DOES TIGHTENING AUDITING STANDARDS

IMPROVE OR IMPAIR WELFARE?

A Dissertation

Presented to

The Faculty of the C.T. Bauer College of Business

University of Houston

In Partial Fulfillment

Of the Requirements for the Degree Doctor of

Philosophy

By

Lijun Ruan

May 2019

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ABSTRACT

This study investigates the effects of tightening auditing standards in a setting of an oligopolistic audit market and a competitive capital market. I look at how tightening auditing standards affects audit quality, audit fee, audit market share, stock price, and investment decisions. Two audit firms engage in a two-stage competition: audit quality competition and audit fee competition. Audit quality has a dual role: (a) audit quality affects the credibility of the accounting reports (precision effect); (b) a company's choice of a high-quality versus a low-quality audit firm signals its hidden information about its economic prospects (signaling effect). I find that tightening auditing standards will improve the credibility of accounting reports of those companies that stick to original auditors and impair the credibility of accounting reports of those companies that switch auditors.

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1 INTRODUCTION

Since the creation of the Public Company Accounting Oversight Board (PCAOB) in 2002, more and more auditing standards have been issued and therefore the required minimum audit quality of audit firms have been raised higher and higher[1]. Conventional wisdom holds that tightening auditing standards will improve the quality of the audited accounting reports and thus unambiguously benefit the capital market investors. Supporters of tighter standards also believe that even though it will force the low-quality audit firms to incur a larger audit quality investment cost, tightening auditing standards will not affect the high-quality audit firms because they have already met the minimum standards.

I investigate the welfare implications of tightening auditing standards. Contrary to the conventional wisdom, I find that tightening auditing standards will not unambiguously improve corporate welfare. Specifically, a minimum audit quality requirement will induce some companies switch from high-quality audit firms to low-quality audit firms. These companies undergo less effective auditing, and therefore their welfare may be impaired.

I interpret the high-quality audit firm as an industry specialist and the low-quality audit firm as a non-specialist. Prior studies investigate the relationship between industry specialization and audit quality (Abbott and Parker 2000; Gramling and Stone 2001; Lowensohn, Johnson, Elder, and Davies 2007; Reichelt and Wang 2009). Most studies suggest that specialized auditors provide higher audit quality. For example, in the U.S. telecommunications services sector, EY is an industry specialist, auditing approximately 92 percent of the S&P 500 market capitalization and providing higher audit quality than the other three Big 4 audit firms.

I focus on a financial accounting and auditing setting in which companies hire audit firms to audit their accounting reports to be presented to investors in the capital market. I incorporate both the demand and supply sides of audits. Regarding the

[1] Up to present, 57 auditing standards have been issued, covering general auditing standards, audit procedures, auditor reporting and so on.

demand for audits, the audit quality of an audit firm has a dual role: (a) the precision effect, in which the audit quality affects the credibility of the accounting reports; (b) the signaling effect, in which a company's choice of a high-quality versus a low-quality audit firm signals its hidden information about its economic prospects. Regarding the supply of audits, the audit firms engage in a two-stage competition: in an earlier stage, they compete in audit quality; in a later stage, they compete in audit fee.

If the standard setter tightens the auditing standards, the low-quality audit firm must raise its audit quality to comply with the regulation, thereby its quality will become a closer substitute to its high-quality rival's audit quality, which in turn will intensify the competition between the two audit firms. To alleviate this fiercer competition, the high-quality audit firm will also raise its own quality to keep it further away from the low-quality audit firm's quality. Thus, both firms' audit qualities will increase. However, because the high-quality firm's existing quality is already at a high level, boosting quality further will necessitate a steep cost hike. At the end of the day, the quality differentiation among audit firms will be reduced, and therefore the competition will be more intensified.

As a result, both audit firms will increase their audit fees accordingly to compensate for the increased audit quality cost, which will induce some companies to switch from a high-quality audit firm to a low-quality one because these companies find the quality-fee ratio offered by the high-quality audit firm is less attractive. For these companies, the direct effect of switching is that their accounting reports become less credible. In addition, such a quality downgrade is treated as a signal of poorer prospects in the eyes of investors.

The above-mentioned effects of tightening standards are critically embedded in the different commitment devices in place in audit markets between the unregulated economy and the regulated economy. At the quality competition stage between the two audit firms, both firms want to keep a sufficient distance in audit quality to avoid fierce fee competition down the road. To attract enough clients, the low-quality audit firm wants to choose a reasonably high quality and wishes to threaten the high-quality firm into picking a much higher quality. At the same time, to avoid steep hikes in costs of quality investment, the high-quality firm does not want to choose an excessively high level of quality; instead, it wishes to threaten the low-quality firm into backing off and picking a sufficiently low quality. Which firm will win depends on whose threat is more credible.

In the unregulated economy, it turns out that the high-quality audit firm wins because of the convexity of the cost function; that is, it is common knowledge that the costs of quality investment are increasing at an increasing rate, thereby making the high-quality firm's threat more credible. As a consequence, the high-quality firm can use the convexity of the cost function as a commitment device to pressure the low-quality firm to settle at a quality level lower than what it wishes.

However, in the regulated economy, when the auditing standard is tightened, the table is turned around. Now, the tighter standard serves as a commitment device for the low-quality firm to raise its quality. Thus, aided by the regulation, the low-quality firm's threat becomes more credible than the high-quality firm's. As a result of tighter standards, the high-quality firm has to raise its audit quality to alleviate the quality and fee competition but does not increase the quality too much due to the convexity of cost function.

In terms of social welfare implications of tightening auditing standards, I identify two social inefficiencies. First, tightening auditing standards exacerbates the overinvestment in high-quality audit firm's audit quality. In the unregulated economy, the high-quality audit firm overinvests in audit quality to differentiate itself from the low-quality audit firm. When the auditing standard is tightened, the high-quality audit firm further increases its audit quality to alleviate the competition between the two audit firms.

Second, tightening standards will induce some companies to switch from high-quality audit firm to low-quality audit firm, thereby decreasing the informativeness of these companies' accounting reports.

I also identified a social benefit: tightening auditing standards mitigates the underinvestment in low-quality audit firm's audit quality. In the unregulated economy, the low-quality audit firm underinvests in audit quality to alleviate the competition between the two audit firms. When auditing standards are tightened, the low-quality audit firm increase its audit quality to comply with the standards.

I contribute to the theoretical literature in auditing in several ways:

(1) To my knowledge, this is the first theoretical study that employs a *general equilibrium* framework in which companies and audit firms interact in oligopolistic audit markets and companies' existing shareholders and potential shareholders interact in competitive capital markets. Therefore, I can investigate the effects of tightening auditing standards on social welfare.

Previous research has identified the signaling effect of audit quality. Titman and Trueman (1986) tell a signaling story in which companies choose audit firms with different audit qualities in order to signal their hidden information about their prospects. Datar et al. (1991) suggest that entrepreneurs may communicate their private information with their choice of auditors. I incorporate this signaling role of audit quality in my study. Slovin et al. (1990) provide empirical evidence that market reacts positively if companies switch to high quality auditors.

Ronnen (1991) and Ronnen (1996), on the other hand, hold the opposite view. Ronnen (1991) focuses on a product market with a two-stage competition in quality and price. Ronnen (1996) focuses on audit markets alone but treats the capital market demand for audits as exogenous and thus is a partial equilibrium analysis. Gao and Zhang (2018) also study how auditing standards affect audit quality. They incorporate a tradeoff in which a tighter auditing standard, while improving the precision of accounting reports, may restrict auditors' ability to exercise their professional judgment, thus impairing audit quality. I abstract away from auditors' professional judgment but instead highlight the tension caused by audit firms' competition in quality and fee.

I find that tightening standards induces some companies to switch to an audit firm that provides a different quality level. This result counters Shapiro (1983), who finds that service purchasers do not change their quality selection in response to a tighter standard. The difference is due to the two-stage competition in quality and fee in my model, as in Ronnen (1991); Shapiro (1983) studies a one-stage competition model. A similar study of Leland (1979) and Shapiro (1983) show that some service purchasers may be hurt by the higher prices triggered by tighter standards. Blazenko and Scott (1986) identify the investor-manager misalignment as a driver of demand for auditing regulation, whereas I identify social welfare as the driver.

(2) I identify different *commitment devices* in an unregulated economy and a regulated economy that cause diametrically opposite equilibrium results. Specifically, in the unregulated audit market, the high-quality audit firm may employ the convexity of the cost function to make a credible threat to the low-quality audit firm. In contrast, in the regulated audit market, it is the other way around: The low-quality audit firm can use the tightened auditing standards as a credible commitment device to threaten the high-quality audit firm. Therefore, in the unregulated economy, the credible commitment device is a firm's technological feature, whereas in the regulated economy, the credible commitment device is a governmental regulation.

A large theoretical literature exists regarding audit liability as a mechanism to affect audit quality (Dye 1993; Smith and Tidrick 1998; Ewert 1999; Patterson and Wright 2003; Laux and Newman 2010; Bigus 2012; Simunic, Ye, and Zhang 2017). The enforcement of auditing standards is not my focus.

Ye and Simunic (2013) examine both the toughness (the mean) and vagueness (the variance) of audit quality mandated by standard setters. In contrast, I focus on the signaling effect of audit quality as well as its toughness. Chen, Jiang, and Zhang (2018) study the disclosure of audit quality whereas I study the determination of audit quality.

(3) I make a set of empirical predictions on auditing (Propositions 1 to 4). They can be classified into the categories of supply of audits and demand for audits, as in DeFond and Zhang's (2014) survey of the empirical auditing literature. Regarding the supply of audits, I make predictions on audit qualities, audit fees, and audit firms' market shares. Regarding the demand for audits, I make predictions on stock price reactions to audit quality and the informativeness of audited accounting reports perceived by

the capital markets.

Section 2 describes the model setup. Section 3 analyzes the unregulated economy in which no auditing standards exist. Section 4 examines the effects of tightening the audit quality standards on audit fees, audit qualities, and social welfare. The Appendix contains the proofs of propositions. Section 5 discusses potential research extensions and summarizes this study.

2 MODEL SETUP

I study an oligopolistic audit market and a competitive capital market setting in which each company hires an audit firm to audit its accounting report and present the audited accounting report to the capital market investors.

Each company makes an investment at level k, where k is also the investment cost, and the investment return is w. k can either be I or 0, $k \in \{0, I\}$. w is the state of the company, which can also be interpreted as the profitability of the company. w can either be favorable G or unfavorable 0. The prior probability of a favorable state ($w = G$) is θ, which is uniformly distributed on $[0, 1]$. And the prior probability of an unfavorable state ($w = 0$) is $1 - \theta$. The company's existing shareholders privately know the realized value of θ.

An audit firm with audit quality q can verify whether the accounting report faithfully represents the state of the company. Audit firms publish audited accounting report $r \in \{g, b\}$. Without auditing, companies will always present a good report to public. Auditing makes accounting reports more credible. An audited accounting report r will be consistent with the underlying state of the company with probability $q \in (\frac{1}{2}, 1)$. The higher the audit quality q, the more likely that the accounting report will truthfully represent the underlying state of the company. If the underlying state is good G, it is guaranteed that a good audited accounting report g will be produced. Because companies will always require auditors re-audit their accounting reports and provide more evidences to show that they have bad fundamentals. In another word, there is no possibility for a downward biased audited accounting report, which is also captured by audit conservatism. Below is the information structure:

In this paper, I focus on Big 4 auditors because they perform more than 80 percent of the public company audits in the U.S. For each public company, it's choice of auditors is even limited to 2 within the Big 4 auditors: 1) it won't choose it's competitor's auditor, and 2) it can't use the auditor conducting the consulting service for it. Therefore in my paper, the audit market consists of two audit firms. Each audit firm chooses its

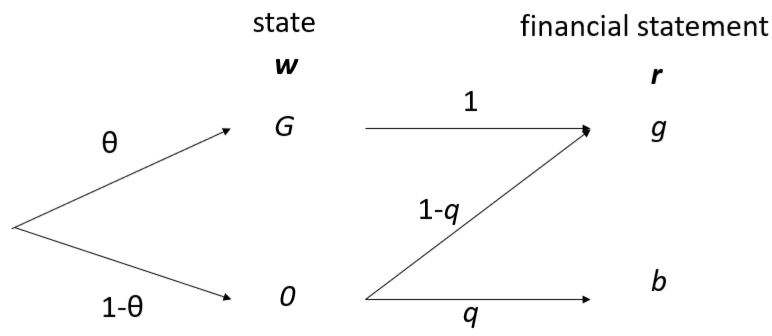

Figure 1: Information Structure

own firm-wide audit quality level $q \in (\frac{1}{2}, 1)$. q is not the quality of one particular engagement. I call the higher of the two qualities chosen "q_H" and the lower of the two "q_L." I call the audit firm that chooses q_H the high-quality audit firm and call the audit firm that chooses q_L the low-quality audit firm. High-quality audit firm can be interpreted as an industry specialist and low-quality audit firm can be interpreted as an industry non-specialist. For example, E&Y is the industry specialist in finance industry, therefore it provides higher audit quality compared with other Big 4 members.

An audit firm must maintain a uniform firm-wide quality level, which is required by both the PCAOB and the American Institute of Certified Public Accountants (AICPA) in the U.S. and implemented by an audit firm's quality control program. Each audit firm must offer the same audit quality to all its clients. Because I focus on Big 4 auditors, these audit firms compete in the same market niche, and therefore share the same quality cost function. Specifically, to achieve a quality level q, both audit firms incur the cost function of $C(q)$ which is increasing and convex with $C(\frac{1}{2}) = C'(\frac{1}{2}) = 0$, $C'(1) = \infty$ and $C'''(q) > 0$. $C(q)$ is a fixed cost which can be interpreted as a development cost to maintain the audit firm's quality control program. For example, the costs of hardware, computer software, and employee training, which do not vary with the number of audits audit firms conduct.

I model the competition between the two audit firms as a two-stage competition. In stage 1, the two firms compete in audit quality q. In stage 2, they compete in audit fee F. Audit fee is not contingent on accounting report or the state of the company. An audit firm charges one price for all clients, so there is no price discrimination. The two-stage competition captures the following two real-world features in the auditing industry: (a) It takes a non-trivial amount of time for audit firms to build up their human capital and knowledge capital in order to realize their desired level of firm-wide audit quality. (b) At the time of choosing its audit fee, an audit firm knows the quality chosen by its rival as well as its own chosen quality level.

2.1 Time Line

The sequence of events is as follows:

- Stage 0. Minimum auditing standard $\underline{q}$ is imposed by auditing standard setters.
- Stage 1. Each of the two audit firms chooses its own audit quality, denoted by $q \in \{q_L, q_H\}$ where $\underline{q} \leq q_L < q_H$.
- Stage 2. Firm q_L chooses its audit fee F_L and Firm q_H chooses its audit fee F_H.
- Stage 3. A company's existing shareholders with hidden information θ choose (i) to hire the high-quality audit firm, or (ii) to hire the low-quality audit firm, which determines two audit firms' market share S.
- Stage 4. An audit firm then conducts its audit and produces an audited accounting report $r \in \{g, b\}$.
- Stage 5. A company's existing shareholders transfer the ownership to new shareholders for liquidity reasons at price P in a competitive capital market.
- Stage 6. The new shareholders choose the investment level k. The investment return $w = G$ is realized if the state is G and 0 otherwise. $V = -k + w$ is the NPV of the project.

Because an audit firm can change its audit fee almost instantaneously whereas a change in the audit technology takes a nontrivial amount of time, Stage 2 comes only after the completion of Stage 1. If audit quality and audit fee are chosen at the same time, two audit firms will always adjust their quality and fee combo in later stage based on their rival's action, which is not a stable status.

All decisions within a stage are made simultaneously, that is, when one party makes her decision, she does not observe the other party's decision.

2.2 Payoffs

New shareholders pay price P to acquire the firm and incur cost k to generate the investment return w. $V = -k + w$ is the NPV of the investment in project. Therefore, new shareholders' payoff is

$$-P + V. \tag{1}$$

Companies are takers of audit fee and audit quality because a large number of companies exist whereas only two audit firms exist. A company with private information θ has two options: (i) Hire an audit firm with a high audit quality; and (ii) hire an audit firm with a low audit quality. A company's payoffs in these two cases are, respectively:

(i) $-F_H + P(r, q_H)$, that is, the stock market price given an audited accounting report r and the audit quality q_H, less the audit fee F_H;

(ii) $-F_L + P(r, q_L)$, that is, the stock market price given an audited accounting report r and the audit quality q_L, less the audit fee F_L;

An audit firm's payoff is composed of its revenue (that is, the product of the audit fee F it received and its market share S) less the audit quality cost:

(i) $-C(q_H) + F_H S_H$, high-quality audit firm's payoff;

(ii) $-C(q_L) + F_L S_L$, low-quality audit firm's payoff.

3 ANALYSIS

I employ the subgame perfect equilibrium as the solution concept in solving this model in the following section. Specifically, using the backward induction, I derive the following endogenous variables: (i) new shareholders' investment decision k; (ii) stock price P; (iii) existing shareholders' choice of an audit firm, which collectively gives rise to an audit firm's market share S; (iv) audit fee F; and (v) audit quality q.

3.1 Capital Market Price

After acquiring a company's ownership, new shareholders choose an investment level k to maximize their expected payoff V, which is the expected investment return w less the investment cost k, $k \in \{0, I\}$. Their expectation of investment return is based on the accounting report r audited by an audit firm with an audit quality q.

$$V \equiv \max_{k \in \{0,I\}} \; -k + \mathbb{E}[w|r,q], \tag{2}$$

where $\mathbb{E}[w|r,q] = Pr(w = G|r,q) \times G + Pr(w = 0|r,q) \times 0 = Pr(w = G|r,q) \times G$.

Because I assume there is no downward biased audited accounting reports, the expected investment return given a bad accounting report b is 0: $\mathbb{E}[w = G|b,q] = 0$. Let μ_H denote $Pr(w = G|g,q_H)$ and μ_L denote $Pr(w = G|g,q_L)$. μ is the probability of a good state ($w = G$) given a good audited accounting report g and audit quality q. Then I can rewrite expected investment return$\mathbb{E}[w = G|g,q_H]$ as $\mu_H G$, and $\mathbb{E}[w = G|g,q_L]$ as $\mu_L G$.

(i) When $r = b$, $V = \mathbb{E}[w = G|b,q] - k = -k$, therefore the optimal investment level $k^* = 0$;

(ii) When $r = g$ and $q = q_H, V = \mu_H G - k_H$, therefore the optimal investment level $k_H^* = I$;

(iii) Similarly when $r = g$ and $q = q_L,$ the optimal investment level $k_L^* = I$.

Combining the above three results, it can be easily concluded that as long as the audited accounting report is good g, the company will make an investment, independent of the audit quality the company chose.

Substituting k^* into (2) yields the new shareholders' expected net cash flow from investment V. Because the capital market is competitive, there is no abnormal profits for investors. Thus, the equilibrium stock price of the company in the competitive capital market is:

$$\begin{cases} P(b,q) = V = 0 \\ P(g,q) = V = \mu G - I \end{cases} . \tag{3}$$

Given the conjecture that companies with $\theta \in [z,1]$ hire the high-quality audit firm, the capital market investors will assess the probability of the good state G conditional on the report g audited by an audit firm with quality q_H in the following fashion:

$$\mu_H = Pr(G|g,q_H) = \int_z^1 \frac{\theta}{\theta+(1-\theta)(1-q_H)} \frac{1}{1-z} d\theta \tag{4}$$

It can be proved that μ_H increases in q_H : $\frac{\partial \mu_H}{\partial q_H} = \frac{1}{1-z} \int_z^1 \frac{(1-\theta)\theta}{[1-(1-\theta)q_H]^2} d\theta > 0$, which means that the higher the audit quality, the higher the investors' posterior belief that the state is good.

Similarly, given the conjecture that companies with $\theta \in [0,z)$ hire the low-quality audit firm, the capital market investors will assess the probability of the good state G conditional on the report g audited by an audit firm with quality q_L in the following fashion:

$$\mu_L = Pr(G|g,q_L) = \int_0^z \frac{\theta}{\theta+(1-\theta)(1-q_L)} \frac{1}{z} d\theta \tag{5}$$

It can also be proved that μ_L increases in q_L: $\frac{\partial \mu_L}{\partial q_L} = \frac{1}{z} \int_0^z \frac{(1-\theta)\theta}{[1-(1-\theta)q_L]^2} d\theta > 0$.

A higher audit quality has a dual role. First, the precision effect: A higher audit quality enhances the information quality of an audited accounting report r. The favorable report is more precise and thus more credible because it is produced by a high-quality audit. Second, the signaling effect: The very fact that a company hires a high-quality audit firm signals that its hidden information θ is favorable. Taken together, the dual role of the audit quality implies the following results: $P(g, q_H) > P(g, q_L)$, where $P(g, q) = \mu G - I$.

3.2 Shareholders' Choice of Audit Firms

A public company with private information θ has two options regarding audit firms: (i) Hire an audit firm with a high audit quality; and (ii) hire an audit firm with a low audit quality. The expected payoffs of a company with hidden information θ in these two cases are, respectively:

(i) $-F_H + \mathbb{E}[P(g, q_H)|\theta]$, that is, the expected stock market price given an audited accounting report g and the audit quality q_H, less the audit fee F_H;

(ii) $-F_L + \mathbb{E}[P(g, q_L)|\theta]$, that is, the expected stock market price given an audited accounting report g and the audit quality q_L, less the audit fee F_L;

A company will hire a high-quality audit firm if and only if its expected payoff in option (i) exceeds that of option (ii). That is, a company will hire an audit firm with $\{q_H, F_H\}$ if and only if the following condition is met:

$$-F_H + \mathbb{E}[P(r, q_H)|\theta] \geq -F_L + \mathbb{E}[P(r, q_L)|\theta] \tag{6}$$

which is equivalent to

$$(1 - q_H + \theta q_H)(\mu_H G - I) - (1 - q_L + \theta q_L)(\mu_L G - I) \geq F_H - F_L \tag{7}$$

The conditions in (7) are equivalent to $\theta \geq z$, where

$$(1 - q_H + z q_H)(\mu_H G - I) - (1 - q_L + z q_L)(\mu_L G - I) = F_H - F_L \tag{8}$$

The above graph shows that when $\theta = z$, the company is indifferent between choosing a high-quality audit firm and a low- quality audit firm.

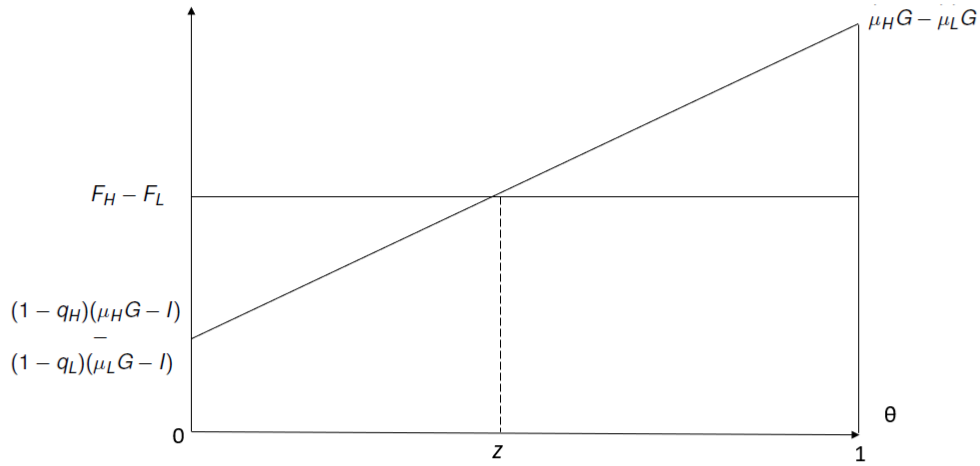

Figure 2: Choice of Auditors

$\frac{\partial LHS \text{ of Equation 7}}{\partial \theta} = q_H(\mu_H G - I) - q_L(\mu_L G - I) > 0$: The left hand side of equation 7 increases in θ,meaning that a company with more favorable θ will choose a high-quality audit firm.

Analogously, a company will hire a low-quality audit firm if and only if its expected payoff in option (ii) exceeds that of option (i). That is, a company will hire an audit firm with $\{q_L, F_L\}$ if and only if the following condition is met:

$$-F_H + \mathbb{E}[P(r, q_H)|\theta] < -F_L + \mathbb{E}[P(r, q_L)|\theta] \tag{9}$$

The conditions in (9) are equivalent to $\theta < z$.

In brief, a company will hire a high-quality audit firm if and only if its hidden information θ about the good state G is sufficiently favorable ($\theta \geq z$), and it will hire a low-quality audit firm if and only if its hidden information θ about the good state G is not sufficiently favorable ($\theta < z$).

Proposition 1. *A company with hidden information θ about the good state G will hire a high-quality audit firm $\{q_H, F_H\}$ if and only if $\theta \geq z$, and it will hire a low-quality audit firm $\{q_L, F_L\}$ if and only if $\theta < z$.*

Thus, the high-quality audit firm's market share is $S_H = 1 - z$ *and the low-quality audit firm's market share is* $S_L = z$.

Proof: see appendix.

3.3 Audit Fee Decisions

Because the high-quality audit firm's market share S_H is $1 - z$ (Proposition 1), its audit revenue is the product of the audit fee per audit and its market share. It chooses the audit fee F_H to maximize its revenue R_H:

$$R_H \equiv \max_{F_H} F_H \times (1 - z). \tag{10}$$

Similarly, the low-quality audit firm's market share S_L is z (Proposition 1), and thus its audit revenue is the product of the audit fee per audit and its market share. It chooses the audit fee F_L to maximize its revenue R_L:

$$R_L \equiv \max_{F_L} F_L \times z. \tag{11}$$

Because $\theta = z$ is the boundary of the two audit firms' market shares, the company with $\theta = z$ is indifferent between hiring a high-quality audit firm and hiring a low-quality audit firm. Thus, z is a function of both the high-quality firm's audit fee F_H and the low-quality firm's audit fee F_L. The two audit firms engage in fee competition in this stage to maximize their own revenues.

Proposition 2. *The high-quality firm's optimal audit fee* F_H *and the low-quality firm's optimal audit fee* F_L *are, respectively,*

$$2F_H = G\left\{[\tfrac{1}{1-z} + 1 - (1-z)q_H]\mu_H + [\tfrac{(1-q_L)}{z} - 1 + (1-z)q_L]\mu_L - \tfrac{1}{1-z}\right\} - \tfrac{I}{G}(q_H - q_L)z;$$
$$2F_L = G\left\{[\tfrac{1}{1-z} - 1 + (1-z)q_H]\mu_H + [\tfrac{(1-q_L)}{z} + 1 - (1-z)q_L]\mu_L - \tfrac{1}{1-z}\right\} - \tfrac{I}{G}(q_H - q_L)(2-z). \tag{12}$$

Moreover, $\frac{\partial z}{\partial F_L} < 0$ *and* $\frac{\partial z}{\partial F_H} > 0$.

Proof: see appendix.

Remark 1. When high-quality audit firm increases audit fee, some companies will switch from the high-quality audit firm to the low-quality audit firm because the audit quality and audit fee combo provided by high-quality audit firm is less attractive to these companies, therefore low-quality audit firm's market share increases ($\frac{\partial z}{\partial F_H} = \frac{\partial S_L}{\partial F_H} > 0$); similarly, when low-quality audit firm increases audit fee, companies will switch from low-quality audit firm to high-quality audit firm because low-quality audit firm's audit fee is less competitive, therefore low-quality audit firm's market share decreases ($\frac{\partial z}{\partial F_L} = \frac{\partial S_L}{\partial F_L} < 0$).

3.4 Audit Quality Decisions

In Stage 1, audit firms choose their optimal audit quality level to maximize their revenue minus audit quality cost. The high-quality audit firm's optimization program is

$$\pi_H \equiv \max_{q_H} R_H - C(q_H), \tag{13}$$

where $R_H = F_H \times (1-z)$ by (10). Analogously, the low-quality audit firm's optimization program is

$$\pi_L \equiv \max_{q_L} R_L - C(q_L), \tag{14}$$

where $R_L = F_L \times z$ by (11).

Proposition 3. *The two audit firms' optimal audit qualities q_H and q_L are jointly determined by the following two equations:*

$$\begin{aligned} MR_H &= C'(q_H) \\ MR_L &= C'(q_L) \end{aligned} \tag{15}$$

Moreover, (i) When low-quality audit firm increases its audit quality, high-quality audit firm also increases its audit quality: $\frac{\partial q_H(q_L)}{\partial q_L} > 0$;

(ii) Low-quality firm's market share increases in q_L and q_H : $\frac{\partial z}{\partial q_L} > 0$, $\frac{\partial z}{\partial q_H} > 0$;

(iii) When an audit firm increases its audit quality, both its audit fee and its rival's audit fee increase: $\frac{\partial F_L}{\partial q_L} > 0, \frac{\partial F_H}{\partial q_L} > 0$, $\frac{\partial F_L}{\partial q_H} > 0$, and $\frac{\partial F_H}{\partial q_H} > 0$.

Proof: see appendix.

Remark 2. (i) When the low-quality audit firm increases its quality, the two firms' qualities will become closer substitutes to each other, which will intensify the competition between the two firms. As a consequence, the high-quality firm will push its own quality higher to alleviate the competition ($\frac{\partial q_H(q_L)}{\partial q_L} > 0$).

(ii) When the low-quality audit firm increases its audit quality, it becomes a closer substitute to high-quality audit firm and it charges a lower audit fee compared with the high-quality audit firm; therefore some companies will switch from the high-quality firm to the low-quality firm, and therefore the low-quality firm's market share increases ($\frac{\partial S_L}{\partial q_L} > 0$). When the high-quality audit firm increases its audit quality, its audit fee increases accordingly, therefore some companies will switch from the high-quality audit firm to the low-quality audit firm because they find the quality/fee ratio provided by the high-quality firm is not attractive. Low-quality firm's market share increases ($\frac{\partial S_L}{\partial q_H} > 0$).

(iii) When an audit firm increases its audit quality, it will increase its audit fee accordingly in order to compensate for the increased audit quality cost ($\frac{\partial F_L}{\partial q_L} > 0$, $\frac{\partial F_H}{\partial q_H} > 0$); when the low-quality audit firm increases its audit quality, the high-quality audit firm will also increase audit quality to alleviate the competition, therefore increase its audit fee ($\frac{\partial F_H}{\partial q_L} > 0$); when the high-quality audit firm increases its audit quality, the quality and audit fee competition is less intensified, and therefore the low-quality audit firm can increase its audit fee to gain more margin ($\frac{\partial F_L}{\partial q_H} > 0$).

3.5 Social Welfare

When setting the minimum audit quality standards, standard setters pay attention to minimize the audit inefficiency, that is the investment inefficiency caused by audit failure. Since it is too costly to make auditing perfect (audit quality q is less than 1), audit failure cannot be avoided. To be more specific, it is possible that the underlying state of the company is bad, but a good accounting report g is produced. If the state is bad, the optimal investment level should be 0 (section 3.1). Therefore, overinvestment occurs when audit fails.

I define social welfare as the negative overinvestment costs minus audit quality costs in both audit firms:

$$W = -\int_z^1 (1-\theta)(1-q_H)Id\theta - C(q_H) - \int_0^z (1-\theta)(1-q_L)Id\theta - C(q_L) \qquad (16)$$

where $\int_z^1(1-\theta)(1-q_H)Id\theta$ is the product of the high-quality audit firm's probability of audit failure $\int_z^1(1-\theta)(1-q_H)d\theta$ and the investment cost I; similarly $\int_0^z(1-\theta)(1-q_L)Id\theta$ is the product of the low-quality audit firm's probability of audit failure of $\int_0^z(1-\theta)(1-q_L)d\theta$ and the investment cost I. From standard setter's perspective, investment cost in audit quality is also socially wasteful, therefore should be minimized.

4 TIGHTENING AUDITING STANDARDS

Proposition 3 describes the audit firms' equilibrium quality choices q_H and q_L in the unregulated economy, that is, in the economy in which auditing standards do not exist. In contrast, in a regulated economy in which an auditing standard setter such as the PCAOB in the U.S. sets the minimum quality standards, what will be the effects of regulation on the social welfare?

If the auditing standard is set less than or equal to q_L (the equilibrium quality chosen by the low-quality audit firm in the unregulated economy), the standard will be met by both audit firms with or without the standard. Therefore, I consider the case in which the standard has "teeth," that is, the auditing standard exceeds the equilibrium quality chosen by the low-quality audit firm in the unregulated economy: $\underline{q} > q_L$.

If the auditing standard $\underline{q}$ is extremely high, it will force both audit firms to incur extremely high costs of quality investment and thus exit the audit market. If the auditing standard $\underline{q}$ is sufficiently but not extremely high, it will force one of the two audit firms to incur prohibitively high costs of quality investment and thus exit the audit market, thereby creating a monopoly in the audit market. Thereafter, I focus on the interesting case in which the auditing standard setter raises the standard $\underline{q}$ a little bit above q_L such that both audit firms will find it still profitable to operate in the audit market.

In the following, I use the superscript m to indicate a variable in the regulated economy. Specifically, $[0, z^m)$ is the low-quality audit firm's market share, $[z^m, 1]$ is the high-quality audit firm's market share, and q_H^m is the quality chosen by the high-quality audit firm in the regulated economy. The quality chosen by the low-quality audit firm in the regulated economy is, of course, $\underline{q}$.

Proposition 4. *A increase in $\underline{q}$ above q_L will*

(i) increase both audit firms' quality levels (from q_L to $\underline{q}$ for the low-quality firm and from q_H to q_H^m for the high-quality firm) but decrease their distance $q_H^m - \underline{q} < q_H - q_L$;

(ii) increase the low-quality audit firm's market share (from $[0, z)$ to $[0, z^m)$ and

decrease the high-quality audit firm's market share from $[z, 1]$ *to* $[z^m, 1]$ *as follows:*

range of θ	$[0, z]$	$[z, z^m)$	$[z^m, 1]$
looser standard	q_L	q_H	q_H
tighter standard	$\underline{q}$	$\underline{q}$	q_H^m

Remark 3. (i) If the auditing standard is raised marginally above q_L, the low-quality audit firm will raise its quality from q_L to $\underline{q}$ in order to comply with the standard. The low-quality firm will thus become a closer substitute to the high quality of the high-quality firm and thus shorten the quality differential between the firms. The reduced quality differentiation will heighten the fee competition in the next stage. Anticipating the future heightened fee competition, the high-quality firm will increase its own quality from q_H to q_H^m in order to keep a distance from the low-quality firm. However, because the high-quality firm's existing quality is already at a high level, further pushing it up will require a steep increase in the cost of quality investment due to the convexity of the cost function. Therefore, at the end of the day, even though the high-quality firm increases its quality further, the quality differentiation between the two firms will be shortened ($q_H^m - \underline{q} < q_H - q_L$), which will intensify the quality and fee competition between two audit firms.

(ii) Tightening the auditing standard will increase both firms' quality levels and therefore both audit firms will increase their audit fees accordingly. However, due to the convexity cost function, the high-quality audit firm will incur higher costs to increase audit quality compared with the low-quality audit firm. As a result, the high-quality audit firm will charge a much higher audit fee to compensate for the increased audit quality cost. This effect will (1) directly induce some companies to switch from the high-quality firm to the low-quality firm (that is, companies whose type θ is in $[z, z^m)$). For these companies, they undergo less effective auditing because the audit quality they receive downgrades. (2) Moreover, for those companies that stick to their audit firms, the audit quality they receive increases (that is, from q_L to $\underline{q}$ for companies whose type θ is in $[0, z)$ and from q_H to q_H^m for companies whose type θ is in $[z^m, 1]$). Increase in audit quality has two effects: (a) improve the precision of accounting reports (precision effect); and (b) signal a better company prospect (signaling effect).

4.1 Welfare Effects

This section examines the welfare effects of imposing minimum auditing standards when both audit firms exist in the market. Social welfare is defined as the negative sum of overinvestment costs and audit quality costs.

Proposition 5. *An increase in $\underline{q}$ above q_L may*

(i) mitigate the social loss caused by underinvestment in q_L;

(ii) exacerbate the social loss caused by overinvestment in q_H;

(iii) increase the investment inefficiency by inducing some companies to switch from the high-quality audit firm to the low-quality audit firm.

Remark 4. (i) With respect to q_L, the q_L chosen by the low-quality audit firm is lower than the optimal q_L chosen by standard setters. For the low-quality audit firm, increase audit quality would shorten the distance between the two audit firms, therefore intensify the competition in the audit market. As a result, the low quality audit firm underinvests in audit quality. However, for standard setters, increase q_L would improve the precision of accounting reports, and therefore mitigate the overinvestment problem.

(ii) With respect to q_H, the q_H chosen by the high-quality audit firm is higher than the optimal q_H chosen by standard setters. For the high-quality audit firm, it overinvests in audit quality in order to differentiate itself from the low-quality audit firm. However, for standard setters, although increase q_H would also improve the precision of accounting reports, due to the convexity of cost function, higher q_H would lead to extremely high audit quality cost, which is socially wasteful. So the optimal q_H standard setters chose is lower than the one the high-quality audit firm chose.

(iii) Tightening auditing standards will induce some companies to switch from the high-quality audit firm to the low-quality audit firm. Therefore, these companies' accounting reports become less credible and it is more likely that audit fails. As a result, the investment inefficiency caused by the switch decreases social welfare.

As a result, when setting the minimum auditing standards, standard setters should balance between the benefits received from reducing the investment inefficiency and the costs from increasing the audit quality. Increase in minimum audit quality is a double-edged sword.

5 CONCLUSIONS

This study focuses on the welfare effects of tightening the auditing standards in a general equilibrium framework in which stakeholders play in capital markets and audit markets.

In the current model, I look only into the case of the duopoly. Another potentially fruitful extension is to introduce n audit firms as opposed to two firms. Then, I may investigate the effects of tightening standards on the audit market structure. Such an extension may encompass the whole spectrum of industry organization including perfect competition and monopoly as two polar cases and monopolistic competition and oligopoly as intermediate cases.

Another fruitful future research avenue is to introduce the possibility of the collusion of audit firms. In that setting, the two audit firms may collude to set the same audit quality and the same audit fee and therefore as a whole to monopolize the audit market. The audit firms' aggregate payoff will exceed that of the current model in which they compete in quality and fee; however, the corporate welfare may suffer as a result.

APPENDIX: PROOFS

PROOF OF PROPOSITION 1

A company will hire a high-quality audit firm if and only if the payoffs received from hiring a high-quality audit firm is greater than hiring a low-quality audit firm:

$-F_H + \mathbb{E}[P(r, q_H)|\theta] \geq -F_L + \mathbb{E}[P(r, q_L)|\theta]$, which can be expanded as follows:

$-F_H + Pr(g|\theta, q_H)P_H + Pr(b|\theta, q_H)P(b, q_H) \geq -F_L + Pr(g|\theta, q_L)P_L + Pr(b|\theta, q_L)P(b, q_L)$

$-F_H + (1 - q_H + \theta q_H)P_H + (1 - \theta)q_H P(b, q_H) \geq -F_L + (1 - q_L + \theta q_L)P_L + (1 - \theta)q_L P(b, q_L)$

$(1 - q_H + \theta q_H)P_H - (1 - q_L + \theta q_L)P_L \geq F_H - F_L$

$(1 - q_H + \theta q_H)(\mu_H G - I) - (1 - q_L + \theta q_L)(\mu_L G - I) \geq F_H - F_L$

Let $\theta = z$ if $(1 - q_H + \theta q_H)(\mu_H G - I) - (1 - q_L + \theta q_L)(\mu_L G - I) = F_H - F_L$, which means z is the boundary point between choosing a high-quality audit firm and a low-quality audit firm.

Because I consider mandatory auditing, the high-quality audit firm's market share is $S_H = 1 - z$ and the low-quality audit firm's market share is $S_L = z$.

PROOF OF PROPOSITION 2

From the proof of proposition 1, I can solve for the boundary point $z(q_H, q_L, F_H, F_L)$

$(1 - q_H + zq_H)(\mu_H G - I) - (1 - q_L + zq_L)(\mu_L G - I) = F_H - F_L$

Take the first-order condition of the above equation with respect to F_H :

$\frac{\partial z}{\partial F_H} \left\{ [1 - (1 - z)q_H]G\frac{\partial \mu_H}{\partial z} - [1 - (1 - z)q_L]G\frac{\partial \mu_L}{\partial z} + q_H(\mu_H G - I) - q_L(\mu_L G - I) \right\} = 1$

Take the first-order condition of the above equation with respect to F_L :

$\frac{\partial z}{\partial F_L} \left\{ [1 - (1 - z)q_H]G\frac{\partial \mu_H}{\partial z} - [1 - (1 - z)q_L]G\frac{\partial \mu_L}{\partial z} + q_H(\mu_H G - I) - q_L(\mu_L G - I) \right\} = -1$

Let $\Omega \equiv [1 - (1 - z)q_H]G\frac{\partial \mu_H}{\partial z} - [1 - (1 - z)q_L]G\frac{\partial \mu_L}{\partial z} + q_H(\mu_H G - I) - q_L(\mu_L G - I)$

$= G(\frac{\mu_H}{1-z} + \frac{(1-q_L)\mu_L}{z} - \frac{1}{1-z}) - I(q_H - q_L)$

Therefore $\begin{cases} \frac{\partial z}{\partial F_H}\Omega = 1 \\ \frac{\partial z}{\partial F_L}\Omega = -1 \end{cases}$

At date 2, two audit firms choose optimal audit fee to maximize their revenues:

- High-quality audit firm: $R_H \equiv \underset{F_H}{max}\ F_H \times (1 - z)$

  FOC $1 - z - F_H \frac{\partial z}{\partial F_H} = 0 \Longleftrightarrow 1 - z - \frac{F_H}{\Omega} = 0 \Longleftrightarrow F_H = \Omega(1 - z^*) > 0 \Rightarrow \Omega > 0$

- Low-quality audit firm: $R_L \equiv \underset{F_L}{max}\ F_L \times z$

  FOC $z + F_L \frac{\partial z}{\partial F_L} = 0 \Longleftrightarrow z - \frac{F_L}{\Omega} = 0 \Longleftrightarrow F_L = \Omega z > 0 \Rightarrow \Omega > 0$

From the above two FOCs, I get $\begin{cases} F_H + F_L = \mathit{\Omega} \\ F_H - F_L = \mathit{\Omega}(1 - 2z) \end{cases}$

$$\Rightarrow \begin{cases} F_H + F_L = G(\frac{\mu_H}{1-z} + \frac{(1-q_L)\mu_L}{z} - \frac{1}{1-z}) - I(q_H - q_L) \\ F_H - F_L = G[1 - (1 - z)q_H]\mu_H - G[1 - (1 - z)q_L]\mu_L + I(1 - z)(q_H - q_L) \end{cases}$$

Then I get

$$\begin{cases} 2F_H = G\left\{[\frac{1}{1-z} + 1 - (1 - z)q_H]\mu_H + [\frac{(1-q_L)}{z} - 1 + (1 - z)q_L]\mu_L - \frac{1}{1-z}\right\} - I(q_H - q_L)z \\ 2F_L = G\left\{[\frac{1}{1-z} - 1 + (1 - z)q_H]\mu_H + [\frac{(1-q_L)}{z} + 1 - (1 - z)q_L]\mu_L - \frac{1}{1-z}\right\} - I(q_H - q_L)(2 - z) \end{cases}$$

$$\because \Omega > 0, \therefore \begin{cases} \frac{\partial z}{\partial F_H}\Omega = 1 \Rightarrow \frac{\partial z}{\partial F_H} > 0 \\ \frac{\partial z}{\partial F_L}\Omega = -1 \Rightarrow \frac{\partial z}{\partial F_L} < 0 \end{cases}$$

PROOF OF PROPOSITION 3

(ii) At date 1, two audit firms choose optimal audit quality to maximize their payoffs:

- High quality audit firm: $\pi_H \equiv \underset{q_H}{max}\ F_H \times [1 - z(q_H, q_L, F_H, F_L)] - C(q_H)$

  By envelop theorem: $-F_H[\frac{\partial z}{\partial q_H} + \frac{\partial z}{\partial F_L}\frac{\partial F_L}{\partial q_H}] = C'(q_H)$

- Low quality audit firm: $\pi_L \equiv \underset{q_L}{max}\ F_L \times z(q_H, q_L, F_H, F_L) - C(q_L)$

  By envelop theorem: $F_L[\frac{\partial z}{\partial q_L} + \frac{\partial z}{\partial F_H}\frac{\partial F_H}{\partial q_L}] = C'(q_L)$

Let $Q \equiv (1 - q_H + zq_H)(\mu_H G - I) - (1 - q_L + zq_L)(\mu_L G - I)$

Therefore, $\begin{cases} 2F_H = 2\Omega(1-z) \\ 2F_H = \Omega + Q \end{cases} \Rightarrow \Omega = \frac{Q}{1-2z} \Rightarrow \begin{cases} F_H = \frac{1-z}{1-2z}Q \\ F_L = \frac{z}{1-2z}Q \end{cases}$

Take the FOC of Q w.r.t. q, $\begin{cases} \frac{\partial Q}{\partial q_H} = (-1+z^*)(\mu_H G - I) + (1 - q_H + zq_H)\frac{\partial \mu_H}{\partial q_H}G \\ \frac{\partial Q}{\partial q_L} = -(-1+z^*)(\mu_L G - I) - (1 - q_L + zq_L)\frac{\partial \mu_L}{\partial q_L}G \end{cases}$

Take the full derivates of Q w.r.t. q,

$$\begin{cases} \frac{\partial Q}{\partial q_H} + \frac{\partial Q}{\partial z}\frac{\partial z}{\partial q_H} + \frac{\partial Q}{\partial \mu}\frac{\partial \mu}{\partial z}\frac{\partial z}{\partial q_H} = \frac{\partial Q}{\partial q_H} + (\frac{\partial Q}{\partial z} + \frac{\partial Q}{\partial \mu}\frac{\partial \mu}{\partial z})\frac{\partial z}{\partial q_H} = \frac{\partial Q}{\partial q_H} + \Omega\frac{\partial z}{\partial q_H} = 0 \\ \frac{\partial Q}{\partial q_L} + \frac{\partial Q}{\partial z}\frac{\partial z}{\partial q_L} + \frac{\partial Q}{\partial \mu}\frac{\partial \mu}{\partial z}\frac{\partial z}{\partial q_L} = \frac{\partial Q}{\partial q_L} + (\frac{\partial Q}{\partial z} + \frac{\partial Q}{\partial \mu}\frac{\partial \mu}{\partial z})\frac{\partial z}{\partial q_L} = \frac{\partial Q}{\partial q_L} + \Omega\frac{\partial z}{\partial q_L} = 0 \end{cases}$$

which implies that $\begin{cases} \frac{\partial z}{\partial q_H} = -\frac{1}{\Omega}\frac{\partial Q}{\partial q_H} = -\frac{1-2z}{Q}\frac{\partial Q}{\partial q_H} \\ \frac{\partial z}{\partial q_L} = -\frac{1}{\Omega}\frac{\partial Q}{\partial q_L} = -\frac{1-2z}{Q}\frac{\partial Q}{\partial q_L} \end{cases}$

$-F_H[\frac{\partial z}{\partial q_H} + \frac{\partial z}{\partial F_L}\frac{\partial F_L}{\partial q_H}] = C'(q_H) \Rightarrow F_H[\frac{1}{\Omega}\frac{\partial Q}{\partial q_H} - \frac{1}{\Omega}\frac{1-z}{1-2z}\frac{\partial Q}{\partial q_H}] = C'(q_H)$

$\Rightarrow -\frac{F_H}{\Omega}\frac{\partial Q}{\partial q_H}\frac{z}{1-2z} = C'(q_H) \Rightarrow -\frac{\partial Q}{\partial q_H}\frac{z(1-z)}{1-2z} = C'(q_H) > 0$

$\Rightarrow \frac{\partial Q}{\partial q_H} < 0 \Rightarrow \frac{\partial z}{\partial q_H} > 0$

$F_L[\frac{\partial z}{\partial q_L} + \frac{\partial z}{\partial F_H}\frac{\partial F_H}{\partial q_L}] = C'(q_L) \Rightarrow -F_L[\frac{1}{\Omega}\frac{\partial Q}{\partial q_L} + \frac{1}{\Omega}\frac{z}{1-2z}\frac{\partial Q}{\partial q_L}] = C'(q_L)$

$\Rightarrow -\frac{F_L}{\Omega}\frac{\partial Q}{\partial q_L}\frac{1-z}{1-2z} = C'(q_L) \Rightarrow -\frac{\partial Q}{\partial q_L}\frac{z(1-z)}{1-2z} = C'(q_L)$

$\Rightarrow \frac{\partial Q}{\partial q_L} < 0 \Rightarrow \frac{\partial z}{\partial q_L} > 0$

(iii) $\frac{\partial F_H}{\partial q_L} = \frac{1-z}{1-2z}\frac{\partial Q}{\partial q_L} + \frac{Q}{(1-2z)^2}\frac{\partial z}{\partial q_L} = \frac{1-z}{1-2z}\frac{\partial Q}{\partial q_L} - \frac{Q}{(1-2z)^2}\frac{1-2z}{Q}\frac{\partial Q}{\partial q_L} = \frac{-z}{1-2z}\frac{\partial Q}{\partial q_L} > 0$

$\frac{\partial F_H}{\partial q_H} = \frac{1-z}{1-2z}\frac{\partial Q}{\partial q_H} + \frac{Q}{(1-2z)^2}\frac{\partial z}{\partial q_H} = \frac{1-z}{1-2z}\frac{\partial Q}{\partial q_H} - \frac{Q}{(1-2z)^2}\frac{1-2z}{Q}\frac{\partial Q}{\partial q_H} = \frac{-z}{1-2z}\frac{\partial Q}{\partial q_H} > 0$

$\frac{\partial F_L}{\partial q_H} = \frac{z}{1-2z}\frac{\partial Q}{\partial q_H} + \frac{Q}{(1-2z)^2}\frac{\partial z}{\partial q_H} = \frac{z}{1-2z}\frac{\partial Q}{\partial q_H} - \frac{Q}{(1-2z)^2}\frac{1-2z}{Q}\frac{\partial Q}{\partial q_H} = -\frac{1-z}{1-2z}\frac{\partial Q}{\partial q_H} > 0$

$\frac{\partial F_L}{\partial q_L} = \frac{z}{1-2z}\frac{\partial Q}{\partial q_L} + \frac{Q}{(1-2z)^2}\frac{\partial z}{\partial q_L} = \frac{z}{1-2z}\frac{\partial Q}{\partial q_L} - \frac{Q}{(1-2z)^2}\frac{1-2z}{Q}\frac{\partial Q}{\partial q_L} = -\frac{1-z}{1-2z}\frac{\partial Q}{\partial q_L} > 0$

(i) $\frac{C'(q_H)}{C'(q_L)} = \frac{F_H\frac{\partial Q}{\partial q_H}z}{F_L\frac{\partial Q}{\partial q_L}1-z} = \frac{(1-z)(\mu_H G - I) - [1-(1-z)q_H]G\frac{\partial \mu_H}{\partial q_H}}{[1-(1-z)q_L]G\frac{\partial \mu_L}{\partial q_L} - (1-z)(\mu_L G - I)} \equiv \frac{N}{D}$

$$\begin{cases} N = -\frac{\partial Q}{\partial q_H} = \frac{1-2z}{z(1-z)}C'(q_H) \\ D = -\frac{\partial Q}{\partial q_L} = \frac{1-2z}{z(1-z)}C'(q_L) \end{cases}$$

Take the derivative of the above two equations w.r.t z, I get

$$\begin{cases} \frac{\partial N}{\partial z} = -\frac{2z^2-2z+1}{[z(1-z)]^2}C'(q_H) \\ \frac{\partial D}{\partial z} = -\frac{2z^2-2z+1}{[z(1-z)]^2}C'(q_L) \end{cases}$$

Therefore $\begin{cases} N\frac{z(1-z)}{1-2z} = C'(q_H) \\ D\frac{z(1-z)}{1-2z} = C'(q_L) \end{cases}$

Take the derivative of the above two equations w.r.t q, I get

$$\begin{cases} \frac{z(1-z)}{1-2z}\frac{\partial N}{\partial q_H} + \frac{z(1-z)}{1-2z}\frac{\partial N}{\partial z}\frac{\partial z}{\partial q_H} + \frac{2z^2-2z+1}{(1-2z)^2}\frac{\partial z}{\partial q_H}N - C''(q_H) < 0 \\ \frac{z(1-z)}{1-2z}\frac{\partial D}{\partial q_L} + \frac{z(1-z)}{1-2z}\frac{\partial D}{\partial z}\frac{\partial z}{\partial q_L} + \frac{2z^2-2z+1}{(1-2z)^2}\frac{\partial z}{\partial q_L}D - C''(q_L) < 0 \end{cases}$$

Therefore, $\begin{cases} \frac{z(1-z)}{1-2z}(\frac{\partial N}{\partial q_H} + \frac{\partial N}{\partial z}\frac{\partial z}{\partial q_H}) < C''(q_H) - \frac{2z^2-2z+1}{1-2z}\frac{\partial z}{\partial q_H}\frac{1}{z(1-z)}C'(q_H) \\ \frac{z(1-z)}{1-2z}(\frac{\partial D}{\partial q_L} + \frac{\partial D}{\partial z}\frac{\partial z}{\partial q_L}) < C''(q_L) - \frac{2z^2-2z+1}{1-2z}\frac{\partial z}{\partial q_L}\frac{1}{z(1-z)}C'(q_L) \end{cases}$

$C'(q_H)D = C'(q_L)N$

Take derivative of the above equation w.r.t. q_L

$C''(q_H)\frac{\partial q_H}{\partial q_L}D + C'(q_H)[\frac{\partial D}{\partial q_L} + \frac{\partial D}{\partial z}\frac{\partial z}{\partial q_L} + \frac{\partial D}{\partial z}\frac{\partial z}{\partial q_H}\frac{\partial q_H}{\partial q_L}]$

$= C''(q_L)N + C'(q_L)[\frac{\partial N}{\partial q_H}\frac{\partial q_H}{\partial q_L} + \frac{\partial N}{\partial z}\frac{\partial z}{\partial q_L} + \frac{\partial N}{\partial z}\frac{\partial z}{\partial q_H}\frac{\partial q_H}{\partial q_L}]$

$\Rightarrow \frac{\partial q_H}{\partial q_L}[C'(q_L)\frac{\partial N}{\partial q_H} + C'(q_L)\frac{\partial N}{\partial z}\frac{\partial z}{\partial q_H} - C''(q_H)D - C'(q_H)\frac{\partial D}{\partial z}\frac{\partial z}{\partial q_H}]$

$= C'(q_H)\frac{\partial D}{\partial q_L} + C'(q_H)\frac{\partial D}{\partial z}\frac{\partial z}{\partial q_L} - C''(q_L)N - C'(q_L)\frac{\partial N}{\partial z}\frac{\partial z}{\partial q_L}$

Let $L \equiv C'(q_L)(\frac{\partial N}{\partial q_H} + \frac{\partial N}{\partial z}\frac{\partial z}{\partial q_H}) - C''(q_H)D - C'(q_H)\frac{\partial D}{\partial z}\frac{\partial z}{\partial q_H}$

$R \equiv C'(q_H)(\frac{\partial D}{\partial q_L} + \frac{\partial D}{\partial z}\frac{\partial z}{\partial q_L}) - C''(q_L)N - C'(q_L)\frac{\partial N}{\partial z}\frac{\partial z}{\partial q_L}$

$L < \frac{1-2z}{z(1-z)}C'(q_L)C''(q_H) - \frac{2z^2-2z+1}{[z(1-z)]^2}\frac{\partial z}{\partial q_H}C'(q_L)C'(q_H) - \frac{1-2z}{z(1-z)}C''(q_H)C'(q_L) - C'(q_H)\frac{\partial D}{\partial z}\frac{\partial z}{\partial q_H} = -C'(q_H)\frac{\partial z}{\partial q_H}[\frac{2z^2-2z+1}{[z(1-z^*)]^2}C'(q_L) + \frac{\partial D}{\partial z}] = 0$

$R < \frac{1-2z}{z(1-z)}C''(q_L)C'(q_H) - \frac{2z^2-2z+1}{[z(1-z)]^2}\frac{\partial z}{\partial q_L}C'(q_L)C'(q_H) - \frac{1-2z}{z(1-z)}C''(q_L)C'(q_H) - C'(q_L)\frac{\partial N}{\partial z}\frac{\partial z}{\partial q_L} = -C'(q_L)\frac{\partial z}{\partial q_L}[\frac{2z^2-2z+1}{[z(1-z)]^2}C'(q_H) + \frac{\partial N}{\partial z}] = 0$

$\because L < 0$ and $R < 0 \therefore \frac{\partial q_H}{\partial q_L} > 0$

PROOF OF PROPOSITION 5

To examine the welfare effects of increasing q_L to $\underline{q}$, I take the full derivative of $W = -\int_z^1(1-\theta)(1-q_H)Id\theta - C(q_H) - \int_0^z(1-\theta)(1-q_L)Id\theta - C(q_L)$ with respect to $\underline{q}$:

$$\frac{dW}{dq_L} = \frac{2z-z^2}{2}I - C'(q_L) + [\frac{(1-z)^2}{2}I - C'(q_H)]\frac{\partial q_H}{\partial q_L} - (1-z)(q_H - q_L)I(\frac{\partial z}{\partial q_L} + \frac{\partial z}{\partial q_H}\frac{\partial q_H}{\partial q_L}) = 0$$

The optimal $\underline{q}$ can be solved using the above derivative. I then compare the F.O.C of audit firms' payoffs with respect to q, and find that:

	q_H	q_L
$\frac{dW}{dq_L}$	$[\frac{(1-z)^2}{2}I - C'(q_H)]\frac{\partial q_H}{\partial q_L}$	$\frac{2z-z^2}{2}I - C'(q_L)$
$\frac{\partial \pi_H}{\partial q_H}$	$C'(q_H)\frac{1-z}{z} - C'(q_H)$	
$\frac{\partial \pi_L}{\partial q_L}$		$C'(q_L)\frac{z}{(1-z)} - C'(q_L)$
	$\frac{1-z}{z} > 1$: overinvest in q_H	$\frac{z}{(1-z)} < 1$: underinvest in q_L

Because $-(1-z)(q_H - q_L)I(\frac{\partial z}{\partial q_L} + \frac{\partial z}{\partial q_H}\frac{\partial q_H}{\partial q_L}) < 0$, increase in z will decrease W.

$\blacksquare$

References

Abbott, L., and Parker S. "Auditor selection and audit committee characteristics." Auditing: A Journal of Practice and Theory, Vol. 19 (2000), issue 2, pp. 47–66.

Bigus, J. "Vague auditing standards and ambiguity aversion." AUDITING: A Journal of Practice & Theory, Vol. 31 (2012), issue 3, pp. 23-45.

Blazenko, G., and Scott, W. "A model of standard setting in auditing." Contemporary Accounting Research, Vol. 3 (1986), pp. 68-92.

Chen, Q., Jiang, X., and Zhang Y. "The effects of audit quality disclosure on audit effort and investment efficiency." The Accounting Review (2018).

Datar, S., Feltham, G., and Hughes J. "The role of audits and audit quality in valuing new issues." Journal of Accounting and Economics, Vol. 14 (1991), issues 1, pp. 3–49.

DeFond, Z., and Zhang, J. "A review of archival auditing research." Journal of Accounting and Economics, Vol. 58 (2014), issues 2–3, pp. 275-326.

Dye, R. "Auditing standards, legal liability, and auditor wealth." Journal of Political Economy, Vol. 101 (1993), issue 5, pp. 887–914.

Ewert, R. "Auditor liability and the precision of auditing standards." Journal of Institutional and Theoretical Economics, Vol. 155 (1999), issue 1, pp. 181–206.

Gao, P., and Zhang, G. "Auditing standards, professional judgement, and audit quality." Working paper (2018).

Gramling, A., and Stone, D. "Audit firm industry expertise: A review and synthesis of the archival literature." Journal of Accounting Literature, Vol. 20 (2001), pp. 1-29.

Laux V, Paul Newman D. Auditor liability and client acceptance decisions. The Accounting Review. Vol. 85 (2010), pp. 261-285.

Leland, H.E. "Quacks, lemons, and licensing: A theory of minimum quality standards." Journal of Political Economy, Vol. 87 (1979), pp. 1328-1346.

Lowensohn, S., Johnson, L., Elder, R., and Davies S. “Auditor specialization, perceived audit quality, and audit fees in the local government audit market.” Journal of Accounting and Public Policy, Vol. 26 (2007), issue 6, pp. 705-732.

Patterson E, and Wright D. “Evidence of fraud, audit risk and audit liability regimes.” Review of Accounting Studies. Vol. 8 (2003), pp. 105-131.

Reichelt, K., and Wang, D. “National and office-specific measures of auditor industry expertise and effects on audit quality.” Journal of Accounting Research, Vol 48 (2010), issue 3, pp. 647-686.

Ronnen, U. “Minimum quality standards, fixed costs, and competition.” The RAND Journal of Economics, Vol. 22 (1991), pp. 490-504.

Ronnen, U. “The effects of mandated versus voluntary auditing policy on the quality of auditing.” Journal of Accounting, Auditing, and Finance, Vol. 11 (1996), issue 3, pp. 393-419.

Shapiro, C. “Premium for high quality products as returns to reputations.” Quarterly Journal of Economics, Vol. 98 (1983), pp. 659-679.

Simunic, D., Ye, M., and Zhang P. “The joint effects of multiple legal system characteristics on auditing standards and auditor behavior.” ContemporaryAccounting Research, Vol. 34 (2017), issue 1, pp. 7–38.

Slovin, M., Sushka, M., and Hudson, C. “External monitoring and its effect on seasoned common stock issues.” Journal of Accounting and Economics, Vol. 12 (1990), issues 4, pp. 397-417.

Smith, J. R., and Tidrick, D. E. “The Effect of Alternative Judicial Systems and Settlement on Auditing.” Review of Accounting Studies, Vol. 2 (1998), issue 4, pp. 353-381.

Titman, S., and Trueman, B. “Information quality and the valuation of new issues.” Journal of Accounting and Economics, Vol. 8 (1986), pp. 159-172.

Ye, M., and Simunic, D. “The economics of setting auditing standards.” Contemporary Accounting Research, Vol. 30 (2013), issue 3, pp. 1191–1215.