

# Auditing Standards, Professional Judgement, and Audit Quality\*

Pingyang Gao

Gaoqing Zhang

Booth School of Business

Carlson School of Management

The University of Chicago

University of Minnesota

pingyang.gao@chicagobooth.edu

zhangg@umn.edu

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## Abstract

The establishment of the PCAOB has profoundly changed the auditing profession. We propose a model to study how auditing standards affect audit quality. Auditing standards provide remedy to the auditors' possible misalignment of interest with investors. However, auditing standards also restrict auditors' exercise of professional judgement, which in turn leads to compliance mentality and reduces auditors' incentive to become competent in the first place. We identify the conditions under which stricter auditing standards increase or decrease audit quality. We also show that stricter auditing standards always increase audit fees and that they can hurt firms more than auditors. The model also generates a number of testable empirical predictions.

**Key words:** Auditing Standards, Audit Quality, Audit Fee, Professional Judgement, Compliance Mentality

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# 1 Introduction

In the wake of accounting frauds and audit failure in the early 2000s, the Congress created the Public Company Accounting Oversight Board (also known as the PCAOB) in 2003 to ensure that auditors of a public company follow a set of strict guidelines. The investigation into the accounting and audit failures revealed that auditors did not conduct proper audits in discharging their responsibilities and that the auditing profession’s self-regulation failed to hold auditors to strict auditing standards.<sup>1</sup> In response, the PCAOB was given broad authority to fulfill its mandate to “improve audit quality, reduce the risks of auditing failures in the U.S. public securities market, and promote public trust in both the financial reporting process and auditing profession.” The PCAOB establishes auditing standards for auditors to follow in the preparation of audit reports, inspects auditors’ compliance with standards, and uses its investigative and disciplinary authority to sanction non-compliance.

While the PCAOB’s stricter auditing standards can increase the overall audit level, their effects on audit quality are more controversial. Conceptually, many have observed that the PCAOB’s non-expert model in standards setting and inspection makes it more likely that its auditing standards are distant from auditing practice reality and conflict with auditors’ exercise of professional judgement.<sup>2</sup> Empirical evidence supporting such a view is also emerging. For example, Doogar, Sivadasan, and Solomon (2010) shows that the PCAOB’s first substantive auditing standard (AS 2) was too stringent (relative to its replacement AS 5). AS 2 required that auditors conduct an unprecedented degree of detailed testing, much of which was deemed as unnecessary by practicing auditors. Eventually, PCAOB admitted that “specific requirements directing the auditor (to test ICFR) are unnecessary and could contribute

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<sup>1</sup>The Panel on Audit Effectiveness, in the aftermath of the ever increasingly frequent restatements in late 1990’s (e.g., GAO (2002a)), expressed grave concerns that “auditors may not be requiring enough evidence, that is, they have reduced the scope of their audits and level of testing, to achieve reasonable assurance” (PAE (2000)). The panel’s report recommended that auditing standards be tightened to effect a substantial increase in auditors’ performance. After the revelation of audit failure in Enron, the government conducted its own investigation to the auditing practice and concluded that a government agency was the only way to fix the lax auditing standards (e.g., GAO (2002b)).

<sup>2</sup>For example, the Sarbanes-Oxley Act of 2002 (SOX), which created the PCAOB, stipulates that no more than two Board members (out of five) can be CPAs and that the chairperson cannot be an active CPA. Moreover, the lack of auditing experience and expertise also extends to major staff positions and inspectors. This non-expert model is widely discussed in Kinney Jr (2005), Palmrose (2006), Glover, Prawitt, and Taylor (2009), Cox (2007), Knechel (2013) and DeFond and Zhang (2014).

to a checklist approach to compliance” and removed many such requirements in AS 5 to “allow auditors to apply more professional judgement as they work through the top-down approach”(PCAOB (2007)). After reviewing the literature, DeFond and Zhang (2014) encourage “more research on the consequences of standard setting by examining how auditing standards might change the auditor’s incentives and/or competency, and ultimately audit quality.” We respond to this call.

We develop a formal model to study the effects of auditing standards on audit quality. We hope to shed light on some aspects of the following questions. Do stricter auditing standards improve audit quality? How do auditing standards affect auditors’ audit choices and competency? How do auditing standards affect audit fees? What determine the auditors and firms’ preferences for auditing standards?

In the model, the auditor chooses audit level to balance the audit cost with her legal liabilities associated with audit failure. The auditor’s interests may be misaligned with investors due to the inherent imperfection in the legal liability system. The misalignment of interest leads the auditor to perform subpar audits. This creates a demand for auditing standards in the form of a minimum auditing requirement. Built on this basic audit model, we introduce auditors’ professional judgement. Auditors’ professional judgement is modeled as their ability to assess the audit risk and allocate the audit resources accordingly. Auditors rely on their knowledge, experience and training to understand the particular circumstances of an engagement and then choose audit procedures accordingly to strike the balance between the audit failure risk and the audit cost.

We solve for the auditor’s equilibrium choices of audit level and expertise development. The auditor’s equilibrium audit choice depends, in an intuitive manner, on her interest alignment with the firm, her assessment of audit risk, and the auditing standards. Moreover, the auditor acquires more expertise when she anticipates that the expertise is more useful for her future audits. Finally, the audit fee is determined endogenously from the bargaining between the firm and the auditor.

Having solved the equilibrium, we conduct comparative statics to provide insights about auditing standard’s economic consequences. We first show that auditing standards affect the

auditor's audit choice and expertise development in three ways. First, auditing standards counteract the misaligned auditor's misconduct. The misaligned auditor would like to shirk on audit but is compelled to do more by stricter auditing standards. Second, auditing standards restrict the auditor's exercise of professional judgement and result in her compliance mentality. Since auditing standards cannot be tailored to every possible engagement circumstance, they could force the auditor to perform audits that are not cost-benefit effective judged from her professional perspective. Under those circumstances, the auditor has to suppress her professional judgement and comply with the standards. Finally, the auditor invests less in developing professional expertise as auditing standards become stricter. A requirement that the auditor has to perform a procedure renders irrelevant her ability to assess the procedure's cost-benefit effectiveness in the particular context of an engagement. Since it is costly to develop expertise, the auditor acquires less expertise in the first place when her professional judgement is more likely to be constrained by standards.

Built on these three elements of economic forces, we examine the effects of auditing standards on audit quality. Audit quality in our model is defined as the inverse of the audit failure risk, the event when a firm with an unqualified audit report later fails. We identify the conditions under which auditing standards increase or decrease audit quality. First, fixing the auditor's competence, stricter auditing standards always improve audit quality. Auditing standards restrict the auditor's exercise of professional judgement in a systematic manner. Whenever the auditor's judgement disagrees with the standards, the auditor is forced to perform more audit work, which always reduces audit failure. Therefore, that auditing standards constrain the auditor's exercise of professional judgement, or the compliance mentality, is not sufficient for auditing standards to reduce audit quality. Second, one necessary condition under which auditing standards reduce audit quality is that the auditor's expertise development decision is sufficiently sensitive to auditing standards. When the auditor can adjust her expertise development decision, auditing standards affect audit quality also through an indirect channel. Stricter auditing standards reduce the auditor's expertise acquisition and the lower auditor competence reduces the audit quality. In other words, auditing standards directly force auditors to do more work, but indirectly induce auditors to do the work in a

less competent way. Overall, stricter auditing standards lead to lower audit quality when the indirect channel dominates the direct channel, which occurs when the auditor’s expertise acquisition decision is sufficiently sensitive to auditing standards.

We have also examined auditing standards’ effects on audit fees and the expected payoffs to the auditor and to the firm. We show that stricter auditing standards always increase audit fees and increase audit fees more when the auditor’s ability to adjust expertise is larger. Moreover, the equilibrium payoffs to the auditor and to the firm have an inverse U-shaped relation with auditing standards. Moderate auditing standards benefit both the auditor and the firm, but too high standards could hurt both. In particular, as auditing standards increase, they are more likely to hurt the firm than the auditor due to the auditor’s ability to adjust her expertise.

We have also provided one extension to accommodate imperfect enforcement of auditing standards. We show that improving enforcement for given standards has the similar effects of tightening the standards. Thus, our model also provides insights about the economic consequences of enforcement and inspection (e.g., DeFond (2010), Gipper, Leuz, and Maffett (2015), and DeFond and Lennox (2017)).

Our model generates empirical predictions about the effects of auditing standards on audit quality, audit fees, and audit expertise development. In particular, the model highlights that the auditor’s ability to adjust her expertise acquisition could qualitatively affect auditing standards’ economic consequences. To the extent that auditors can adjust their expertise more easily in the long run than in the short run, tighter auditing standards always increase audit quality in the short run but can reduce audit quality in the long run. As a result, empirical tests face a critical research design choice regarding the timing. Even though examining the consequences of new standards in a timely manner improves the measurement and increases the policy relevance, the short-run consequences systematically favor tighter standards. Moreover, the model has policy implications as well. For example, even if the PCAOB cares more about audit quality than audit cost, setting too high standards could back fire. For another example, our model also predicts that standard setters with shorter horizons are inclined to set higher accounting standards.

We contribute to the theoretical literature on the determinants of audit quality and audit fees.<sup>3</sup> One stream of this literature studies the effects of auditing standards on audit quality, but most papers have focused on the standards' interaction with auditors' legal liabilities. In his seminal paper, Dye (1993) studies the effects of auditing standards on audit quality. Among other results, he shows that tighter auditing standards could reduce audit quality. In his model, the auditor can either comply with the auditing standards that perfectly shields her from liabilities or conduct subpar audit that exposes her to liabilities. When the bar (auditing standards) is set too high, the auditor finds it too costly to comply and thus chooses to lower the level of audit. Ye and Simunic (2013) study the optimal design of both the tightness and vagueness of auditing standards. They show that the optimal standard should have no vagueness if the tightness of the standard can be set optimally. However, vague standards can be optimal if the tightness of the standards cannot be optimally set (see also Caskey (2013) for a discussion). We complement this literature by studying the effects of auditing standards from a different angle. We examine the standards' interaction with auditors' exercise and development of professional expertise and competence, and we show that tighter standards could reduce audit quality because requiring auditors to do more work induces auditors to do the work in a less competent manner.

In addition, our model is also broadly related to the delegation literature and the labor economics literature. That auditing standards circumscribe auditors' discretion in exercising professional judgement resembles the basic trade-off between utilizing the agent's private information and restricting the agent's devious behavior in the delegation problem.<sup>4</sup> Moreover, the hold-up problem in auditors' expertise acquisition decision in our model is studied in labor economics (see recent survey by Malcomson (1999)) and in the agency literature (e.g., Lambert (1986), Demski and Sappington (1987)). Our model complements these two

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<sup>3</sup>DeFond and Zhang (2014) provide a recent review of this vast literature. See, e.g., Dye (1993), Dye (1995), Newman, Patterson, and Smith (2005), Beyer and Sridhar (2006), Lu and Sapra (2009), Laux and Newman (2010), Deng, Melumad, and Shibano (2012), Deng, Lu, Simunic, and Ye (2014).

<sup>4</sup>The seminal paper in the delegation literature, Holmstrom (1984), studies the principal's problem of delegating decision rights to an informed agent without transfer payment. The established basic trade-off has been applied to understand various issues. For example, the literature has used this basic insight to study the value of communication (e.g. Melumad and Shibano (1991), Newman and Novoselov (2009)), organizational structures (e.g., Aghion and Tirole (1997)), project choices (e.g., Armstrong and Vickers (2010)), among others.

literatures by applying these basic economic forces to study a rich auditing setting. By incorporating specific auditing institutional arrangements, our model generates many comparative statics useful for both empirical tests and policy discussions. In particular, the combination of the two streams of literatures generates a new result that tightening auditing standards has qualitatively different consequences in the long-run than in the short-run.

The rest of the paper proceeds as follows. Section 2 describes the model. Section 3 solves the equilibrium decisions. Section 4 examines the economic consequences of auditing standards. Section 5 provides two extensions to the main model. Section 6 discusses empirical implications of the model, and Section 7 concludes.

## 2 The model

We augment a standard audit model with the auditors' exercise and acquisition of professional expertise. The standard component follows Dye (1995) and Laux and Newman (2010). The model consists of two players, one auditor and one firm representing its investors. The firm hires the auditor to perform an audit and then makes an investment decision.<sup>5</sup> The firm's project requires an initial investment  $I$ . The project ultimately either succeeds (a good project) or fails (a bad project), denoted as  $\omega \in \{G, B\}$ . The success generates cash flow  $G > I$  while the failure generates cash flow  $B$ , which is normalized to be 0. The prior probability that the investment will be a failure is  $p$ . We assume  $W_0 \equiv (1 - p)G - I > 0$ , which implies that the firm's default decision is to invest in absence of additional information.<sup>6</sup> The firm doesn't have private information about  $\omega$  and always sends the auditor a favorable report for attestation.<sup>7</sup>

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<sup>5</sup>We assume that the firm makes the investment on behalf of investors. Alternatively, we could distinguish between current and new investors. The current investors sell the firm in a competitive market to new investors who in turn make the investment decision. Such a setting introduces additional notations without affecting the main results.

<sup>6</sup>Alternatively, if  $W_0 < 0$ , the firm's default decision is not to invest. The value of audit report is then to identify the good projects, rather than to cull out the bad ones. Such an alternative assumption doesn't qualitatively affect the results. What is important for our results is that audit reports are relevant for the investment decisions and thus there is demand for audit.

<sup>7</sup>This assumption simplifies the firm's reporting issue and focuses the model on the auditing issue. It is commonly made in the auditing literature (e.g., Dye (1993), Dye (1995), Lu and Sapra (2009), Laux and Newman (2010), Ye and Simunic (2013)). For the interaction between financial reporting and auditing, see Newman, Patterson, and Smith (2001), Patterson and Smith (2003), Caskey, Nagar, and Petacchi (2010), Mittendorf (2010), Deng, Melumad, and Shibano (2012), and Kronenberger and Laux (2016).

The firm hires an auditor for a negotiated fee, denoted as  $\xi$ . The fee negotiation is conducted as a Nash Bargaining process. The auditor has bargaining power  $t \in (0, 1)$  and the firm  $1 - t$ . The bargaining power is determined by the competition in the market for audit services. The auditor has more bargaining power (a larger  $t$ ) when the audit market is less competitive.<sup>8</sup>

In return for the fee, the auditor issues an audit report  $r$  and bears possible legal liability for audit failure. The auditor performs an audit in order to issue an audit report. Denote the audit report as  $r \in \{g, b\}$ .  $r = g$  is an unqualified opinion that the firm's favorable report is prepared appropriately, while  $r = b$  is a qualified opinion that disapproves the firm's initial favorable report. Denote  $a \in [0, 1]$  as the audit level the auditor chooses. The audit technology is as follows:

$$\begin{aligned}\Pr(r = g | \omega = G, a) &= 1, \\ \Pr(r = g | \omega = B, a) &= \gamma(1 - a).\end{aligned}\tag{1}$$

The essence of this audit technology is that more audit reduces audit failure, which is defined as the event whereby the firm fails after the auditor issued an unqualified opinion, i.e., the event  $(\omega = B, r = g)$ .<sup>9</sup> The audit failure risk is  $p\gamma(1 - a)$  and it is decreasing in audit level  $a$ .<sup>10</sup> Parameter  $\gamma$  captures the audit risk and we will return to it later. The cost of audit  $a$  is  $C(a)$ .  $C(a)$  has the standard properties:  $C(0) = C'(0) = 0$ ,  $C' > 0$  for  $a > 0$ ,  $C'' > 0$ ,  $C''' \leq 0$ , and  $C'(1)$  being sufficiently large. One example of such a cost function is  $C(a) = \frac{c}{2}a^2$  with a sufficiently large  $c$ .

In addition to issuing an audit report, the auditor is also subject to legal liabilities. A

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<sup>8</sup>We use an open interval for  $t$  to avoid discussions of corner solutions. Empirically,  $t$  is likely to be interior, that is, the auditor has some but not all the bargaining power with its clients.

<sup>9</sup>This audit technology is commonly adopted in the literature, e.g., Dye (1993), Dye (1995), Schwartz (1997), Bockus and Gigler (1998), Chan and Pae (1998), Hillegeist (1999), Radhakrishnan (1999), Chan and Wong (2002), Mittendorf (2010), and Laux and Newman (2010), among others. The technology assumes away the possibility that the audit could create concerns of false positives whereby the good state is mistaken as bad. The possibility of these errors can place an additional burden of proof on auditors but won't affect our results qualitatively as long as the audit is overall still valuable to the firm.

<sup>10</sup>One interpretation of audit  $a$  could be sample size. Auditors employ sampling techniques and inherent sampling error routinely arise in auditing. Auditors face some risk that misstatements will not be uncovered in test work; however, such risk is mitigated as the sample size increases.



perfect legal liability system would require that the auditor reimburse the firm the investment cost  $I$  in the event of audit failure. Under such a perfect system the auditor would fully internalize the consequences of audit failure and there would be no demand for auditing standards. To create such demand, we assume that the legal liability system is not perfect. In particular, in the event of audit failure, the auditor pays damage  $\theta I$  with  $\theta \in \{0, 1\}$  and  $\Pr(\theta = 1) = s$ . The auditor pays the full damage only with probability  $s \in (0, 1)$ . With the complementary probability  $1 - s$ , the auditor gets away and pays no damage.<sup>11</sup>  $s$  measures the incentive alignment between the auditor and the firm. For simplicity, we refer to  $\theta$  as the auditor's type and call the auditor with aligned incentives ( $\theta = 1$ ) as the aligned auditor and the one with misaligned incentives ( $\theta = 0$ ) as the misaligned auditor. We assume that the auditor observes  $\theta$  after she accepts the engagement but before she chooses audit level  $a$ . We discuss in Section 5.2 an alternative timing when  $\theta$  is observed by both parties before negotiating the audit fee  $\xi$ .

An auditing standard  $Q \in (0, 1)$  requires that the auditor choose at least audit level  $a \geq Q$ . To focus on the effects of standards, we assume away the enforcement issue in the main model. Instead, we assume that the auditor obeys any given standard  $Q$  (and otherwise receives a sufficiently large penalty from the regulator). Since  $Q$  is a minimum audit requirement, its satisfaction does not shield the auditor from the legal liabilities.<sup>12</sup> We extend the model to incorporate imperfect enforcement and inspection in Section 5.1.

So far our model is a fairly standard one (e.g., Dye (1995), Laux and Newman (2010)). Now we augment it with auditors' professional expertise. An effective audit balances the benefit of reducing audit failure risk with the increased audit cost. In planning and conducting the audit, auditors use not only hard and quantifiable information but also subjective and soft information about the specific engagement (e.g., Bertomeu and Marinovic (2015)) to allocate the audit efforts to the areas with greater risk of audit failure. We interpret the use of soft and subjective information in assessing the audit risk as the exercise of profes-

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<sup>11</sup>In practice, the legal system is not perfect in disciplining the auditor (i.e.,  $s$  could be smaller than 1) for at least three reasons. First, some audit failures don't lead to litigations against auditors. Second, auditors don't always lose the litigations. Finally, even if an auditor loses a litigation, she is protected by limited liability and may not pay the entire damage suffered by investors.

<sup>12</sup>Dye (1995) provides multiple justifications for this assumption (see page 81).

sional judgement. By this definition, professional judgment cannot be completely replaced by auditing standards. This assumption is similar to that made in the incomplete contracting literature that some information can be used in decision-making but cannot be contracted on (e.g., Grossman and Hart (1986)). Auditors obtain such subjective information from their training, knowledge, and experience. Thus, they could make costly investment to improve their professional expertise.

We operationalize professional judgement as follows. First, we assume that the audit risk parameter  $\tilde{\gamma}$  in equation 1 is a random variable over  $[0, 1]$  with mean  $\gamma_0$ . The c.d.f and p.d.f. of  $\tilde{\gamma}$  are  $F(\tilde{\gamma})$  and  $f(\tilde{\gamma})$ , respectively. In other words, the audit risk may vary across engagements. Second, an auditor with more expertise has better ability in assessing audit risk. Specifically, denote  $\tau \in \{i, u\}$  with  $\Pr(\tau = i) = e \in [0, 1]$ . The auditor with expertise  $e$  becomes an expert ( $\tau = i$ ) with probability  $e$  and non-expert ( $\tau = u$ ) with probability  $1 - e$ . Later it is more convenient to work with the auditor's posterior belief about audit risk  $\tilde{\gamma}$ . Denote  $m_\tau = E[\tilde{\gamma}|\Omega_\tau]$ ,  $\tau \in \{i, u\}$ , as the auditor's conditional expectation of audit risk.  $\Omega_\tau$  reflect all the information and professional judgement available to the auditor. That the expert auditor has better judgement about audit risk than her non-expert counterpart is captured by our assumption that  $\Omega_i$  is finer than  $\Omega_u$  in Blackwell sense.<sup>13</sup>  $m_\tau$  is a random variable with c.d.f  $F_\tau(\cdot)$ . Since  $\Omega_i$  is finer than  $\Omega_u$ ,  $m_i$  is a mean-preserving spread of  $m_u$ , that is, the expert auditor's posterior belief about audit risk  $m_i$  is more precise than  $m_u$ . For example, if the expert's judgement is perfect while the non-expert has no clue at all, then  $m_i = \tilde{\gamma}$ ,  $m_u = \gamma_0$  and  $m_i$  is a mean-preserving spread of  $m_u$ . Third, auditing standard  $Q$  is independent of  $\gamma$  and/or  $m_\tau$ . Finally, it is costly for the auditor to develop expertise. Before accepting the audit contract, the auditor chooses expertise  $e$  at cost  $kK(e)$ .  $kK(e)$  has the standard properties:  $K(0) = K'(0) = 0$ ,  $K' > 0$  for  $e > 0$ ,  $K'' > 0$ ,  $K''' \leq 0$  and  $kK'(1)$  being sufficiently large. One example of such a cost function is  $kK(e) = \frac{k}{2}e^2$  with  $k$  being

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<sup>13</sup>Lambert (1986) and Demski and Sappington (1987) also model an expert agent as one with a larger set of subjective information, which in turn leads to the assumption that an expert agent's posterior belief or judgement about the state is more precise than her non-expert counterpart. An alternative way to provide a microfoundation for the expert's better judgement is to assume that an expert can process the same set of materials more efficiently, just like an expert analyst generates more precise forecasts from reading the same set of public information. This interpretation leads to the same assumption that the expert auditor's posterior belief about audit risk is more precise than the non-expert's. Thus, all our results are intact with this alternative interpretation.

properly restricted. The auditor's expertise  $e$  is observable to the firm at the time of contract negotiation.

The timeline is summarized as follows:

At date 0, the auditor chooses expertise  $e$  at cost  $kK(e)$ . Observing the auditor's expertise  $e$ , the firm hires the auditor and negotiates the audit fee  $\xi$ .

At date 1, the auditor discovers engagement details  $m_\tau$  and her incentive alignment  $\theta$ , chooses audit level  $a$  at cost  $C(a)$ , and issues audit report  $r$ .

At date 2, the firm invests only upon receiving an unqualified report.<sup>14</sup> If the investment is made, the payoffs are realized. If the audit failure occurs, the auditor pays damage  $\theta I$  to the investors.

The equilibrium solution concept for the model is subgame perfection.

Finally, we describe the payoffs to the auditor and to the firm. The auditor's expected payoff at date 0 is

$$U = \xi - E_{m_\tau, \theta}[C(a_\theta) + pm_\tau(1 - a_\theta)\theta I] - kK(e). \quad (2)$$

In addition to the audit fee  $\xi$  and the cost of expertise acquisition  $kK(e)$ , the auditor choose audit  $a_\theta$  with cost  $C(a_\theta)$  and pays legal damage  $\theta I$  in the event of audit failure, which occurs with probability  $pm_\tau(1 - a_\theta)$ .

The firm's expected payoff at date 0 is

$$W = W_0 + pIE_{m_\tau, \theta}[(1 - m_\tau(1 - a_\theta)(1 - \theta))] - \xi. \quad (3)$$

The firm's payoff in absence of audit is  $W_0$ . The firm pays audit fee  $\xi$  and receives both an audit report and insurance from the auditor. If the audit report is  $r = b$ , which occurs with probability  $pE_{m_\tau, \theta}[1 - m_\tau(1 - a_\theta)]$ , the firm doesn't invest and saves the investment cost  $I$ . If

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<sup>14</sup>To simplify the exposition, we omit the firm's investment decision from the equilibrium description. It can be verified that at date 2 it is indeed optimal for the firm not to invest when  $r = b$  and to invest when  $r = g$ . When the audit report is  $r = b$ , the audit technology suggests that  $\Pr(\omega = G|r = b) = 0$  and thus the firm doesn't invest. On the other hand,  $r = g$  revises upward the belief about the project's fundamental. Under the assumption of  $W_0 > 0$ , the firm invests with the prior belief and thus will invest when the belief improves. In sum, it is optimal to invest if and only if an unqualified report is issued.

the audit report is  $r = g$ , the firm invests and receives a damage payment  $\theta I$  from the auditor in the event of audit failure. Thus, the expected damage payment is  $pE_{m_\tau, \theta}[m_\tau(1 - a_\theta)\theta]I$ . Collecting these two benefits,  $pE_{m_\tau, \theta}[1 - m_\tau(1 - a_\theta)]I + pE_{m_\tau, \theta}[m_\tau(1 - a_\theta)\theta]I$ , we obtain the second term in  $W$ .

### 3 The equilibrium

The model is solved by backward induction.

#### 3.1 The auditor's audit choice

At date 1, after observing her incentive alignment  $\theta$  and assessing the engagement's audit risk  $m_\tau$ , the auditor chooses audit level  $a_\theta(m_\tau)$  to maximize her expected payoff  $U$  defined in equation 2 subject to the auditing standard  $Q$ . We have written  $a_\theta(m_\tau)$  to highlight the fact that the auditor observes  $\theta$  and  $m_\tau$  before choosing the audit level  $a$ . The audit choice problem is summarized below:

$$\begin{aligned} \max_{a_\theta(m_\tau)} U &= \xi - C(a_\theta(m_\tau)) - pm_\tau(1 - a_\theta(m_\tau))\theta I - kK(e) \\ \text{s.t.} \quad a_\theta(m_\tau) &\geq Q. \end{aligned} \tag{4}$$

On one hand, audit benefits the auditor by reducing her possible legal liabilities arising from audit failure. With audit  $a$ , the auditor detects the bad state with probability  $p(1 - m_\tau(1 - a))$  and avoids legal liabilities  $\theta I$ . On the other hand, audit is expensive and costs the auditor  $C(a)$ . The auditor chooses the optimal audit level to balance this trade-off. To highlight the impacts of the auditing standard constraint  $a \geq Q$ , we start with the relaxed problem without the constraint. Denoting  $a_\theta^{**}(m_\tau)$  as the auditor's optimal audit choice in absence of auditing standards, we solve the optimization problem and obtain

$$a_\theta^{**}(m_\tau) = C'^{-1}(pm_\tau\theta I). \tag{5}$$

In absence of auditing standards, the auditor's audit choice depends on both her assess-

ment of audit risk  $m_\tau$  and her incentive alignment  $\theta$ . She conducts more audit when she judges that the engagement's audit risk is higher (e.g., a higher  $m_\tau$ ) and/or when she is more likely to be subject to legal liabilities in the event of audit failure (i.e., a higher  $\theta$ ).

Now we introduce the regulatory constraint  $a \geq Q$ . Given the simple structure, we can obtain the closed-form solution for the auditor's optimal audit choice:

$$a_\theta^*(m_\tau) = \max\{a_\theta^{**}(m_\tau), Q\} = \max\{C'^{-1}(pm_\tau\theta I), Q\}. \quad (6)$$

In the presence of auditing standards, the auditor compares her optimal choice in absence of standards ( $a_\theta^{**}(m_\tau)$ ) with the requirement ( $Q$ ) and chooses the larger one.

### 3.2 The audit fee negotiation

At date 0, before the auditor observes the engagement details  $m_\tau$  and  $\theta$ , the auditor negotiates audit fee  $\xi$  with the firm through Nash bargaining in which they divide the expected audit value according to their respective bargaining power  $t$  and  $1 - t$ .

The expected audit value is derived as follows. At the stage of negotiating audit fees, both parties observe the auditor's expertise  $e$  but anticipate the auditor's equilibrium audit choice  $a_\theta^*(m_\tau)$  in equation 6. From the perspective of the joint payoffs to the auditor and the firm, audit  $a$  detects the bad project with probability  $p[1 - m_\tau(1 - a)]$  but costs  $C(a)$ . Thus, the equilibrium audit value, conditional on the equilibrium audit choice  $a_\theta^*(m_\tau)$ , is thus

$$\pi_\theta^*(m_\tau) = p[1 - m_\tau(1 - a_\theta^*(m_\tau))]I - C(a_\theta^*(m_\tau)). \quad (7)$$

We write the equilibrium audit value as a function of auditor type  $\theta$  and information  $m_\tau$  because  $a_\theta^*(m_\tau)$  is ultimately a function of  $\theta$  and  $m_\tau$ . Since the two parties haven't observed  $\theta$  and  $m_\tau$  at date 0, they negotiate to divide the expected equilibrium audit value  $E_{m_\tau, \theta}[\pi_\theta^*(m_\tau)]$ .

The auditor and the firm compare their equilibrium expected payoffs from a successful negotiation with those off equilibrium (if they were to walk away from the negotiation) in order to determine their surplus from the cooperation. Their expected payoffs in the various

scenarios are summarized in Table 1.

Table 1: Audit Fee Negotiation		
	Auditor	Firm
Negotiation fails	$-kK(e)$	$W_0$
Negotiation succeeds	$U$	$W$

The auditor's expected payoff from walking away the negotiation is  $-kK(e)$ . The auditor doesn't perform any audit and is not subject to any legal liability. However, at the time of the negotiation, the auditor has already acquired expertise  $e$  at the cost of  $kK(e)$  and still bears this sunk cost if she were to walk away from the negotiation. Similarly, in absence of an audit the firm always makes the investment and the firm's payoff is  $W_0$ . This explains the first row in Table 1.

The equilibrium payoffs to the auditor and the firm are  $U$  and  $W$  in equation 2 and 3 evaluated at the equilibrium audit choice  $a_\theta^*(m_\tau)$ . The audit fee  $\xi$  is set as such that the auditor's net surplus from the engagement is equal to  $t$  portion of the expected audit value  $E_{m_\tau, \theta}[\pi_\theta^*(m_\tau)]$ .<sup>15</sup> In other words,  $\xi$  is determined by

$$U + kK = tE_{m_\tau, \theta}[\pi_\theta^*(m_\tau)]. \quad (8)$$

Writing out the expectation and rearranging the terms, we can express the audit fee as a function of audit expertise  $e$  in the following way:

$$\xi(e) = E_{m_\tau, \theta}[C(a_\theta^*(m_\tau)) + pm_\tau(1 - a_\theta^*(m_\tau))\theta I] + tE_{m_\tau, \theta}[\pi_\theta^*(m_\tau)]. \quad (9)$$

The three components of audit fee  $\xi$  are intuitive. They are the reimbursement for the expected audit cost, the reimbursement for the legal liabilities cost, and the  $t$  fraction of the audit surplus. Moreover, the cost of expertise development,  $kK(e)$ , is not directly reimbursed through the audit fee. This reflects the hold-up problem between the auditor and the firm. At the time of audit fee negotiation, the auditor's expertise development cost is sunk and

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<sup>15</sup>  $\xi$  could be equivalently derived from the firm's perspective that  $W - W_0 = (1 - t) E_{m, \theta}[\pi_\theta^*(m)]$ . Simple calculation confirms that both approaches lead to the same expressions of  $\xi$ .

thus irrelevant for the negotiation. This affects the auditor's incentive to develop expertise in the first place, to which we turn now.

### 3.3 The auditor's expertise acquisition decision

Before the audit fee negotiation, the auditor chooses expertise  $e$  to maximize her expected payoff  $U$  defined in equation 2. Equation 8 from the previous subsection suggests that  $U$  can be rewritten as

$$\begin{aligned} U(e) &= tE_{m_\tau, \theta}[\pi_\theta^*(m_\tau)] - kK(e) \\ &= t(1-s)E_{m_\tau}[\pi_0^*(m_\tau)] + tsE_{m_u}[\pi_1^*(m_u)] + tse(E_{m_i}[\pi_1^*(m_i)] - E_{m_u}[\pi_1^*(m_u)]) - kK(e). \end{aligned}$$

The auditor enjoys  $t$  fraction of the expected equilibrium audit value  $E_{m_\tau, \theta}[\pi_\theta^*(m_\tau)]$  but bears the entire cost of expertise acquisition  $kK(e)$ . The expected equilibrium audit value  $E_{m_\tau, \theta}[\pi_\theta^*(m_\tau)]$  is decomposed into three components in the second line. The first and second components are the expected audit value contributed by a misaligned auditor and an aligned non-expert auditor, respectively. The last component is the incremental audit value contributed by an aligned expert auditor (relative to an aligned non-expert auditor). The auditor chooses  $e$  to maximize  $U(e)$  and the first-order condition is

$$(E_{m_i}[\pi_1^*(m_i)] - E_{m_u}[\pi_1^*(m_u)])ts = kK'(e^*). \quad (10)$$

The right hand side is the marginal cost of expertise. As the cost parameter  $k$  increases, the auditor acquires less expertise in equilibrium. The left hand side is the marginal benefit of expertise, which is affected by three factors. First, the aligned auditor performs the audit in a more effective way when she is an expert than when she is not. This benefit is captured by the incremental audit value  $E_{m_i}[\pi_1^*(m_i)] - E_{m_u}[\pi_1^*(m_u)]$ , which is proved to be positive in the Appendix. The expert auditor who understands the audit risk  $\gamma$  better can allocate the audit resources more efficiently to the area of greater audit risk. Even though the proof of this claim is technically involved, the intuition is clear. At the stage of performing the audit, the audit fee is sunk and the aligned auditor's audit choice is an effectively single-person

decision. Expertise allows the aligned expert auditor to increase the dispersion of her audit choices ex post and thus her audit choice becomes more efficient.

The second determinant of the auditor's expertise acquisition is the auditor's bargaining power  $t$ . As we have discussed toward the end of the previous subsection, the auditor's expertise development is subject to a hold-up problem in that the audit fee doesn't directly reimburse the auditor for her expertise development cost. However, the auditor does indirectly benefit from her own expertise because it increases the size of expected audit value  $E_{m_\tau, \theta}[\pi_\theta^*(m_\tau)]$ , of which she is able to secure  $t$  fraction in the bargaining process. Thus, the auditor's bargaining power in fee negotiation helps mitigate the hold-up problem and encourages the auditor to develop more expertise.

Finally, the auditor acquires more expertise if she expects that the legal liability system is more likely to hold her responsible in the future (i.e., a higher  $s$ ). When the auditor's incentive is not aligned with investors, i.e.,  $\theta = 0$ , she works only to fulfill the minimum requirement and thus doesn't utilize her professional judgement. As a result, the misaligned auditor's expected audit value,  $E_{m_\tau}[\pi_0^*(m_\tau)]$ , is not affected by her expertise, either. In other words, the weaker ex post discipline from the legal liability system (a lower  $s$ ) also reduces the auditor's ex ante incentive to develop professional expertise.

We have solved all the equilibrium decisions. The equilibrium is summarized below.

**Proposition 1** *The unique sub-game perfect equilibrium is as follows:*

1. *the auditor with incentive  $\theta$  and risk assessment  $m_\tau$  chooses audit level  $a_\theta^*(m_\tau)$  according to equation 6;*
2. *the equilibrium audit fee  $\xi^*$  is determined by equation 9 evaluated at  $e = e^*$ ;*
3. *the auditor develops expertise  $e^*$  according to equation 10.*

## 4 The economic consequences of auditing standards

To highlight the model's insights and empirical predictions, we now conduct comparative statics in three steps. First, we examine how auditing standards affect the equilibrium de-



cisions described in Proposition 1. Second, we use the effects of auditing standards on the equilibrium decisions as building blocks to study our central question about how auditing standards affect the equilibrium audit quality. Finally, we also study the effects of auditing standards on audit fees and on the equilibrium payoffs to the auditor and the firm.

#### 4.1 The auditing standards' effects on audit level and auditor competence

**Proposition 2** *Defining  $\hat{m} \equiv \frac{C'(Q)}{pI}$ . As auditing standard  $Q$  increases,*

1. *the equilibrium audit level by both the aligned and misaligned auditors are higher, i.e.,  $\frac{\partial a_0^*(m_\tau)}{\partial Q} > 0$ ,  $\frac{\partial a_1^*(m_\tau)}{\partial Q} > 0$  if  $m_\tau < \hat{m}$ , and  $\frac{\partial a_1^*(m_\tau)}{\partial Q} = 0$  if  $m_\tau \geq \hat{m}$ ;*
2. *the equilibrium audit expertise  $e^*$  is lower, i.e.,  $\frac{de^*}{dQ} < 0$ .*

Proposition 2 is intuitive. First, higher auditing standards lead the auditor to work more. To see this, we can check who find the auditing standards binding. Equation 6 suggests that the auditing standard  $Q$  binds, i.e.,  $C'^{-1}(pm_\tau\theta I) \leq Q$ , if and only if

$$m_\tau\theta \leq \hat{m}.$$

Specifically, auditing standard  $Q$  constrains two groups of auditors. The first group is the misaligned auditor with  $\theta = 0$ . She is always forced to increase her audit level, that is,  $a_0^*(m_\tau) = Q > a_0^{**}(m_\tau) = 0$ . She won't be able to choose  $a_0^{**}(m_\tau) = 0$  any longer. Thus, auditing standards provide remedy for the interest misalignment between the auditor and the firm. This is the source of the benefit of auditing standards. The second group of auditors whose audit choices are constrained are the aligned auditor in the circumstances of  $m_\tau \leq \hat{m}$ . When the aligned auditor judges that the audit risk  $m_\tau$  is low, she would choose  $a_1^*(m_\tau) = a_1^{**}(m_\tau)$ , which is lower than the auditing standard  $Q$ . Despite her proper incentives and better judgement, she is constrained by the auditing standard to increase her audit level from  $a_1^{**}(m_\tau)$  to  $Q$ . In other words, her audit choice is not sensitive to her judgement any longer and she simply follows the standard  $Q$ . In this sense, auditing standards lead to the auditor's compliance mentality or check-list approach. In sum, we have  $\frac{\partial a_\theta^*(m_\tau)}{\partial Q} = 1$  for

those auditors with binding auditing standard constraints (*i.e.*,  $m_\tau \theta \leq \hat{n}$ ) and  $\frac{\partial a_\theta^*(m_\tau)}{\partial Q} = 0$  otherwise.

The second part of Proposition 2 states that auditing standards always reduce the auditor's expertise acquisition. To explain its intuition, we go back to the first-order condition for the expertise choice, equation 10. The expertise is motivated by the incremental value an expert auditor creates (relative to a non-expert auditor),  $E_{m_i}[\pi_1^*(m_i)] - E_{m_u}[\pi_1^*(m_u)]$ . First, auditing standard  $Q$  reduces the expected equilibrium audit value created by both the expert and non-expert auditors. As we have discussed above, the aligned auditor finds the minimum requirement  $Q$  binds if her ex post risk assessment is low (*i.e.*,  $m_\tau < \hat{n}$ ). Whenever the aligned auditor finds the auditing standard constraint binding, the audit level she ends up performing is higher than that justified by her professional judgement. Therefore, ex ante (before observing  $m_\tau$ ) a tighter standard always reduces the aligned auditor's expected equilibrium audit value. In other words, the compliance mentality induced by auditing standards lowers the audit value created by both the expert and non-expert auditors. Second, auditing standard  $Q$  reduces the audit value created by the expert auditor more than that by the non-expert auditor. This is the key intuition why auditing standards  $Q$  reduce the auditor's incentives to become an expert. The technical proof of this result is complicated, but the intuition is relatively straightforward. When auditing standards constrain the auditor's exercise of expertise, the constraint is more consequential for an expert than for a non-expert. When the auditor has to perform a set of audit procedures regardless of her assessment of the audit risk, her expertise in assessing the audit risk becomes irrelevant and thus her incentive to acquire such expertise diminishes. As a result, auditing standards lead to less competent auditors. This inherent conflict between auditing standards and professional expertise is a key force to understand the auditing standards' economic consequences.

That the auditor's expertise acquisition is sensitive to auditing standards plays an important role in the subsequent results. We further study the determinants of the sensitivity of the auditor's equilibrium expertise to auditing standards.

**Lemma 1** *The speed at which the equilibrium expertise  $e^*$  decreases in auditing standard  $Q$  is increasing in  $s$  and  $t$  but decreasing in  $k$ . That is,  $\frac{d^2 e^*}{dsdQ} < 0$ ,  $\frac{d^2 e^*}{dtdQ} < 0$ ,  $\frac{d^2 e^*}{dkdQ} > 0$ .*

The intuition for the lemma is as follows. By diminishing the value of expertise to the auditor, auditing standards reduces her expertise acquisition. This adverse effect is stronger when the value of expertise to the auditor is larger, which occurs when the auditor has more bargaining power, better incentive alignment, or lower cost of expertise acquisition.

Having understood how auditing standards affect the auditor's equilibrium choices, we are now ready to study the effects of auditing standards on audit quality. Before proceeding, note that since we work with the general cost functions for audit and expertise acquisition and the general distribution of audit risk  $\gamma$ , the second-order effects of auditing standard  $Q$  on the equilibrium variables are often complex. Thus, we assume that the relevant second-order conditions with the general structure are satisfied so that we could focus on the unique thresholds. We verify that they are indeed satisfied in a quadratic-cost-uniform-distribution specification elaborated in the Appendix.

## 4.2 The auditing standards' effects on audit quality

The (equilibrium) audit quality is defined as the complement to the ex ante audit failure risk:

$$A^*(Q) \equiv 1 - E_{m_\tau, \theta}[pm_\tau(1 - a_\theta^*(m_\tau))] = 1 - p\gamma_0 + pE_{m_\tau, \theta}[m_\tau a_\theta^*(m_\tau)]. \quad (11)$$

Audit quality  $A^*$  depends on not only the audit level  $a_\theta^*(m_\tau)$  per se but also the match between the audit level choice and the audit risk  $\tilde{\gamma}$ .

Intuitively, if auditing standards were set to the extreme by mandating the maximum possible audit regardless of the engagement circumstances, then the audit quality would be the highest possible. However, such extreme auditing standards would be prohibitively costly. Define  $\bar{Q} \equiv C'^{-1}(p\gamma_0 I)$ , the auditing standard an aligned auditor without professional judgement will find binding. An audit standard tighter than  $\bar{Q}$  is extreme because it always hurts the interests of both the auditor and the firm (regardless of the auditor's incentive alignment), as we will show in later subsections.

We now turn to the more interesting case with non-extreme standards  $Q \leq \bar{Q}$ .

**Proposition 3** *If  $s$  or  $t$  are sufficiently large or if  $k$  is sufficiently small, there exists a*

threshold  $Q_A < \bar{Q}$ , such that audit quality  $A^*$  is increasing in  $Q$  if  $Q \leq Q_A$  and decreasing in  $Q$  if  $Q \in (Q_A, \bar{Q}]$ .

Proposition 3 gives the conditions under which auditing standards lead to *lower* audit quality. This result might be surprising, in particular in light of Proposition 2 that auditing standards increase ex post audit levels by both types of auditors. By mandating a higher level of minimum audit and forcing all auditors to work more, tighter auditing standards could paradoxically reduce audit quality.

To understand the intuition, we differentiate  $A^*$  with respect to  $Q$  and obtain

$$\frac{dA^*}{dQ} = \frac{\partial A^*}{\partial Q} + \frac{\partial A^*}{\partial e} \Big|_{e=e^*} \frac{de^*}{dQ}.$$

Auditing standard  $Q$  affects audit quality through two channels. The first is a direct channel  $\frac{\partial A^*}{\partial Q}$ , which is always positive. Keeping the audit expertise  $e^*$  constant, a tighter auditing standard always improves audit quality, as we show formally in the following corollary.

**Corollary 1** *If the auditor's expertise is exogenous, auditing standards always improve audit quality, i.e.,  $\frac{\partial A^*}{\partial Q} > 0$ .*

The positive direct effect is due to the following reasons. First, the higher audit level by the misaligned auditor improves audit quality. Second, the higher audit level by the aligned auditor also improves audit quality when the auditor's expertise is fixed. This is because auditing standard  $Q$  restricts the aligned auditor's exercise of professional judgment in a systematic manner. Whenever the aligned auditor finds the auditing standard binding, she performs more audit than that justified by her professional judgement. The excessive audit improves the probability of uncovering errors and thus improves audit quality. Overall, the audit quality increases in auditing standard  $Q$  when the audit expertise is fixed. Therefore, auditing standards' constraint of auditors' exercise of professional judgement, or the compliance mentality, is not sufficient for auditing standards to reduce audit quality.

However, auditing standards have an indirect effect on auditing quality through their effects on auditors' expertise acquisition decision. As we have seen in Proposition 2, auditing

standards reduce the auditor's expertise acquisition, that is,  $\frac{de^*}{dQ} < 0$ . Moreover, the lower audit expertise leads to lower audit quality  $\frac{\partial A^*}{\partial e} < 0$ . Audit expertise enables the aligned auditor to tailor audit resources to areas of greater audit risk and thus reduce audit risk more efficiently. Combining  $\frac{de^*}{dQ} < 0$  and  $\frac{\partial A^*}{\partial e} > 0$ , we have shown that auditing standards indirectly reduce audit quality by lowering the auditor's competence.

Therefore, there is a trade-off between the direct effect of forcing auditors to do more work and the indirect effect of inducing auditors to be less competent. The indirect effect is stronger when the auditor's expertise acquisition decision is more sensitive to auditing standards. It dominates the direct effect, and as a result tighter auditing standards reduce audit quality, when the auditors' expertise acquisition decision is sufficiently sensitive to auditing standards. The sensitivity is increasing in the auditor's incentive alignment  $s$  and bargaining power  $t$  but decreasing in the auditor's cost of expertise acquisition  $k$ , as we have seen in Lemma 1. This explains the conditions in Proposition 3.

### 4.3 The auditing standards' effects on audit fee

We now examine the effects of auditing standards on audit fee  $\xi^* \equiv \xi(e^*)$ , as given in equation 9.

**Proposition 4** *The equilibrium audit fee  $\xi^*$  is increasing in auditing standard  $Q$ , i.e.  $\frac{d\xi^*}{dQ} > 0$ .*

Stricter auditing standards always lead to higher audit fees. To understand the intuition, we also differentiate  $\xi^*$  with respect to  $Q$  and obtain

$$\frac{d\xi^*}{dQ} = \frac{\partial \xi^*}{\partial Q} + \frac{\partial \xi^*}{\partial e} \Big|_{e=e^*} \frac{de^*}{dQ}.$$

The direct effect of auditing standards on audit fee is positive. To see this, we rewrite the audit fee in equation 9 as follows (the derivation can be found in the proof of Proposition 4):

$$\begin{aligned}\xi^*(Q) = & (1-s)((1-t)C(Q) + tp(1-\gamma_0(1-Q))I) \\ & + s \sum_{\tau \in \{i,u\}} \Pr(\tau)(pI - (1-t)E_{m_\tau}[\pi_1^*(m_\tau)]).\end{aligned}\tag{12}$$

The first component is the audit fee for the misaligned auditor. When she has no bargaining power, which occurs with probability  $(1-t)$ , she receives only the reimbursement of audit cost  $C(Q)$ . When she has all the bargaining power, she receives both the cost reimbursement and the audit value, which amounts to the gross audit value  $p(1-\gamma_0(1-Q))I$ . Since both terms are increasing in  $Q$ , the audit fee to the misaligned auditor is increasing in  $Q$ . Higher auditing standards compel the misaligned auditor to perform more audit, which increases both the audit cost and the gross audit value.

The second component of audit fee is for the aligned auditor. Since we focus on the direct effect here,  $\Pr(\tau)$ , which is a function of expertise  $e^*$ , is fixed. Thus, we only need to understand how  $Q$  affects  $pI - (1-t)E_{m_\tau}[\pi_1^*(m_\tau)]$ . It is more instructive to understand this component from the firm's perspective. Even though the firm doesn't observe the auditor's type, it reasons as follows. If it is dealing with the aligned auditor, which occurs with probability  $s$ , the firm receives the damage of  $I$  in the event of audit failure. Compared with the no auditing case, the firm saves the investment cost in the bad project,  $pI$ . The firm subtracts its share of surplus,  $(1-t)E_{m_\tau}[\pi_1^*(m_\tau)]$ , from the total saving of  $pI$  and remits the rest to the auditor through the audit fee. Since auditing standard  $Q$  always reduces the aligned auditor's expected audit value  $E_{m_\tau}[\pi_1^*(m_\tau)]$ , this second component in equation 12 is also increasing in  $Q$ .

The indirect effect of auditing standards on audit fee through their effect on expertise acquisition is positive as well. We have known from Proposition 2 that stricter auditing standards reduce expertise acquisition, *i.e.*,  $\frac{de^*}{dQ} < 0$ . We now explain why the equilibrium audit fee is decreasing in audit expertise, that is,  $\frac{\partial \xi^*}{\partial e} < 0$ .  $\frac{\partial \xi^*}{\partial e}$  captures the fee differences

paid to an expert relative to a non-expert aligned auditor.<sup>16</sup> From the discussion in the previous paragraph about the second component of audit fee in equation 12, the audit fee for the aligned auditor is decreasing in the expected audit value. Because the non-expert auditor creates a smaller expected audit value, the fee paid to an expert auditor is thus lower than to her non-expert counterpart. A stricter auditing standard reduces auditor expertise and the lower audit expertise in turn leads to higher audit fee. Therefore, the indirect effect is also positive and stricter auditing standards unambiguously lead to higher audit fees.

Since the indirect effect further increases audit fee, the audit fee increases faster when the indirect effect is stronger. The indirect effect is stronger when the auditor's expertise acquisition is more sensitive to auditing standards. Thus, we have the following result.

**Corollary 2** *Auditing standards increase audit fee faster when the auditor's expertise acquisition is more sensitive to auditing standards.*

#### 4.4 The auditing standards' effects on payoffs

Audit quality and audit fees are two important audit outcomes that are empirically widely researched. However, neither is comprehensive in measuring the effects of auditing standards on the auditor and the firm, to which we turn now. The equilibrium expected payoffs to the auditor and to the firm, given in equation 9 and in Footnote 15 and evaluated at the equilibrium, can be rewritten as

$$U^* \equiv U(e^*) = tE_{m_\tau, \theta}[\pi_\theta^*(m_\tau)] - kK(e^*), \quad (13)$$

$$W^* \equiv W(e^*) = (1 - t)E_{m_\tau, \theta}[\pi_\theta^*(m_\tau)] + W_0. \quad (14)$$

Recall that  $E_{m_\tau, \theta}[\pi_\theta^*(m_\tau)]$  is the expected equilibrium audit value (gross of expertise acquisition cost). It is divided between the auditor and the firm according to their respective

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<sup>16</sup>This can be derived explicitly as follows:

$$\begin{aligned} \frac{\partial \xi^*}{\partial e} &= s(pI - (1 - t)E_{m_i}[\pi_1^*(m_i)]) - s(pI - (1 - t)E_{m_u}[\pi_1^*(m_u)]) \\ &= s(1 - t)(E_{m_u}[\pi_1^*(m_u)] - E_{m_i}[\pi_1^*(m_i)]) \end{aligned}$$

bargaining power  $t$  and  $1 - t$ . In addition, the auditor pays the expertise acquisition cost  $kK(e^*)$  and the firm has the outside option value of  $W_0$  (without using audit).

**Proposition 5** *1. There exists a threshold  $Q_U$  such that the auditor's equilibrium payoff*

*$U^*$  is increasing in  $Q$  if  $Q \leq Q_U$  and decreasing in  $Q$  if  $Q > Q_U$ ;*

*2. There exists a threshold  $Q_W$  such that the firm value  $W^*$  is increasing in  $Q$  if  $Q \leq Q_W$  and decreasing in  $Q$  if  $Q > Q_W$ ;*

*3.  $Q_W < Q_U < \bar{Q}$ .*

Proposition 5 states that the equilibrium payoffs to both the auditor and the firm have an inverse U-shaped relation with auditing standards. Moreover, stricter standards are more likely to hurt the firm than the investors because  $Q_W < Q_U$ . Finally, extreme auditing standards that exceed  $\bar{Q}$  reduce the payoffs to both the auditor and the firm, as we have claimed in Subsection 4.2.

To better understand the intuition for these results, we again decompose the effects of auditing standards to the direct and indirect effects. The direct effect can be isolated when we fix the auditor's expertise, as summarized in the following corollary.

**Corollary 3** *For any given audit expertise  $e$ ,*

*1. There exists a threshold  $\hat{Q}_U$  such that the auditor's equilibrium payoff  $U$  is increasing in  $Q$  if  $Q \leq \hat{Q}_U$  and decreasing in  $Q$  if  $Q > \hat{Q}_U$ ;*

*2. There exists a threshold  $\hat{Q}_W$  such that the firm value  $W$  is increasing in  $Q$  if  $Q \leq \hat{Q}_W$  and decreasing in  $Q$  if  $Q > \hat{Q}_W$ .*

*3.  $\hat{Q}_W = \hat{Q}_U < \bar{Q}$ .*

Corollary 3 shows that auditing standards have two opposing effects on the auditor and the firm's payoffs even in absence of auditors' adjustment of expertise acquisition. On one hand, the auditing standard moves the misaligned auditor's choice toward the efficient level and improves the equilibrium payoffs to both parties. On the other hand, the auditing standard



constrains the aligned auditor from fully exercising her professional judgement and compels her to perform excessive procedures that are not justified by her professional judgement. The excessive audit reduces the equilibrium audit value due to the excessive cost. The value loss from constraining the aligned auditor can dominate the benefit of disciplining the misaligned auditor, resulting in net loss of audit value and lower equilibrium payoffs to both parties.

Moreover, when the audit expertise is fixed, the effects of auditing standards on the auditor and on the firm are the same, *i.e.*,  $\hat{Q}_W = \hat{Q}_U$ . In this case, auditing standards affect only the equilibrium audit value  $E_{m_\tau, \theta}[\pi_\theta^*(m_\tau)]$  (but doesn't affect the expertise acquisition). Since the audit value is divided proportionately between the auditor and the firm, the effects of the auditing standards on the audit value are also borne proportionately by the two parties.

In addition to the direct effect, auditing standards also have an indirect effect on audit value through the auditor's expertise acquisition. We have known from Proposition 2 that stricter auditing standards reduce expertise acquisition, *i.e.*,  $\frac{de^*}{dQ} < 0$ . Now we explain how the firm and the auditor's equilibrium payoffs respond to audit expertise. Since the auditor chooses expertise  $e$  to maximize her equilibrium payoff, optimality requires that the marginal effect of expertise on the auditor's equilibrium payoff is 0, *i.e.*,  $\frac{dU}{de}|_{e=e^*} = 0$ . The firm's perspective, however, is different. The firm shares  $1 - t$  fraction of the audit value, but doesn't bear any of the expertise development cost. As a result of this hold-up problem, the firm prefers a higher level of audit expertise than the auditor. At the point  $e = e^*$  where the marginal benefit and marginal costs of expertise are equal for the auditor, the firm still finds that the marginal benefit is larger than the marginal cost and that its equilibrium payoff is still increasing in expertise. Therefore, a stricter standard reduces the auditor's expertise acquisition, and the lower expertise doesn't affect the auditor's payoff but does reduce the firm value on margin. In other words, the indirect effect of auditing standards is absent for the auditor's equilibrium payoff but is negative for the firm value. Taking into account both the direct and indirect effects, there exist thresholds above which stricter standards could hurt the auditor and/or the firm.

Part 3 of Proposition 5 becomes intuitive as well. In absence of the indirect effect, the auditor and the firm have the same preferences for auditing standards. The indirect

effect doesn't affect the auditor's preference because the auditor could adjust the acquisition expertise optimally, but it reduces the firm value. Therefore, the presence of the indirect channel leads to the result that the firm is more likely to be hurt by stricter auditing standards than the auditor.

Finally, one could also add up the payoffs to the audit and to the firm and calculate the joint payoff as  $V^* = W^* + U^*$ . Since we have explained how auditing standards affect both components  $W^*$  and  $U^*$ , it is straightforward to understand how auditing standards affect the joint payoff.

**Corollary 4** *There exists a threshold  $Q_V$  such that the joint payoff  $V^*$  is increasing in  $Q$  if  $Q \leq Q_V$  and decreasing in  $Q$  if  $Q > Q_V$ . Moreover,  $Q_W < Q_V < Q_U$ .*

## 5 Extensions

### 5.1 Imperfect enforcement and inspection

The PCAOB affects auditing standards not only through its standard setting activities but also through its enforcement and inspection activities. In the baseline model we have isolated the effects of auditing standards from their enforcement and inspection by assuming perfect enforcement. In practice, enforcement and inspection also affect the economic consequences of auditing standards. While it is beyond this paper's scope to fully examine the interaction between auditing standards and their enforcement, we provide a simple extension to show that improving enforcement and inspection could be viewed as one way to increase auditing standards.<sup>17</sup> Thus, our results on the economic consequences of tightening auditing standards can also be extrapolated to understand the economic consequences of improving enforcement and inspections.

We relax the assumption that auditing standards are always followed by the auditor. Instead, we explicitly introduce the auditor's decision on whether to abide by the standard. At  $t = 1$  the auditor can choose any audit level  $a \geq 0$ . After the auditor has chosen  $a$ , the

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<sup>17</sup>Models that focus on enforcement issues have been studied in recent papers (e.g., Laux and Stocken (2013) and Ewert and Wagenhofer (2015)).

regulator (e.g., the PCAOB) inspects the auditor's work and finds out whether  $a \geq Q$  with a probability  $f$ .  $f$  is thus the enforcement/inspection strength. If the auditor is found to have chosen  $a < Q$ , she receives a penalty. The penalty is heterogeneous across auditors because it is related to detailed characteristics of auditors and engagements. We denote the penalty as  $\tilde{x}$  and for simplicity assume that  $\tilde{x}$  follows a uniform distribution in the interval  $[0, \bar{x}]$  with  $\bar{x} > 0$ . All other aspects of the model are the same in the main model. The auditor learns about  $x$  at the time of choosing audit level but before the fee negotiation.

We verify that, for a given standard  $Q$ , enforcement strength  $f$  affects the auditor's equilibrium choices in the same way as auditing standards do. Increasing the inspection probability  $f$  increases the expected penalties for violating auditing standards and strengthens auditors' compliance incentives. This in turn forces auditors to increase their audit levels, restricts the aligned auditors' exercise of professional judgement and reduces their incentive to acquire expertise in the first place. These results are summarized below.

**Corollary 5** *Defining  $\hat{m} \equiv \frac{C'(Q)}{pI}$ . As enforcement strength or inspection probability  $f$  increases,*

1. *the equilibrium audit level by both the aligned and misaligned auditors averaged over  $\tilde{x}$  are higher, i.e.,  $\frac{\partial E_x[a_0^*(m_\tau)]}{\partial f} > 0$ ,  $\frac{\partial E_x[a_1^*(m_\tau)]}{\partial f} > 0$  if  $m_\tau < \hat{m}$ , and  $\frac{\partial E_x[a_1^*(m_\tau)]}{\partial f} = 0$  if  $m_\tau \geq \hat{m}$ ;*
2. *the equilibrium audit expertise  $e^*$  is lower, i.e.,  $\frac{de^*}{df} < 0$ .*

Corollary 5 resembles Proposition 2. It confirms that increasing enforcement  $f$  has the same effects on auditors' behavior as tightening auditing standards. Since these basic elements of economic forces drive our results about the auditing standards' economic consequences in the main model, improving enforcement or increasing inspection probability would have the similar effects on audit quality and audit fees as well.

## 5.2 Different timing of observing legal liability exposure

In our main model, we have assumed that the auditor observes her type  $\theta$  after the fee negotiation. Now we study an alternative timing assumption that  $\theta$  is observed before the

fee negotiation by both the auditor and the firm. All other aspects of the model are the same as the main model.

**Corollary 6** *When the auditor's type  $\theta$  is observed before fee negotiation by both the auditor and the firm, the equilibrium audit and expertise levels  $\{a_\theta^*, e^*\}$  are the same as in our main model. Audit fee is a function of  $\theta$ ,  $\xi_\theta^*$ . Moreover,  $\xi^* = E_\theta[\xi_\theta^*]$ .*

Corollary 6 shows that both the equilibrium audit level and expertise acquisition remain the same as in our main model. The audit fees  $\xi^*$  are now contingent on  $\theta$ , but the expected audit fees remain the same as in the main model (*i.e.*,  $\xi^* = E_\theta[\xi_\theta^*]$ ). The equilibrium audit choice  $a_\theta^*$  is independent of the audit fee because at the time of making audit choice the audit fee is already sunk. As a result, the equilibrium audit value is the same as in the main model. Moreover, the expertise decision is made at date  $t = 0$  and thus depends on the expected equilibrium audit value and audit fees averaged over  $\theta$ . Since both the expected audit fees and the expected equilibrium audit values are not affected, the auditor's expertise acquisition decision is the same. Since this alternative timing leads to the same equilibrium choices of audit and expertise acquisition, all our main results in the main model are intact.

## 6 The empirical implications

The model generates a number of empirical implications. Most of our formal results provide empirical predictions about the auditing standards' effects on audit quality, audit fees, and audit expertise acquisition. To save space, we highlight only a few results here.

First, stricter auditing standards can either increase or decrease audit quality. They are more likely to decrease audit quality when 1) the initial standards are already high; 2) when the auditors' incentives are better aligned with investors; 3) the auditors' bargaining power is high; and 4) when the auditors' cost of expertise development is lower. The latter three factors determine the strength of the indirect effect, as explained in Lemma 1.

Second, the auditing standards' economic consequences differ in the short-run and in the long-run to the extent that auditors can adjust their expertise level more easily in the long-run than in the short-run. For example, stricter auditing standards always increase audit

quality in the short-run but could reduce audit quality in the long-run (Corollary 1 and Proposition 3). For another example, stricter auditing standards increase audit fees more in the long-run (Corollary 2). Yet another result is that the auditor and the firm share the same preferences for auditing standards in the short run but diverge in the long-run (Corollary 3 and Proposition 5). As a result of these differences, empirical tests of the economic consequences of auditing standards face a critical research design choice regarding the timing. On one hand, there is a premium for examining the consequences of new standards as soon as possible. Moreover, the measurement of the short-run consequences is more accurate because it is less vulnerable to confounding effects from other concurrent events. On the other hand, auditing standards' short-run consequences systematically favor stricter standards. It is important to account for this built-in bias when we interpret the empirical results on short-run data. The exact definition of the long-run vs. short-run is related to the length of time it takes for auditors to adjust their investment in expertise after a new standard.

In addition, these differences also have policy implications. If a regulator such as the PCAOB cares about the standards' consequences in the short-run more than in the long-run, then the regulator has a bias towards excessively strict standards. The regulator's lack of long-term stake is a realistic feature of the regulatory system design (e.g., Kinney Jr (2005)). Our model thus predicts that a myopic regulator has an inherent bias toward setting too tight standards.

## 7 Conclusion

The establishment of the PCAOB has profoundly changed the auditing profession. Yet the empirical evidence about the effects of the PCAOB's auditing standard setting on audit quality is limited and difficult to obtain. We have studied a model to understand the economic consequences of auditing standards. On one hand, auditing standards force the misaligned auditor to perform more audit. On the other hand, they restrict the auditor's exercise of professional judgement, lead to the compliance mentality, and reduce the auditor's acquisition of expertise in the first place. In other words, auditing standards compel auditors to do more

work, but auditors end up becoming less competent. As a result of this trade-off, auditing standards reduce audit quality when the auditor's expertise acquisition is sufficiently sensitive to auditing standards.

The ultimate friction in our model is that auditing standards cannot replace auditors' professional judgement. This friction is perhaps common for any standard setters but is particularly relevant for the PCAOB due to its non-expert model discussed in the introduction. The friction is akin to the incomplete contracting literature in which all contingencies cannot be ex ante specified in a contract. Like in the incomplete contracting literature, including more contingencies to the auditing standards would improve efficiency. For example, when the auditing standard can be conditioned on a noisy signal of audit risk  $\tilde{\gamma}$ , which is likely to be the case in practice, the adverse effect of such standards on audit quality will be mitigated. However, to the extent that there is still residual information that the auditor observes about engagement but that cannot be incorporated into auditing standards, the trade-off in our model still applies.

We have interpreted an auditor's expertise as her ability to assess audit risk. Audit expertise is of course a broad notion and can take other forms. The interaction between auditing standards and other forms of audit expertise may have different economic consequences than we have examined here. For example, audit expertise could also refer to the auditor's ability to do the same audit at a lower cost. In our model, it would be equivalent to assume that the audit cost  $C(a; e)$  is decreasing in audit expertise  $e$ . Consider the audit task of counting inventory. Counting inventory is costly but reduces audit failure risk. The optimal amount of inventory to be counted depends on an engagement's particular circumstances. We interpret audit expertise as an auditor's ability to assess the audit risk of inventory, while the alternative interpretation refers to an auditor's ability to count inventory more quickly. How auditing standards may affect the auditor's incentive to acquire this type of audit expertise is left for future research.

We have focused on auditing standards related to conducting audits. Auditing standards are broader as they are also related to professional conduct, independence and quality control. In particular, auditing standards that govern entering the profession (examination and

licensing laws) can be relevant for our thesis. For example, the auditing standards on continuing professional education could serve as a tool to regulate the auditor's choice of expertise  $e$  in our model and thus may mitigate the adverse consequences of stricter auditing standards. However, to the extent that audit expertise  $e$  cannot be perfectly regulated, we face a problem similar to what we have studied in the model.

## 8 Appendix

We first establish the following Lemma for future results.

**Lemma 2** *The following holds:*

1.  $\pi_1^*(m_\tau)$  is convex in  $m_\tau$ ;
2.  $\frac{\partial \pi_1^*(m_\tau)}{\partial Q}$  is concave in  $m_\tau$ ;
3.  $m_\tau a_1^*(m_\tau)$  is convex in  $m_\tau$ .

**Proof.** of Lemma 2: We have derived the audit choice in equation 6 in the main text, which is reproduced here:

$$a_\theta^*(m_\tau) = \max\{C'^{-1}(p\theta m_\tau I), Q\}.$$

For the misaligned auditor ( $\theta = 0$ ),  $a_0^* = Q$ . For the aligned auditor ( $\theta = 1$ ),  $a_1^*(m_\tau) = Q$  if and only if  $C'^{-1}(pm_\tau I) < Q$ . Since  $C'^{-1}$  is strictly increasing, this reduces into  $m_\tau < \hat{m} \equiv \frac{C'(Q)}{pI}$ . For  $m_\tau \geq \hat{m}$ ,  $a_1^*(m_\tau) = C'^{-1}(pm_\tau I)$ . In other words, the auditing standards always bind for the misaligned auditor and bind for the aligned auditor when her assessment of audit risk is sufficiently low, i.e.,  $m_\tau < \hat{m}$ .

We first prove part 1 that  $\pi_1^*(m_\tau)$  is convex in  $m_\tau$ . We look at the two cases of  $m_\tau < \hat{m}$  and  $m_\tau \geq \hat{m}$  separately. When  $m_\tau < \hat{m}$ ,

$$a_1^*(m_\tau) = Q.$$

Substituting it into  $\pi_1^*(m_\tau)$ , we have

$$\pi_1^*(m_\tau) = p(1 - m_\tau(1 - Q))I - C(Q).$$

Thus,  $\pi_1^*(m_\tau)$  is linear in  $m_\tau$ .

When  $m_\tau \geq \hat{m}$ ,

$$a_1^*(m_\tau) = C'^{-1}(pm_\tau I).$$

Substituting it into  $\pi_1^*(m_\tau)$ , we have

$$\pi_1^*(m_\tau) = p(1 - m_\tau(1 - a_1^*(m_\tau)))I - C(a_1^*(m_\tau)).$$

The second-order derivative of  $\pi_1^*(m_\tau)$  is given by

$$\begin{aligned}\frac{\partial^2 \pi_1^*(m_\tau)}{\partial m_\tau^2} &= \frac{\partial}{\partial m_\tau} \left( -pI(1 - a_1^*(m_\tau)) + [pm_\tau I - C'(a_1^*)] \frac{\partial a_1^*(m_\tau)}{\partial m_\tau} \right) \\ &= pI \frac{\partial a_1^*(m_\tau)}{\partial m_\tau} > 0.\end{aligned}$$

Collecting both cases,  $\pi_1^*(m_\tau)$  is linear in  $m_\tau$  when  $m_\tau < \hat{m}$  and strictly convex in  $m_\tau$  when  $m_\tau \geq \hat{m}$ . Therefore, overall,  $\pi_1^*(m_\tau)$  is convex in  $m_\tau$ . This proves Part 1.

The concavity of  $\frac{\partial \pi_1^*(m_\tau)}{\partial Q}$  in  $m_\tau$  can be directly calculated. When  $m_\tau < \hat{m}$ , then  $a_1^*(m_\tau) = Q$  and  $\frac{\partial \pi_1^*(m_\tau)}{\partial Q} = pm_\tau I - C'(Q)$ . Thus,  $\frac{\partial \pi_1^*(m_\tau)}{\partial Q}$  is linearly increasing in  $m_\tau$ . When  $m_\tau \geq \hat{m}$ ,  $a_1^*(m_\tau) = C'^{-1}(pm_\tau I)$  and  $\pi_1^*(m_\tau)$  is independent of  $Q$ . Thus,  $\frac{\partial \pi_1^*(m_\tau)}{\partial Q} = 0$ . Therefore,  $\frac{\partial \pi_1^*(m_\tau)}{\partial Q}$  is concave in  $m_\tau$  (because it is first increasing in  $m_\tau$  and then flat after  $m_\tau \geq \hat{m}$ ). This proves Part 2.

Now we prove Part 3 that  $m_\tau a_1^*(m_\tau)$  is convex in  $m_\tau$ . When  $m_\tau < \hat{m}$ ,  $m_\tau a_1^*(m_\tau) = m_\tau Q$  and is linear in  $m_\tau$ . When  $m_\tau \geq \hat{m}$ ,

$$\begin{aligned}\frac{\partial^2 m_\tau a_1^*(m_\tau)}{\partial m_\tau^2} &= \frac{\partial}{\partial m_\tau} \left( \frac{\partial m_\tau a_1^*(m_\tau)}{\partial m_\tau} \right) \\ &= \frac{\partial}{\partial m_\tau} \left( a_1^*(m_\tau) + m_\tau \frac{\partial a_1^*(m_\tau)}{\partial m_\tau} \right) \\ &= m_\tau \frac{\partial^2 a_1^*(m_\tau)}{\partial m_\tau^2} + 2 \frac{\partial a_1^*(m_\tau)}{\partial m_\tau} \\ &= -m_\tau \frac{C'''(a_1^*)}{C''(a_1^*)} \left( \frac{pI}{C''(a_1^*)} \right)^2 + \frac{2pI}{C''(a_1^*)} \\ &= \frac{pI}{(C''(a_1^*))^3} \left[ 2(C''(a_1^*))^2 - pIm_\tau C'''(a_1^*) \right] \\ &= \frac{pI}{(C''(a_1^*))^3} \left[ 2(C''(a_1^*))^2 - C'(a_1^*) C'''(a_1^*) \right] \\ &> 0.\end{aligned}$$

The fourth equality is from applying the implicit function theorem (twice) on the first-order condition  $a_1^* = C'^{-1}(pm_\tau I)$ . More specifically, by applying the implicit function theorem,

$$\begin{aligned}C''(a_1^*) \frac{\partial a_1^*(m_\tau)}{\partial m_\tau} &= pI, \\ C''(a_1^*) \frac{\partial^2 a_1^*(m_\tau)}{\partial^2 m_\tau} + C'''(a_1^*) \left( \frac{\partial a_1^*(m_\tau)}{\partial m_\tau} \right)^2 &= 0,\end{aligned}$$

which gives

$$\begin{aligned}\frac{\partial a_1^*(m_\tau)}{\partial m_\tau} &= \frac{pI}{C''(a_1^*)}, \\ \frac{\partial^2 a_1^*(m_\tau)}{\partial m_\tau^2} &= -\frac{C'''(a_1^*)}{C''(a_1^*)} \left( \frac{\partial a_1^*(m_\tau)}{\partial m_\tau} \right)^2.\end{aligned}$$



The sixth equality is from the first-order condition  $pm_\tau I = C'(a_1^*)$ . The last inequality is from the assumption that for any  $a$ ,  $C''' \leq 0$ .

Therefore, we have proved that  $m_\tau a_1^*(m_\tau)$  is linear in  $m_\tau$  when  $m_\tau < \hat{m}$  and strictly convex in  $m_\tau$  when  $m_\tau \geq \hat{m}$ . Overall,  $m_\tau a_1^*(m_\tau)$  is convex in  $m_\tau$ . This proves the last part of the Lemma. ■

**Proof.** of Proposition 1: The equilibrium  $a_\theta^*(m_\tau)$  and  $\xi^*$  have already been derived in equation 6 and 9. We will explore the first-order condition 10 for the optimal choice of  $e$  extensively in the subsequent analysis, which is reproduced here:

$$ts(E_{m_i}[\pi_1^*(m_i)] - E_{m_u}[\pi_1^*(m_u)]) = kK'(e^*).$$

The second-order condition is satisfied by  $K'' > 0$ . For ease of reference, we define

$$\Delta \equiv E_{m_i}[\pi_1^*(m_i)] - E_{m_u}[\pi_1^*(m_u)]. \quad (15)$$

$\Delta$  is independent of  $\{s, t, k\}$ . As we have mentioned in the text, we now verify that  $\Delta > 0$  and thus  $e^* > 0$ . From Lemma 2,  $\pi_1^*$  is convex in  $m_\tau$ . Since the posterior  $m_i$  is a mean-preserving spread of  $m_u$ ,  $\Delta = E_{m_i}[\pi_1^*(m_i)] - E_{m_u}[\pi_1^*(m_u)] > 0$  by the second-order stochastic dominance. This proves the Proposition.

Later it is more convenient to write out  $e^*$  explicitly as

$$e^* = K'^{-1} \left( \frac{ts}{k} \Delta \right). \quad (16)$$

■

**Proof.** of Proposition 2: We first examine how  $Q$  affects the auditor's equilibrium audit level choice  $a_\theta^*(m_\tau)$ , which is derived in equation 6 in the main text and reproduced here:

$$a_\theta^*(m_\tau) = \max\{C'^{-1}(p\theta m_\tau I), Q\}.$$

For the misaligned auditor ( $\theta = 0$ ),  $a_0^*(m_\tau) = Q$  and the auditing standards always bind for the misaligned auditor. Thus,  $\frac{\partial a_0^*(m_\tau)}{\partial Q} = 1$ .

For the aligned auditor ( $\theta = 1$ ),  $a_1^*(m_\tau) = \max\{C'^{-1}(pm_\tau I), Q\}$ . Because  $C'^{-1}$  is strictly increasing,  $\hat{m} \equiv \frac{C'(Q)}{pI}$  is the threshold for  $m_\tau$  above which  $C'^{-1}(pm_\tau I) > Q$  (and below which  $C'^{-1}(pm_\tau I) \leq Q$ ). In other words, the auditing standards bind for the aligned auditor if and only if her assessment of audit risk is sufficiently low. Therefore, when  $m_\tau < \hat{m}$ ,  $\frac{\partial a_1^*(m_\tau)}{\partial Q} = 1$ , and when  $m_\tau \geq \hat{m}$ ,  $\frac{\partial a_1^*(m_\tau)}{\partial Q} = \frac{\partial C'^{-1}(pm_\tau I)}{\partial Q} = 0$ . This proves the first part of Proposition 2.

The effect of  $Q$  on  $e^*$  is obtained by differentiating equation 16:

$$\begin{aligned} \frac{de^*}{dQ} &= \frac{1}{K''} \frac{ts}{k} \frac{\partial \Delta}{\partial Q} \\ &= \frac{1}{K''} \frac{ts}{k} \frac{\partial}{\partial Q} (E_{m_i}[\pi_1^*(m_i)] - E_{m_u}[\pi_1^*(m_u)]) \\ &= \frac{1}{K''} \frac{ts}{k} \left( E_{m_i} \left[ \frac{\partial \pi_1^*(m_i)}{\partial Q} \right] - E_{m_u} \left[ \frac{\partial \pi_1^*(m_u)}{\partial Q} \right] \right) \\ &< 0. \end{aligned} \quad (17)$$

The third step changes the order of differentiation and expectation. This is true by the Leibniz rule because  $\frac{\partial \pi_1^*(m_\tau)}{\partial Q}$  and  $\pi_1^*$  are both continuous in  $m_\tau$  and  $Q$ . The final step is obtained as a result of Part 2 of Lemma 2 that  $\frac{\partial \pi_1^*(m_\tau)}{\partial Q}$  is concave in  $m_\tau$ . This proves the second part of Proposition 2.

For ease of reference, we define

$$\Delta_Q \equiv \frac{\partial \Delta}{\partial Q}.$$

$\Delta_Q < 0$  and is independent of  $\{k, s, t\}$ . ■

**Proof.** of Lemma 1: Differentiating equation 17, we have:

$$\begin{aligned} \frac{d}{ds} \frac{de^*}{dQ} &= \frac{1}{K''} \frac{t}{k} \Delta_Q + \frac{-K'''}{(K'')^2} \frac{ts}{k} \Delta_Q \frac{de^*}{ds} \\ &= \frac{1}{K''} \frac{t}{k} \Delta_Q + \frac{-K'''}{(K'')^2} \frac{ts}{k} \Delta_Q \frac{t\Delta}{kK''} \\ &= \frac{t}{k} \frac{\Delta_Q}{K''} \left( 1 - \frac{K'''}{(K'')^2} s \frac{t\Delta}{k} \right) \\ &= \frac{t}{k} \frac{\Delta_Q}{K''} \left( 1 - \frac{K'''}{(K'')^2} K' \right) \\ &< 0. \end{aligned}$$

The second equality uses  $\frac{de^*}{ds} = \frac{t\Delta}{kK''}$ , which is obtained from differentiating equation 16. The last equality utilizes the first-order condition for  $e^*$  (equation 10). Similarly, we can obtain

$$\begin{aligned} \frac{d}{dt} \frac{de^*}{dQ} &= \frac{s}{k} \frac{\Delta_Q}{K''} \left( 1 - \frac{K'''}{(K'')^2} K' \right) < 0, \\ \frac{d}{dk} \frac{de^*}{dQ} &= -\frac{ts}{k^2} \frac{\Delta_Q}{K''} \left( 1 - \frac{K'''}{(K'')^2} K' \right) > 0. \end{aligned}$$

This proves Lemma 1. ■

**Proof.** of Proposition 3 and Corollary 1: The equilibrium audit quality is defined in equation 11 and reproduced here:

$$A^*(Q) \equiv 1 - p\gamma_0 + pE_{m_\tau, \theta}[m_\tau a_\theta^*(m_\tau)].$$

The total effect of  $Q$  on  $A^*$  is given by:

$$\frac{dA^*}{dQ} = \frac{\partial A^*}{\partial Q} + \frac{\partial A^*}{\partial e^*} \frac{de^*}{dQ}.$$

Our proof proceeds in three steps. First, we show that the direct effect is positive, i.e.,  $\frac{\partial A^*}{\partial Q} > 0$ , which proves Corollary 1. Second, we show that  $\frac{\partial A^*}{\partial e^*} = \frac{\partial A^*}{\partial e}|_{e=e^*} > 0$ . This, together with  $\frac{de^*}{dQ} < 0$ , proves that the indirect effect is negative. Finally, we use the intermediate

value theorem to give the conditions under which the indirect effect dominates the direct effect.

Step 1: we show the direct effect of  $Q$  on  $A^*$  is positive, i.e.,  $\frac{\partial A^*}{\partial Q} > 0$ . In particular,

$$\begin{aligned}
\frac{\partial A^*}{\partial Q} &= p(1-s) \frac{\partial}{\partial Q} E_{m_\tau} [m_\tau a_0^*(m_\tau)] + ps \frac{\partial}{\partial Q} E_{m_\tau} [m_\tau a_1^*(m_\tau)] \\
&= (1-s) p E_{m_\tau} \left[ m_\tau \frac{\partial a_0^*}{\partial Q} \right] + sp \frac{\partial}{\partial Q} E_\tau \left[ \int_0^{\hat{m}} m_\tau a_1^* dF_\tau + \int_{\hat{m}}^1 m_\tau a_1^* dF_\tau \right] \\
&= (1-s) p \gamma_0 + sp E_\tau \left[ \int_0^{\hat{m}} m_\tau dF_\tau \right] \\
&= (1-s) p \gamma_0 + sp (e^* \int_0^{\hat{m}} m_i dF_i(m_i) + (1-e^*) \int_0^{\hat{m}} m_u dF_u(m_u)) \\
&> 0.
\end{aligned} \tag{18}$$

The first and second equalities write out the expectation. The third equality utilizes Proposition 2 and the law of iterated expectations. The last equality writes out the expectation with respect to  $\tau$ .

Step 2: we show that  $\frac{\partial A^*}{\partial e^*} = \frac{\partial A^*}{\partial e} |_{e=e^*} > 0$ . Writing out the expectations,

$$\begin{aligned}
A^* &= (1-s) E_{m_\tau} [m_\tau a_0^*(m_\tau)] + s E_{m_u} [m_u a_1^*(m_u)] \\
&\quad + se^* (E_{m_i} [m_i a_1^*(m_i)] - E_{m_u} [m_u a_1^*(m_u)]).
\end{aligned}$$

For ease of reference, we define

$$\lambda \equiv E_{m_i} [m_i a_1^*(m_i)] - E_{m_u} [m_u a_1^*(m_u)].$$

We have proved in Part 3 of Lemma 2 that  $m_\tau a_1^*(m_\tau)$  is convex in  $m_\tau$ . Thus,  $\lambda \equiv E_{m_i} [m_i a_1^*(m_i)] - E_{m_u} [m_u a_1^*(m_u)] > 0$ . Therefore,

$$\frac{\partial A^*}{\partial e^*} = s\lambda > 0. \tag{19}$$

In combination with  $\frac{de^*}{dQ} < 0$  from Proposition 2, we have proved that the indirect effect is negative, i.e.,  $\frac{\partial A^*}{\partial e^*} \frac{de^*}{dQ} < 0$ .

Step 3: we show that the direct and indirect effects could dominate one another and we specify the conditions for the dominance by using the intermediate value theorem. First, we write out  $\frac{dA^*}{dQ}$  by plugging  $\frac{\partial A^*}{\partial Q}$  from equation 18,  $\frac{\partial A^*}{\partial e^*}$  from equation 19 and  $\frac{de^*}{dQ}$  from equation 17:

$$\frac{dA^*}{dQ} = (1-s) p \gamma_0 + sp \left( e^* \int_0^{\hat{m}} m_i dF_i(m_i) + (1-e^*) \int_0^{\hat{m}} m_u dF_u(m_u) \right) + \frac{ts^2}{kK''} \lambda \Delta_Q.$$

Second, we show that  $\frac{dA^*}{dQ}|_{Q=0} = (1-s)p\gamma_0 > 0$ . The second term is 0 because  $\hat{m}|_{Q=0} = \frac{C'(Q)}{pI} = 0$ . The third term is 0 because

$$\begin{aligned}\Delta_Q|_{Q=0} &= \frac{d\Delta}{dQ}|_{Q=0} \\ &= \frac{\partial E_{m_i}[\pi_1^*(m_i)]}{\partial Q} - \frac{\partial E_{m_u}[\pi_1^*(m_u)]}{\partial Q} \\ &= \int_0^{\hat{m}} \frac{\partial \pi_1^*(m_i)}{\partial Q} dF_i(m_i) - \int_0^{\hat{m}} \frac{\partial \pi_1^*(m_u)}{\partial Q} dF_u(m_u) \\ &= 0.\end{aligned}\tag{20}$$

The third equality follows from  $\frac{\partial E_{m_\tau}[\pi_1^*(m_\tau)]}{\partial Q} = \int_0^{\hat{m}} \frac{\partial \pi_1^*(m_\tau)}{\partial Q} dF_\tau(m_\tau)$  as proved in Part 2 of Lemma 2. Therefore,  $\frac{dA^*}{dQ}|_{Q=0} = (1-s)p\gamma_0 > 0$ .

Third, we show that  $\frac{dA^*}{dQ}|_{Q=\bar{Q}} < 0$  under conditions specified in Proposition 3. Evaluated at  $Q = \bar{Q}$ ,  $\hat{m} = \frac{C'(Q)}{pI} = \gamma_0$ . Moreover, since  $K''$  is continuous and  $e^* \in [0, 1]$  (which is a compact set), there exists a maximum on  $K''(e^*)$  for  $e^* \in [0, 1]$ . Define  $K''_{\max} \equiv \max_{e^* \in [0, 1]} K''$ . We have

$$\begin{aligned}\frac{dA^*}{dQ}|_{Q=\bar{Q}} &= (1-s)p\gamma_0 + sp \left( e^* \int_0^{\gamma_0} m_i dF_i(m_i) + (1-e^*) \int_0^{\gamma_0} m_u dF_u(m_u) \right) + \frac{ts^2}{kK''} \lambda \Delta_Q \\ &< p\gamma_0 + \frac{ts^2}{kK''} (\lambda \Delta_Q)|_{Q=\bar{Q}} \\ &< p\gamma_0 + \frac{ts^2}{kK''_{\max}} (\lambda \Delta_Q)|_{Q=\bar{Q}}.\end{aligned}$$

The first inequality is by the definition of probabilities that  $\int_0^{\gamma_0} m_i dF_i(m_i) < \gamma_0$  and  $\int_0^{\gamma_0} m_u dF_u(m_u) < \gamma_0$ . The second inequality is by the definition of  $K''_{\max}$  (and that  $\Delta_Q < 0$ ). Therefore, a sufficient condition for  $\frac{dA^*}{dQ}|_{Q=\bar{Q}} < 0$  is

$$p\gamma_0 + \frac{ts^2}{kK''} (\lambda \Delta_Q)|_{Q=\bar{Q}} < 0,$$

which can be rewritten as

$$\frac{k}{ts^2} \leq -\frac{(\lambda \Delta_Q)|_{Q=\bar{Q}}}{p\gamma_0 K''_{\max}}.\tag{21}$$

Since both  $\lambda > 0$  and  $\Delta_Q < 0$  are independent of  $\{k, s, t\}$ ,  $(\lambda \Delta_Q)|_{Q=\bar{Q}}$  is negative and independent of  $\{k, s, t\}$  as well. Thus, the RHS of the inequality is strictly positive and independent of  $\{k, s, t\}$ . Therefore, if  $k$  is sufficiently small or  $t$  and/or  $s$  is sufficiently large,  $\frac{dA^*}{dQ}|_{Q=\bar{Q}} < 0$ . Thus, we have proved that  $\frac{dA^*}{dQ}|_{Q=\bar{Q}} < 0$  under the conditions specified in the Proposition.

Finally, collecting  $\frac{dA^*}{dQ}|_{Q=0} > 0$  and  $\frac{dA^*}{dQ}|_{Q=\bar{Q}} < 0$ , there exists a  $Q_A < \bar{Q}$  such that  $\frac{dA^*}{dQ}|_{Q=Q_A} = 0$  by the intermediate value theorem. Since we have assumed that the second-order condition  $\frac{d^2 A^*}{dQ^2} < 0$ , such a  $Q_A$  is also unique.

As we have discussed in the text, since we work with the general cost functions for audit and expertise acquisition and with the general distribution of audit risk  $\gamma$ , the second-order ef-

fects of auditing standard  $Q$  on the equilibrium variables are often complex. Thus, we assume that the relevant second-order conditions with the general structure are satisfied. However, a quadratic-uniform specification is sufficient to guarantee the second-order conditions. In the quadratic-uniform specification, we assume that  $C(a) = \frac{c}{2}a^2$  and  $kK(e) = \frac{k}{2}e^2$  where  $c$  and  $k$  are sufficiently large to ensure interior solutions. Moreover, we assume that  $\tilde{\gamma}$  is uniformly distributed over  $[0, 1]$  and that the expert auditor knows  $\tilde{\gamma}$  perfectly but the non-expert auditor knows nothing about  $\tilde{\gamma}$ , *i.e.*,  $m_i = \tilde{\gamma}$  and  $m_u = \gamma_0 = \frac{1}{2}$ . With this specification, a direct computation of  $\frac{d^2 A^*}{dQ^2}$  shows that it is negative. ■

**Proof.** of Proposition 4 and Corollary 2: From equation 9 in the main text, the audit fee is given by

$$\begin{aligned}\xi^*(Q) &= E_{m_\tau, \theta}[C(a_\theta^*(m_\tau)) + pm_\tau(1 - a_\theta^*(m_\tau))\theta I + t\pi_\theta^*(m_\tau)] \\ &= (1 - s) E_{m_\tau}[C(a_0^*(m_\tau)) + t\pi_0^*(m_\tau)] + s E_{m_\tau}[pI - (1 - t)\pi_1^*(m_\tau)].\end{aligned}$$

The second equality utilizes the definition of  $\pi_1^*(m_\tau)$  defined in equation 7. The total effect of  $Q$  on  $\xi^*$  is given by:

$$\frac{d\xi^*}{dQ} = \frac{\partial \xi^*}{\partial Q} + \frac{\partial \xi^*}{\partial e^*} \frac{de^*}{dQ}.$$

First, we show the direct effect of  $Q$  on  $\xi^*$  is positive, *i.e.*,  $\frac{\partial \xi^*}{\partial Q} > 0$ . In particular,

$$\frac{\partial \xi^*}{\partial Q} = (1 - s) \frac{\partial}{\partial Q} E_{m_\tau}[C(a_0^*(m_\tau)) + t\pi_0^*(m_\tau)] - s(1 - t) \frac{\partial E_{m_\tau}[\pi_1^*(m_\tau)]}{\partial Q}.$$

The first term is positive because

$$\begin{aligned}\frac{\partial}{\partial Q} E_{m_\tau}[C(a_0^*(m_\tau)) + t\pi_0^*(m_\tau)] &= \frac{\partial}{\partial Q} (C(Q) + t(p(1 - \gamma_0(1 - Q))I - C(Q))) \\ &= \frac{\partial}{\partial Q} ((1 - t)C(Q) + tp(1 - \gamma_0(1 - Q))I) \\ &= (1 - t)C'(Q) + tp\gamma_0 I \\ &> 0.\end{aligned}$$

The second term is positive because for any  $\tau \in \{i, u\}$ ,

$$\begin{aligned}\frac{E_{m_\tau}[\pi_1^*(m_\tau)]}{Q} &= \frac{\partial}{\partial Q} \left[ \int_0^{\hat{m}} \pi_1^*(m_\tau) dF_\tau(m_\tau) + \int_{\hat{m}}^1 \pi_1^*(m_\tau) dF_\tau(m_\tau) \right] \\ &= \int_0^{\hat{m}} \frac{\partial \pi_1^*(m_\tau)}{\partial Q} dF_\tau(m_\tau) + \frac{\partial \hat{m}}{\partial Q} \pi_1^*(\hat{m}) f_\tau(\hat{m}) \\ &\quad + \int_{\hat{m}}^1 \frac{\partial \pi_1^*(m_\tau)}{\partial Q} dF_\tau(m_\tau) - \frac{\partial \hat{m}}{\partial Q} \pi_1^*(\hat{m}) f_\tau(\hat{m}) \\ &= \int_0^{\hat{m}} \frac{\partial \pi_1^*(m_\tau)}{\partial Q} dF_\tau(m_\tau) \\ &= \int_0^{\hat{m}} (pm_\tau I - C'(Q)) dF_\tau(m_\tau) \\ &< 0.\end{aligned}\tag{22}$$

The fourth equality is obtained from the proof of Part 2 of Lemma 2. The last step is by the definition of  $\hat{m}$ .

Second, we derive the indirect effect of  $Q$  on  $\xi^*$ ,  $\frac{\partial \xi^*}{\partial e^*} \frac{de^*}{dQ} \cdot \frac{dQ}{dQ} < 0$  follows from Proposition 2. We now prove that  $\frac{\partial \xi^*}{\partial e^*} < 0$ . Writing out the expectations,

$$\begin{aligned} \xi^* &= (1-s) E_{m_\tau} [C + t\pi_0^*(m_\tau)] + s E_{m_u} [pI - (1-t) \pi_1^*(m_u)] \\ &\quad + s e^* (1-t) (E_{m_u} [\pi_1^*(m_u)] - E_{m_i} [\pi_1^*(m_i)]). \end{aligned}$$

Therefore,

$$\frac{\partial \xi^*}{\partial e^*} = -s(1-t) [E_{m_i} [\pi_1^*(m_i)] - E_{m_u} [\pi_1^*(m_u)]] = -s(1-t) \Delta < 0.$$

Thus  $\frac{\partial \xi^*}{\partial e^*} \frac{de^*}{dQ} > 0$ .

In sum,  $\frac{d\xi^*}{dQ} = \frac{\partial \xi^*}{\partial Q} + \frac{\partial \xi^*}{\partial e^*} \frac{de^*}{dQ} > 0$  and we have proved Proposition 4.

The proof of Corollary 2 is straightforward because

$$\frac{d\xi^*}{dQ} = \frac{\partial \xi^*}{\partial Q} + \frac{\partial \xi^*}{\partial e^*} \frac{de^*}{dQ} > \frac{\partial \xi^*}{\partial Q}.$$

Thus, the effect of auditing standards on audit fee is stronger when the auditor can adjust her expertise acquisition than when she cannot. ■

**Proof.** of Proposition 5, Corollary 3 and Corollary 4: The auditor's equilibrium payoff and the firm value (investors' payoff) are defined in equation 13 and 14 and reproduced below:

$$\begin{aligned} U^*(Q) &= t E_{m_\tau, \theta} [\pi_\theta^*(m_\tau)] - kK(e^*), \\ W^*(Q) &= (1-t) E_{m_\tau, \theta} [\pi_\theta^*(m_\tau)] + W_0. \end{aligned}$$

We could also define the joint payoffs as

$$\begin{aligned} V^*(Q) &= U^*(Q) + W^*(Q) \\ &= E_{m_\tau, \theta} [\pi_\theta^*(m_\tau)] - kK(e^*) + W_0. \end{aligned}$$

For  $Z^* \in \{U^*, W^*, V^*\}$ , the total effect of  $Q$  on  $Z^*$  is given by:

$$\frac{dZ^*}{dQ} = \frac{\partial Z^*}{\partial Q} + \frac{\partial Z^*}{\partial e^*} \frac{de^*}{dQ}.$$

Our proof proceeds in three steps. First, we examine the direct effect  $\frac{\partial Z^*}{\partial Q}$  to prove Corollary 3. Second, we examine the indirect effect. Third, we combine the direct and indirect effect and use the intermediate value theorem to prove Proposition 5.

Step 1: we derive the direct effect of  $Q$  on  $U^*$ ,  $W^*$  and  $V^*$ . In particular,

$$\begin{aligned}\frac{\partial U^*}{\partial Q} &= t \frac{\partial}{\partial Q} E_{m_\tau, \theta}[\pi_\theta^*(m_\tau)], \\ \frac{\partial W^*}{\partial Q} &= (1-t) \frac{\partial}{\partial Q} E_{m_\tau, \theta}[\pi_\theta^*(m_\tau)], \\ \frac{\partial V^*}{\partial Q} &= \frac{\partial}{\partial Q} E_{m_\tau, \theta}[\pi_\theta^*(m_\tau)].\end{aligned}$$

Thus, the direct effects of  $Q$  on  $U^*$ ,  $W^*$  and  $V^*$  are all determined by the sign of  $\frac{\partial}{\partial Q} E_{m_\tau, \theta}[\pi_\theta^*(m_\tau)]$ . Moreover,

$$\frac{\partial}{\partial Q} E_{m_\tau, \theta}[\pi_\theta^*(m_\tau)] = (1-s) \frac{\partial E_{m_\tau}[\pi_0^*(m_\tau)]}{\partial Q} + s \frac{\partial E_{m_u}[\pi_1^*(m_u)]}{\partial Q} + se^* \Delta_Q.$$

First, when  $Q > \bar{Q}$ ,  $\frac{\partial}{\partial Q} E_{m_\tau, \theta}[\pi_\theta^*(m_\tau)] < 0$ . The first term  $\frac{\partial E_{m_\tau}[\pi_0^*(m_\tau)]}{\partial Q} = p\gamma_0 I - C'(Q) < 0$  when  $Q > \bar{Q}$ . The second term  $\frac{\partial E_{m_u}[\pi_1^*(m_u)]}{\partial Q} < 0$  from equation 22. The third term  $se^* \Delta_Q < 0$ .

Second, we have

$$\begin{aligned}\frac{\partial}{\partial Q} E_{m_\tau, \theta}[\pi_\theta^*(m_\tau)]|_{Q=0} &= (1-s) \frac{\partial E_{m_\tau}[\pi_0^*(m_\tau)]}{\partial Q}|_{Q=0} + s \frac{\partial E_{m_u}[\pi_1^*(m_u)]}{\partial Q}|_{Q=0} + se^* \Delta_Q|_{Q=0} \\ &= (1-s) p\gamma_0 I + s \int_0^{\hat{m}} \frac{\partial \pi_1^*(m_u)}{\partial Q} dF_u(m_u)|_{Q=0} + se^* \Delta_Q|_{Q=0} \\ &= (1-s) p\gamma_0 I + s \int_0^0 \frac{\partial \pi_1^*(m_u)}{\partial Q} dF_u(m_u)|_{Q=0} + se^* \Delta_Q|_{Q=0} \\ &> 0.\end{aligned}\tag{23}$$

The last step relies on  $\Delta_Q|_{Q=0} = 0$ , which is proved in equation 20.

Finally, by the intermediate value theorem, for  $Z \in \{U, W, V\}$ , there exists a unique  $\hat{Q}_Z < \bar{Q}$  such that  $\frac{\partial}{\partial Q} E_{m_\tau, \theta}[\pi_\theta^*(m_\tau)] = 0$ . The uniqueness is guaranteed by the second-order conditions. Therefore,  $\hat{Q}_U = \hat{Q}_V = \hat{Q}_W$ .

Step 2: we derive the indirect effect of  $Q$  on  $U^*$ ,  $W^*$  and  $V^*$ .  $\frac{de^*}{dQ} < 0$  follows from Proposition 2. We now prove that  $\frac{\partial U^*}{\partial e^*} = 0$ ,  $\frac{\partial W^*}{\partial e^*} > 0$  and  $\frac{\partial V^*}{\partial e^*} > 0$ . First,

$$\begin{aligned}\frac{\partial U^*}{\partial e^*} &= ts [E_{m_i}[\pi_1^*(m_i)] - E_{m_u}[\pi_1^*(m_u)]] - kK'(e^*) \\ &= ts\Delta - kK'(e^*) \\ &= kK'(e^*) - kK'(e^*) \\ &= 0.\end{aligned}$$

The third equality utilizes the first-order condition on  $e^*$ ,  $K'(e^*) = \frac{ts}{k} \Delta$ .

Second,

$$\begin{aligned}\frac{\partial W^*}{\partial e^*} &= (1-t)s[E_{m_i}[\pi_1^*(m_i)] - E_{m_u}[\pi_1^*(m_u)]] \\ &= (1-t)s\Delta > 0.\end{aligned}$$

Lastly,

$$\frac{\partial V^*}{\partial e^*} = \frac{\partial U^*}{\partial e^*} + \frac{\partial W^*}{\partial e^*} = (1-t)s\Delta > 0.$$

Step 3: we combine the direct and indirect effect to prove Proposition 5. We start with  $\frac{dU^*}{dQ}$ . Since  $\frac{dU^*}{dQ} = \frac{\partial U^*}{\partial Q}$ , we have  $Q_U = \hat{Q}_U$ .

Second,  $\frac{dW^*}{dQ} = \frac{\partial W^*}{\partial Q} + \frac{\partial W^*}{\partial e^*} \frac{de^*}{dQ} = (1-t)s \frac{\partial}{\partial Q} E_{m_\tau, \theta}[\pi_\theta^*(m_\tau)] + \frac{\partial W^*}{\partial e^*} \frac{de^*}{dQ}$ . At  $Q = 0$ , since  $\Delta_Q|_{Q=0} = 0$  (from equation 20),  $\frac{de^*}{dQ}|_{Q=0} = \frac{ts}{kK''}\Delta_Q|_{Q=0} = 0$  and  $\frac{dW^*}{dQ}|_{Q=0} = (1-t) \frac{\partial}{\partial Q} E_{m_\tau, \theta}[\pi_\theta^*(m_\tau)]|_{Q=0} > 0$ . For  $Q \geq \bar{Q}$ ,  $\frac{dW^*}{dQ} = \frac{\partial W^*}{\partial Q} + \frac{\partial W^*}{\partial e^*} \frac{de^*}{dQ} < 0$  because  $\frac{\partial W^*}{\partial Q}|_{Q=\bar{Q}} < 0$  and  $\frac{\partial W^*}{\partial e^*} \frac{de^*}{dQ} < 0$ . By the intermediate value theorem and the second-order condition assumption, there exists a unique  $Q_W < \bar{Q}$  such that  $\frac{dW^*}{dQ}|_{Q=Q_W} = 0$ .

Lastly,  $\frac{dV^*}{dQ} = \frac{dU^*}{dQ} + \frac{dW^*}{dQ}$ . Thus,  $\frac{dV^*}{dQ}|_{Q=0} > 0$  and  $\frac{dV^*}{dQ} < 0$  for  $Q \geq \bar{Q}$ . By the intermediate value theorem and the second-order condition assumption, there exists a unique  $Q_V < \bar{Q}$  such that  $\frac{dV^*}{dQ}|_{Q=Q_V} = 0$ .

We verify that these second-order conditions are indeed satisfied in the quadratic-uniform specification elaborated in the proof of Proposition 3.

Finally, we compare  $Q_U$ ,  $Q_W$  and  $Q_V$ .

$$\begin{aligned}\frac{dU^*}{dQ}|_{Q=Q_V} &= \frac{\partial U^*}{\partial Q}|_{Q=Q_V} \\ &= t \frac{\partial V^*}{\partial Q}|_{Q=Q_V} \\ &= t \left( \frac{dV^*}{dQ}|_{Q=Q_V} - \frac{\partial V^*}{\partial e^*} \frac{de^*}{dQ}|_{Q=Q_V} \right) \\ &= -t \frac{\partial V^*}{\partial e^*} \frac{de^*}{dQ}|_{Q=Q_V} \\ &> 0.\end{aligned}$$

The fourth equality uses  $\frac{dV^*}{dQ}|_{Q=Q_V} = 0$ . The last inequality is due to  $\frac{\partial V^*}{\partial e^*} \frac{de^*}{dQ}|_{Q=Q_V} < 0$ . Since  $\frac{dU^*}{dQ}|_{Q=Q_U} = 0$  and  $\frac{d^2U^*}{dQ^2} < 0$ , it must be the case that  $Q_U > Q_V$ .



Similarly,

$$\begin{aligned}
\frac{dW^*}{dQ}|_{Q=Q_V} &= \frac{\partial W^*}{\partial Q}|_{Q=Q_V} + \frac{\partial W^*}{\partial e^*} \frac{de^*}{dQ}|_{Q=Q_V} \\
&= (1-t) \frac{\partial V^*}{\partial Q}|_{Q=Q_V} + \frac{\partial W^*}{\partial e^*} \frac{de^*}{dQ}|_{Q=Q_V} \\
&= (1-t) \left( \frac{\partial V^*}{\partial Q}|_{Q=Q_V} + \frac{\partial V^*}{\partial e^*} \frac{de^*}{dQ}|_{Q=Q_V} \right) \\
&\quad + \frac{\partial W^*}{\partial e^*} \frac{de^*}{dQ}|_{Q=Q_V} - (1-t) \frac{\partial V^*}{\partial e^*} \frac{de^*}{dQ}|_{Q=Q_V} \\
&= \left[ \frac{\partial W^*}{\partial e^*} - (1-t) \frac{\partial V^*}{\partial e^*} \right] \frac{de^*}{dQ}|_{Q=Q_V} \\
&= (1-t) k K'(e^*) \frac{de^*}{dQ}|_{Q=Q_V} \\
&< 0.
\end{aligned}$$

The fourth step uses  $\frac{dV^*}{dQ}|_{Q=Q_V} = 0$ . The fifth step uses  $\frac{\partial W^*}{\partial e^*} = (1-t) s\Delta$  and  $\frac{\partial V^*}{\partial e^*} = s\Delta - kK'(e^*)$ . Since  $\frac{dW^*}{dQ}|_{Q=Q_W} = 0$  and  $\frac{d^2W^*}{dQ^2} < 0$ , it must be the case that  $Q_V > Q_W$ . In sum,  $Q_U > Q_V > Q_W$ . Thus, we have proved both Proposition 5 and Corollary 3. ■

**Proof.** of Corollary 5: We first consider the choice of the misaligned auditor. If the auditor follows the standard, she chooses  $a_0^* = Q$  and bears the audit cost  $C(Q)$ . If she chooses not to follow, she chooses not to audit ( $a_0^* = 0$ ), and bears the expected penalty  $fx$ . Therefore, there exists a  $x_0$  at which a misaligned auditor is indifferent, i.e.,  $fx_0 = C(Q)$ . The threshold  $\frac{\partial x_0}{\partial f} = -\frac{x_0}{f} < 0$ . In addition,

$$\frac{\partial E_x[a_0^*]}{\partial f} = \frac{\partial \left( \int_{x_0}^{\bar{x}} \frac{Q}{\bar{x}} dx \right)}{\partial f} = -\frac{\partial x_0}{\partial f} \frac{Q}{\bar{x}} > 0.$$

For an aligned auditor with  $m_\tau \geq \hat{m}$ , the auditing standard is not binding and she chooses  $a_1^*(m_\tau) = a_1^{**}(m_\tau) \equiv C'^{-1}(pm_\tau I)$ , regardless of  $x$ . If  $m_\tau < \hat{m}$ , the auditor chooses  $a_1^*(m_\tau) = Q$  and earns  $\pi_1^*(Q)$  when following the standard. If she does not follow, she chooses  $a_1^*(m_\tau) = a_1^{**}(m_\tau)$  and earns  $\pi_1^*(a_1^{**}(m_\tau)) - fx$ . There exists a  $x_1(m_\tau)$  at which the aligned auditor is indifferent, i.e.,  $fx_1 = \pi_1^*(a_1^{**}(m_\tau)) - \pi_1^*(Q)$ . Since  $\pi_1^*(a_1^{**}(m_\tau)) \geq \pi_1^*(Q)$ ,  $x_1 \geq 0$  and  $\frac{\partial x_1}{\partial f} = -\frac{x_1}{f} < 0$ . In addition, for  $m_\tau < \hat{m}$ ,

$$E_x[a_1^*] = \int_0^{x_1(m_\tau)} \frac{a_1^{**}(m_\tau)}{\bar{x}} dx + \int_{x_1(m_\tau)}^{\bar{x}} \frac{Q}{\bar{x}} dx,$$

and

$$\frac{\partial E_x[a_1^*]}{\partial f} = [a_1^{**}(m_\tau) - Q] \frac{\partial x_1(m_\tau)}{\partial f} \frac{1}{\bar{x}} > 0.$$

The inequality is due to  $a_1^{**}(m_\tau) < Q$  for  $m_\tau < \hat{m}$ . For  $m_\tau \geq \hat{m}$ ,  $a_1^*(m_\tau) = a_1^{**}(m_\tau)$  is independent of  $f$ . Thus  $\frac{\partial E_x[a_1^*]}{\partial f} = 0$ .

The expected audit value of the aligned auditor is given by

$$\begin{aligned}
E_{m_\tau, x}[\pi_1^*(m_\tau, x)] &= E_{m_\tau} E_x[\pi_1^*(m_\tau, x)] \\
&= E_{m_\tau} \left[ \int_0^{x_1(m_\tau)} \frac{\pi_1^*(a_1^{**}(m_\tau))}{\bar{x}} dx + \int_{x_1(m_\tau)}^{\bar{x}} \frac{\pi_1^*(Q)}{\bar{x}} dx \right] \\
&= E_{m_\tau} \left[ \int_0^{x_1(m_\tau)} \frac{\pi_1^*(Q) + f x_1(m_\tau)}{\bar{x}} dx + \int_{x_1(m_\tau)}^{\bar{x}} \frac{\pi_1^*(Q)}{\bar{x}} dx \right] \\
&= E_{m_\tau} \left[ \pi_1^*(Q) + f \frac{(x_1(m_\tau))^2}{\bar{x}} \right].
\end{aligned}$$

The third step uses  $f x_1(m_\tau) = \pi_1^*(a_1^{**}(m_\tau)) - \pi_1^*(Q)$ . Thus

$$\begin{aligned}
\frac{\partial E_{m_\tau, x}[\pi_1^*(m_\tau, x)]}{\partial f} &= \frac{\partial}{\partial f} E_{m_\tau} \left[ \pi_1^*(Q) + f \frac{(x_1(m_\tau))^2}{\bar{x}} \right] \\
&= E_{m_\tau} \left[ \frac{\partial}{\partial f} \left( \pi_1^*(Q) + f \frac{(x_1(m_\tau))^2}{\bar{x}} \right) \right] \\
&= \frac{E_{m_\tau} \left[ (x_1(m_\tau))^2 + 2f x_1(m_\tau) \frac{\partial x_1(m_\tau)}{\partial f} \right]}{\bar{x}} \\
&= - \frac{E_{m_\tau} \left[ (x_1(m_\tau))^2 \right]}{\bar{x}} \\
&< 0.
\end{aligned} \tag{24}$$

The fourth step uses  $\frac{\partial x_1(m_\tau)}{\partial f} = -\frac{x_1(m_\tau)}{f}$ .

Lastly, we verify that  $\frac{de^*}{df} < 0$ . As in the main model, it is straightforward to verify that

$$ts\Delta = ts(E_{m_i, x}[\pi_1^*(m_i, x)] - E_{m_u, x}[\pi_1^*(m_u, x)]) = kK'(e^*).$$

Thus  $\frac{de^*}{df} = \frac{ts}{kK''} \frac{d\Delta}{df}$  and  $\frac{de^*}{df} < 0$  if and only if  $\frac{d\Delta}{df} < 0$ . Since  $E_{m_\tau, x}[\pi_1^*(m_\tau, x)]$  is continuous in  $m_\tau$ , applying the Leibniz rule gives,

$$\begin{aligned}
\frac{d\Delta}{df} &= \frac{\partial E_{m_i, x}[\pi_1^*(m_i, x)]}{\partial f} - \frac{\partial E_{m_u, x}[\pi_1^*(m_u, x)]}{\partial f} \\
&= E_{m_i} \left[ \frac{\partial E_x[\pi_1^*(m_i, x)]}{\partial f} \right] - E_{m_u} \left[ \frac{\partial E_x[\pi_1^*(m_u, x)]}{\partial f} \right].
\end{aligned}$$

We now show that  $\frac{\partial E_x[\pi_1^*(m_\tau, x)]}{\partial f}$  is concave in  $m_\tau$ . For  $m_\tau \geq \hat{m}$ ,  $\pi_1^*(m_\tau, x) = p[1 - m_\tau(1 - a_1^{**}(m_\tau))]I - C(a_1^{**}(m_\tau))$  and  $\frac{\partial E_x[\pi_1^*]}{\partial f} = 0$ . For  $m_\tau < \hat{m}$ , from equation (24),  $\frac{\partial E_x[\pi_1^*]}{\partial f} = -\frac{(x_1(m_\tau))^2}{\bar{x}} < 0$ .

The second-order derivative of  $-\frac{(x_1(m_\tau))^2}{\bar{x}}$  with respect to  $m_\tau$  is then given by

$$\begin{aligned}\frac{\partial}{\partial m_\tau} \frac{\partial E_x[\pi_1^*]}{\partial f} &= -\frac{2x_1}{\bar{x}} \frac{\partial x_1}{\partial m_\tau}, \\ \frac{\partial^2}{\partial m_\tau^2} \frac{\partial E_x[\pi_1^*]}{\partial f} &= -\frac{2}{\bar{x}} \left( \frac{\partial x_1}{\partial m_\tau} \right)^2 - \frac{2x_1}{\bar{x}} \frac{\partial^2 x_1}{\partial m_\tau^2},\end{aligned}$$

where

$$\begin{aligned}\frac{f}{pI} \frac{\partial x_1}{\partial m_\tau} &= a_1^{**}(m_\tau) + m_\tau \frac{pI}{C'''} - (Q+1), \\ \frac{f}{pI} \frac{\partial^2 x_1}{\partial m_\tau^2} &= \frac{2pI}{C'''} - m_\tau \frac{pIC'''}{(C'')^2} > 0.\end{aligned}$$

The last inequality is due to  $C''' \leq 0$ . Therefore,  $\frac{\partial^2 x_1}{\partial m_\tau^2} > 0$  which leads to  $\frac{\partial^2}{\partial m_\tau^2} \frac{\partial E_x[\pi_1^*]}{\partial f} < 0$ . In sum,  $\frac{\partial E_x[\pi_1^*(m_\tau, x)]}{\partial f}$  is concave in  $m_\tau$ . By the Blackwell theorem,

$$\frac{d\Delta}{df} = E_{m_i} \left[ \frac{\partial E_x[\pi_1^*(m_i, x)]}{\partial f} \right] - E_{m_u} \left[ \frac{\partial E_x[\pi_1^*(m_u, x)]}{\partial f} \right] < 0.$$

■

**Proof.** of Corollary 6: It is straightforward to see that the equilibrium audit choice  $a_\theta^*$  depends only on the audit value  $\pi_\theta$  but is independent of the audit fee. As a result, both  $a_\theta^*$  and  $\pi_\theta^*$  are the same as in our main model.

We now show that the equilibrium expertise  $e^*$  also remains the same. To see this, notice that with  $\theta$  observable at the time of audit fee negotiation, the audit fee depends on  $\theta$  and we denote it by  $\xi_\theta$ . The payoff to the auditor then becomes

$$U_\theta = \xi_\theta - E_{m_\tau}[C(a_\theta^*) + pm_\tau(1 - a_\theta^*)\theta I] - kK(e).$$

As in the main model, the audit fee  $\xi_\theta$  is set as such that the auditor's net surplus from the engagement is equal to  $t$  portion of the expected audit value  $E_{m_\tau}[\pi_\theta^*(m_\tau)]$ . In other words,  $\xi_\theta$  is determined by

$$U_\theta + kK = tE_{m_\tau}[\pi_\theta^*(m_\tau)],$$

which gives

$$\xi_\theta^* = tE_{m_\tau}[\pi_\theta^*(m_\tau)] + E_{m_\tau}[C(a_\theta^*) + pm_\tau(1 - a_\theta^*)\theta I],$$

and

$$U_\theta = tE_{m_\tau}[\pi_\theta^*(m_\tau)] - kK.$$

Obviously,  $E_\theta[\xi_\theta^*] = \xi^*$  given in equation 9 of the main text.

At  $t = 0$ , the auditor's expected payoff is given by

$$E_\theta[U_\theta] = tE_{m_\tau, \theta}[\pi_\theta^*(m_\tau)] - kK,$$

which is the same as in our main model. As a result, the equilibrium expertise choice  $e^*$  remains the same. ■

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