/\theta$ for non-Big 10 audits.

Table 7: Mandatory Audit

Panel A: Mandatory Audit

(1)	(2)	(3)	(4)
Mandatory Audit		Voluntary Audit	
$\Pr\{l=1\}$	$\Pr\{j=b\}$	$\Pr\{l=1\}$	$\Pr\{j=b\}$
37.4%	85.7%	57.2%	21.4%

Panel B: Audit quality and audit fee offered by auditors

	(1)	(2)	(3)	(4)
	Q_{nb}	Q_b	p_{nb}	p_b
Mandatory Audit	0.335	1.009	0.401	0.541
Voluntary Audit	0.332	0.999	0.332	0.591

This table examines firms' debt and auditor choices when audits are mandatory. Panel A columns (1) and (2) present the probabilities of increasing debt and choosing Big 10, respectively, under mandatory audit. Panel A columns (3) and (4) present the probabilities of increasing debt and choosing Big 10 (conditional on choosing an audit), respectively, under voluntary audit. Panel B presents the average q offered by Big 10 and non-Big 10 in columns (1) and (2) and the average p offered by Big 10 and non-Big 10 in columns (3) and (4).

Table 8: Mandatory Audit with Entrant

Panel A: Mandatory Audit with Entrant

(1)	(2)	(3)	(4)
Mandatory Audit		Voluntary Audit	
$\Pr\{l=1\}$	$\Pr\{j=b\}$	$\Pr\{l=1\}$	$\Pr\{j=b\}$
38.4%	72.3%	57.2%	21.4%

Panel B: Audit quality and audit fee

	(1)	(2)	(3)	(4)
	Q_{nb}	Q_b	p_{nb}	p_b
Mandatory Audit	0.335	1.010	0.396	0.514
Voluntary Audit	0.332	0.999	0.332	0.591

This table examines firms' debt and auditor choices when audits are mandatory and a new audit firm with the same cost parameter as the non-Big 10 enters. Panel A columns (1) and (2) present the probabilities of increasing debt and choosing Big 10, respectively, under mandatory audit. Panel A columns (3) and (4) present the probabilities of increasing debt and choosing Big 10 (conditional on choosing an audit), respectively, under voluntary audit. Panel B presents the average q offered by Big 10 and non-Big 10 in columns (1) and (2) and the average p offered by Big 10 and non-Big 10 in columns (3) and (4).

Table 9: Audit Quality Received by Clients (Voluntary vs. Mandatory)

Panel A: Average Audit Quality

	No Prior Audit	With Prior Audit
Voluntary Audit	0.050	0.347
Mandatory Audit (No Reoptimization)	0.332	0.551
Mandatory Audit (With Reoptimization)	0.947	0.812

Panel B: Regression Analyses of Changes in Audit Quality	(1)	(2)
$\mathbb{1}\{j_{-1}=0\}$	2.146***	2.305***
	(0.001)	(0.002)
$\mathbb{1}\{j_{-1}=nb\}$	1.440***	1.607***
	(0.002)	(0.003)
$\mathbb{1}\{j_{-1}=b\}$	0.745***	0.980***
	(0.004)	(0.005)
Size		-0.080***
		(0.001)
Loss		-0.009***
		(0.002)
NegEq		-0.003
		(0.003)
Adj. R^2	0.801	0.804
Num. obs.	1064931	1064931

$^{***}p<0.01$; $^{**}p<0.05$; $^{*}p<0.1$

This table analyzes changes in the audit quality received by clients around mandatory audit. Panel A reports the average quality ($Q \equiv \frac{q}{\theta}$) of the auditor chosen by the client, separately for clients who had an auditor in the prior year (column (1)) and for those who did not have one (column (2)). The first row corresponds to the voluntary audit regime. The second row corresponds to the mandatory audit regime, assuming that clients and audit firms do not re-optimize. Therefore, q does not change, and the probability of choosing Big 10, relative to that of choosing non-Big 10, remains the same as that under the voluntary regime. The third row represents the mandatory audit regime, assuming that clients re-optimize their auditor choices given the updated audit offering by audit firms. Panel B analyzes changes in audit quality based on clients' characteristics *before* audit mandates. The dependent variable is the audit quality of the chosen auditor under the mandatory audit minus that under the voluntary regime, where audit quality equals $\frac{q}{\theta}$ with $Q=0$ when clients do not choose an audit in the voluntary regime. Other variables are as defined above.

Table 10: Likelihood of Debt Expansion (Voluntary vs. Mandatory)

	No Prior Audit	With Prior Audit
Voluntary Audit	0.575	0.566
Mandatory Audit (No Reoptimization)	0.706	0.455
Mandatory Audit (With Reoptimization)	0.372	0.379

This table reports the probability of debt increases, separately for clients who had an auditor in the prior year (column (1)) and for those who did not have one (column (2)). The first row corresponds to the voluntary audit regime. The second row corresponds to the mandatory audit regime, assuming that clients and audit firms do not re-optimize. Therefore, q does not change, and the probability of choosing Big 10, relative to that of choosing non-Big 10, remains the same as that under the voluntary regime. The third row represents the mandatory audit regime, assuming that clients re-optimize their auditor choices given the updated audit offering by audit firms.

Table 11: Welfare Comparisons

Panel A: Client Firms' Ex-ante Value

	(1)
Mandatory Audit	0.562
Voluntary Audit	0.603

Panel B: Audit Firms' Expected Profits

	(1)	(2)
	Non-Big 10 Expected Profit	Big 10 Expected Profit
Mandatory Audit	0.041	0.055
Voluntary Audit	0.036	0.009

This table compares welfare changes for client firms and auditors under the audit mandate regime, relative to the voluntary regime. Panel A reports the annualized expected lifetime utility, expressed in percentage points of total assets and averaged over sample client firms,

$$\frac{log\left(\sum_{j\in\{0,b,nb\}}\left(e^{v_{j,0}(\mathbf{s})}+e^{v_{j,1}(\mathbf{s})}\right)\right)+\gamma}{\theta}(1-\beta),$$

where γ is the Euler's constant and $v_{jl}(\mathbf{s})$ is the choice-specific value function,

$$v_{jl}(\mathbf{s},p_j,q_j)=\bar{u}_{jl}(\mathbf{s},p_j,q_j)+\beta\mathbb{E}_{s',\varepsilon'}\left[\max_{j',l'}\left\{v_{j',l'}(s')+\varepsilon'_{j',l'}|j,l,s\right\}\right].$$

Panel B presents the expected annual profits of Big 10 and non-Big 10 audit firms, averaged over all firms,

$$\bar{\pi}_k(\mathbf{p},\mathbf{q},\mathbf{s})=\left(d_{k,0}(\mathbf{p},\mathbf{q},\mathbf{s})+d_{k,1}(\mathbf{p},\mathbf{q},\mathbf{s})\right)\left(p_k-\frac{c_k}{2}q_k^2\right),$$

where $\mathbf{p}\equiv(p_b(\mathbf{s}),p_{nb}(\mathbf{s}))'$ is a vector of the audit fees offered by audit firms b and nb, respectively, conditional on state $\mathbf{s}$; $\mathbf{q}\equiv(q_b(\mathbf{s}),q_{nb}(\mathbf{s}))'$ is a vector of the audit service value offered by audit firms b and nb, respectively, conditional on state $\mathbf{s}$; and $d_{k,0}(.)$ and $d_{k,1}(.)$ denote the *probability* that audit firm k is chosen and the client does not increase or increases debt, respectively.

Table 12: Debt and Audit Choices of Myopic Clients

Panel A: Changes in Debt and Audit Probabilities ($\beta = 0$ vs. $\beta = 0.9$)

(1) $\Delta Pr\{l = 1\}$	(2) $\Delta Pr\{j = b\}$	(3) $\Delta Pr\{j = nb\}$
-0.000	-0.027	-0.025

Panel B: Expected Future Utility

	$\Delta \Pr\{l = 1\}$	$\Delta \Pr\{j = b\}$	$\Delta \Pr\{j = nb\}$
$\mathbb{E}_{s'}(V(s')\|j, l = 1, s) - \mathbb{E}_{s'}(V(s')\|j, l = 0, s)$	-0.18***		
	(0.00)		
$\mathbb{E}_{s'}(V(s')\|j = b, l, s) - \mathbb{E}_{s'}(V(s')\|j = 0, l, s)$		-0.01***	
		(0.00)	
$\mathbb{E}_{s'}(V(s')\|j = nb, l, s) - \mathbb{E}_{s'}(V(s')\|j = 0, l, s)$			-0.04***
			(0.00)
R^2	0.88	0.39	0.47
Num. obs.	1064931	1064931	1064931

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

This table examines myopic firms' audit and debt choices by setting β to zero. Panel A presents the median changes in the probability of increasing debt (column (1)), the probability of choosing a Big 10 (column (2)), and the probability of choosing a non-Big 10 (column (3)) in the counterfactual scenario of $\beta = 0$, relative to $\beta = 0.9$. Panel B regresses changes in the probabilities of debt and auditor choices (i.e., the choices by myopic clients relative to those by forward-looking clients) as a function of the expected future utility associated with these choices. The regression model is:

$$\Delta \Pr\{a\} = \alpha_0 + \alpha_1 \left(\mathbb{E}_{s'} \left[V(s') | a \right] - \mathbb{E}_{s'} \left[V(s') | a_0 \right] \right) + \varepsilon,$$

where a denotes a specific action chosen by the client, namely $l = 1$, $j = b$, or $j = nb$; $\Delta \Pr\{a\}$ is the probability of the action under $\beta = 0$, relative to that under $\beta = 0.9$; and $\mathbb{E}_{s'}[V(s')|a] - \mathbb{E}_{s'}[V(s')|a_0]$ is the expected future utility associated with action a, relative to that associated with the benchmark action a_0.

A Appendix

A.1 Industry composition

Table A.1 illustrates the industry distribution of our sample. The top four industries in our sample are manufacturing (22.88%), wholesale and retail (18.10%), leasing and business services (12.12%), and scientific research and technical services (9.26%). On the one hand, manufacturing, scientific research, and technical services might require more long-term investments from banks to maintain efficient manufacturing processes and develop new products. On the other hand, leasing and business services are more likely to require shorter loans to keep honoring their contracts and cover their short-term liquidity needs. The industry distribution is consistent with prior research (Liu and Tong, 2025).

Table A.1: Industry Distribution

Industry	Percentage
Manufacturing	22.88%
Wholesale and Retail Trade	18.10%
Leasing and Business Services	12.12%
Scientific Research and Technical Services	9.26%
Real Estate	8.54%
Construction	6.96%
Financial Services	3.60%
Information Transmission, Software, and Information Technology Services	3.47%
Transportation, Warehousing, and Postal Services	3.29%
Electricity, Heat, Gas, and Water Production and Supply	2.62%
Agriculture, Forestry, Animal Husbandry, and Fishing	2.36%
Water Conservancy, Environmental Protection, and Public Facilities Management	1.57%
Resident Services, Repair, and Other Services	1.25%
Culture, Sports, and Entertainment	1.39%
Accommodation and Catering Services	1.20%
Mining	1.00%
Health and Social Work	0.19%
Education	0.14%
Comprehensive	0.03%
International Organizations	0.01%
Total	100%

This table presents the industry distribution.

A.2 Choice-specific Value Functions and the CCP Approach

This section derives the relations between the choice-specific value functions and the conditional choice probabilities (CCPs). For a given pair of audit and leverage choices, $j \in \{0,1,2\}, l \in \{0,1\}$,

we can express the choice-specific value functions as

$$
\begin{aligned}
v_{j,l}(\mathbf{s}, j_{-1}) &= \bar{u}_{j,l} + \beta \mathbb{E}\left[V(\mathbf{s}', j'_{-1}) | s, j, l \right] \\
&= \bar{u}_{j,l} + \beta \mathbb{E}\left[log\left(\sum_{j' \in \{0,1,2\}, l' \in \{0,1\}} e^{v_{j',l'}(\mathbf{s}', j'_{-1})} \right) + \gamma | \mathbf{s}, j, l \right] \\
&= \bar{u}_{j,l} + \beta \mathbb{E}\left[v_{j_{-1},l}(\mathbf{s}', j) - \mathbb{D}_{j_{-1},l}(\mathbf{s}', j) + \gamma | \mathbf{s}, j, l \right],
\end{aligned} \tag{A.1}
$$

where γ is the Euler's constant; $\mathbf{s}$ represents the vector of state variables (i.e., size, loss, leverage), excluding the previous year's audit choice j_{-1}; and $\mathbb{D}_{j,l}(s, j_{-1}) \equiv log(d_{j,l}(s, j_{-1}))$. Note that in the last line of equation A.1, researchers can specify any choices j', l' inside the expectation operator. The only requirement is that these choices span all combinations of j, l, which is necessary for solving all choice-specific value functions. We have chosen j_{-1} and l.

To avoid solving (A.1) by looping over different values of s, we collect all $v_{j,l}(\mathbf{s}, j_{-1})$ for each unique combinations of $\mathbf{s}$ and j_{-1} into a vector called $\mathbf{v}_{j,l}(\mathbf{S})$, where, with a slight abuse of notation, $\mathbf{S}$ is a *matrix* with rows corresponding to unique combinations of $\mathbf{s}$ and j_{-1} and columns correspond to $Size \in \{0,1\}$, $Loss \in \{0,1\}$, $Lev \in \{0,1\}$, $j_{-1} \in \{0,1,2\}$.[15] The dimension of $\mathbf{s}$ is 24×4 for a given j, l. We present the first eight rows of the matrix below, which correspond to the case of $j_{-1} = 0$. The remaining 16 rows just repeat the same matrix but replace the last column (indicating j_{-1}) with 1 and 2, respectively.

$$
\begin{pmatrix}
Size & Loss & Lev & j_{-1} = 0 \\
0 & 0 & 0 & 0 \\
1 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 \\
1 & 1 & 0 & 0 \\
0 & 0 & 1 & 0 \\
1 & 0 & 1 & 0 \\
0 & 1 & 1 & 0 \\
1 & 1 & 1 & 0
\end{pmatrix} \tag{A.2}
$$

We next collect all $\mathbf{v}_{j,l}(\mathbf{S})$ into a vector called $\mathbf{v}(\mathbf{S})$. This vector concatenates the six cases of $\mathbf{v}_{j,l}(\mathbf{S})$, which corresponds to the leverage and auditor decisions, namely $j \in \{0,1,2\}$, $l \in \{0,1\}$. Thus, the length of $\mathbf{v}$ is 144. We organize $\bar{\mathbf{u}}$ the same way. The order of j, l matters, which will be described next along with the transition matrix.

Let F be the transition matrix mapping current states to future states, given the client's current states and choices (i.e., debt and audit firm choices). As is standard in the analyses of Markov transitions, each element of F denotes the probability of switching to a future state, represented by a column, given the current state, represented by a row. Thus, the sum of the probabilities in a row should equal one. As we have 24 unique values of states, as shown in (A.2), and six distinct choices (i.e., $l \in \{0,1\}$ and $j \in \{0,1,2\}$), the dimension of F is 144×144,[16] with the number of rows equal to the length of $\mathbf{v}(\mathbf{S})$.

[15] In our estimation, we use quitiles of firm sizes. The example here uses a binary classification to conserve space.

[16] The transition matrix illustrates the curse of dimensionality problem. Increases in the number of state variables or the unique values of a given state variable exponentially increase the number of cells in the transition matrix.

It is important that the organization of F is consistent with the elements of $\mathbf{v}(\mathbf{S})$ and, in turn, with the order of the variables in $\mathbf{s}$ and the choices by the client. A proper organization ensures that each element in $\mathbf{v}$ correctly maps to future states given the client's choices, $l \in \{0,1\}$ and $j \in \{0,1,2\}$. Specifically, F is a block diagonal matrix with the form

$$F = \begin{pmatrix} F_0 & 0 \\ 0 & F_1 \end{pmatrix}, \tag{A.3}$$

where F_l with $l \in \{0,1\}$ is a 72×72 Markov transition matrix corresponding to the case in which the client chooses $l \in \{0,1\}$. Given the specification of F, it is important to organize $\mathbf{v}$ so the first 72 cells correspond to $l = 0$ (i.e., $\mathbf{v}_{j,0}$) and the remaining 72 cells correspond to $l = 1$ (i.e., $\mathbf{v}_{j,1}$).

We next specify F_l. Let T_l be the Markov transition matrix for $(Size, Loss, Lev)$ given $l \in \{0,1\}$. The dimension of T_l is 8×8, as we have two unique values each for *Size*, *Loss*, and *Lev*. F_l is then a 9×9 block matrix with each block corresponding to unique combinations of j_{-1} and j. Specifically, F_l equals

$$F_l = \begin{array}{c} \begin{matrix} (0,0) & (1,0) & (2,0) & (0,1) & (1,1) & (2,1) & (0,2) & (1,2) & (2,2) \end{matrix} \\ \begin{bmatrix} T_l & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & T_l & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & T_l & 0 & 0 \\ 0 & T_l & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & T_l & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & T_l & 0 \\ 0 & 0 & T_l & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & T_l & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & T_l \end{bmatrix} \end{array} \begin{array}{l} j_{-1}=0, j=0 \\ j_{-1}=1, j=0 \\ j_{-1}=2, j=0 \\ j_{-1}=0, j=1 \\ j_{-1}=1, j=1 \\ j_{-1}=2, j=1 \\ j_{-1}=0, j=2 \\ j_{-1}=1, j=2 \\ j_{-1}=2, j=2 \end{array}. \tag{A.4}$$

Each block of F_l is an 8×8 zero matrix except for nine blocks. In these nine blocks, the 8×8 block equals T_l. The organization of the matrix needs to satisfy: (1) $j = j'_{-1}$ and (2) $j' = j_{-1}$. The latter requirement is explained above to ensure we can span all choice-specific value functions. For example, block $(1,1)$ corresponds to the case of $(0,0)$ (row), with the first element indicating j_{-1} and the second j, and $(0,0)$ (column), with the first element indicating j'_{-1} and the second element j'; block (4,2) corresponds to the case of $(0,1)$ (row) and $(1,0)$ (column);...; block (8,6) corresponds to the case of $(1,2)$ (row) and $(2,1)$ (column); block (9,9) corresponds to the case of (2,2) (row) and (2,2) (column).

Finally, the organization of T_l needs to be consistent with $\mathbf{v}_{j,l}(\mathbf{S})$ given j, l. This, in turn, means that the rows of T_l need to be consistent with the rows of matrix (A.2).

Given the setup above, we have

$$\begin{aligned}
&\mathbf{v}(\mathbf{S}) = \mathbf{u}(\mathbf{S}) + \beta F\Big[\mathbf{v}(\mathbf{S}) - \boldsymbol{D}(\mathbf{S}) + \boldsymbol{\gamma}\Big] \\
\implies &\mathbf{v}(\mathbf{S}) = (1-\beta F)^{-1}\Big(\mathbf{u}(\mathbf{S}) - \beta F \boldsymbol{D}(\mathbf{S}) + \beta F \boldsymbol{\gamma}\Big) \qquad \text{(A.5)} \\
\implies &\mathbf{v}(\mathbf{S}) = (1-\beta F)^{-1}\Big(\mathbf{u}(\mathbf{S}) - \beta F \boldsymbol{D}(\mathbf{S}) + \beta \boldsymbol{\gamma}\Big), \qquad \text{(A.6)}
\end{aligned}$$

where $\boldsymbol{\gamma}$ is a column vector of γ, and the third step follows because the row sum of the transition matrix equals one.

Two points are worth elaboration. The first, as discussed above, is that the current setup of F ensures that $1-\beta F$ has a full-rank and invertible, which is necessary to solve for all choice-specific value functions. The second point is that the size of F exponentially increases as the number of state variables and the unique values of each state increase. As we need to invert F, the computation burden exponentially increases with the number of state variables and the unique values of each state. This illustrates that even without value function or policy function iterations, which involve repeatedly inverting F, and without accounting for the supply side, solving a dynamic model is non-trivial.

A.3 Estimation Procedures

To estimate the model, we first derive the quality of audit services. We start with the first-order conditions of audit firms, assuming $\mathfrak{p}$, and $\mathfrak{q}$ are at their equilibrium levels as a function of the state variables. As such, we remove the conditioning on $\mathfrak{p}$ and $\mathfrak{q}$:

$$\begin{aligned}
\frac{\partial W_k(s)}{\partial q_k} &= \frac{\partial \bar{\pi}_k(s)}{\partial q_k} + \beta\Bigg\{ d_{k,0}(1-d_{k,0})\Big[W_k(s')|k,0,s\Big] - \sum_{j\neq k} d_{j,0}d_{k,0}\Big[W_k(s')|j,0,s\Big] \\
&\quad + (1+\delta)\Bigg(d_{k,1}(1-d_{k,1})\Big[W_k(s')|k,1,s\Big] - \sum_{j\neq k} d_{j,1}d_{k,1}\Big[W_k(s')|j,1,s\Big]\Bigg)\Bigg\}, \\
\frac{\partial W_k(s)}{\partial p_k} &= \frac{\partial \bar{\pi}_k(s)}{\partial p_k} - \beta\sum_l \theta d_{k,l}(1-d_{k,l})\Big[W_k(s')|k,l,s\Big] \\
&\quad + \beta\sum_{j\neq k,l}\Big\{\theta d_{j,l}d_{k,l}\Big[W_k(s')|j,l,s\Big]\Big\}. \qquad \text{(A.7)}
\end{aligned}$$

From the first-order condition for q_k, we can express q_k as

$$\begin{aligned} c_k q_k = & \left(\frac{d_{k,0}(1-d_{k,0})}{d_{k,0}+d_{k,1}} + \frac{d_{k,1}(1-d_{k,1})}{d_{k,0}+d_{k,1}}(1+\delta) \right) \left(p_k - \frac{c_k}{2} q_k^2 \right) \\ & + \beta \frac{\left\{ d_{k,0}(1-d_{k,0}) \left[W_k(s') | k,0,s \right] - \sum_{j \neq k} d_{j,0} d_{k,0} \left[W_k(s') | j,0,s \right] \right\}}{d_{k,0}+d_{k,1}} \\ & + \beta(1+\delta) \frac{\left\{ d_{k,1}(1-d_{k,1}) \left[W_k(s') | k,1,s \right] - \sum_{j \neq k} d_{j,1} d_{k,1} \left[W_k(s') | j,1,s \right] \right\}}{d_{k,0}+d_{k,1}}. \end{aligned} \tag{A.8}$$

Dividing the first-order condition for p_k by $-\theta / p_k$ and rearranging yields

$$\begin{aligned} p_k = & \frac{c_k}{2} q_k^2 + \frac{d_{k,0}+d_{k,1}}{\theta(d_{k,0}(1-d_{k,0}) + d_{k,1}(1-d_{k,1}))} \\ & - \beta \frac{\sum_l \left\{ d_{k,l}(1-d_{k,l}) \left[W_k(s') | k,l,s \right] - \sum_{j \neq k} d_{j,l} d_{k,l} \left[W_k(s') | j,l,s \right] \right\}}{d_{k,0}(1-d_{k,0}) + d_{k,1}(1-d_{k,1})}. \end{aligned} \tag{A.9}$$

With (A.8) and (A.9), we estimate the model by modifying the conditional choice probabilities method by Hotz and Miller (1993). We describe the details below.

1. We solve for θW_k.

   From (A.9), we solve for $p_k - \frac{c_k}{2} q_k^2$, conditional on $d_{j,l} \forall j,l$ and $W(s)$.

   $$\left(p_k - \frac{c_k}{2} q_k^2 \right) = A_k, \tag{A.10}$$

   where A_k can be inferred from (A.9)

   $$\begin{aligned} \theta A_k = & \frac{d_{k,0}+d_{k,1}}{(d_{k,0}(1-d_{k,0}) + d_{k,1}(1-d_{k,1}))} \\ & - \beta \frac{\sum_l \left\{ d_{k,l}(1-d_{k,l}) \left[\theta W_k(s') | k,l,s \right] - \sum_{j \neq k} d_{j,l} d_{k,l} \left[\theta W_k(s') | j,l,s \right] \right\}}{d_{k,0}(1-d_{k,0}) + d_{k,1}(1-d_{k,1})}. \end{aligned} \tag{A.11}$$

   Let us define $\bar{W} \equiv \theta W$ and $\bar{A}_k \equiv \theta A_k$. Equation (A.11) does not depend on any model parameters and can be estimated prior to the estimation. Given (A.10), we can solve for the value functions of audit firm k.

   $$\begin{aligned} W_k(s) &= \bar{\pi}(s) + \beta \sum_{j,l} \left\{ d_{j,l} \left[W_k(s') | j,l,s \right] \right\} \\ &= (d_{k,0}+d_{k,1}) A_k + \beta \sum_{j,l} \left\{ d_{j,l} \left[W_k(s') | j,l,s \right] \right\}. \end{aligned} \tag{A.12}$$

Multiplying each side by θ gives

$$\bar{W}_k(s) = (d_{k,0} + d_{k,1})\bar{A}_k + \beta \sum_{j,l} \left\{ d_{j,l} \left[\bar{W}_k(s') | j, l, s \right] \right\}. \tag{A.13}$$

Note that this step does not depend on the model parameters and can thus be completed prior to estimating the model.

2. We solve for q_k.

   Substituting (A.10) and (A.11) into (A.8) yields

$$q_k = \frac{B_k \bar{A}_k + \bar{C}_k}{\theta c_k}, \tag{A.14}$$

   where

$$B_k = \frac{d_{k,0}(1 - d_{k,0}) + (1 + \delta) d_{k,1}(1 - d_{k,1})}{d_{k,0} + d_{k,1}},$$

$$\bar{C}_k = \beta \frac{\left\{ d_{k,0}(1 - d_{k,0}) \left[\bar{W}_k(s') | k, 0, s \right] - \sum_{j \neq k} d_{j,0} d_{k,0} \left[\bar{W}_k(s') | j, 0, s \right] \right\}}{d_{k,0} + d_{k,1}}$$

$$+ \beta(1 + \delta) \frac{\left\{ d_{k,1}(1 - d_{k,1}) \left[\bar{W}_k(s') | k, 1, s \right] - \sum_{j \neq k} d_{j,1} d_{k,1} \left[\bar{W}_k(s') | j, 1, s \right] \right\}}{d_{k,0} + d_{k,1}}.$$

3. We compute the likelihood function. The first part is clients' leverage and audit choices by plugging in the value of audit services in (A.14) into the client's choice-specific value functions (derived in the previous section). The second part is the audit fee, which takes the form based on (A.14),

$$\begin{aligned} p_k &= \frac{c_k}{2} q_k^2 + \frac{\bar{A}_k}{\theta} + \varepsilon_k \\ &= \frac{1}{2c_k} \bar{q}_k^2 + \frac{\bar{A}_k}{\theta} + \varepsilon_k. \end{aligned}$$