Does Audit Transparency Improve Audit Quality and Investment E¢ ciency?

Qi Chen Xu Jiang Yun Zhang

This draft: December 2014

Abstract

We examine e¤ects of disclosing precisions of audit opinions (i.e., enhancing audit transparency) on auditor quality and investment e¢ ciency in a setting where the usefulness of an audited …nancial report is jointly determined by the quality of the underlying …nancial reporting (i.e., a mapping from a …rm's fundamentals into an unobservable true accounting signal), misreporting of the true signal by the …rm's manager, and audit quality (i.e., the precision with which audit evidence collected by the auditor correctly captures the underlying true accounting signal and hence uncovers managerial misreporting). In our model, the auditor exerts an unobservable e¤ort to in‡uence audit quality and is motivated by liability in the event of an audit failure. We show that while higher transparency enhances the information decision usefulness of audited …nancial reports for investors, it can also adversely a¤ect the auditor's incentives and consequently lower the expected audit quality and investment e¢ ciency. We show that the underlying quality of …nancial reporting is an important determinant for this

*Preliminary and comments welcome. We bene…t from discussions with Morris Mitler, Brian Mittendorf, Doug Prawitt, Katherine Schipper, and Dae-Hee Yoon. We thank participants at the 2014 Chicago Accounting Theory Conference for their helpful comments. Chen (qc2@duke.edu) and Xu (xu.jiang@duke.edu) are from the Fuqua School of Business at Duke University. Zhang (yunzhang@gwu.edu) is from George Washington University School of Business.

tradeoff, and the case for audit transparency is weaker when the underlying financial reporting quality is high. Our findings also imply that the underlying financial reporting quality and auditing regulations are two interconnected elements. That is, whether increasing the underlying financial reporting quality has a favorable effect on audit effort and investment efficiency depends on the auditor's disclosure requirement, and whether expanding the scope of auditors' communication is desirable depends on the underlying reporting quality.

1 Introduction

This paper analytically evaluates and compares alternative regulatory regimes that impose different disclosure requirements upon auditors. Specifically, we study a setting where in-the audit quality only in expectation (i.e., increases the probability of a high realized audit quality) and assume that the realized audit quality, unless publicly disclosed, is not directly observable to the investors. The auditor's effort is motivated by the liability she faces and the investors receive as damage compensation in the event of an audit failure, which occurs when the auditor does not catch managerial misreporting and the investors' investment in the firm fails. We study and compare two regulatory regimes that differ only in how much the auditor's incentives to exert effort. On the other hand, when the underlying reporting quality is high, the investors rely on the audit opinion primarily for its informativeness value, and therefore are less likely to invest when the realized audit quality is low. Since investment is a necessary condition for audit failure, this implies that from the auditor's perspective, lower audit quality can reduce her expected liability, muting the auditor's incentives to exert effort. In contrast, the investors cannot fine-tune their decisions based on the realized audit quality under the No Disclosure Regime, which results in higher equilibrium auditor's effort than the Disclosure Regime if and only if the underlying reporting quality is high.

Our second main result is with respect to investment efficiency, which we define as the (inverse) of the expected loss from type I (a good project gets passed) and type II (a bad project gets taken) errors. We show that enhancing audit transparency (i.e., disclosing realized audit quality) has three effects. First, it enables the investors to fine-tune their use of audit opinion to better match with the firm's fundamentals, thus improving investment efficiency. Second, it further enables the investors to bias their investment decisions to seek more insurance from the auditor in case of an audit failure, hence diminishing investment efficiency. Finally, as discussed earlier, disclosing realized audit quality may either increase or decrease audit effort and consequently investment efficiency, depending on the underlying financial reporting quality. Therefore, the net effect of audit transparency on investment efficiency is a complex tradeoff between these forces. Numerical examples suggest that on the net, investment efficiency is lower under the Disclosure Regime than under the No Disclosure Regime when the underlying reporting quality is high.

Our third result deals with the effect of underlying financial reporting quality on audit effort and investment efficiency. We show that under the No Disclosure Regime while enhancing the underlying reporting quality leads to increased audit effort, it could reduce the equilibrium investment efficiency. This is because making the underlying true accounting signal more accurate not only enables the investors to better assess the firm's fundamentals but also enables them to better assess if the auditor has failed to catch the manager's misreporting by comparing their private signal with the audit opinion. When the latter effect dominates, the investors will over-weigh the audit opinion and under-weigh their private signal in order to exploit the insurance provided by the auditor in the form of the auditor's liability, generating the aforementioned efficiency loss. We then demonstrate that under the Disclosure Regime, enhancing the underlying reporting quality has an additional effect on their accuracy/reliability.[3] While the content of the additional disclosure requirement at debate depends on the speci…c initiatives/proposals, the general idea is that more information should assist investors to evaluate the usefulness of audit opinions. Proponents argue that more information not only assists investors' investment decisions, it can also provide stronger incentives for auditors to exert more e¤ort in order to improve audit quality. Opponents, however, argue that the additional information may induce undue reliance by investors in making investment decisions, while at the same time it may increase audit costs and auditor's liability. This paper contributes to this policy debate by providing a theoretical framework to evaluate e¤ects of increasing audit transparency and belongs to the broad literature on understanding how audit rules and regulations a¤ect market participants' behaviors (e.g., Dye (1993), Narayanan (1994), Hillegeist (1999)), and more speci…cally, the literature on evaluating their e¤ects on audit quality and investment e¢ ciency (e.g., Schwartz (1997), Pae and Yoo (2001), Deng, Melumad, and Shibano (2011)).[4] While most prior studies focus on e¤ects of audit liability rules, we contribute to the literature by examining the e¤ect of audit disclosure rules (i.e., audit transparency).[5] Our analysis on endogenous liability demonstrates that these two types of regulations have di¤erent impacts on audit quality and investment e¢ ciency and their e¤ects may not entirely o¤set each other.

Furthermore,,"9(,)-3e,6B11(e)9(,6B11(e)96ab)-3ot(n)39(t)(e)-232(s)8(a)74ort in2712(d)-315(t)8(h(t)(

cial reporting quality demonstrates the subtle e¤ect of …nancial accounting regulartions (e.g., IAS and US GAAP that determine the underlying reporting quality) when investors and au-

report $\hat{R}_G$ to a unfavorable one $\hat{R}_B$.[8] While the assumption is a simplification, it is needed to allow a role for the auditor. If it is public knowledge that managers always truthfully reveal R, auditors are not needed in the first place.

After observing the manager's report $\hat{R}$, the auditor spends resources and exerts effort, denoted by $e \in [0;1]$, to collect audit evidence $\ \in \{\ _g;\ _b\}$ to verify the accounting signal. The auditing technology is imperfect and correctly reveals the underlying accounting signal only with probability $\ $:

$$p(\ _g|R_G) = p(\ _b|R_B) = \ :$$

reflects the notion of audit quality: the higher $\ $ is, the more likely audit evidence reveals the underlying accounting signal, the more likely the auditor can detect manager's misreporting. Without loss of generality, we assume that there are two levels of audit quality $\ \in \{\ _h;\ _l\}$ with $1 \ \ _h > \ _l \ $ – and that higher auditor's effort can stochastically improve the audit quality in that $\Pr(\ = \ _h) = e$ and $\Pr(\ = \ _l) = 1 \ e$. The auditor privately observes e and $\ $. She also bears the cost of effort, given by $C(e)$, with $C' \ 0$, $C'' > 0$, $C'(0) = 0$ and $C'(1) = 1$.

After observing evidence $\ $, the auditor issues an audit opinion, denoted by $AO \in \{U;Q\}$ where U stands for an unqualified opinion and Q for a qualified opinion. We assume that the auditor can issue a qualified opinion only when her evidence supports it (i.e., $\ = \ _b$). This is consistent with the practice that a qualified opinion usually is accompanied with detailed discussions and hence is likely to be based on evidence collected.[9]

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[8] Our results are qualitatively unchanged if we allow stochastic misreporting by the manager. Stochastic misreporting can be introduced in two ways. First, we can allow the manager to choose $\ \in [0\ ]$ such that $\Pr\ \hat{}_G|\ _b\ = \ $, where $\ \ 1$ is an exogenous upper bound on the manager's misreporting. It is easy to

Investors observe both the manager's report and the auditor's opinion. In addition, investors collectively have access to a noisy signal of their own $S \in \{S_g, S_b\}$ that is informative of the underlying state with

$$p(S_g|G) = p(S_b|B) = p \in \left(\frac{1}{2}, 1\right).$$

p reflects the quality of investors' signal and is itself a random variable, uniformly distributed on $[-, 1]$. p and S are realized and privately observed by investors after the auditor chooses her effort e and issues her opinion. Investors then decide whether to invest in the project based on information available to them.

The auditor gets a non-contingent fee F from the firm at the beginning of their relationship. We assume a competitive audit market such that the audit fee is set to equal the auditor's cost of effort and expected liability in the event of an audit failure.[10] An audit failure occurs when investors choose to invest and the state turns out to be B; and at the same time, the accounting signal correctly captures the state (i.e., $R = R_B$) but the auditor fails to detect managerial misreporting by issuing an unqualified opinion.

We assume that in the event of an audit failure, the auditor's liability is K which accrues to investors as damage compensation. $\in (0, 1)$ is a known parameter that reflects the severity of the auditor's liability. For expositional ease, in our main setup we will treat as exogenous and doesn't allow it to vary with either the auditing regulatory regime (to be discussed below) or the quality of the underlying accounting system q. We will extend our model to endogenize in section 4.

Alternatively, one can model the auditor's liability as a function of whether $_h$ or $_l$ is realized (e.g., holding the auditor liable only when $_l$ is observed *ex post*). However, for this arrangement to be implementable, the court not only needs to be able to verify the level

(2008) assume an exogenous cost from qualified opinions. The nature of audit evidence in their model differs from ours. In their model, the auditor either knows for sure whether manager lied, or is left uncertain. In the latter case, auditor needs to decide whether to issue qualified or unqualified opinion. In i0 issue qualified to deci39(cas)-1(e,5 of realized (say, = 3 has realized) but also has to know the exact space of all possible 's (i.e., whether the observed 3 is $_h$ or $_l$). Therefore, making the auditor's liability depend only on investors' investment amount K as our model formulates, while a stylized assumption, does capture those realistic situations in which the court faces frictions and is informationally constrained. With that being said, our results are not qualitatively a¤ected if the liability can be based on a *noisy* signal of whether $_h$ or $_l$ is realized.

We study two auditing regulatory regimes, a No Disclosure regime (***NDn***

Date 3. The auditor determines her e¤ort ***e*** and issues her opinion based on collected evidence.

– In the No Disclosure regime, is disclosed only if a quali…ed opinion is issued.

– In the Disclosure regime, is disclosed for both quali…ed and unquali…ed opinions.

Date 4. Investors observe their private information (***p*** and ***S***) and make investment decisions.

Date 5. The state of nature is revealed. Project payo¤ is realized and distributed. Auditor's liability is assessed.

Figure 1 illustrates the information structure modeled in the paper. Figure 1A shows the auditor's audit evidence , while Figure 1B corresponds to investors' signal ***S***.

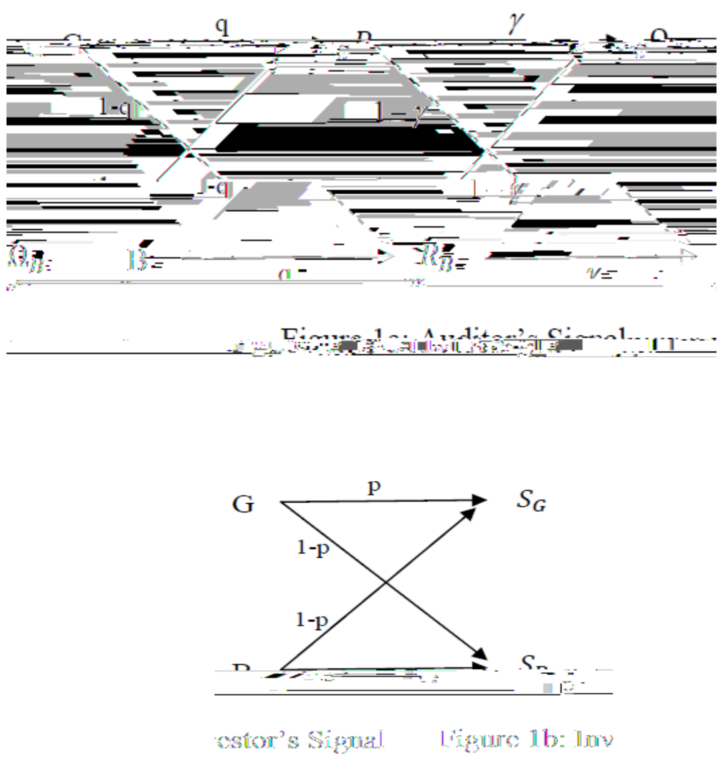

Fig 1 Graphical Illustration of Auditor's and Investor's Signal

We next de…ne the equilibrium concept for our model.

3 Main Results

3.1 Auditor's opinion decision

Lemma 2 Let

$$\tilde{} = \begin{cases} b, & \text{with an unqualified opinion under } \boldsymbol{ND}; \\ , & \text{with a qualified opinion under } \boldsymbol{ND}; \\ , & \text{under } \boldsymbol{N} = \boldsymbol{D}. \end{cases}$$

and define

$$\boldsymbol{p}\,(\ ) = \tilde{}\boldsymbol{q} + (1 \quad \tilde{})\,(1 \quad \boldsymbol{q})\,: \tag{4}$$

When $= 0$, investors' optimal investment decision is given by

When > 0, investors rely on auditor's opinion not only for its informative value effect in predicting the project's terminal cash flow, but also for its insurance value effect (i.e., obtaining damage compensation from the auditor when an audit failure occurs). Since an auditor failure can possibly happen only if the auditor issues an unqualified opinion and the project is taken, this insurance effect biases investors' investment decision away from the First Best, when the auditor issues an unqualified opinion. Proposition 1 below summarizes investors' optimal investment rule with > 0.

Proposition 1 Let ~ be as defined in Lemma 2. When > 0, investors' optimal investment decision is given by

Scenario where =	Investment Decision
1. $\hat{R} = \hat{R}_G; AO = Q; S = S_b$	Not invest
2. $\hat{R} = \hat{R}_G; AO = U; S = S_g$	Invest
3. $\hat{R} = \hat{R}_G; AO = Q; S = S_g$	Invest iff p p (~)
4. $\hat{R} = \hat{R}_G; AO = U; S = S_b$	Invest iff p $\bar{p}$(~)

where

$$\bar{p}(\sim) \quad p\ (\sim)\ (\sim;\ ;q) \tag{5}$$

$$\text{with} \quad (\sim;\ ;q) \quad \frac{1}{1 \quad q\,(1 \quad \sim)} > 1. \tag{6}$$

As expected, here investors deviate from the First Best investment rule by over-weighing the auditor's unqualified opinion and under-weighing a conflicting signal S. Specifically, the investment threshold $\bar{p}(\sim) = p\ (\sim)\ (\sim;\ ;q)$

threshold $\bar{p}(\sim)$ is evaluated at. In the Disclosure regime, $\bar{p}(\sim)$ depends on the actual observed; whereas in the No Disclosure regime, $\bar{p}(\sim)$ is evaluated at investors' conjectured audit quality ^ as de…ned in (3) if and only if the auditor issues an unquali…ed opinion.

p (^).

Given Pr ($=$ $_h$) $= e$, the auditor's total expected cost for a given effort level e is

$$[e\,\text{Pr}\,(\text{audit failure j } {}_h; \hat{}\,) + (1 \quad e)\,\text{Pr}\,(\text{audit failure j } {}_l; \hat{}\,)] \quad K + C\,(e): \qquad (10)$$

The first term reflects the expected liability and the second term the cost of effort. The auditor's equilibrium effort choice is solved by choosing e to minimize (10) and is summarized in Proposition 2 below.

Proposition 2 Under the No Disclosure regime,

(a) given investors' conjecture $\hat{e}$, the auditor's optimal effort choice is determined by

$$K[I(q; \;{}_l; \;) \quad I(q; \;{}_h; \;)]\bar{p}\;(\hat{}\,) = C^0(e): \qquad (11)$$

Imposing the rational expectation equilibrium condition, the auditor's equilibrium effort e_{ND} is characterized by

$$K[I(q; \;{}_l; \;) \quad I(q; \;{}_h; \;)]\bar{p}\;(e_{ND} \;{}_h + (1 \quad e_{ND}) \;{}_l) = C^0(e_{ND}) \qquad (12)$$

and strictly lies between 0 and 1;

(b) there exists at least one stable equilibrium under the No Disclosure regime;

(c) $\frac{de_{ND}}{dq} > 0$ for any stable equilibrium;

(d) there exists a $\;> 0$ such that 8 $_h <$, the investment efficiency strictly decreases with q.

(11) shows the marginal benefit and cost of the auditor's effort. Holding investors' conjecture constant at $\hat{e}$, a higher effort improves the accuracy of audit evidence in the bad state and reduces the auditor's vulnerability, as reflected by $[I(q; \;{}_l; \;) \quad I(q; \;{}_h; \;)]$ on the the left-hand side (LHS) of (11). A higher effort is also costlier to the auditor as shown in the right-hand side (RHS) of (11). The equilibrium condition is given by replacing investors'

conjecture $\hat{e}$ in (11) with the auditor's actual effort. This ensures that investors' conjecture is rational in equilibrium.

The equilibrium uniqueness is not guaranteed as both sides of (12) can be increasing in the auditor's effort. Multiple equilibria can occur because investors' conjecture $\hat{e}$ can be self-fulfilling. Under certain parameter values, the higher the effort investors conjecture, the more likely they rely on the auditor's opinion (i.e., $p(\hat{\ })$ increases in $\hat{\ }$). This in turn increases the auditor's expected liability and can provide more incentives for effort. With multiple equilibria comes the issue of equilibrium selection. We note that any equilibrium with $\frac{\partial LHS \text{ of}}{\partial e}|_{e \ e_{ND}} > C''(e_{ND})$ is unstable in that a small deviation in investors' conjecture $\hat{e}$ will not converge back to that equilibrium (Stokey, Lucas, and Prescott (1989)). Proposition 2(b) shows that under the assumption of $C'(1) = +1$, there must exist at least a stable equilibrium where $\frac{\partial LHS \text{ of}}{\partial e}|_{e \ e_{ND}} < C''(e_{ND})$.

Proposition 2(c) can be proved by noticing that a larger q unambiguously increases the marginal benefit of the auditor's effort: both terms on the LHS of (11), $I(q; \ _{l}; \ ) \quad I(q; \ _{h}; \ )$ and $\bar{p}(\hat{\ })$, are strictly increasing in q, while the RHS is unaffected. The intuition comes from the fact that the auditor's incentives to exert effort is motivated by the threat of audit failure. The odds of an audit failure can be reduced either when the auditor exerts more effort to reduce her vulnerability, and/or when investors rely less on the auditor's opinion (i.e., less investors' facilitation). Both forces can be affected by q. First, $I(q; \ _{l}; \ ) \quad I(q; \ _{h}; \ )$ increases with q. The intuition is the familiar informativeness principle in agency theory (Holmstrom (1979)) in that a higher q reduces the noise in vulnerability as a performance measure for more on the auditor's opinion than their own signal: $\bar{p}$ (^) increases with q. More reliance means that when the auditor fails to catch managerial misreporting, her mistake is more likely to lead to a full-blown auditor failure, thus providing more incentives for the auditor exert effort.

As shown in Proposition 2(d), although a larger q induces a higher auditor effort, increasing q can potentially reduce investment efficiency. Intuitively, increasing q strengthens the insurance effect of the auditor's opinion by making investors increasingly confident that the auditor has committed an audit failure when the auditor issues an unqualified opinion and the opinion contradicts investors' signal S. To see this, in the extreme case of $q = 1/2$, the auditor's signal becomes independent of S and thus is not useful in predicting whether the auditor has made a mistake or not. The larger q is, the more correlated S and are, and the more certain investors are that the auditor has committed an audit failure when their signal conflicts with the auditor's opinion. An increased likelihood of an audit failure enhances the insurance effect and induces investors to ignore their own signal more often with a larger $\bar{p}$. Proposition 2(d) shows that this unintended consequence of increasing q becomes dominant when h

Similar to (12) in Proposition 2, the left-hand side of (13) expresses the marginal benefit of the auditor's effort. However, there are two differences here. First, (12) admits multiple self-fulling equilibria whereas (13) pins down an unique equilibrium. Multiple equilibria do not arise in the Disclosure regime because investors directly observe and no longer need to base the investment decision on their conjecture.

Second, (12) guarantees an interior solution, while a corner solution of $e_D = 0$ is possible under (13). This is because unlike in the No Disclosure regime, the marginal benefit of effort are not necessarily always positive. To see this, let's denote the auditor's probability assessment of an audit failure on under the Disclosure regime conditional as Pr (audit failure|). It is easy to obtain

$$\frac{\partial \Pr(\text{audit failure}| \ )}{\partial \ } = \frac{\partial I(q; \ ; \ )}{\partial \ } p$$

Proposition 4 shows that more audit transparency increases the auditor's e¤ort (i.e., higher audit quality in expectation) only when the underlying accounting quality is relatively poor; and the Proposition is crucially linked to the sign of $@\bar{p}$

auditor's incentives to exert effort are heightened.

It is worth noting that when investors rely on the auditor's opinion for its insurance value, they do so at the expense of investment efficiency (i.e., sometime they purposely disregard their own informative signal and follow the auditor's opinion precisely when the auditor's opinion is of low precision). The silver lining of the insurance effect, however, is to provide extra incentive to motivate auditor effort, although this effect is only present in the disclosure regime.

Since e

To see the intuition behind Proposition 5(a), consider the extreme case where $q = 1/2$ and is close to zero. Here the auditor's opinion is irrelevant for assessing the project's underlying state of the world (i.e., the auditor's opinion has no information value); and investors do not care much of the opinion's insurance value. As such, $\bar{p}(\ _h) \quad \bar{p}(\ _l) \quad 1/2$. This in turn implies that auditor's e¤ort does not very much a¤ect the probability that his vulnerability is acted upon by investors. When q increases, investors' reliance on the auditor's opinion is more sensitive to ($\frac{\partial^2 p}{\partial \ \partial q} > 0$). However, since this reliance is purely for the information value of the auditor's opinion, it has the perverse e¤ect on the auditor's e¤ort. In contrast, under the No Disclosure regime, the link between the auditor's actual

cl11(e(e01)18(d)12(1)11(a)11(h)114(32)(3258)-33(495)(11)(89(e)96(6)(5)955(28)(1)1.701(9)-57)-(406(e)3018(9)(h(32(i))(

the Disclosure regime's favor. That is, *Ceteris Paribus*, the flexibility to adjust the investment decision as a function of should improve the *ex ante* investment efficiency under the Disclosure regime relative to the No Disclosure regime.

Second, there is an insurance effect. Because investors receive damages when an audit failure occurs, their investment decision deviates from the First Best. This effect is manifested by $(\tilde{}; \; ; q)$ in (5). While this insurance effect is present under both regimes, it is easy to verify that $(\tilde{}; \; ; q)$ is a convex function in ~, implying that the deviation from the First Best is weaker under the No Disclosure regime than under the Disclosure regime. Intuitively, not knowing under the No Disclosure regime hampers investors' ability to take full advantage of the insurance, thus alleviating the inefficient use of information by investors and resulting in more efficient investment. Thus, this insurance effect works in favor of the No Disclosure regime.

Finally, we have an effort effect. Specifically, Proposition 4 shows that the equilibrium effort can be either higher or lower under the Disclosure regime than under the No Disclosure regime depending on the magnitude of q. The efficiency comparison of the two regimes hence is determined by a fairly complex tradeoff among these three forces, which unfortunately does not easily lend itself to a complete analytical solution. To fix idea, Claim 1 below sheds light on a partial tradeoff between the Blackwell and insurance effect.

Claim 1 Holding the auditor's effort constant at the same level for the two regimes, $IE_D > IE_{ND}$ if and only if $q > q$ where q is defined in Proposition 4.

Claim 1 shows that, in a hypothetical situation void of a differential effort effect between the two regimes, Blackwell effect dominates insurance effect if and only if $q > q$. The intuition is that when the underlying accounting quality is low (i.e., q is small), the auditor's opinion cannot provide much information for the project's terminal case flow and thus investors simply use the opinion for insurance purposes. When $q = q$, these two effects exactly cancel each other out, making $IE_D = IE_{ND}$.

When the effort effect is present, the picture becomes more complicated. As Proposition 4 shows, the auditor's effort is higher under the No Disclose regime if and only if $q > q$, thus countervailing the directional prediction outlined in Claim 1. Next, we present three sets of numerical examples to illustrate the tradeo¤ between these forces. In all examples, the auditor's e¤ort function is represented by $C(e) = -ce$ and $\frac{K}{c} = 1$. These examples di¤er in the level of liability. In each example, we plot the equilibrium e¤ort level and investment e¢ ciency as a function of q. For investment e¢ ciency, we plot both the e¤ect around q as well as globally.

In Figure 2, is relatively large ($= 0{:}8$). Figure 2a shows that the auditor's e¤ort under the Disclosure regime is higher if and only if $q < q = 0{:}69$. Figure 2b shows that around q the e¢ ciency comparison follows Claim 1's prediction. That is, when q is slightly below q, the investment e¢ ciency is higher in the No Disclosure Regime and the opposite holds when q is slightly above q. However, as shown in Figure 2c, when q is much larger than q, the e¤ort di¤erence between the two

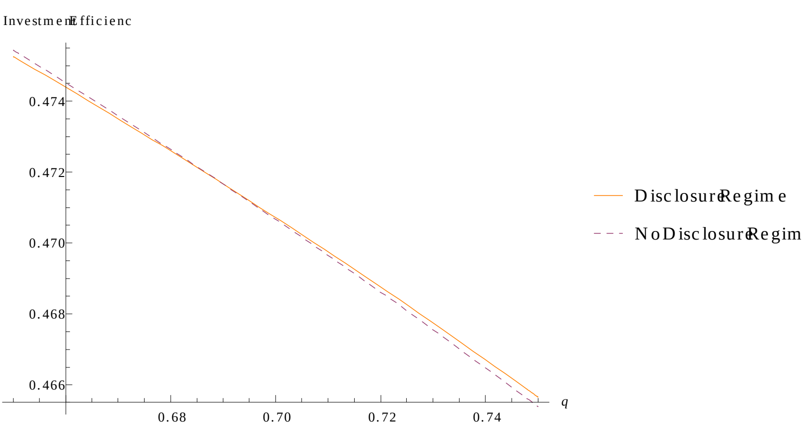

Fig 2b: IE around q with = 0:8.

Fig 2c: IE with = 0:8.

Figure 3 and 4 illustrate cases where is moderately big (= 0:5) and is relatively small (= 0:1), respectively. They are qualitatively similar to Figure 2: the e¢ ciency comparison is consistent with Claim 1 around q ; but the No Disclosure regime becomes dominant in terms of investment e¢ ciency when q is su¢ ciently big.

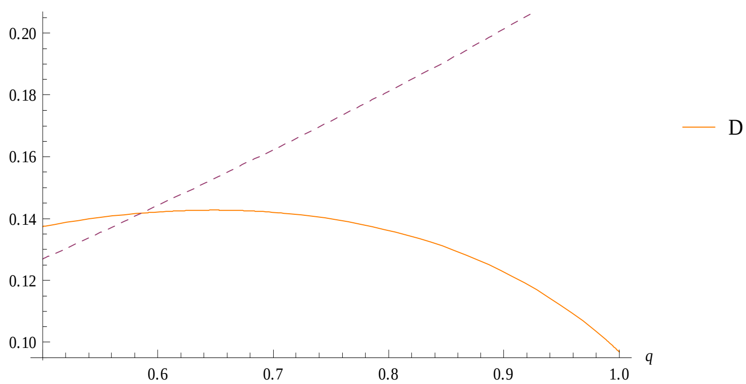

Fig 3a E¤ort level in the two regimes when $_h$ = 0:70, $_l$ = 0:50 and = 0:5.

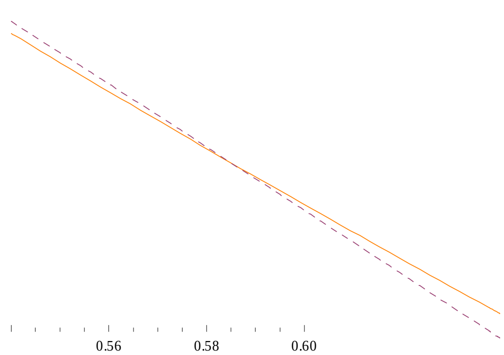

Fig 3b Investment e¢ ciency when q is around q in the two regimes when ${}_h$ = 0:70, ${}_l$ = 0:50 and = 0:5.

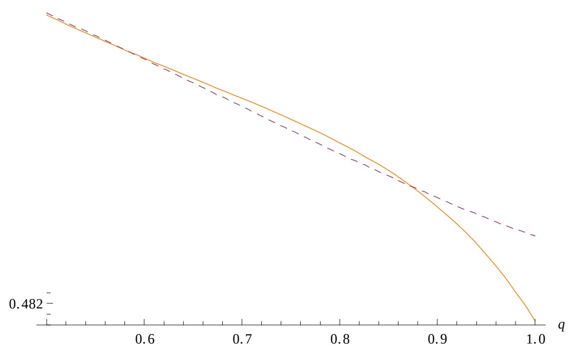

Fig 3c Investment e¢ ciency with respec to q over the whole range in the two regimes when ${}_h$ = 0:70, ${}_l$ = 0:50 and = 0:5.

Fig 4a E¤ort level in the two regimes when ${}_h$ = 0:70, ${}_l$ = 0:50 and = 0:1.

Fig 4b Investment E¢ ciency when q is around q in the two regimes when ${}_h$ = 0:70, ${}_l$ = 0:50 and = 0:1.

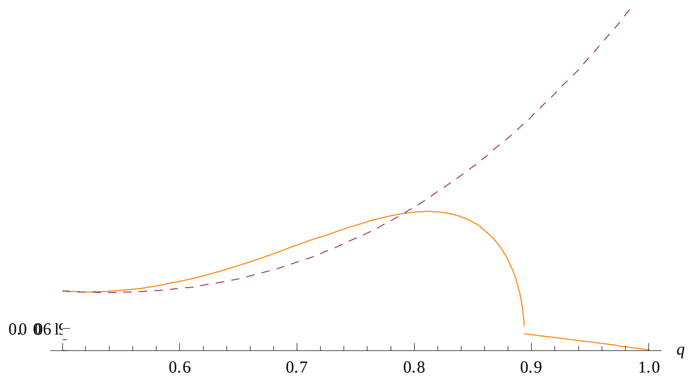

Fig 4c Investment e¢ ciency with respec to q over the whole range in the two regimes when $_h = 0{:}70$, $_l = 0{:}50$ and $= 0{:}1$.

4 Endogenizing Liability Parameter

to the investment amount (K), and that the auditor effort is sufficiently productive (that $e_h - e_l$ is sufficiently big). Under these assumptions, we allow to be chosen to maximize investment efficiency given the disclosure environment. Thus, can be different in the two regimes and can be a function of q. The following proposition characterizes and compares the equilibrium solution under the two regimes.

Proposition 6 Assume the value of auditor's effort is sufficiently high (relative to its cost) and that the informativeness of audited report is sufficiently high (relative to investors' private information).

(a) Under the No Disclosure regime, setting $^{ND} = \frac{c}{e_h \; e_l \; (\;_h \; \frac{1}{2})(\; \frac{1}{2}p_h)qI}$ induces the auditor to exert effort e_h and maximizes the expected investment efficiency. Under ND, investment efficiency strictly increases with q.

(b) Under the Disclosure regime, there exists a q such that, for $\forall q \; q$, $^{D} = 2 \; \overline{p_l}$ induces the auditor to exerts effort e_h and maximizes investment efficiency. Under ^{D}, investment efficiency increases in q. For $\forall q > q$, $= 0$ maximizes investment efficiency but can only induces e_l. Under $= 0$, investment efficiency increases in q. There is a discontinuous drop in investment efficiency at q.

(c) Investment efficiency is strictly higher under the No Disclosure regime than that under the Disclosure regime if and only if $q \in (q; 1]$.

Proposition 6 shows that our results are robust to endogenizing the liability parameter . This may come at a surprise as one suspects that any reduced incentives for the auditor to exert effort can be made up for by ramping up liability. However, as Proposition 6 shows that increasing and thus restoring the auditor's effort incentive are optimal if and only if q is relatively small. The intuition is as follows. Though increasing could increase effort provision, it comes with a cost in the form of increased insurance effect that leads to more inefficient use of information by investors. Such cost becomes high when q is big; and in this case the optimal solution is to forego motivating high effort by the auditor. This result

References

[1] Deng, M., Melumad, N., & Shibano, T. (2012). Auditors' Liability, Investments, and Capital Markets: A Potential Unintended Consequence of the Sarbanes-Oxley Act.

[11] Patterson, E. R., & Smith, R. (2003). Materiality uncertainty and earnings misstatement. The Accounting Review, 78(3), 819-846.

[12] Schwartz, R. (1997). Legal regimes, audit quality and investment. Accounting Review, 385-406.

6 Appendix

Proof of Proposition 1 When S is consistent with the auditor's opinion (scenarios 1 and 2), it is obvious that investors optimally invest when $S = S_G$ and the auditor unqualifies; and that they do not invest when $S = S_B$ and the auditor qualifies, the proof of which is hence omitted. When $S = S_G$ and the auditor qualifies (scenario 3), investors' expected payoff from taking the project net of the initial investment is

$$\Pr\ \ G \mid \hat{R} = \hat{R}_G; AO = Q; S = S_g;\ \ \ RK\ \ \ K =$$

$$\frac{p[q(1\ \ \ ) + (1\ \ q)\ \ ]}{p[q(1\ \ \ ) + (1\ \ q)\ \ ] + (1\ \ \ )(1\ \ p)[(1\ \ q)(1\ \ \ ) + q\ \ ]}\frac{K}{\ }\ \ K\ \ \ 0;$$

if and only if $p\ \ \ q\ \ + (1\ \ q)(1\ \ \ )$.

Finally, when $S = S_B$ and the auditor unqualifies (scenario 4), investors' expected

(a) Given (7), the auditor's expected loss when choosing an e¤ort level e is

$$e \Pr(\text{audit failure} \mid {}_h) \quad K + (1 \quad e) \Pr(\text{audit failure} \mid {}_l) \quad K + C(e): \tag{15}$$

Taking a …rst-order derivative on (15) with respect to e and sets it to zero, we obtain

$$K[I(q; {}_l; \;) \quad I(q; {}_h; \;)]p(\hat{}) = C^{0}(e); \tag{16}$$

where $I(q; \; ; \;) \quad (1 \quad)(1$ (l w

As the ...rst term is clearly positive and

$$\frac{@\overline{p}(e \ _h + (1 \quad e) \ _l)}{@q} = \frac{2[e \ _h + (1 \quad e) \ _l] \quad 1 + \quad f1 \quad [e \ _h + (1 \quad e) \ _l]g}{f1 \quad q f1 \quad [e \ _h + (1 \quad e) \ _l]gg} > 0;$$

we have $\frac{@ \ LHS \text{ of }}{@q} > 0$. Finally, recall that, by de...nition, in a stable equilibrium $\frac{@ \ LHS \text{ of }}{@e} j_{e \ e} < C^{00}(e \ )$. Thus $\frac{@e}{@q} > 0$.

(d) Note that

$$IE \qquad \Pr(\text{Project Rejected } j \ G)(RI \quad I) \quad (1 \quad)\Pr(\text{Project Undertaken } j \ B) I$$

$$= \quad [1 \quad \Pr(\text{Project Undertaken } j \ G)] \ \frac{I}{} \quad I \quad (1 \quad)\Pr(\text{Project Undertaken } j \ B) I$$

$$= \quad (1 \quad) I [\Pr(\text{Project Undertaken } j \ G) \quad \Pr(\text{Project Undertaken } j \ B) \quad 1],$$

where the second equality obtains because $R = -$ and Pr (Project Rejected j G) = 1 Pr (Project Undertaken j G). De...ne

$$\Pr(\text{Project Undertaken } j \ G) \quad \Pr(\text{Project Undertaken } j \ B):$$

Clearly, our comparative static analysis on IE with respect to q can be equivalently performed on . With a slight abuse of notation, in what follows let's use $\overline{p}$ as a shorthand for $\overline{p}(e \ _h + (1 \quad e) \ _l)$ to save space and use subscript ND to denote the No Disclosure regime.

$$_{ND} = e_{ND}[q \ _h + (1 \quad q)(1 \quad _h)] \int_{=}^{} 2p dp + \int_{=}^{\overline{p}} 2(1 \quad p) dp$$

$$+ (1 \quad e_{ND})[q \ _l + (1 \quad q)(1 \quad _l)] \int_{=}^{} 2p dp + \int_{=}^{\overline{p}} 2(1 \quad p) dp$$

$$+ e_{ND}[(1 \quad q) \ _h + q(1 \quad _h)] \int_{t_h} 2p dp + (1 \quad e_{ND})[(1 \quad q) \ _l + q(1 \quad _l)] \int_{t_l} 2p dp$$

$$e_{ND}[q \ _h + (1 \quad q)(1 \quad _h)] \int_{t_h} 2(1 \quad p) dp \quad (1 \quad e_{ND})[q \ _l + (1 \quad q)(1 \quad _l)] \int_{t_l} 2(1 \quad p) dp$$

$$e_{ND}[(1 \quad q) \ _h + q(1 \quad _h)] \int_{=}^{} 2(1 \quad p) dp + \int_{=}^{\overline{p}} 2p dp$$

$$(1 \quad e_{ND})[(1 \quad q) \ _l + q(1 \quad _l)] \int_{=}^{} 2(1 \quad p) dp + \int_{=}^{\overline{p}} 2p dp \ ;$$

where $t_h \quad (2q \quad 1) \ _h + 1 \quad q$ and $t_l \quad (2q \quad 1) \ _l + 1 \quad q:$

Note that

$$\frac{d\ \ _{ND}}{dq} = \frac{\partial\ \ _{ND}}{\partial q} + \frac{\partial\ \ _{ND}}{\partial e_{ND}} \frac{de_{ND}}{dq}.$$

The first term $\frac{\partial\ \ _{ND}}{\partial q}$ is

$$\frac{\partial\ \ _{ND}}{\partial q} = e_{ND} f(4\ \ _h\ \ \ 2)\bar{p} + [(4q$$

and $\boldsymbol{C}^{0}(1) = +1$ and the ***LFS***

Next consider the case q 2 $(q\ ;1]$ which implies implies $\overline{p}^{0}(\ ) > 0$. As Proposition 2 has established e_{ND} 2 $(0;1)$, we have

$$_{h} > e_{ND\ h} + (1 \quad e_{ND})\ _{l} > \ _{l} =)$$

$$\overline{p}(\ _{h}) > \overline{p}(e_{ND\ h} + (1 \quad e_{ND})\ _{l}) > \overline{p}(\ _{l}).$$

Thus,

$$l(q;\ _{l};\ )\overline{p}(e_{ND\ h} + (1 \quad e_{ND})\ _{l}) \quad l(q;\ _{h};\ )\overline{p}(e_{ND\ h} + (1 \quad e_{ND})\ _{l}) >$$

$$l(q;\ _{l};\ )\overline{p}(\ _{l}) \quad l(q;\ _{h};\ )\overline{p}(\ _{h}) \ =)$$

$$LHS \text{ of } (12) > l(q;\ _{l};\ )p(\ _{h}) \quad l(q;\ _{h};\ )p(\ _{l})$$

Note LHS of (12) > 0. Thus,

$$LHS \text{ of } (12) > \max \quad K[l(q;\ _{l};\ )p(\ _{h}) \quad l(q;\ _{h};\ )p(\ _{l})\ ];0 \ = LHS \text{ of } (13) =)$$

$$e_{ND} > e_{D}:$$

Finally, when $q = q$, $\overline{p}^{0}(\ ) > 0$. Hence,

$$\overline{p}(\ _{h}) = \overline{p}(e_{ND\ h} + (1 \quad e_{ND})\ _{l}) = \overline{p}(\ _{l}) =)$$

$$l(q;\ _{l};\ )\overline{p}(e_{ND\ h} + (1 \quad e_{ND})\ _{l}) \quad l(q;\ _{h};\ )\overline{p}(e_{ND\ h} + (1 \quad e_{ND})\ _{l}) =$$

$$l(q;\ _{l};\ )\overline{p}(\ _{l}) \quad l(q;\ _{h};\ )\overline{p}(\ _{h}) \ =)$$

$$e_{ND} = e_{D}:$$

Q.E.D.

Proof of Proposition 5

(a) We …rst show that when q is su¢ ciently small $e_{D} > 0$. Clearly, the equilibrium e¤ort level is strictly positive, i¤,

$$(1 \quad _{l})\overline{p}(\ _{l}) \quad (1 \quad _{h})\overline{p}(\ _{h}) > 0:$$

Thus, a su¢ cient condition for $e_{D} > 0$ is for $(1 \quad)\overline{p}(\ )$ to be decreasing in .

$$\frac{@[(1 \quad)\overline{p}(\ )\ ]}{@} = \frac{[(2q \quad 1) \quad + 1 \quad q]}{[1 \quad q(1 \quad)]}v(\ ;q);$$

where $v(;q;) = 3(1) + 5 + (1) 6 q (1)(3 2)q$. Since $\frac{q}{q} \frac{q}{3} > 0$, the sign of $\frac{@[p 2]}{@}$ is determined by $v(;q;)$. Note that

$$\frac{@v(;q;)}{@} = q(1) q (1)(3 2) 0:$$

To see the last inequality, note

$$\frac{@ q(1) q (1)(3 2)}{@q}$$
$$= (1) 2q(1)(3 2)$$
$$= (1)[1 2q(3 2)] (1)[1 (3 2)]$$
$$= (1)[2] < 0:$$

Thus,

$$q(1) q (1)(3 2)$$
$$\frac{1}{2}(1) \frac{1}{4}(1)(3 2)$$
$$= \frac{1}{4}(1) 0:$$

Since $\frac{@v ;q;}{@} 0$, we have $v(;q;) 3(1) + (5 6)q$. Note that $3(1) + (5 6)q < 0$ if and only if $q <$ ——. Since —— is increasing in , a su¢ cient condition for $e_D > 0$ is $q < \frac{l}{l}$.

Next, we show that when and h

where

$$h(\;;q;\;) \quad 3(1\quad)\; + 4(1\quad)[4\quad(1\quad)\quad 6\;]q$$
$$[15 + 4\;(1\quad)\qquad(1\quad)\quad 48\; + 36\;]q$$
$$4\;(1\quad)(3\quad 2\;)(2\quad 1)q \qquad (1\quad)\;[3\quad 4(2\quad)\;]q\;:$$

When $= 0$, we have

$$h(\;;q;0) = \quad 3(1\quad)\; + 8(1\quad)(2\quad 3\;)q + 3(2\quad 1)(5\quad 6\;)q\;:$$

$h(\;;q;0)$ is clearly increasing in q when $\;-$; and $h\;\;;-;0\; = -\;\;2\; > 0$ when $< -$. Thus, by continuity, when and is su¢ ciently small, $q\,[(1\quad{}_l)\overline{p}(\;_l)\quad(1\quad{}_h)\overline{p}(\;_h)\;]$ decreases with respect to q. Lastly, in order for $\frac{de_D}{dq} < 0$, we not only need and su¢ - ciently small but also q su¢ ciently small to make sure $e_D > 0$ (i.e., $q\,[(1\quad{}_l)\overline{p}(\;_l)\quad(1\quad{}_h)\overline{p}(\;_h)\;] >$ 0) as shown at the beginning of the proof.

(b) Recall that in the proof to Proposition 2(d) we have de…ned

$$\Pr(\text{Project Undertaken} \mid G) \quad \Pr(\text{Project Undertaken} \mid B)\,;$$
$$t_h \quad (2q\quad 1)\;_h + 1\quad q \text{ and } t_l\quad (2q\quad 1)\;_l + 1\quad q;$$

and shown the comparative static analysis on IE with respect to q can be equivalently performed on . Particularly, under the Disclosure regime (denoted by a subscript D),

$$_D = e_D\,[q\;_h + (1\quad q)\,(1\quad{}_h)]\left[\int_{=} 2pdp + \int_{=}^{p}{}^{p_h} 2\,(1\quad p)\,dp\right]$$
$$+ (1\quad e_D)\,[q\;_l + (1\quad q)\,(1\quad{}_l)]\left[\int_{=} 2pdp + \int^{p}{}^{p_l}\right.$$

Obviously,

$$\frac{d \quad _D}{dq} = \frac{@ \quad _D}{@q} + \frac{@ \quad _D}{@e_D}\frac{de_D}{dq};$$

let's go through the three expressions in $\frac{d \quad _D}{dq}$ one by one. Part (a) of the proposition has already established that $\frac{de_D}{dq} < 0$ when , q and $_h$ are su¢ ciently small. Next, note that when = 0,

$$\frac{@ \quad _D}{@e_D} = 2\left(t_h \quad t_l\right)\left(t_h + t_l \quad 1\right) > 0;$$

which impli

Sketch Proof of Proposition 6 To ease exposition, here we only provide a sketch proof for the proposition. A complete proof is available from the authors upon request.

(a) Suppose e_h needs to be motivated. Setting $= \frac{C}{e_h \quad e_l \; (\quad _h \; \frac{1}{2})(\quad \frac{1}{2} p_h) q l}$. $) e_l \, (\quad ^1$

$$p \quad e_h \quad _h + \frac{1}{2}(1 \quad e_h) \quad = \frac{(2q \quad 1) \quad e_h \quad _h + -(1 \quad e_h) \quad + 1 \quad q}{1 \qquad 1 \quad e_h \quad _h \quad -(1 \quad e_h)}$$

$$> \quad (2q \quad 1) \quad e_h \quad _h + \frac{1}{2}(1 \quad e_h) \quad + 1 \quad q$$

$$> \quad p_l \text{ (as } q > \hat{q} \text{ and } e_h \text{ sufficiently big).}$$

Also, when G is su¢ ciently small, is su¢ ciently small and thus $p\,(e_h \quad _h + (1 \quad e_h) \quad _l) <$ p_h. Since $p\,(e_h \quad _h + (1 \quad e_h) \quad _l) \; 2 \; (p_l; p_h)$, the auditor's expected loss from choosing e_h and e_l is $l\,(1 \qquad) \, q \quad e_h\,(1 \qquad _h) + (1 \quad e_h) - \quad 1 \quad - p_h \; + C$ and $l\,(1 \qquad) \, q \quad e_l\,(1 \qquad _h) + (1 \quad e_l) -$ respectively. Hence, at $= \frac{C}{\qquad}$

$$p_h = \frac{q \qquad {}_h \qquad q}{1}$$