Auditing Standards, Professional Judgement, and Audit Quality*

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Abstract

This paper examines the economic consequences of tightening auditing standards. We recognize that both auditors' incentives and expertise are relevant for audit effectiveness. On one hand, tighter auditing standards counter the misbehavior of rogue auditors. On the other hand, tighter standards restrict auditors' exercise of professional judgement, leads to auditors' compliance mentality, and reduces their ex ante acquisition of professional expertise. In the short run, tighter standards could increase both audit fee and audit quality, but may result in lower social welfare. In the long run, they may lead to the least desirable scenario of higher audit fee, lower audit quality, and lower social welfare. Finally, the optimal auditing standards are higher when the auditor's incentives are more misaligned with investors, when the audit tasks are less complex, and when the audit market is more competitive.

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1 Introduction

Auditors are awashed in auditing standards. Various professional and regulatory bodies have established auditing standards that dictate how auditors perform their jobs. Despite their prevalence in the auditing profession, the economic effects of auditing standards are still controversial.

Proponents often argue that auditing standards are incrementally useful to counter the misbehavior of rogue auditors whose incentives may not be well aligned with investors (e.g., Berkowitz and Rampell (2002), Weil (2004), Knechel (2013)). In the United States, this belief has arguably contributed to the establishment of the Public Company Accounting Oversight Board (hereafter PCAOB) and has been a major driver for PCAOB's push of tighter standards. PCAOB was established mainly as a political response to the public revelation that auditors did not conduct enough auditing tests in discharging their responsibilities. In the aftermath of the ever increasingly frequent restatements in late 1990's (e.g., GAO (2002a)), the Panel on Audit Effectiveness was formed in 2000 by the auditors' self-regulator at that time, the Public Oversight Board at AICPA, to study the effectiveness of the audit model. The Panel 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)). The insufficient audits performed by rogue auditors with misaligned incentives have led to the demand for tighter auditing standards.

Opponents, on the other hand, have warned about the undesirable consequences of tighter auditing standards (e.g., Sunder (1997) and Dye, Glover, and Sunder (2014)). Auditing has long been a learned profession and auditors take pride in exercising their professional judgement. However, auditing standards of all forms have the effects of constraining auditors' activities and thus may interfere with auditors' exercise of professional judgement. A case to the point is PCAOB's first substantive auditing standard, AS 2 (e.g. PCAOB (2004))[1]. AS 2 was commonly criticized for being too stringent regarding the scope and extent of testing of internal controls over financial reporting (ICFR) (e.g., Cox (2007), Doogar, Sivadasan, and Solomon (2010)). It required an unprecedented degree of detailed testing of ICFR, much of which was deemed as unnecessary by many auditors. Eventually, PCAOB admitted that "specific requirements directing the auditor (to test ICFR) are unnecessary and could contribute 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)). Grout, Jewitt, Pong, and Whittington (1994) and Arruñada (2000) provide synthesis of both sides of arguments.

We develop a formal model to study this balance between auditing standards and auditors' professional judgement. We hope to shed light on some aspects of the following questions. Do tighter auditing standards always improve audit quality? How do auditing standards interact with auditors' exercise and development of professional judgment? How do audit standards affect the value of audits? What would be the optimal auditing standards a benevolent social planner would choose?

In the model, auditors choose the audit level to balance their legal liabilities associated with audit failure and the audit cost. Auditors' interests may be misaligned with investors due to the inherent imperfection in their legal liabilities. When the legal liabilities system is less effective, the auditors perform less audit. This creates a demand for auditing standards in the form of a minimum auditing requirement. Built on this baseline 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.

An increase in auditing standards has the intuitive benefit of correcting the misconduct of rogue auditors. A tighter auditing standard compels those auditors to increase their audit

[1] Auditing Standard No. 2, "An Audit of Internal Control over Financial Reporting Performed in Conjunction with an Audit of Financial Statements."

above the level they would have chosen in absence of standards. Even though it drives up the audit cost, it also improves the audit quality. In absence of auditors' professional judgment, the minimum requirement wouldn't affect the choices of auditors with aligned incentives and thus will improve the overall audit value (or equivalently social welfare).

The cost of a tighter auditing standard arises endogenously in our model when auditors' professional judgment is present. By imposing a minimum audit level, an auditing standard may interfere with auditors' exercise of professional judgment. A requirement that auditors have to perform a procedure renders irrelevant the auditors' ability to assess the procedure's cost-benefit effectiveness in the particular context of an engagement. By restricting the exercise of professional judgment, auditing standards could be costly in two ways. First, it sometimes forces auditors to perform unnecessary and excessive audits that are not cost-benefit effective. Second, since the constrained exercise of professional judgement reduces the value of professional expertise, the auditors invest less to acquire expertise in the first place. The reduction in equilibrium audit expertise is costly for social welfare.

The interaction between auditing standards and professional judgment changes the economic consequences of auditing standards. While a tighter auditing standard always drives up audit fees, it doesn't necessarily improves audit quality and/or audit value. In the benchmark case in which the audit task is simple and requires no professional judgment, an increase in auditing standard improves audit quality and the overall audit value. For complex audit engagements, the consequences of tighter standards depend on the auditors' ability to adjust their expertise acquisition. In the short run when the auditors' expertise is relatively fixed, a tighter auditing standard may reduce audit value even though it always improves audit quality. In the long run when auditors can adjust their acquisition of expertise, raising the minimum required audit level can result in lower audit quality, together with higher audit fee and lower audit value. This occurs when the deterioration of audit quality resulting from auditors cutting back on expertise investment dominates the improvement from correcting the conduct of auditors with misaligned incentives.

This trade-off between imposing more work on the rogue auditors and interfering with auditors' professional judgement, determines the optimal auditing standard a benevolent social planner would choose to maximize the audit value (social welfare). The optimal level of standard depends on the characteristics of auditors, the audit market, and the audit task. It is higher if auditors are more likely to have misaligned incentives or lack accountability, if the audit market is more competitive and thus auditors have less bargaining power, and if the audit tasks are less complex.

Our model generates empirical predictions about the effects of auditing standards on audit fee, audit quality and auditors' expertise development, about the determinants of the optimal auditing standards, and about the effects of audit expertise on audit fee and audit quality. Moreover, the model highlights the difference between the standards' long-run and short-run consequences. The accumulation of audit expertise is often slow. We show that the positive effect of increasing auditing standard declines over time as the auditors have more time to adjust their investment in expertise acquisition. This issues a caveat when we interpret the empirical results on the economic consequences of new auditing standards that tend to focus more on the short-run consequences.

To our best knowledge, our paper is the first analytical model to study the interaction between auditors' professional judgement and auditing standards. Most prior studies on auditing standards have focused on their 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 introducing auditors' professional judgment and studying its interaction with auditing standards.

We also contribute to the theoretical literature on audit quality and audit fees, two commonly used proxies for audit outcomes. This literature has analyzed various determinants of audit quality and audit fees.[2] We provide a different angle from the interaction of auditing standards with the auditors' exercise and development of professional expertise. We formalize the consequences of the check-list approaches induced by auditing standards. 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 efficient manner.

More broadly, the law and economics literatures have studied both ex ante regulation and ex post legal liabilities as two modes of regulating behaviors (e.g., Kolstad, Ulen, and Johnson (1990), Shavell (2013)). The prior auditing literature has focused more on the ex post legal liabilities.[3] Since the establishment of PCAOB, auditing standards that regulate auditors' ex ante behavior have been exerting more influence on auditors' behavior. Thus, understanding the economic consequences of auditing standards become more important.

Since auditing standards circumscribe auditors' discretion in exercising professional judgement, the problem of setting auditing standards is also related to the delegation problem. 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. It has established a basic trade-off between utilizing the agent's private information and restricting the agent's devious behavior. This basic insight 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. Built on this basic insight, our model complements the delegation literature by examining a rich setting that involves the standard setter's choice of auditing standards, auditors' decisions to develop expertise and to conduct costly audit, the audit fee negotiation between auditors and firms, and the firms' investment decisions. By incorporating specific auditing institutional arrangements, our model generates many comparative statics useful for

[2] DeFond and Zhang (2014) provide a recent review of this vast literature. See also, 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).

[3] e.g., Antle and Nalebuff (1991), Dye (1995), Schwartz (1997), Choi, Kim, Liu, and Simunic (2008), Newman, Patterson, and Smith (2005), Lu and Sapra (2009), Laux and Newman (2010), Deng, Melumad, and Shibano (2012).

both empirical tests and policy discussions. The determinants of audit quality and audit fees are empirically testable. The characterization of the optimal auditing standard has immediate policy implications. In addition, we have also endogenized cost of restricting professional judgment through auditors' ex ante expertise acquisition decision. This "hold-up" problem in expertise acquisition has been studied in labor economics (see recent survey by Malcomson (1999)) and in the agency literature (e.g., Lambert (1986) Demski and Sappington (1987)). 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. These differences are useful for refining empirical research design and have implications for policy making.

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 studies the optimal auditing standard. 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, an auditor and the investors represented by a firm. The firm hires an auditor to perform an audit and then makes an investment decision.[4] The firm's project requires an initial investment of 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. Denote the investment decision as $\iota \in \{0, 1\}$. $\iota = 1$ denotes the event that the investment is made. We assume $(1 - p)\, G > I$, which implies that

[4] 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.

the firm always makes the investment in absence of an audit report.[5] The firm doesn't have private information about ω and always sends the auditor a favorable report for attestation.[6]

The firm hires an auditor for a negotiated fee, denoted as ξ. 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.

In return for the fee, the auditor issues an audit report r and bears 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 $(\omega = B, r = g)$.[7] The audit failure risk is $p\gamma(1-a)$ and it is decreasing in audit level a.[8] Parameter γ captures the audit risk and we will return to it later. The cost of audit

[5] Alternatively, if $(1-p)G < I < G$, 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.

[6] 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 Mittendorf (2010), Caskey, Nagar, and Petacchi (2010), Deng, Melumad, and Shibano (2012), and Kronenberger and Laux (2016).

[7] Note that 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. 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.

[8] One interpretation of audit a could be sample size. Auditors employ sampling techniques and inherent

a is $C(a)$. $C(a)$ has the standard properties: $C(0) = C'(0) = 0$, $C' > 0$ for $a > 0$, $C'' > 0$, $C'C''' < (C'')^2$, 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 to investors. A perfect legal liability system would require that the auditor reimburse investors the investment cost I in 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. Instead, we assume that the legal liability system is not perfect. In particular, in event of audit failure, the auditor pays damage I to investors only with probability $s \in (0, 1)$. With the complementary probability $1 - s$, the auditor gets away and pays no damage.[9] Denote the former event as $\theta = 1$ and the latter $\theta = 0$. Thus, the auditor pays damage θI to investors with $\Pr(\theta = 1) = s$. $s \in (0, 1)$ measures the effectiveness of the legal liabilities and determines the incentive alignment between auditors and investors. For simplicity, we refer to θ as the auditor's type and call the auditor with aligned incentive ($\theta = 1$) as the good auditor and the one with misaligned incentives ($\theta = 0$) as the bad auditor. Since θ is an engagement-specific feature, the auditor observes θ after she accepts the engagement but before she chooses audit level a.[10]

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 (e.g., Ewert and Wagenhofer (2015), Gipper, Leuz, and Maffett (2015), Ye and Simunic (2016)). 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 the legal liabilities.[11]

So far our model is a fairly standard one (e.g., Dye (1995), Laux and Newman (2010)).

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.

[9] 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.

[10] If θ is observed by both parties before negotiating the audit fee ξ, then ξ will depend on θ. However, we have verified that the optimal expertise e^* and the optimal audit level choice a_θ^* will be the same as in our current setup. The proof is available upon request.

[11] Dye (1995) provides multiple justifications for this assumption (see page 81).

Now we augment it with auditors' professional expertise. We follow Lambert (1986) and Demski and Sappington (1987) to model 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 (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 professional 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 auditors' exercise and acquisition of professional expertise as follows. First, we assume that the audit risk parameter $\tilde{\gamma}$ in equation 1 is a random variable over $[0,1]$ with mean γ_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 is informed ($\tau = i$) with probability e and uninformed ($\tau = u$) with probability $1 - e$. Denote the auditor's set of subjective information as Ω_τ, $\tau \in \{i, u\}$. The informed auditor's information Ω_i is finer than her uninformed counterpart Ω_u in Blackwell sense. 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. m_τ is a random variable with c.d.f $F_\tau(\cdot)$. Since Ω_i is finer than Ω_u, m_i is a mean-preserving spread of m_u. Third, since auditing standards cannot be conditioned on auditors' subjective information, auditing standard Q is independent of γ and/or m_τ. 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 $e > 0$, $K'' > 0$, $K'K''' < (K'')^2$ and $kK'(1)$ being sufficiently large. One example of such a cost function is $kK(e) = \frac{k}{2}e^2$ with k being 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 ξ.

At date 1, the auditor discovers her information and incentive alignment, chooses audit level a at cost $C(a)$, and issues audit report r.

At date 2, the firm makes the investment decision ι. If the investment is made, the payoffs are realized. If the audit failure occurs, the auditor pays damage θI to the investors.

3 The equilibrium

The model is solved by backward induction.

3.1 The investment decisions

At date 2, the firm decides whether to invest upon receiving the audit report. When the audit report is $r = b$, the firm doesn't invest, *i.e.*, $\iota^*(r = b) = 0$. The audit technology suggests that $\Pr(\omega = G|r = b) = 0$. Thus, the investment costs I, but is expected to return 0 cash flow. On the other hand, the investment is made when the unqualified report $r = g$ is issued, *i.e.*, $\iota^*(r = g) = 1$. $r = g$ revises upward the belief about the project's fundamental. Under the assumption of $(1 - p)\, G > I$, investors invest with their prior belief and thus will invest when their belief improves. In sum, it is optimal to invest if and only if an unqualified report is issued, *i.e.*, $\iota^*(r = b) = 0$ and $\iota^*(r = g) = 1$.

3.2 The auditor's audit choice

At date 1, after observing her incentive alignment θ and assessing audit risk m_τ, the component of the auditor's expected utility relevant for audit choice a is $p(1-m_\tau(1-a))\theta I - C(a)$.[12]

[12] The complete expression of the auditor's utility function, specified in equation 8 on page 15, also includes the audit fee ξ and the cost of expertise acquisition $kK(e)$. However, they are sunk at the time the audit choice is made and thus are not relevant for the audit choice.

Thus, the auditor's audit choice problem is summarized as

$$\max_{a} p(1 - m_\tau(1 - a))\theta I - C(a) \tag{2}$$
$$s.t. \qquad a \geq Q \geq 0.$$

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 θI. 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 regulatory 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

$$a_\theta^{**}(m_\tau) = C'^{-1}(pm_\tau\theta I). \tag{3}$$

In absence of regulatory constraints, the auditor's audit choice depends on both her assessment of audit risk $pm_\tau I$ and her incentive alignment θ. She conducts more audit when she judges that the audit risk is higher (e.g., a higher m_τ) and/or when she is more likely to be subject to legal liabilities in the event of audit failure (i.e., a higher θ). Therefore, professional judgement or her subjective assessment of audit risk γ is relevant for audit cost-benefit effectiveness.

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 in the presence of the regulatory constraint:

$$a_\theta^*(m_\tau) = \max\{a_\theta^{**}(m_\tau), Q\} = \max\{C'^{-1}(pm_\tau\theta I), Q\}. \tag{4}$$

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

The impact of auditing standard Q on the auditor's optimal audit choice is straightforward. Defining $\hat{m} \equiv \frac{C'(Q)}{pI}$, equation 4 suggests that the auditing standard Q binds if and only if

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

Specifically, auditing standard Q affects two groups of auditors. First, the bad auditor, for whom $\theta = 0$, 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. When the ex post legal liability system fails, the ex ante auditing regulation could improve the auditors' behavior. Second, the good auditor with $m_\tau \leq \hat{m}$ also finds the constraint binding. When she judges that the audit risk m_τ 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 forced 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, the auditing standard restricts the auditor's exercise of professional judgment and leads to the check-list approach. In sum, we have $\frac{da_\theta^*(m_\tau)}{dQ} = 1$ for those auditors with binding regulatory constraints ($i.e., m_\tau \theta \leq \hat{m}$) and $\frac{da_\theta^*(m_\tau)}{dQ} = 0$ otherwise. Ex ante before the auditor observes information about the audit risk m_τ, the auditing standard Q increases the equilibrium audit level for both types of auditors, that is, $\frac{dE_{m_\tau}[a_\theta^*(m_\tau)]}{dQ} > 0$ for any θ. We summarize these results in the following Lemma.

Lemma 1 *The regulatory constraint Q binds for the good auditor with $m_\tau \leq \hat{m}$ and always binds for the bad auditor. The expected audit level, $E_{m_\tau}[a_\theta^*(m_\tau)]$, is increasing in Q for both types of auditors.*

We now turn to the efficiency consequences of a tighter standard. From a social planer's perspective, audit a detects the bad project with probability $p\,[1 - m_\tau\,(1-a)]$ but costs $C(a)$. The audit value π, conditional on the information m_τ and audit choice a, is thus

$$\pi(a, m_\tau) = p\,[1 - m_\tau\,(1-a)]\,I - C(a). \tag{5}$$

The socially optimal level of audit, denoted as $a^S(m_\tau)$, is

$$a^S_\theta(m_\tau) = C'^{-1}(pm_\tau I). \tag{6}$$

The difference between the audit's social value π and its private value for the auditor in expression 2 is captured by parameter θ, the incentive alignment between the auditor and investors. The auditor is driven only by her legal liabilities θI while the social planer is concerned about avoiding bad investment I. As a result of this misalignment of incentives, the auditor's privately optimal audit choice $a^*_\theta(m_\tau)$ may differ from the socially optimal choice $a^S_\theta(m_\tau)$. Specifically, the bad auditor ($\theta = 0$) chooses an audit level lower than the socially optimal level, that is, $a^{**}_0(m_\tau) = 0 < a^S(m_\tau)$ for any m_τ. Since she doesn't internalize the full social cost of audit failure and since audit is costly, the bad auditor chooses an inefficiently low level of audit in absence of auditing standards. In contrast, the good auditor chooses the socially optimal level of audit in absence of standards, that is, $a^{**}_1(m_\tau) = a^S(m_\tau)$. Since she reimburses the investors the investment cost I in the event of audit failure, the good auditor bears the full social consequences of the audit and thus has the right incentive to strike the balance between audit benefit and cost.

Even though the auditing standard forces both the bad auditor and some good auditors to perform more audit, the increase in audit by two types of auditors has different efficiency consequences. For notational ease, we define the equilibrium audit value, which is a function of the auditor type θ and information m_τ, as

$$\pi^*_\theta(m_\tau) \equiv \pi(a^*_\theta(m_\tau), m_\tau) = p\left[1 - m_\tau\left(1 - a^*_\theta(m_\tau)\right)\right] I - C(a^*_\theta(m_\tau)). \tag{7}$$

We are interested in how auditing standard Q affects $E_{m_\tau}[\pi^*_\theta(m_\tau)]$, the expected equilibrium audit value (before the auditor observes audit risk m_τ). The good auditor finds the minimum requirement Q binds if her ex post risk assessment is low (*i.e.*, $m_\tau < \hat{m}$). When Q is not binding, a tighter standard doesn't affect the audit value. When Q is binding, a tighter standard always reduces the good auditor's audit value. Whenever the good auditor finds the regulatory constraint binding, the audit level she ends up choosing is higher than that justified by her professional judgement. Therefore, ex ante (before observing m_τ) a tighter standard always reduces the good auditor's expected equilibrium audit value.

A tighter standard has different efficiency consequences for the bad auditor. Since the bad auditor is not concerned about audit failure, she has no incentive to exercise her professional judgement and her privately optimal audit choice is lower than the socially optimal level. Therefore, a tighter standard can improve efficiency by pushing her choice toward socially optimal level when the initial audit standard Q is low. However, when the initial audit standard Q is already high, increasing Q further may not be cost-benefit effective any longer. The turn point is $\bar{Q} \equiv a^S(\gamma_0)$, the audit level the social planer would choose if she didn't use any information about audit risk. Since the benefit of auditing standards is to improve the audit value by the bad auditor, we call a standard mild if $Q \leq \bar{Q}$ and excessive if $Q > \bar{Q}$.

Lemma 2 *A tighter auditing standard increases (decreases) the bad auditor's expected equilibrium audit value if the initial standard is mild (excessive). It always reduces the good auditor's equilibrium expected audit value. That is,* $\frac{\partial E_{m_\tau}[\pi_0^*(m_\tau)]}{\partial Q} > 0$ *if* $Q \leq \bar{Q}$*;* $\frac{\partial E_{m_\tau}[\pi_0^*(m_\tau)]}{\partial Q} < 0$ *if* $Q > \bar{Q}$*; and* $\frac{\partial E_{m_\tau}[\pi_1^*(m_\tau)]}{\partial Q} < 0$ *for any* Q*.*

3.3 The audit fee negotiation

At date 0, before the auditor observes m_τ and θ, the auditor negotiates audit fee ξ with the firm through Nash bargaining. The audit value created by audit is $E_{m_\tau,\theta}[\pi_\theta^*(m_\tau)]$. The auditor and the firm negotiate audit fee ξ to divide this surplus according to their respective bargaining power t and $1-t$.

The auditor and the investors 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	Investors
Negotiation fails	$-kK$	$(1-p)\,G-I$
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 investors' payoff is $(1-p)\,G-I$. This explains the first row in Table 1.

If the negotiation succeeds, the expected payoffs to the auditor and investors are represented by U and W, respectively. In addition to the audit fee ξ and the sunk cost of expertise acquisition $kK(e)$, the auditor expects to choose optimal audit $a^*_\theta(m_\tau)$ and pays legal damage I with probability $pm_\tau(1-a^*_\theta)\theta$. Therefore, taking expectation with respect to the auditor's posterior belief m_τ and incentive θ, the auditor's expected payoff at date 0 is

$$U = \xi - E_{m_\tau,\theta}[C(a^*_\theta) + pm_\tau(1-a^*_\theta)\theta I] - kK(e). \tag{8}$$

With a successful negotiation, the firm pays audit fee ξ and makes the investment only upon receiving $r=g$ from the auditor. The investment in the good project generates an expected NPV of $(1-p)\,(G-I)$. In the event of audit failure, the investors lose the initial investment I but receives legal payment θI from the auditor, resulting in the net loss of $(1-\theta)\,I$. Therefore, the investors' expected payoff at $t=0$ is

$$W = (1-p)\,(G-I) - E_{m_\tau,\theta,r}[pm_\tau(1-a^*_\theta)\,(1-\theta)\,I] - \xi. \tag{9}$$

The audit fee ξ is set as such that the auditor's net surplus from the engagement is equal to t portion of the expected audit value $E_{m_\tau,\theta}[\pi^*_\theta(m_\tau)]$.[13] In other words, ξ is determined by

$$U + kK = tE_{m_\tau,\theta}[\pi^*_\theta(m_\tau)]. \tag{10}$$

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

$$\xi(a^*) = E_{m_\tau,\theta}[C(a^*_\theta(m_\tau)) + pm_\tau(1 - a^*_\theta(m_\tau))\theta I + t\pi^*_\theta(m_\tau)]. \tag{11}$$

The three components of audit fee ξ 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 thus irrelevant for the negotiation. This affects the auditor's incentive to develop expertise in the first place, to which we turn now.

3.4 The auditor's expertise acquisition decision

Before the audit fee negotiation, the auditor chooses expertise e to maximize her expected payoff U define in equation 8. Equation 10 from the previous subsection suggests that U can be rewritten as

$$\begin{aligned} U(e) &= tE_{m_\tau,\theta}[\pi^*_\theta(m_\tau)] - kK(e) \\ &= t(1-s)E_{m_\tau}[\pi^*_0(m_\tau)] + tsE_{m_u}[\pi^*_1(m_u)] + tse\left(E_{m_i}[\pi^*_1(m_i)] - E_{m_u}[\pi^*_1(m_u)]\right) - kK(e). \end{aligned}$$

We decompose the expected audit value $E_{m_\tau,\theta}[\pi^*_\theta(m_\tau)]$ into three components. The first and second components are the expected audit value by the bad auditor $E_{m_\tau}[\pi^*_0(m_\tau)]$ and by the good uninformed auditor $E_{m_u}[\pi^*_1(m_u)]$, and the last is the incremental audit value

[13] Equivalently, ξ could be derived from the condition that the investors' net surplus from the negotiation, $W - (1-p)G + I$, is equal to $(1-t)E_{m,\theta}[\pi^*_\theta(m)]$. Simple calculation shows that both approaches lead to the same expressions of ξ.

contributed by the good informed auditor. The auditor chooses e to maximize $U(e)$ and the first-order condition is

$$(E_{m_i}[\pi_1^*(m_i)] - E_{m_u}[\pi_1^*(m_u)])\, ts = kK'\left(e^*\right). \tag{12}$$

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 good auditor performs the audit in a more effective way when she is informed. 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 informed auditor who understands the audit risk γ better can allocate the audit resources better to the area of greater audit risk. Even though the proof of this claim is a bit involved, the intuition is clear. At the stage of performing the audit, the good auditor's audit choice is a single-person decision. Expertise allows the informed good auditor to increase the dispersion of her audit choices ex post and thus her audit choice becomes more efficient.

This intuition also explains how auditing standard Q affects the benefit of audit expertise and the auditor's incentive to acquire expertise. As we have discussed in Lemma 1, a tighter auditing standard restricts the good auditor's audit choice in that she may be forced to choose an audit level not justified by her professional judgment. 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. Therefore, the compliance mentality not only reduces the ex post audit value but also discourages the auditor from developing expertise ex ante. This inherent conflict between auditing standards and professional expertise is a key force to understand the auditing standards' economic consequences.

The second determinant of the auditor's expertise acquisition incentive is the auditor's bargaining power t. As we 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 through her bargaining power. Thus, the auditor's bargaining power in fee negotiation helps mitigates 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). We know from the discussion of Lemma 1 and 2 that the bad auditor chooses only the minimum required audit level and thus doesn't utilize her professional judgement. As a result, the bad 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 summarize the determinants of the auditor's incentives to acquire expertise in the following proposition.

Proposition 1 *The equilibrium expertise is strictly decreasing in Q, i.e., $\frac{de^*}{dQ} < 0$. Moreover, e^* is increasing in s and t, but decreasing in k.*

4 The economic consequences of auditing standards

Having characterized the equilibrium decisions $(a^*_\theta(m_\tau), \xi^*, e^*)$, we now analyze the economic consequences of auditing standards. We will focus on three equilibrium variables, the audit fee ξ^*, the audit quality A^*, and the social welfare V^*. Audit fee and audit quality are two directly observed aspects of audit outcomes and are most commonly used in empirical works. Social welfare is not directly observable, but it is the theoretically most comprehensive and relevant variable for measuring audit outcomes. We look at all three variables from an ex ante perspective at date 0.

The (equilibrium) audit fee ξ^* is obtained by plugging the equilibrium e^* into equation 11.

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

$$A^*(Q) \equiv 1 - E_{m_\tau,\theta,\tilde{\gamma}}[p\tilde{\gamma}\,(1 - a^*_\theta(m_\tau))] = 1 - p\gamma_0 + pE_{m_\tau,\theta,\tilde{\gamma}}[\tilde{\gamma}a^*_\theta(m_\tau)]. \tag{13}$$

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

The (equilibrium) social welfare is the sum of the expected payoffs to the auditor and to the investors. It is obtained by plugging in the equilibrium decisions to the expected payoff to the auditor (equation 8) and to the investors (equation 9):

$$V^*(Q) = W^* + U^* = E_{m_\tau,\theta}[\pi^*_\theta(m_\tau)] - kK\,(e^*) + (1-p)\,G - I \tag{14}$$

The social welfare has three components. The first is the expected audit value, the second is the auditor's expertise acquisition cost, kK^* and the last term is the baseline social welfare in absence of audit.

To highlight the critical role professional judgement plays in our model, we start with a benchmark in which the audit is so simple that professional judgement is of no use for audit effectiveness. This is obtained if the auditor risk is the same across all engagements, *i.e.*, $\tilde{\gamma} \equiv \gamma_0$. In this case the auditor's expertise in assessing audit risk is irrelevant.

We then study a more realistic scenario in which auditor's ability to assess audit risk matters for audit cost-benefit effectiveness. In this scenario, the auditor's response to auditing standards may differ in the short run and long run. As the auditing standard changes, the auditor is more likely (and easier) to adjust her costly expertise acquisition in the long run than in the short run. We distinguish between the auditing standard's long-run and short term consequences. In particular, we treat the auditor's expertise acquisition e^* as exogenous in the short run ($i.e.$, $e^* > 0$ and $\frac{de^*}{dQ} = 0$) but endogenous in the long run $\left(i.e., \frac{de^*}{dQ} \neq 0\right)$.

Generically, denoting $X \in \{\xi^*, A^*, V^*\}$, we have

$$\frac{dX}{dQ} = \frac{\partial X}{\partial Q} + \frac{\partial X}{\partial e^*}\frac{de^*}{dQ}.$$

Auditing standards affect audit fee, audit quality and social welfare through both the direct and indirect channels. First, $\frac{\partial X}{\partial Q}$ is the direct effect of auditing standard Q on audit outcome X, controlling for auditor expertise e^*. Second, $\frac{\partial X}{\partial e^*}\frac{de^*}{dQ}$ captures the indirect effect auditing standard Q has on audit outcome through its interactions with the auditor's expertise acquisition. The benchmark of trivial expertise is represented by $\frac{dX}{dQ}|_{\tilde{\gamma}\equiv\gamma_0}$, the short-run effect of auditing standards is captured by $\frac{\partial X}{\partial Q}$, and the long-run consequence of auditing standards is reflected in $\frac{dX}{dQ}$.

Finally, we analyze the case of mild initial auditing standard ($Q \leq \bar{Q}$) first and the case of excessive initial auditing standard ($Q > \bar{Q}$) at the end. Recall from Lemma 2 that when the initial standard is mild an increase in auditing standard increases the expected audit value by the bad auditor but decreases that by the good auditor, creating an interesting trade-off. In contrast, when the initial auditing standard is excessively high, *i.e.*, $Q > \bar{Q}$, such trade-off is absent. An increase in Q reduces the expected audit value by both types of auditors and thus is never efficient.

4.1 The benchmark: simple audits

Proposition 2 *Assuming mild initial auditing standard ($Q \leq \bar{Q}$). When the audit is simple (i.e., $\tilde{\gamma} \equiv \gamma_0$), an increase in auditing standard Q*

1. *increases the audit fee;*

2. *increases the audit quality;*

3. *increases the social welfare.*

When the audit is simple and professional judgment is not relevant for audit effectiveness, the audit value created by the uninformed auditor is the same as that by the informed auditor. Thus, the auditor has no incentives to acquires expertise, regardless of the auditing standard level, *i.e.*, $e^* = 0$ and $\frac{de^*}{dQ} = 0$. In absence of expertise, a minimum requirement of audit, as long as it is mild (lower than $\bar{Q}$), moves the bad auditor's choice toward the socially optimal level without affecting the good auditor's choice, as we have seen from Lemma 2. Such an auditing standard increases the auditor's cost of audit, but the cost increase is dominated by the accompanying improvement in audit quality, resulting in higher social welfare.

4.2 The auditing standard's short-run consequences

Now we turn to the case that audit risk $\tilde{\gamma}$ varies across engagements and that auditing standards cannot specify all possible circumstances. In this case auditors' professional judgment is important and the auditing standard may interfere with the exercise of such professional judgement. Despite the auditing standard's restriction on the auditor's exercise of professional judgment, the auditor can do little to change her audit expertise in short run.

Proposition 3 *Assuming mild initial auditing standard ($Q \leq \bar{Q}$). In the short run when the auditor's expertise is fixed, an increase in auditing standard Q*

1. *increases the audit fee;*
2. *increases the audit quality;*
3. *could reduce the social welfare.*

Proposition 3 is a natural extension of the benchmark in Proposition 2. As the audit risk varies more across engagements, the auditor's professional judgment becomes important for audit effectiveness.

A tighter auditing standard increases audit fee. To see this, we rewrite the audit fee in equation 11 as follows (the derivation can be found in the proof of Proposition 3):

$$\xi^*(Q) = (1-s)\,E_{m_\tau}[C(Q) + t\pi_0^*(m_\tau)] + sE_{m_\tau}[pI - (1-t)\,\pi_1^*(m_\tau)]. \tag{15}$$

The first component is the audit fee for the bad auditor. The bad auditor receives the reimbursement of her audit cost (*i.e.*, $C(Q)$) all the time but receives the expected audit value (*i.e.*, $E_{m_\tau}[\pi_0^*(m_\tau)]$) only when she has all the bargaining power (which occurs with probability t). Since a tighter standard increases both $E_{m_\tau}[\pi_0^*(m_\tau)]$ and $C(Q)$, it increases the audit fee for the bad auditor. The second component of the audit fee is the fee for the good auditor. It is more instructive to understand this component from the investors' perspective. When the investors deal with the good auditor, they receive the damage of I in the event of audit failure. Compared with the no auditing case, the investors save the cost of investment in the bad project, pI. The investors subtract their share of surplus, $(1-t)\, E_{m_\tau}[\pi_1^*(m_\tau)]$, from the total saving of pI and remit the rest to the auditor through the audit fee. Since regulation Q always reduces the good auditor's expected audit value $E_{m_\tau}[\pi_1^*(m_\tau)]$, this second component in equation 15 is also increasing in Q. Therefore, a tighter standard leads to higher audit fee.

A tighter auditing standard also improves audit quality for the following reasons. First, the higher audit level by the bad auditor improves audit quality. Second, the higher audit level by the good auditor also improves audit quality when the auditor's expertise is fixed. This is because the auditing standard Q restricts the good auditor's exercise of professional judgment in a systematic manner. Whenever the good auditor finds the regulatory constraint 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.

However, the auditing standard's effect on social welfare has a trade-off. On one hand, the auditing standard moves the bad auditor's choice toward the socially optimal level and improves the audit value. On the other hand, the auditing standard constrains the good auditor from fully exercising her professional judgement and compels her to perform excessive procedures that are not justified by her professional judgement. While the excessive audit improves the audit quality on margin, it reduces the social welfare due to the excessive cost. Overall, the auditing standard could reduce social welfare when its beneficial effect on the bad auditor is dominated by its adverse effect on the good auditor.

4.3 The auditing standard's long-run consequences

Now we turn to the long-run consequences of auditing standards. In the short run, the auditing standard restricts the auditor's exercise of professional judgment and reduces the value of expertise. In the long run, this restriction on professional judgement has an additional cost. Since the auditor could adjust her development of expertise in the long run, she would acquire less expertise as auditing standard increases, as we have seen in Proposition 1, *i.e.*, $\frac{de^*}{dQ} < 0$. The reduced expertise acquisition, in turn, affects audit outcome X. In other words, in the long run, auditing standard Q affects audit outcomes both directly $(\frac{\partial X}{\partial Q})$ and indirectly through its interaction with the auditor's expertise acquisition ($\frac{\partial X}{\partial e^*}\frac{de^*}{dQ}$). To explain the indirect effect $\frac{\partial X}{\partial e^*}\frac{de^*}{dQ}$, we need one more intermediate result about $\frac{\partial X}{\partial e^*}$: how expertise affects the audit outcome X.[14]

Proposition 4 *At $e = e^*$, an equilibrium increase in audit expertise*

1. *reduces the audit fee;*
2. *increases the audit quality;*
3. *increases the social welfare.*

Proposition 4 reveals the value of audit expertise. First, audit expertise reduces audit fee. Audit expertise doesn't affect the audit fee for the bad auditor as she doesn't utilize professional judgement in her audit. Audit expertise increases the expected audit value by the good auditor, as we have discussed in Proposition 1. As expected audit value increases, the audit fee for the good auditor is lower, as the discussions following equation 15 suggest. Therefore, audit fee is decreasing in the auditor's expertise.

Second, it is straightforward to see that audit expertise increases audit quality. The good auditor with higher expertise is better informed about the audit risk, which enables her to tailor audit resources to areas of greater audit risk.

Finally, increasing audit expertise is also socially valuable. In other words, the equilibrium audit expertise e^* is lower than the socially optimal level. This is due to the hold-up problem in the auditor's investment in expertise. The auditor acquires audit expertise before the audit fee is negotiated. At the time of audit fee negotiation, the auditor's expertise acquisition cost is sunk and irrelevant for the division of the surplus. Thus, the firm can "hold up" the auditor, resulting in underinvestment in audit expertise from the social planer's perspective. The smaller the auditor's bargaining power t is, the more severe the underinvestment in audit expertise. The underinvestment in audit expertise indicates that the reduction in audit expertise induced by a tighter standard is indeed detrimental to social welfare.

Now we are ready to address the economic effects of tighter auditing standards in the long run.

[14] More rigorously, we should have written $\frac{\partial X}{\partial e^*}$ as $\frac{\partial X}{\partial e}|_{e=e^*}$ as expertise e is an endogenous variable.

Proposition 5 *Assuming mild initial auditing standards ($Q \leq \bar{Q}$). In the long run when the auditor's expertise acquisition is endogenous, an increase in auditing standard Q*

1. *increases the audit fee;*

2. *could reduce the audit quality;*

3. *could reduce the social welfare.*

Proposition 5 states that the auditing standard's long-run consequences differ *qualitatively* from its short-run consequences in Proposition 3. When the auditor's expertise acquisition is endogenous, an increase in the auditing standard can lead to the worst combination of higher audit fee, *lower* audit quality, and lower social welfare. Given Proposition 3, it is intuitive that auditing standards could lead to higher audit fee and lower social welfare. However, the auditing standard's effect on audit quality is perhaps surprising. By mandating a higher level of minimum audit, the auditing standard could paradoxically reduce audit quality. To see this effect, we differentiate A^* with respect to Q and obtain

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

Auditing standard Q affects audit quality through two channels. Keeping the audit expertise constant, a higher minimum requirement of audit always improves audit quality, *i.e.*, $\frac{\partial A^*}{\partial Q} > 0$, as have been shown in Proposition 3. Even though it is not socially efficient to force the good informed auditor to perform more audit than justified by the circumstances, more audit nonetheless reduces the audit failure risk and improves audit quality (albeit at an excessively high cost). In the long run, however, the auditing standard also affects audit quality through its effect on audit expertise acquisition. Proposition 1 shows that the auditing standard reduces auditors' expertise acquisition, *i.e.*, $\frac{de^*}{dQ} < 0$. Proposition 4 shows further that less auditor expertise leads to lower audit quality, *i.e.*, $\frac{\partial A^*}{\partial e^*} > 0$. Therefore, auditing standards reduce the audit quality through the indirect effect. Overall, it is possible that the indirect effect dominates the direct effect.

In other words, an increase in auditing standard directly improves the audit quality by forcing both the bad and good auditors to perform more audit. However, forcing the good auditors to perform more audit reduces their incentives to acquire expertise ex ante. The ensuing lower expertise leads to lower audit quality. This trade-off underlies the auditing standard's non-monotonic effect on audit quality.

We summarize the auditing standards' economic consequences in the following table.

Table 2: The Economic Consequences of a Tighter Auditing Standard			
	Audit fee (ξ^*)	Audit quality (A^*)	Social welfare (V^*)
Simple audit	+	+	+
Short-run	+	+	+/-
Long-run	+	+/-	+/-

So far we have confined our discussions to mild initial auditing standards. We complete the analysis with the case of excessive initial auditing standard.

Proposition 6 *When the initial auditing standard is excessively high* $\left(Q > \bar{Q}\right)$, *an increase in auditing standard* Q

1. *increases the audit fee;*

2. *could reduce the audit quality;*

3. *reduces the social welfare.*

Proposition 6 suggests that when the initial auditing standard is excessive, an increase in the auditing standard *always* reduces the social welfare as it reduces the audit value by both the good and the bad auditors. Therefore, the optimal auditing standard is never excessive, which complements our previous focus on mild initial auditing standards.

5 The optimal auditing standard

We have made qualitative predictions about the auditing standard's long-run consequences and demonstrated the existence of the most undesirable scenario in which an increase in the auditing standard increases audit fees, reduces audit quality and decreases social welfare. Now we characterize the optimal auditing standard a benevolent social planner would choose to maximize social welfare. To do so, we need more structure to guarantee the second order condition. We therefore impose a quadratic-uniform structure for the remainder of the analysis. First, we assume $C(a) = \frac{c}{2}a^2$ and $kK(e) = \frac{k}{2}e^2$ where c and k are sufficiently large to ensure interior solutions. Second, we assume that $\tilde{\gamma}$ is uniformly distributed over $[\frac{1}{2}-n, \frac{1}{2}+n]$. $n \in [0, \frac{1}{2}]$ is a parameter such that the distribution $F(\tilde{\gamma}; n_2)$ is a mean preserving spread of $F(\tilde{\gamma}; n_1)$ for any $n_2 > n_1$. In other words, a higher n indicates that an engagement's circumstances are more varied and thus more complex. $n = 0$ corresponds to the benchmark of a simple audit with $\tilde{\gamma} \equiv \gamma_0 = \frac{1}{2}$. Finally, the informed auditor knows $\tilde{\gamma}$ perfectly and the uninformed auditor knows nothing about $\tilde{\gamma}$, that is, $m_i = \tilde{\gamma}$ and $m_u = \gamma_0$.

Proposition 7 *Assuming the quadratic-uniform specification.*

1. There exists a unique optimal auditing standard Q^*.
2. The optimal auditing standard Q^* is mild, *i.e*, $Q^* \leq \bar{Q}$.
3. The optimal auditing standard Q^* is lower if the auditor's incentive alignment s is higher, if the audit is more complex (a larger n), if the auditor's bargaining power t is higher, or if the auditor's cost of expertise acquisition k is lower.

Proposition 7 characterizes the optimal auditing standard determined by the following trade-off. The benefit of tightening the standard is to compel the bad auditor to increases audit, while its cost is to restrict the auditor's exercise of professional judgement and discourage her expertise acquisition. As the standard becomes tighter, the benefit is diminishing since the bad auditor's audit becomes closer to the socially optimal level, but the cost is increasing as more and more good auditor's exercise of professional judgement is restricted. The optimal standard Q^* is chosen to balance these two effects. Its uniqueness is obtained with the aid of the quadratic-uniform specification. Finally, recall that $\bar{Q}$ is the auditing standard that maximizes the social welfare in absence of professional judgement. Since $\bar{Q}$

is chosen without considering the standard's adverse effect on professional judgement, $\bar{Q}$ is higher than Q^*.

The determinants of the optimal standard are intuitive. First, the optimal standard decreases in the auditor's incentive alignment s. As the incentive alignment s increases, the fraction of bad auditors drops, which reduces the direct benefit of raising the auditing standard. Moreover, better incentive alignment also increases the auditor's ex ante acquisition of professional expertise, which in turn further increase the cost of a tighter standard. Second, the optimal standard decreases in the audit's complexity n. When the audit is more complex and thus professional judgement is more important, restricting the auditor's professional judgement becomes more costly. As a result, the optimal standard becomes lower. Third, the optimal standard increases in the auditor's bargaining power t and decreases in the auditor's cost parameter of expertise acquisition k. Both t and k affect the trade-off of raising auditing standards only indirectly through their effects on the auditor's expertise acquisition. When the auditor's bargaining power t is high or the auditor's cost of expertise acquisition k is low, the auditor's equilibrium expertise level is high. This makes the restriction on the exercise of professional judgment more costly and thus calls for lower optimal standard.

6 The empirical and policy implications

Our model generates a number of empirical implications. Our formal results provide following empirical predictions:

1. the effects of auditing standards on audit choice, audit fee, audit quality, and audit expertise acquisition
2. the determinants of the optimal auditing standards
3. the effects of audit expertise on audit fee and audit quality

In addition, we would like to emphasize that the auditing standard's consequences differ in the short run and in the long run. In the short run, the compliance mentality is harmful in that it restricts the auditor's exercise of professional judgement. In the long run, the compliance mentality could be even more detrimental as it discourages auditors from developing professional expertise in the first place. We formally compare the long-run and short-run consequences of the auditing standard.

Corollary 1 *Assuming the quadratic-uniform specification and that the optimal standard Q^* is chosen. There exists an auditing standard $\hat{Q} > Q^*$ such that an unexpected increase of the auditing standard in the region of $\left(Q^*, \hat{Q}\right)$ increases social welfare in the short run (when the auditor's expertise is fixed) but reduces social welfare in the long run (when the auditor's expertise can adjust).*

Corollary 1 has both empirical and policy implications. First, empirical tests of the 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 concurrents events. On the other hand, Corollary 1 cautions that the auditing standard's short-run consequences systematically favors tighter 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 the auditors to adjust their investment in expertise after a new standard.

Second, Corollary 1 also has policy implications. If the regulator cares about the standards' consequences in the short run more than in the long run, the regulator is tempted to increase the standards above the socially optimal level. The regulator's lack of long-term stake is a realistic feature of the regulatory system design (e.g., Kinney Jr (2005)). Corollary 1 predicts that a myopic regulator has an inherent bias toward setting too tight standards.

7 Conclusion

We have studied a model to understand the economic consequences of auditing standards and the determinants of the optimal auditing standards. Auditing standards force the rogue auditors to perform more audit, but also restrict the exercise of auditors' professional judgement and lead to the compliance mentality. In other words, auditing standards compel auditors to do more work, but auditors end up doing the more work in a less smarter way. A tighter auditing standard could lead to the least desirable scenario of higher audit fee, lower audit quality and lower social welfare.

The trade-off between doing more versus doing smarter work also determines the optimal standard a benevolent regulator would choose to maximize the social welfare. The optimal standard is lower if auditors' incentives are better aligned with investors, if auditors' have more bargaining power and lower expertise acquisition cost, and if the audit tasks are more complex.

The ultimate friction in our model is that auditing standards cannot replace auditors' professional judgement. This 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 social welfare is expected to be increasing in the precision of the signal. However, to the extent that there is still residual information that the auditor observes but that cannot be incorporated into auditing standards, the trade-off in our model still applies.

We interpret 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. Auditing standards may not affect the auditor's incentive to acquire this type of audit expertise. We leave the exploration of other forms of audit expertise to 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 tighter 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 3 *The equilibrium audit value from the good auditor* $\pi_1^*(m_\tau) = p(1 - m_\tau(1 - a_1^*(m_\tau)))I - C(a_1^*(m_\tau))$ *is convex in* m_τ, $\frac{d\pi_1^*(m_\tau)}{dQ}$ *is concave in* m_τ, *and* $m_\tau a_1^*(m_\tau)$ *is convex in* m_τ.

Proof. of Lemma 3: From Lemma 1, $a_1^* = Q$ if $m_\tau < \hat{m}$ and $a_1^* = C'^{-1}(pm_\tau I)$ if $m_\tau \geq \hat{m}$. We thus discuss the curvatures of π_1^*, $\frac{d\pi_1^*(m_\tau)}{dQ}$ and $m_\tau a_1^*(m_\tau)$ in the two cases of $m_\tau < \hat{m}$ and $m_\tau \geq \hat{m}$ respectively. For $m_\tau < \hat{m}$, $\pi_1^* = p(1 - m_\tau(1 - Q))I - C(Q)$ is linear in m_τ. Second, $\frac{d\pi_1^*(m_\tau)}{dQ} = pm_\tau I - C'(Q)$ is linearly increasing in m_τ. Finally, $m_\tau a_1^*(m_\tau) = m_\tau Q$ and is linear in m_τ.

For $m_\tau \geq \hat{m}$, $\pi_1^* = p(1 - m_\tau(1 - a_1^*(m_\tau)))I - C(a_1^*(m_\tau))$. The second order derivative of π_1^* is given by

$$\begin{aligned} \frac{d^2\pi_1^*}{dm_\tau^2} &= \frac{d}{dm_\tau}\left(-pI(1 - a_1^*(m_\tau)) + \left[pm_\tau I - C'(a_1^*)\right]\frac{da_1^*}{dm_\tau}\right) \\ &= pI\frac{da_1^*}{dm_\tau} > 0. \end{aligned}$$

The second equality is from the first order condition $pm_\tau I = C'(a_1^*)$ and the last inequality uses $\frac{da_1^*}{dm_\tau} > 0$ in Lemma 1. Since $\frac{d^2\pi_1^*}{dm_\tau^2} > 0$, π_1^* is convex in m_τ. Second, since $a_1^* = C'^{-1}(pm_\tau I)$

is independent of Q, $\frac{d\pi_1^*(m_\tau)}{dQ} = 0$. Lastly,

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

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

$$\left(C''\right)^2 - C'C''' > 0,$$

thus $2\left(C''(a_1^*)\right)^2 > \left(C''(a_1^*)\right)^2 > C'(a_1^*)\,C'''(a_1^*)$. Since $\frac{\partial^2 m_\tau a_1^*(m_\tau)}{\partial m_\tau^2} > 0$, $m_\tau a_1^*(m_\tau)$ is convex in m_τ.

In sum, π_1^* is weakly convex (linear) in m_τ for $m_\tau < \hat{m}$ and strictly convex for $m_\tau \geq \hat{m}$. $\frac{d\pi_1^*(m_\tau)}{dQ}$ is concave in m_τ because it equals zero when m_τ is large and is linearly increasing in m_τ otherwise. $m_\tau a_1^*(m_\tau)$ is weakly convex in m_τ for $m_\tau < \hat{m}$ and strictly convex for $m_\tau \geq \hat{m}$. ∎

Proof. of Lemma 1: Given equation 4 in the main text, the audit choice is given by

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

Thus the regulatory constraint binds for the good auditor ($\theta = 1$) when $C'^{-1}(pm_\tau I) < Q$. Since C'^{-1} is strictly increasing, this reduces into $m_\tau < \hat{m} \equiv \frac{C'(Q)}{pI}$. For the bad auditor ($\theta = 0$), $a_0^* = Q$, i.e., the regulatory constraint always binds. Lastly, since a_1^* and a_0^* are both increasing in Q, the expected audit level, $E_{m_\tau}[a_\theta^*(m_\tau)]$, is increasing in Q for both types of auditors. ■

Proof. of Lemma 2: Given the audit value $\pi_\theta^* = p\left(1 - m_\tau\left(1 - a_\theta^*\left(m_\tau\right)\right)\right)I - C\left(a_\theta^*\left(m_\tau\right)\right)$,

$$\frac{d\pi_\theta^*(m_\tau)}{dQ} = \left(pm_\tau I - C'\left(a_\theta^*(m_\tau)\right)\right)\frac{da_\theta^*(m_\tau)}{dQ}.$$

For the bad auditor, $a_0^* = Q$ and $\left(pm_\tau I - C'\left(a_0^*(m_\tau)\right)\right)\frac{da_0^*(m_\tau)}{dQ} = pm_\tau I - C'(Q)$. Thus the effect of Q on the ex ante expected audit value $\frac{\partial E_{m_\tau}[\pi_0^*(m_\tau)]}{\partial Q}$, is given by

$$\begin{aligned}\frac{\partial E_{m_\tau}[\pi_0^*(m_\tau)]}{\partial Q} &= \int_0^1 \frac{d\pi_0^*(m_\tau)}{dQ}dF_\tau\left(m_\tau\right)\\ &= \int_0^1 \left(pm_\tau I - C'(Q)\right)dF_\tau\left(m_\tau\right)\\ &= p\gamma_0 I - C'(Q).\end{aligned}$$

For $Q > \bar{Q} = C'^{-1}\left(p\gamma_0 I\right)$, $p\gamma_0 I - C'(Q) < 0$ and $\frac{\partial E_{m_\tau}[\pi_0^*(m_\tau)]}{\partial Q} < 0$.

For the good auditor with binding constraint ($m_\tau < \hat{m}$), $a_1^*(m_\tau) = Q$ and $\left(pm_\tau I - C'\left(a_1^*(m_\tau)\right)\right)\frac{da_1^*(m_\tau)}{dQ} = pm_\tau I - C'(Q)$. Since $m_\tau < \hat{m}$, $C'^{-1}(pm_\tau I) < Q$ and $\frac{d\pi_1^*(m_\tau)}{dQ} < 0$. For the good auditor with non-binding constraint ($m_\tau \geq \hat{m}$), $a_1^*(m_\tau) = C'^{-1}\left(pm_\tau I\right)$ is independent of Q. As a result, $\left(pm_\tau I - C'\left(a_1^*(m_\tau)\right)\right)\frac{da_1^*(m_\tau)}{dQ} = 0$ and $\pi_1^*(m_\tau)$ is independent of Q. In sum, $\frac{\partial E_{m_\tau}[\pi_1^*(m_\tau)]}{\partial Q}$, is given by

$$\begin{aligned}\frac{\partial E_{m_\tau}[\pi_1^*(m_\tau)]}{\partial Q} &= \frac{\partial}{\partial Q}\left[\int_0^{\hat{m}} \pi_1^*\left(m_\tau\right)dF_\tau\left(m_\tau\right) + \int_{\hat{m}}^1 \pi_1^*\left(m_\tau\right)dF_\tau\left(m_\tau\right)\right]\\ &= \int_0^{\hat{m}} \frac{d\pi_1^*(m_\tau)}{dQ}dF_\tau\left(m_\tau\right) + \frac{\partial \hat{m}}{\partial Q}\pi_1^*(\hat{m})f_\tau\left(\hat{m}\right)\\ &\quad + \int_{\hat{m}}^1 \frac{d\pi_1^*(m_\tau)}{dQ}dF_\tau\left(m_\tau\right) - \frac{\partial \hat{m}}{\partial Q}\pi_1^*(\hat{m})f_\tau\left(\hat{m}\right)\\ &= \int_0^{\hat{m}} \frac{d\pi_1^*(m_\tau)}{dQ}dF_\tau\left(m_\tau\right) < 0. \qquad (16)\end{aligned}$$

■

Proof. of Proposition 1: From the first order condition of e, we have

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

To prove $e^* > 0$, it suffices to verify that $E_{m_i}[\pi_1^*(m_i)] > E_{m_u}[\pi_1^*(m_u)]$. From Lemma 3, π_1^* is convex in m_τ. Therefore, $E_{m_i}[\pi_1^*(m_i)] > E_{m_u}[\pi_1^*(m_u)]$ follows as an application of the Blackwell (1953) theorem: a garbling decreases the expectation of any convex function of the posteriors. Specifically, since the posterior m_i is a mean-preserving spread of m_u and

$\pi_1^*(m_\tau)$ is convex, $E_{m_i}[\pi_1^*(m_i)] > E_{m_u}[\pi_1^*(m_u)]$ by the second order stochastic dominance. Thus $e^* > 0$. For conciseness, define $\Delta \equiv E_{m_i}[\pi_1^*(m_i)] - E_{m_u}[\pi_1^*(m_u)] > 0$ and

$$e^* = K'^{-1}\left(\frac{ts}{k}\Delta\right). \tag{17}$$

Since K'^{-1} is strictly increasing and Δ is independent of $\{s,t,k\}$, e^* is increasing in s and t and decreasing in k. Finally, the effect of Q on e^* is determined by the effect of Q on Δ, i.e.,

$$\frac{de^*}{dQ} = \frac{ts}{kK''}\frac{d\Delta}{dQ}.$$

$\frac{d\Delta}{dQ}$ is given by

$$\frac{d\Delta}{dQ} = \frac{dE_{m_i}[\pi_1^*(m_i)]}{dQ} - \frac{dE_{m_u}[\pi_1^*(m_u)]}{dQ}.$$

Thus $\frac{d\Delta}{dQ} < 0$ if and only if $\frac{dE_{m_i}[\pi_1^*(m_i)]}{dQ} < \frac{dE_{m_u}[\pi_1^*(m_u)]}{dQ}$. By the Leibniz rule, since $\frac{d\pi_1^*(m_\tau)}{dQ}$ and π_1^* are both continuous in m_τ and Q, we can change the order of differentiation and expectation, i.e.,

$$\frac{d\Delta}{dQ} = E_{m_i}\left[\frac{d\pi_1^*(m_i)}{dQ}\right] - E_{m_u}\left[\frac{d\pi_1^*(m_u)}{dQ}\right].$$

From Lemma 3, $\frac{d\pi_1^*(m_i)}{dQ}$ is concave in m_τ. Therefore, by the Blackwell theorem, $E_{m_i}\left[\frac{d\pi_1^*(m_i)}{dQ}\right] < E_{m_u}\left[\frac{d\pi_1^*(m_u)}{dQ}\right]$ and $\frac{d\Delta}{dQ} < 0$. Thus $\frac{de^*}{dQ} < 0$. For our convenience, define $\Delta_Q \equiv \frac{d\Delta}{dQ} < 0$ which is independent of $\{k,s,t\}$. Thus $\frac{de}{dQ} = \frac{ts}{kK''}\Delta_Q$. ■

Proof. of Proposition 2, Proposition 3, Proposition 4, Proposition 5 and Proposition 6: We first derive the effect of auditing standard on the audit fee. From equation 11 in the main text, the audit fee is given by

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

The second equality utilizes the definition of $\pi_1^* = p\,(1 - m_\tau\,(1 - a_1^*\,(m_\tau)))\,I - C\,(a_1^*\,(m_\tau))$. The total effect of Q on ξ^* 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 ξ^* is positive, i.e., $\frac{\partial\xi^*}{\partial Q} > 0$. In particular,

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

The first term is positive because $a_0^* = Q$ and

$$C + t\pi_0^*(m_\tau) = (1-t)\,C\,(Q) + tp\,(1 - m_\tau\,(1-Q))\,I$$

is strictly increasing in Q. The second term is positive because from Lemma 2, $\frac{\partial E_{m_\tau}[\pi_1^*(m_\tau)]}{\partial Q} < 0$.

Second, we derive the indirect effect of Q on ξ^*, $\frac{\partial \xi^*}{\partial e^*}\frac{de^*}{dQ}$. $\frac{de^*}{dQ} < 0$ follows from Proposition 1. We now prove that $\frac{\partial \xi^*}{\partial e^*} < 0$. Writing out the expectations,

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

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

For Proposition 2, with no professional judgement ($\tilde{\gamma} \equiv \gamma_0$), $\tilde{\gamma} \equiv \gamma_0$, $m_i \equiv m_u = \gamma_0$ and $E_{m_i}[\pi_1^*(m_i)] = E_{m_u}[\pi_1^*(m_u)]$. Thus

$$kK'(e^*) = ts\,(E_{m_i}[\pi_1^*(m_i)] - E_{m_u}[\pi_1^*(m_u)]) = 0,$$

which gives $e^* = 0$. Thus $\frac{de^*}{dQ} = 0$ and $\frac{d\xi^*}{dQ}|_{\tilde{\gamma}\equiv\gamma_0} = \frac{\partial \xi^*}{\partial Q} > 0$. For Proposition 3, with an exogenous e^*, $\frac{de^*}{dQ} = 0$ and $\frac{d\xi^*}{dQ} = \frac{\partial \xi^*}{\partial Q} > 0$. For Proposition 4, $\frac{\partial \xi^*}{\partial e^*} < 0$. For Proposition 5 and Proposition 6, with an endogenous e^*, $\frac{d\xi^*}{dQ} = \frac{\partial \xi^*}{\partial Q} + \frac{\partial \xi^*}{\partial e^*}\frac{de^*}{dQ} > 0$ because the direct and the indirect effects of auditing standard on the audit fee are both positive, regardless of whether $Q \leq \bar{Q}$ and $Q > \bar{Q}$.

Second, we derive the effect of the auditing standard on the audit quality. From equation 13 in the main text, the equilibrium audit quality is

$$\begin{aligned} A^*(Q) &\equiv 1 - p\gamma_0 + pE_{m_\tau,\theta,\tilde{\gamma}}[\tilde{\gamma} a_\theta^*(m_\tau)] \\ &= 1 - p\gamma_0 + pE_{m_\tau,\theta}[m_\tau a_\theta^*(m_\tau)]. \end{aligned}$$

The second equality utilizes the law of iterated expectation,

$$\begin{aligned} E_{m_\tau,\theta,\tilde{\gamma}}[\tilde{\gamma} a_\theta^*(m_\tau)] &= E_{m_\tau,\theta,\tilde{\gamma}}[E_{\tilde{\gamma}}\,[\tilde{\gamma} a_\theta^*(m_\tau)|m_\tau,\theta]] \\ &= E_{m_\tau,\theta,\tilde{\gamma}}[E_{\tilde{\gamma}}\,[\tilde{\gamma}|m_\tau,\theta]\,a_\theta^*(m_\tau)] \\ &= E_{m_\tau,\theta}[m_\tau a_\theta^*(m_\tau)]. \end{aligned}$$

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

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

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

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

The third equality is by Lemma 1, $\frac{\partial a_0^*}{\partial Q} = 1 > 0$, $\frac{\partial a_1^*}{\partial Q} = 1$ if $m_\tau \le \hat{m}$ and $\frac{\partial a_1^*}{\partial Q} = 0$ if $m_\tau > \hat{m}$. The fourth equality follows from the law of iterated expectations $E_{m_\tau}\left[m_\tau\right] = E\left[\tilde{\gamma}\right] = \gamma_0$.

Second, we derive the indirect effect of Q on A^*, $\frac{\partial A^*}{\partial e^*}\frac{de^*}{dQ}$. $\frac{de^*}{dQ} < 0$ follows from Proposition 1. We now prove that $\frac{\partial A^*}{\partial e^*} > 0$. Writing out the expectations,

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

Therefore,

$$\frac{\partial A^*}{\partial e^*} = s\left[E_{m_i}[m_i a_1^*(m_i)] - E_{m_u}[m_u a_1^*(m_u)]\right].$$

From Lemma 3, $m_\tau a_1^*(m_\tau)$ is convex in m_τ. By the Blackwell theorem,

$$E_{m_i}[m_i a_1^*(m_i)] > E_{m_u}[m_u a_1^*(m_u)],$$

and $\frac{\partial A^*}{\partial e^*} > 0$. Thus $\frac{\partial A^*}{\partial e^*}\frac{de^*}{dQ} < 0$. For our convenience, define $\lambda \equiv E_{m_i}[m_i a_1^*(m_i)] - E_{m_u}[m_u a_1^*(m_u)] > 0$ which is independent of $\{k, s, t\}$. Thus $\frac{\partial A^*}{\partial e^*} = s\lambda$.

For Proposition 2, with no professional judgement ($\tilde{\gamma} \equiv \gamma_0$), $e^* = 0$, thus $\frac{de^*}{dQ} = 0$ and $\frac{dA^*}{dQ}|_{\tilde{\gamma}\equiv\gamma_0} = \frac{\partial A^*}{\partial Q} > 0$. For Proposition 3, with an exogenous e^*, $\frac{de^*}{dQ} = 0$ and $\frac{dA^*}{dQ} = \frac{\partial A^*}{\partial Q} > 0$. For Proposition 4, $\frac{\partial A^*}{\partial e^*} > 0$. For Proposition 5 and Proposition 6, with an endogenous e^*, $\frac{dA^*}{dQ} = \frac{\partial A^*}{\partial Q} + \frac{\partial A^*}{\partial e^*}\frac{de^*}{dQ}$. Therefore, the sign of $\frac{dA^*}{dQ}$ depends on the comparison between the direct effect $\frac{\partial A^*}{\partial Q} > 0$ and the indirect effect $\frac{\partial A^*}{\partial e^*}\frac{de^*}{dQ} < 0$.

Substituting the expressions of $\frac{\partial A^*}{\partial Q}$ in equation 18, $\frac{\partial A^*}{\partial e^*} = s\lambda$ and $\frac{de^*}{dQ} = \frac{ts}{kK''}\Delta_Q$ into $\frac{dA^*}{dQ}$, one can simplify $\frac{dA^*}{dQ}$ into:

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

Evaluated at $Q=0$, $\hat{m}=\frac{C'(Q)}{pI}=0$. In addition, from Lemma 2, the effect of Q on Δ is given by

$$\begin{aligned}\Delta_Q|_{Q=0} &= \frac{d\Delta}{dQ}|_{Q=0} \\ &= \frac{\partial E_{m_i}[\pi_1^*(m_i)]}{\partial Q}-\frac{\partial E_{m_u}[\pi_1^*(m_u)]}{\partial Q} \\ &= \int_0^{\hat{m}}\frac{d\pi_1^*(m_i)}{dQ}dF_i\left(m_i\right)-\int_0^{\hat{m}}\frac{d\pi_1^*(m_u)}{dQ}dF_u\left(m_u\right) \\ &= 0. \end{aligned} \tag{19}$$

The third equality follows from $\frac{\partial E_{m_\tau}[\pi_1^*(m_\tau)]}{\partial Q}=\int_0^{\hat{m}}\frac{d\pi_1^*(m_\tau)}{dQ}dF_\tau\left(m_\tau\right)$ in equation 13. Therefore, $\frac{dA^*}{dQ}|_{Q=0}=(1-s)\,p\gamma_0>0$.

Evaluated at $Q=\bar{Q}$, $\hat{m}=\frac{C'(Q)}{pI}=\gamma_0$. $\frac{dA^*}{dQ}|_{Q=\bar{Q}}$ can be simplified into

$$\begin{aligned}&(1-s)\,p\gamma_0+sp\left(e^*\int_0^{\gamma_0}m_i dF_i\left(m_i\right)+(1-e^*)\int_0^{\gamma_0}m_u dF_u\left(m_u\right)\right)+\frac{ts^2}{kK''}\lambda\Delta_Q \\ < \;& p\gamma_0+\frac{ts^2}{kK''}\lambda\Delta_Q.\end{aligned}$$

The inequality is by $\int_0^{\gamma_0}m_i dF_i\left(m_i\right)<\gamma_0$ and $\int_0^{\gamma_0}m_u dF_u\left(m_u\right)<\gamma_0$. In addition, at $Q=\bar{Q}$, $\lambda=E_{m_i}[m_i a_1^*(m_i)|_{Q=\bar{Q}}]-E_{m_u}[m_u a_1^*(m_u)|_{Q=\bar{Q}}]>0$ and $\Delta_Q=E_{m_i}\left[\frac{d\pi_1^*(m_i)}{dQ}|_{Q=\bar{Q}}\right]-E_{m_u}\left[\frac{d\pi_1^*(m_u)}{dQ}|_{Q=\bar{Q}}\right]<0$ are two constants independent of $\{k,s,t\}$. For $\frac{dA^*}{dQ}|_{Q=\bar{Q}}<0$, a sufficient condition is

$$p\gamma_0+\frac{ts^2}{kK''}\lambda\Delta_Q<0,$$

which reduces into

$$k<-\frac{ts^2}{p\gamma_0 K''}\lambda\Delta_Q. \tag{20}$$

Notice that the RHS of the inequality is strictly positive. Thus for k sufficiently small, $\frac{dA^*}{dQ}<0$. Therefore, if Q is sufficiently close to $\bar{Q}$ and (20) is satisfied, $\frac{dA^*}{dQ}<0$. In addition, since K'' is continuous and $e^*\in[0,1]$ which is a compact set, there exists a maximum on K'' for $e^*\in[0,1]$. Define $K''_{\max}\equiv\max_{e^*\in[0,1]}K''$. Thus $\frac{1}{K''}\geq\frac{1}{K''_{\max}}$ and $-\frac{ts^2}{p\gamma_0 K''_{\max}}\lambda\Delta_Q\leq-\frac{ts^2}{p\gamma_0 K''}\lambda\Delta_Q$. A sufficient condition for (20) is then given by

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

The RHS of (21) is strictly increasing in s and t. Thus, for Q close to $\bar{Q}$, $\frac{dA^*}{dQ}<0$ either if s is sufficiently large, t is sufficiently large or k is sufficiently small.

Lastly, we derive the effect of the auditing standard on the social welfare. From equation 14 in the main text, the equilibrium social welfare is

$$\begin{aligned} V^*(Q) &= (1-s)\, E_{m_\tau}[\pi_0^*(m_\tau)] + sE_{m_u}[\pi_1^*(m_u)] \\ &\quad + se^*(E_{m_i}[\pi_1^*(m_i)] - E_{m_u}[\pi_1^*(m_u)]) - kK\,(e^*) + (1-p)\,G - I. \end{aligned}$$

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

$$\frac{dV^*}{dQ} = \frac{\partial V^*}{\partial Q} + \frac{\partial V^*}{\partial e^*}\frac{de^*}{dQ}.$$

First, we derive the direct effect of Q on V^*. In particular,

$$\begin{aligned} \frac{\partial V^*}{\partial Q} &= (1-s)\,\frac{\partial E_{m_\tau}[\pi_0^*(m_\tau)]}{\partial Q} + s\frac{dE_{m_u}[\pi_1^*(m_u)]}{dQ} + se^*\left(\frac{dE_{m_i}[\pi_1^*(m_i)]}{dQ} - \frac{dE_{m_u}[\pi_1^*(m_u)]}{dQ}\right) \\ &= (1-s)\,\frac{\partial E_{m_\tau}[\pi_0^*(m_\tau)]}{\partial Q} + s\frac{dE_{m_u}[\pi_1^*(m_u)]}{dQ} + se^*\Delta_Q. \end{aligned} \tag{22}$$

From Lemma 2, the first term $\frac{\partial E_{m_\tau}[\pi_0^*(m_\tau)]}{\partial Q} = p\gamma_0 I - C'(Q) < 0$ if and only if $Q > \bar{Q}$ and the second term $\frac{dE_{m_u}[\pi_1^*(m_u)]}{dQ} < 0$. The third term $se^*\Delta_Q < 0$.

For $Q > \bar{Q}$, $\frac{\partial E_{m_\tau}[\pi_0^*(m_\tau)]}{\partial Q} < 0$ and all terms in $\frac{\partial V^*}{\partial Q}$ are negative. Thus $\frac{\partial V^*}{\partial Q} < 0$ for any $Q > \bar{Q}$.

For $Q \leq \bar{Q}$, at $Q = 0$, $\hat{m} = 0$. Thus $\frac{dE_{m_u}[\pi_1^*(m_u)]}{dQ} = \int_0^{\hat{m}} \frac{d\pi_1^*(m_u)}{dQ} dF_u\,(m_u) = 0$, $\Delta_Q|_{Q=0} = 0$ (from equation 19) and

$$\frac{\partial V^*}{\partial Q}|_{Q=0} = (1-s)\,p\gamma_0 I > 0. \tag{23}$$

At $Q = \bar{Q}$, $\frac{\partial E_{m_\tau}[\pi_0^*(m_\tau)]}{\partial Q} = p\gamma_0 I - C'(\bar{Q}) = 0$ and the other terms in $\frac{\partial V^*}{\partial Q}$ are negative. Thus $\frac{\partial V^*}{\partial Q} < 0$. That is, for Q sufficiently large and close to $\bar{Q}$, $\frac{\partial V^*}{\partial Q} < 0$.

Second, we derive the indirect effect of Q on V^*, $\frac{\partial V^*}{\partial e^*}\frac{de^*}{dQ}$. $\frac{de^*}{dQ} < 0$ follows from Proposition 1. We now prove that $\frac{\partial V^*}{\partial e^*} > 0$,

$$\begin{aligned} \frac{\partial V^*}{\partial e^*} &= s\,[E_{m_i}[\pi_1^*(m_i)] - E_{m_u}[\pi_1^*(m_u)]] - kK'\,(e^*) \\ &= s\Delta - kK'\,(e^*) \\ &= \frac{kK'\,(e^*)}{t} - kK'\,(e^*) \\ &= \left(\frac{1}{t} - 1\right) kK'\,(e^*) > 0. \end{aligned}$$

The third equality utilizes the first order condition on e^*, $K'\,(e^*) = \frac{ts}{k}\Delta$. Thus $\frac{\partial V^*}{\partial e^*}\frac{de^*}{dQ} < 0$.

For Proposition 2, with no professional judgement ($\tilde{\gamma} \equiv \gamma_0$), $e^* = 0$, $m_i \equiv m_u = \gamma_0$. Thus for $Q \leq \bar{Q}$, $\hat{m} \leq \gamma_0$, and the regulatory constraint never binds for the good auditor.

Therefore, $\frac{dE_{m_u}[\pi_1^*(m_u)]}{dQ} = \frac{dE_{m_i}[\pi_1^*(m_i)]}{dQ} = 0$ and $\Delta_Q = \frac{dE_{m_i}[\pi_1^*(m_i)]}{dQ} - \frac{dE_{m_u}[\pi_1^*(m_u)]}{dQ} = 0$. Thus

$$\begin{aligned}\frac{dV^*}{dQ}|_{\tilde{\gamma}\equiv\gamma_0} &= \frac{\partial V^*}{\partial Q} \\ &= (1-s)\,\frac{\partial E_{m_\tau}[\pi_0^*(m_\tau)]}{\partial Q} \\ &= (1-s)\left(p\gamma_0 I - C'(Q)\right) > 0,\end{aligned}$$

given $Q \leq \bar{Q}$.

For Proposition 3, with an exogenous e^*, $\frac{de^*}{dQ} = 0$ and $\frac{dV^*}{dQ} = \frac{\partial V^*}{\partial Q}$. Thus for Q sufficiently large and close to $\bar{Q}$, $\frac{\partial V^*}{\partial Q} < 0$.

For Proposition 4, $\frac{\partial V^*}{\partial e^*} > 0$.

For Proposition 5, with an endogenous e^*, $\frac{dV^*}{dQ} = \frac{\partial V^*}{\partial Q} + \frac{\partial V^*}{\partial e^*}\frac{de^*}{dQ}$. At $Q = 0$, since $\Delta_Q|_{Q=0} = 0$ (from equation 19), $\frac{de^*}{dQ}|_{Q=0} = \frac{ts}{kK''}\Delta_Q|_{Q=0} = 0$ and $\frac{dV^*}{dQ}|_{Q=0} = \frac{\partial V^*}{\partial Q}|_{Q=0} = (1-s)\,p\gamma_0 I > 0$ (from equation 23). At $Q = \bar{Q}$, $\frac{dV^*}{dQ} = \frac{\partial V^*}{\partial Q} + \frac{\partial V^*}{\partial e^*}\frac{de^*}{dQ} < 0$ because $\frac{\partial V^*}{\partial Q}|_{Q=\bar{Q}} < 0$ and $\frac{\partial V^*}{\partial e^*}\frac{de^*}{dQ} < 0$. Therefore, for Q sufficiently large and close to $\bar{Q}$, $\frac{dV^*}{dQ} < 0$.

For Proposition 6, when $Q > \bar{Q}$, $\frac{dV^*}{dQ} = \frac{\partial V^*}{\partial Q} + \frac{\partial V^*}{\partial e^*}\frac{de^*}{dQ} < 0$ because $\frac{\partial V^*}{\partial Q} < 0$ for any $Q > \bar{Q}$ and $\frac{\partial V^*}{\partial e^*}\frac{de^*}{dQ} < 0$. ■

Proof. of Proposition 7: We first show the optimal auditing standard Q^* exists and is unique. The optimal standard solves the first order condition $\frac{dV^*}{dQ} = \frac{\partial V^*}{\partial Q} + \frac{\partial V^*}{\partial e^*}\frac{de^*}{dQ} = 0$. Substituting the expressions of $\frac{\partial V^*}{\partial Q}$ in equation 22, $\frac{\partial V^*}{\partial e^*} = \left(\frac{1}{t} - 1\right) kK'(e^*)$ and $\frac{de^*}{dQ} = \frac{ts}{kK''}\Delta_Q$ into $\frac{dV^*}{dQ}$, one can simplify $\frac{dV^*}{dQ}$ into:

$$\begin{aligned}\frac{dV^*}{dQ} &= (1-s)\,\frac{\partial E_{m_\tau}[\pi_0^*(m_\tau)]}{\partial Q} + s\frac{dE_{m_u}[\pi_1^*(m_u)]}{dQ} + se^*\Delta_Q + \left(\frac{1}{t} - 1\right) kK'\frac{ts}{kK''}\Delta_Q \\ &= (1-s)\,\frac{\partial E_{m_\tau}[\pi_0^*(m_\tau)]}{\partial Q} + s\frac{dE_{m_u}[\pi_1^*(m_u)]}{dQ} + s\Delta_Q\left(e^* + (1-t)\,\frac{K'}{K''}\right). \qquad (24)\end{aligned}$$

From the proofs in Proposition 5, at $Q = 0$, $\frac{dV^*}{dQ} > 0$ and at $Q = \bar{Q}$, $\frac{dV^*}{dQ} < 0$. Thus by the intermediate value theorem, there exists a Q^* that solves $\frac{dV^*}{dQ} = 0$. We now show such a Q^* is also unique. To show the uniqueness, we compute the second order condition $\frac{d^2V^*}{dQ^2}$ as

$$\begin{aligned}\frac{d^2V^*}{dQ^2} &= (1-s)\,\frac{\partial^2 E_{m_\tau}[\pi_0^*(m_\tau)]}{\partial Q^2} + s\frac{d^2 E_{m_u}[\pi_1^*(m_u)]}{dQ^2} \\ &\quad + s\frac{d\Delta_Q}{dQ}\left(e^* + (1-t)\,\frac{K'(e^*)}{K''}\right) + s\Delta_Q\left(1 + (1-t)\,\frac{(K'')^2 - K'K'''}{(K'')^2}\right)\frac{de^*}{dQ} \\ &= -(1-s)\,C''(Q) + s\frac{d^2 E_{m_u}[\pi_1^*(m_u)]}{dQ^2} \\ &\quad + s\left(\frac{d^2 E_{m_i}[\pi_1^*(m_i)]}{dQ^2} - \frac{d^2 E_{m_u}[\pi_1^*(m_u)]}{dQ^2}\right)\left(e^* + (1-t)\,\frac{K'(e^*)}{K''}\right) \\ &\quad + \frac{ts^2}{kK''}\,(\Delta_Q)^2\left(1 + (1-t)\,\frac{(K'')^2 - K'K'''}{(K'')^2}\right).\end{aligned}$$

The second equality utilizes $\frac{\partial^2 E_{m_\tau}[\pi_0^*(m_\tau)]}{\partial Q^2} = \frac{\partial}{\partial Q}\frac{\partial E_{m_\tau}[\pi_0^*(m_\tau)]}{\partial Q} = \frac{\partial}{\partial Q}\left(p\gamma_0 I - C'(Q)\right) = -C''(Q)$, $\frac{d\Delta_Q}{dQ} = \frac{d^2 E_{m_i}[\pi_1^*(m_i)]}{dQ^2} - \frac{d^2 E_{m_u}[\pi_1^*(m_u)]}{dQ^2}$ and $\frac{de^*}{dQ} = \frac{ts}{kK''}\Delta_Q$.

We now plug in the quadratic-uniform specification, i.e., $C(a) = \frac{c}{2}a^2$, $kK(e) = \frac{k}{2}e^2$, $\tilde{\gamma} \sim U\left[\frac{1}{2} - n, \frac{1}{2} + n\right]$, $\gamma_0 = \frac{1}{2}$, $m_i = \tilde{\gamma}$ and $m_u = \gamma_0$. Notice that for $Q \leq \bar{Q}$, $\hat{m} \leq \gamma_0$ and the regulatory constraint never binds for the uninformed good auditor ($m_u = \gamma_0 \geq \hat{m}$). Thus $\frac{dE_{m_u}[\pi_1^*(m_u)]}{dQ} = \frac{d^2 E_{m_u}[\pi_1^*(m_u)]}{dQ^2} = 0$ and $\Delta_Q = \frac{dE_{m_i}[\pi_1^*(m_i)]}{dQ}$. In addition, $e^* + (1-t)\frac{K'(e^*)}{K''} = (2-t)\,e^*$ and $1 + (1-t)\frac{(K'')^2 - K'K'''}{(K'')^2} = 2 - t$. $\frac{d^2 V^*}{dQ^2}$ can then be simplified into

$$\frac{d^2 V^*}{dQ^2} = -(1-s)\,c + s\,(2-t)\,e^* \frac{d^2 E_{m_i}[\pi_1^*(m_i)]}{dQ^2} + \frac{s^2\,(2-t)\,t}{k}\left(\frac{dE_{m_i}[\pi_1^*(m_i)]}{dQ}\right)^2.$$

The equilibrium expertise

$$\begin{aligned}
e^* &= \frac{ts}{k}\Delta \\
&= \frac{ts}{k}\left(E_{m_i}[\pi_1^*(m_i)] - E_{m_u}[\pi_1^*(m_u)]\right) \\
&= \frac{ts}{k}\left(\int_{\frac{1}{2}-n}^{\hat{m}} \frac{p\tilde{\gamma}QI - \frac{c}{2}Q^2}{2n} d\tilde{\gamma} + \int_{\hat{m}}^{\frac{1}{2}+n} \frac{\frac{(p\tilde{\gamma}I)^2}{2c}}{2n} d\tilde{\gamma} - \frac{(p\gamma_0 I)^2}{2c}\right).
\end{aligned}$$

The term $\frac{dE_{m_i}[\pi_1^*(m_i)]}{dQ}$ is given by

$$\begin{aligned}
\frac{dE_{m_i}[\pi_1^*(m_i)]}{dQ} &= \int_{\frac{1}{2}-n}^{\hat{m}} \frac{d\pi_1^*(\tilde{\gamma})}{dQ}\frac{1}{2n} d\tilde{\gamma} \\
&= \int_{\frac{1}{2}-n}^{\hat{m}} \frac{d\left(p(1-\tilde{\gamma}(1-Q))I - C(Q)\right)}{dQ}\frac{1}{2n} d\tilde{\gamma} \\
&= \int_{\frac{1}{2}-n}^{\hat{m}} \frac{p\tilde{\gamma}I - cQ}{2n} d\tilde{\gamma} < 0. \qquad (25)
\end{aligned}$$

The inequality follows from for $m < \hat{m}$, $\frac{d\pi_1^*(\tilde{\gamma})}{dQ} < 0$ in Lemma 2.

The term $\frac{d^2 E_{m_i}[\pi_1^*(m_i)]}{dQ^2}$ is given by

$$\begin{aligned}
\frac{d^2 E_{m_i}[\pi_1^*(m_i)]}{dQ^2} &= \frac{d}{dQ}\frac{dE_{m_i}[\pi_1^*(m_i)]}{dQ} \\
&= -\int_{\frac{1}{2}-n}^{\hat{m}} \frac{c}{2n} d\tilde{\gamma} + \frac{p\hat{m}I - cQ}{2n}\frac{d\hat{m}}{dQ} \\
&= -\int_{\frac{1}{2}-n}^{\hat{m}} \frac{c}{2n} d\tilde{\gamma} < 0.
\end{aligned}$$

The last equality utilizes $\hat{m} = \frac{cQ}{pI}$. Plug the expressions of e^*, $\frac{dE_{m_i}[\pi_1^*(m_i)]}{dQ}$ and $\frac{d^2E_{m_i}[\pi_1^*(m_i)]}{dQ^2}$ into $\frac{d^2V^*}{dQ^2}$, one can simplify $\frac{d^2V^*}{dQ^2}$ into

$$\begin{aligned}\frac{d^2V^*}{dQ^2} &= -(1-s)c - \frac{s^2t(2-t)}{k}\left(\int_{\frac{1}{2}-n}^{\hat{m}} \frac{c}{2n}d\tilde{\gamma}\right)\left(\int_{\frac{1}{2}-n}^{\hat{m}} \frac{p\tilde{\gamma}QI - \frac{c}{2}Q^2}{2n}d\tilde{\gamma} + \int_{\hat{m}}^{\frac{1}{2}+n} \frac{\frac{(p\tilde{\gamma}I)^2}{2c}}{2n}d\tilde{\gamma} - \frac{(p\gamma_0 I)^2}{2c}\right) \\ &\quad + \frac{s^2t(2-t)}{k}\left(\int_{\frac{1}{2}-n}^{\hat{m}} \frac{p\tilde{\gamma}I - cQ}{2n}d\tilde{\gamma}^2\right)^2.\end{aligned}$$

Through some algebras, we verify that at $\frac{dV^*}{dQ} = 0$, $\frac{d^2V^*}{dQ^2} < 0$. Thus the optimal auditing standard Q^* that solves $\frac{dV^*}{dQ} = 0$ must be unique because $\frac{d^2V^*}{dQ^2} < 0$ at all critical points with $\frac{dV^*}{dQ} = 0$. Since $\frac{dV^*}{dQ}|_{Q=\bar{Q}} < 0$ and from Proposition 6, for any $Q > \bar{Q}$, $\frac{dV^*}{dQ} < 0$, it must be the case that $Q^* < \bar{Q}$.

We now compute the comparative statics on Q^*. By the implicit function theorem,

$$\begin{aligned}\frac{\partial Q^*}{\partial s} &= -\frac{\frac{\partial}{\partial s}\frac{dV^*}{dQ}}{\frac{d^2V^*}{dQ^2}}, \\ \frac{\partial Q^*}{\partial t} &= -\frac{\frac{\partial}{\partial t}\frac{dV^*}{dQ}}{\frac{d^2V^*}{dQ^2}}, \\ \frac{\partial Q^*}{\partial k} &= -\frac{\frac{\partial}{\partial k}\frac{dV^*}{dQ}}{\frac{d^2V}{dQ^2}}, \\ \frac{\partial Q^*}{\partial n} &= -\frac{\frac{\partial}{\partial n}\frac{dV^*}{dQ}}{\frac{d^2V}{dQ^2}}.\end{aligned}$$

The denominator $\frac{d^2V^*}{dQ^2} < 0$. In addition, we now show that $\frac{\partial}{\partial s}\frac{dV^*}{dQ} < 0$, $\frac{\partial}{\partial t}\frac{dV^*}{dQ} < 0$, $\frac{\partial}{\partial k}\frac{dV^*}{dQ} > 0$ and $\frac{\partial}{\partial n}\frac{dV^*}{dQ} < 0$. Thus $\frac{\partial Q^*}{\partial s} < 0$, $\frac{\partial Q^*}{\partial t} < 0$, $\frac{\partial Q^*}{\partial k} > 0$ and $\frac{\partial Q^*}{\partial n} < 0$. In particular, under the quadratic-uniform specification, $\frac{\partial E_{m_\tau}[\pi_0^*(m_\tau)]}{\partial Q} = p\gamma_0 I - cQ^*$, $\frac{dE_{m_u}[\pi_1^*(m_u)]}{dQ} = 0$, $\Delta_Q = \frac{dE_{m_i}[\pi_1^*(m_i)]}{dQ} < 0$ and $e^* + (1-t)\frac{K'}{K''} = (2-t)e^* = \frac{(2-t)ts}{k}\Delta > 0$, one can simplify the first order condition $\frac{dV^*}{dQ} = 0$ in equation 24 into:

$$\frac{dV^*}{dQ} = (1-s)(p\gamma_0 I - cQ^*) + \frac{s^2(2-t)t}{k}\Delta\Delta_Q.$$

Thus $\frac{\partial}{\partial s}\frac{dV^*}{dQ}$ is given by

$$\frac{\partial}{\partial s}\frac{dV^*}{dQ} = -(p\gamma_0 I - cQ^*) + \frac{2s(2-t)t}{k}\Delta\Delta_Q < 0.$$

The last inequality is because at $Q = Q^* < \bar{Q}$, $p\gamma_0 I - cQ^* > 0$. In addition, $\Delta > 0$ and $\Delta_Q < 0$.

$\frac{\partial}{\partial t}\frac{dV^*}{dQ}$ is given by

$$\frac{\partial}{\partial t}\frac{dV^*}{dQ} = \frac{s^2\,(2-2t)}{k}\Delta\Delta_Q < 0.$$

$\frac{\partial}{\partial k}\frac{dV^*}{dQ}$ is given by

$$\frac{\partial}{\partial k}\frac{dV^*}{dQ} = -\frac{s^2\,(2-t)\,t}{k^2}\Delta\Delta_Q > 0.$$

$\frac{\partial}{\partial n}\frac{dV^*}{dQ}$ is given by

$$\frac{\partial}{\partial n}\frac{dV^*}{dQ} = \frac{s^2\,(2-t)\,t}{k}\frac{\partial\Delta}{\partial n}\Delta_Q + \frac{s^2\,(2-t)\,t}{k}\frac{\partial\Delta_Q}{\partial n}\Delta.$$

In the first term,

$$\begin{aligned}\frac{\partial\Delta}{\partial n} &= \frac{\partial}{\partial n}\left[E_{m_i}[\pi_1^*(m_i)] - E_{m_u}[\pi_1^*(m_u)]\right] \\ &= \frac{\partial}{\partial n}E_{m_i}[\pi_1^*(m_i)] \\ &> 0.\end{aligned}$$

The second equality follows from $m_u \equiv \gamma_0$ and thus $\frac{\partial}{\partial n}E_{m_u}[\pi_1^*(m_u)] = 0$. The last inequality follows because from Lemma 3, π_1^* is convex in $m_i = \tilde{\gamma}$ and therefore, increasing the variability of $\tilde{\gamma}\ (n)$ increases $E_{m_i}[\pi_1^*(m_i)]$. Thus $\frac{\partial\Delta}{\partial n}\Delta_Q < 0$.

In the second term,

$$\begin{aligned}\frac{\partial\Delta_Q}{\partial n} &= \frac{\partial}{\partial n}\frac{dE_{m_i}[\pi_1^*(m_i)]}{dQ} \\ &= \frac{\partial}{\partial n}E_{m_i}\left[\frac{d\pi_1^*(m_i)}{dQ}\right] \\ &< 0.\end{aligned}$$

The last inequality follows because from Lemma 3, $\frac{d\pi_1^*(m_i)}{dQ}$ is concave in $m_i = \tilde{\gamma}$ and therefore, increasing the variability of $\tilde{\gamma}\ (n)$ decreases $E_{m_i}\left[\frac{d\pi_1^*(m_i)}{dQ}\right]$. Thus $\frac{\partial\Delta_Q}{\partial n}\Delta < 0$ and $\frac{\partial}{\partial n}\frac{dV^*}{dQ} < 0$. ■

Proof. of Corollary 1: Holding e^* fixed, the total effect of Q on V^* is given by $\frac{dV^*}{dQ} = \frac{\partial V^*}{\partial Q} + \frac{\partial V^*}{\partial e^*}\frac{de^*}{dQ} = \frac{\partial V^*}{\partial Q}$. From the proof of Proposition 3, at $Q = 0$, $\frac{\partial V^*}{\partial Q}|_{Q=0} > 0$ and at $Q = \bar{Q}$, $\frac{\partial V^*}{\partial Q}|_{Q=\bar{Q}} < 0$. Thus by the intermediate value theorem, there exists a $\hat{Q}$ such that $\frac{\partial V^*}{\partial Q}|_{Q=\hat{Q}} = 0$. We now prove that such a $\hat{Q}$ is also unique. To see the uniqueness, we compute the second order derivative as follows given the expression of $\frac{\partial V^*}{\partial Q}$ in equation 22,

$$\begin{aligned}
\frac{\partial^2 V^*}{\partial Q^2} &= (1-s)\,\frac{\partial^2 E_{m_\tau}[\pi_0^*(m_i)]}{\partial Q^2} + s\frac{d^2 E_{m_u}[\pi_1^*(m_u)]}{dQ^2} + se^*\frac{d\Delta_Q}{dQ} \\
&= -(1-s)\,c + s\frac{d^2 E_{m_u}[\pi_1^*(m_u)]}{dQ^2} + se^*\left(\frac{d^2 E_{m_i}[\pi_1^*(m_i)]}{dQ^2} - \frac{d^2 E_{m_u}[\pi_1^*(m_u)]}{dQ^2}\right) \\
&= -(1-s)\,c + se^*\frac{d^2 E_{m_i}[\pi_1^*(m_i)]}{dQ^2}.
\end{aligned}$$

The second equality is from $\frac{d^2 E_{m_u}[\pi_1^*(m_u)]}{dQ^2} = 0$. In the last expression, the first term is negative since $c > 0$. The second term $\frac{d^2 E_{m_i}[\pi_1^*(m_i)]}{dQ^2} < 0$ from equation 25. Thus $\frac{\partial^2 V^*}{\partial Q^2} < 0$. Because V^* is strictly concave in Q holding e^* fixed, there exists a unique global maximum $\hat{Q}$.

Lastly, the long-run optimal auditing standard $Q^* < \hat{Q}$ because plugging $Q = Q^*$ into $\frac{\partial V^*}{\partial Q}$ gives

$$\begin{aligned}
\frac{\partial V^*}{\partial Q}|_{Q=Q^*} &= \frac{dV^*}{dQ}|_{Q=Q^*} - \frac{\partial V^*}{\partial e^*}\frac{de^*}{dQ}|_{Q=Q^*} \\
&= -\frac{\partial V^*}{\partial e^*}\frac{de^*}{dQ}|_{Q=Q^*} \\
&> 0.
\end{aligned}$$

The second equality uses $\frac{dV^*}{dQ}|_{Q=Q^*} = 0$. The last inequality follows from $\frac{\partial V^*}{\partial e^*} > 0$ and $\frac{de^*}{dQ} < 0$. Because $\frac{\partial^2 V^*}{\partial Q^2} < 0$, i.e., $\frac{\partial V^*}{\partial Q}$ is strictly decreasing in Q, $\frac{\partial V^*}{\partial Q}|_{Q=Q^*} > 0$ implies that $Q^* < \hat{Q}$. Moreover, since $\hat{Q}$ is a global maximum, for any $Q \in \left(Q^*, \hat{Q}\right)$, $\frac{\partial V^*}{\partial Q} > 0$. ■

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