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Aggressive Reporting and Probabilistic Auditing in a Principles-Based Environment

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Aggressive Reporting and Probabilistic Auditing in a Principles-Based Environment

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Abstract

We analyze the reporting strategies of firms and the investigation strategies of auditors in an archetype principles-based financial reporting system. To this end, we add a verification stage to a standard cheap-talk game, and apply the resulting game to financial reporting. We show that for a principles-based system to work properly, firms should bear a sufficient share of the cost of a thorough investigation. Furthermore, we find that a principles-based system is a mixed blessing. On the one hand, it leads to a plausible investigation strategy of the auditor, in which "suspected" reports receive most attention. On the other hand, a principles-based system only indirectly weakens firms' incentives to report aggressively.

Keywords: Cheap Talk, Financial Reporting, Principles-based Regulation, Stochastic Auditing

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1 Introduction

A sequence of corporate accounting scandals in the early 2000's (notorious examples are Enron and Worldcom) has escalated the debate on principles-based versus rules-based financial reporting systems[1]. A concern has risen that reporting standards have become too rules-based. The idea is that bright-line guidance encourages gaming the system and aggressive reporting[2]. Moreover, rules limit the role of auditors to only checking compliance to these rules. A more principles-based system would move emphasis from the acceptability of reporting practices to the appropriateness of reporting practices[3].

The accounting scandals illustrate that the root of aggressive reporting is that managers want to paint too rosy a picture of the financial position and performance of their firms. In a rules-based system, this desire provides managers with incentives to report near the limits of rules. As long as managers do not violate reporting rules, it is hard for auditors to constrain this manner of aggressive reporting.

The bad experiences with the rules-based system do not show that a more principles-based system would perform better. Clearly, a shift to a principles-based system does not remove managers' desires to present a too favorable picture of their firms. One might even think that less guidance and fewer rules widen the scope for

[1] "Escalating", because already in 1994, the Advisory Panel on Auditor Independence recommended a shift towards a more principles-based accounting system (see Caplan and Kirschenheiter, 2004).

[2] We define aggressive reporting in accordance with Hackenbrack and Nelson (1996), p.44, and Phillips (1999), p.167, as reporting methods that portray a company's financial situation favorably when those methods are not clearly indicated by the facts and the professional literature. We also refer to Benston et al. (2006) and the Securities and Commission (July 2003) who conclude that rules-based regulation has resulted in less informative and more misleading financial statements.

[3] We refer to the examples mentioned in the introduction of Schipper (2003), for example Joseph Berardino, former CEO of Arthur Andersen, Walter Wriston, former CEO of Citicorp, Sir David Tweedie, former chairman of the International Accounting Standards Board and Harvey Pitt, former chairman of the US Securities Exchange Commission.

aggressive reporting. On the other hand, in appealing to principles, auditors may better combat aggressive reporting. This in turn may discourage firms to report aggressively.

In this paper, we develop an auditing game to examine reporting behavior of firms and investigating behavior of auditors in an archetype principles-based system. Our objective is to identify the weak and strong features of a principles-based system. We believe that a game-theoretical model can help us better understand the functioning of a principles-based system for three reasons. First, at the heart of auditing lies a problem of asymmetric information. Game theory is a well-known tool for investigating such problems. Second, reporting behavior of firms is likely to depend on investigating behavior of auditors and *vice versa*. The interdependency of the behavior of players calls for a game theoretical approach. Third, in game theory, agents are fully rational. Our model shows how rational managers of firms report when they are confronted with rational auditors, and how rational auditors investigate reports prepared by rational managers. In the context of auditing, the assumption of rationality seems plausible, as both players are generally professionals who know "the game", so to speak.

Our game exhibits four key features. First, the objective of the auditor is to determine the financial position, the value, of a firm. The "principle" is thus that the firm's report should reflect its actual financial position. Though the firm is supposed to report truthfully, it wants the market to overestimate its value. A well known motivation for this assumption is that the lending conditions of a firm often depend on creditors' perceptions of its financial position. The firm's desire to mislead external parties opens the role for an auditor as a verifier of information.

A second important feature of the model is asymmetric information. At the beginning of the game, the firm is better informed about its financial position than the auditor. The firm knows its value, while the auditor only knows that the value lies in a certain interval. The firm prepares a report about its financial position. On the basis of this report, the auditor decides whether to conduct a thorough investigation or not. Through the investigation, the auditor learns the firm's value. Investigation is costly, however. These costs are partially borne by the auditor and partially borne by the firm. If in our model, auditors were always to investigate firms thoroughly, they would always learn the financial position of the firms. Such an outcome, however, would have been expensive in terms of investigation costs. In the present paper, we identify equilibria in which firms voluntarily disclose at least some information and auditors do not always choose for a thorough investigation.

A third main feature of our game is the absence of rules and fines. The absence of rules makes it hard to impose fines as, almost by definition, in the absence of rules, rules cannot be violated. Firms are allowed to report anything, but what they report generally affects the probability that they will be investigated. The auditor's investigation strategy may discipline firms. We are aware that in practice, a principles-based system always has some rules. By abstracting from rules, we highlight the difference between rules-based reporting systems and principles-based systems.

Finally, we allow the firm to send a report that leads to a certain thorough investigation. One can think of a firm that by law should prepare a report, but refuses to do so. We, thus, give the firm the option of obstructing the system. The resulting model is sufficiently rich and possesses many kinds of equilibria, some of which do not seem plausible. In our analysis, we focus on the most meaningful equilibria of the model, which we refer to as Perfect Auditing Equilibria. In such equilibria, firms report according to their true value so that the reports are always meaningful, and auditors perform a thorough audit with some probability but not with certainty, so that at least sometimes the public finds out the firm value directly from the firm's report. We disregard equilibria in which a firm deliberately chooses to obstruct the system. More specifically, we identify conditions under which the Perfect Auditing Equilibria exist in which firms do not send reports that lead with certainty to a thorough investigation.

We derive three main results. First, in a principles-based system, the firm should bear a sufficiently large share of the cost of an audit. If the cost borne by the firm is too small, only equilibria exist in which reports do not contain much information about firms' values. A high auditing cost for the firm discourages aggressive reporting. Second, the reporting strategy of the firm is characterized by a partition strategy. The lengths of the partitions indicate the precision of reports. Reports of small values are relatively precise, while reports of high values are relatively imprecise. The maximum length of a partition depends on the cost of investigation borne by the auditor. Third, the investigation strategy of the auditor is probabilistic. Generally, the higher is the value reported by the firm, the higher is the probability that the auditor performs a thorough investigation. As the firm bears part of the cost of an investigation, the auditor's investigation strategy discourages aggressive reporting. It does not eliminate aggressive reporting completely, however.

All in all, our results show that a principles-based system provides a mixed blessing. On the one hand, under certain conditions, it leads to a plausible investigation strategy of the auditor, in which "suspected" reports receive most attention. On the other hand, a principles-based system only indirectly reduces firms' incentives to report aggressively. Rules in combination with fines in case of non-compliance may be a more effective way of combating aggressive reporting.

In section 2, we discuss related literature, and section 3 introduces the basic theoretical model that is used in this paper. Section 4 analyzes the model, and section 5 concludes and gives indications for further research. The appendix contains some proofs.

2 Related Literature

The literature on auditing models is quite extensive. The seminal paper is by Townsend (1979), in which an agent has to report information to a principal. The problem is that the agent has an incentive to misreport. This incentive to misreport, in turn, gives an incentive to the principal to verify the report. Townsend (1979) examines how alternative verification procedures affect reporting.

A major application of auditing models is tax compliance. In the older literature (see, for example, Allingham and Sandmo, 1972), the assumed verification strategy of the tax authority is naive. This literature aims at determining the optimal probability of verification irrespective of reported income. Reinganum and Wilde (1986) are one of the first who allowed the tax authority to choose verification probabilities contingent on reported income. Their paper shows that taxpayers with higher income underreport less, and are verified with lower probability[4]. Our model is similar to that of Reinganum and Wilde (1986) in that we also assume that the principal cannot commit to a verification strategy. In this respect, we deviate from, for instance, Townsend (1979) and Border and Sobel (1987), who assume that the principal can

[4]Erard and Feinstein (1994) show that this result crucially relies on the assumption that no "honest" taxpayers exist. Khalil (1997) applies the Reinganum and Wilde (1986) model to a setting where a manager has an incentive to underreport the cost of production to the owner.

commit to a verification strategy. We deviate from Reinganum and Wilde (1986) in two main respects. First, we do not allow for direct fines. The reason for this modeling choice is that fines are hard to impose in a pure principles-based financial reporting system. Second, in our model, the firm's report does not directly affect its payoff. The firm wants the auditor to overestimate its value. The firm's report is cheap talk as in Crawford and Sobel (1982). In a model of tax compliance, unless audited, misreporting directly leads to lower taxes to be paid.

Another application of auditing models is financial reporting by firms[5]. Morton (1993) and Chatterjee *et al.* (2008) describe a game between a manager of a firm and an auditor. The spirit of the game is similar to the tax compliance model proposed by Reinganum and Wilde (1986). The manager has an incentive to underreport the value of the firm to earn a rent. Based on the manager's report, the auditor chooses whether or not to audit the report. An audit is costly. If the manager is found to misreport, he has to pay a penalty. Morton (1993) assumes that the auditor can commit to an auditing strategy. Chatterjee *et al.* (2008) relax the commitment assumption. We deviate from these studies in the same respects as we deviate from the models of tax compliance.

As discussed in the introduction, our model investigates the incentives arising from a purely principles-based financial reporting system. There are several theoretical studies on how relaxing reporting standards affects the reporting behavior of firms. Dye and Verrecchia (1995) distinguish between an internal problem between the manager and current shareholders on the one hand, and an external problem between the manager and future shareholders on the other. They argue that under

[5]In the insurance literature, similar papers can be found that describe the reporting strategy of a claimant and the auditing strategy of an insurance company, we refer to Picard (1996) and Schiller (2006)

certain conditions, tighter reporting standards can improve the external communication problem, but generally aggravate the internal communication problem. Stocken and Verrecchia (2004) examine an environment in which firms possess relevant information for investors, which is not captured by a financial reporting system. In such an environment, giving the manager reporting discretion enables the manager to convey more information. However the cost of discretion is, that it offers the firm more scope for misreporting. Ewert and Wagenhofer (2005) make the interesting point that tightening reporting standards may shift the manager's attention from accounting earnings management to real earnings management. The contribution of our paper to this literature is limited in the sense that we exclusively focus on the performance of a purely principles-based system. However, in contrast to most other studies in this field, we also examine the effect of a principles-based system on the behavior of the auditor.

A cheap-talk game a la Crawford and Sobel (1982) has already been used in the literature to model financial reporting. Gigler (1994) points out that as financial reports address multiple audiences, there is scope for voluntary disclosure of financial information by firms. Fischer and Stocken (2001) examine the relationship between the quality of the sender's information and the quality of the information communicated. Surprisingly they find that a lower quality of information can improve communication. We contribute to the cheap-talk literature by adding a verification stage to the standard Crawford and Sobel (1982) model.

Our paper is also related to experimental research on the effect of the type of financial reporting system on firms' incentives to report aggressively (see Nelson (2003) for a review of this literature). Jamal and Tan (2010) investigate whether moving towards a principles-based reporting system reduces aggressive reporting by financial managers. They vary the reporting system (a rules-based or principles-based reporting system) and the auditor type (rules-oriented, principles-oriented or client-oriented). The paper finds that a move towards a principles-based system often leads to less aggressive reporting. Jamal and Tan (2010) study an environment in which the auditor always conducts a thorough investigation. Our model shows that in such an environment, firms do not have incentives to report aggressively. We also allow environments in which auditors do not always conduct a thorough investigation. In such environments, firms are only indirectly discouraged to report aggressively. More generally, our model offers predictions that can be tested in future experiments.

3 Model

Our model describes an archetype principles-based system. In our game, there are two active players, a firm (F) and an auditor (A). We consider a situation where the firm is legally obliged to issue a year report that provides accurate information about its financial position. We model this year report as a value. The firm wants external parties, the public, to overestimate its actual value. The auditor's role is to verify information. In our game, the auditor can choose between investigating the firm's report or not investigating it.[6] If the auditor investigates, he learns the true value of the firm, and reports this value to the public. If the auditor does not investigate, the public observes the value reported by the firm. The auditor's objective is that external parties form an accurate perception of the firm's value. In addition, the

[6]The idea is that there has been an initial audit, prepared by the firm and executed by the auditor. This audit has led to a report. On the basis of this report, the auditor bases his decision whether or not to conduct a thorough investigation.

auditor takes his cost of an investigation into account.

We are aware that our model does not describe any real financial reporting system. Financial reporting regulation, *e.g.*, in the form of IFRS,[7] determines reporting standards and includes best-practise guidelines, but does not impose detailed instructions as a rules-based system does. An archetype principles-based system does not exist in reality. Our model describes a principles-based system in the sense that the auditor's focus is on content, not on rules. In addition, we require that in equilibrium, the firm prepares a legitimate report. However, we do allow the firm to obstruct the system by giving it the opportunity to send an illegitimate report. An illegitimate report leads to an investigation with certainty. We identify equilibria in which firms only send legitimate reports.

More formally, our game extends a uniform linear version of the cheap-talk model of Crawford and Sobel (1982) by adding an auditing stage. We assume that the firm's value v is uniformly distributed over the unit interval $V = [0, 1]$. Having observed its value $v \in V$, the firm sends an initial report r_0 to the auditor. Report r_0 can be legitimate, in which case, $r_0 \in V$ and its literal meaning is "my value is r_0", or it can be illegitimate, which case is denoted by $r_0 = \varnothing$. Thus, $r_0 \in R$, where $R \equiv V \cup \{\varnothing\}$.

Having received a report $r_0 \in V$, the auditor decides whether to investigate the firm, which is denoted by $q = 1$, or not, $q = 0$. If the report is $r_0 = \varnothing$, the auditor must investigate it. Hence, $q = 1$, if $r_0 = \varnothing$. An investigation informs the auditor about the true value v. As a result, if $q = 1$, the auditor sends an altered report $r_1 = v$ to the public. Without investigation, $r_1 = r_0$.

The public observes the final report $r_1 \in V$ and whether investigation has taken

[7]The International Financial Reporting Standards (IFRS) concern a set of international accounting standards that prescribe how financial transactions should be represented in the financial statements.

place, q. It forms expectation $\hat{v}$ of the value of the firm on the basis of r_1 and q, $\hat{v} = E(v|r_1, q)$. The preferences of the firm and the auditor are given by the following utility functions:

$$u^A(v, \hat{v}, q) = -|\hat{v} - v| - qc^A \tag{1}$$

$$u^F(v, \hat{v}, q) = -|\hat{v} - (v + x)| - qc^F \tag{2}$$

where c^F and c^A are the investigation costs for the firm and the auditor, respectively, and x measures by how much the firm wants the public to overestimate its value. Equation (1) shows that the auditor wants the public to have a correct perception of the firm's value. Notice that both the firm and the auditor bear a part of the investigation costs. Our focus is on equilibria in which some reports are investigated with positive probability.

As an equilibrium concept, we use the Perfect Bayesian Equilibrium, PBE hereinafter, which satisfies the following additional requirements.

(a) In equilibrium, the set of values V is partitioned into a finite sequence of intervals, and the firm only reports which interval its value belongs to.

(b) In equilibrium, there are no reports that are investigated with certainty.

The first requirement guarantees that in equilibrium, a firm with a higher value is expected to report a higher value. We believe that the uniform-linear model considered here admits only such equilibria. However, since the single-crossing property fails in our model, other types of equilibria may exist for other generic distributions and loss functions.

The second requirement is an interpretation of a "proper" performance of the auditing system. It guarantees that all firm's reports are trusted, at least partially. If this requirement is dropped, other equilibria appear, in which there are such reports that the auditor never trusts and, consequently, always investigates. This undermines the legitimacy of these reports. Thus, we focus on PBE that are similar to equilibria of Crawford and Sobel (CS). We denote the intervals by (b_{i-1}, b_i), and the corresponding partition by $B \equiv \{(b_{i-1}, b_i)\}$, $i = 1, \ldots, n$, where $n \geq 1$ is the number of pooling intervals in B.

As is usual in cheap talk models, a firm's exact reporting strategy is of no importance for an equilibrium. For the audit system, however, there is a very natural interpretation of the equilibrium reporting strategy: if the firm value v lies in an interval (b_{i-1}, b_i), the firm reports any number $r_0 \in (b_{i-1}, b_i)$ with equal probability.

Having observed a report $r_0 \in (b_{i-1}, b_i)$, the auditor investigates the firm with probability $p_i \in [0, 1)$, and $P \equiv \{p_i\}$ is an auditor's equilibrium investigation strategy. Consequently, an equilibrium Ω can be written as a tuple $\Omega = \langle B, P \rangle$ consisting of the reporting strategy B of the firm, and the investigation strategy P of the auditor, such that the following conditions are satisfied:

(a) For any value $v \in (b_{i-1}, b_i)$, sending any report $r_0 \in (b_{i-1}, b_i)$ is optimal to the firm.

(b) For any report $r_0 \in (b_{i-1}, b_i)$, investigating the firm with probability p_i is optimal to the auditor.

Investigation probability $p_i = 1$ is excluded by our assumption that the firm must have strict incentives to send a legitimate report. Auditor's beliefs are implicit in this characterization. In particular, having observed a report $r_0 \in (b_{i-1}, b_i)$ the auditor believes that $r_0 \in (b_{i-1}, b_i)$ with the prior (uniform distribution). Moreover, if $r_0 = \varnothing$, he investigates the firm irrespective of his beliefs. From now on, we call an equilibrium of this kind a "perfect auditing equilibrium", hereafter PAE.

4 Analysis

We analyze our model in three steps. First, we look at the auditor and analyze which reports he investigates. Next, we look at the firm and analyze under which conditions the firm sends a legitimate report. As a result, we obtain two conditions that must necessarily hold in a PAE. Third, using these necessary conditions, we derive conditions for the existence and uniqueness of the equilibrium. We illustrate typical equilibria of the model with examples.

4.1 Problem of The Auditor

Suppose the auditor observes a report $r_0 \in (b_{i-1}, b_i)$ in equilibrium. Let d_i be the length of this interval:

$$d_i \equiv b_i - b_{i-1}$$

The length of d_i can be interpreted as the measure of the accurateness of the report r_0.

The auditor knows that the firm sends report r_0 only when the true value is $v \in (b_{i-1}, b_i)$. Consequently, he faces the following trade-off.

(a) If the auditor investigates the firm ($q = 1$), the auditor pays auditing cost c^A. There are no other utility losses since the external parties get to know the exact value, $\hat{v} = v$. The utility of the auditor is equal to $u^A(v, v, 1) = -c^A$.

(b) If the auditor does not investigate the firm ($q = 0$), the auditor passes the firm's initial report r_0 to the public. The auditor saves on the investigation cost but bears a utility loss due to inaccurate reporting. Indeed, the public only knows that $v \in (b_{i-1}, b_i)$ and, therefore, the firm's expected value is $\hat{v} = \frac{1}{2}(b_{i-1} + b_i)$. The utility of the auditor is

$$U^A = E[u^A(v, \hat{v}, 0)|v \in (b_{i-1}, b_i)] = -\frac{1}{d_i} \int_{b_{i-1}}^{b_i} |\hat{v} - v| dv = -\tfrac{1}{4} d_i$$

By comparing utilities for $q = 0$ and $q = 1$ we conclude that the auditor does not investigate the firm if the length of the interval d_i is small relative to the audit cost c^A, *i.e.*, $p_i = 0$ if $c^A > \frac{1}{4}d_i$. If, to the contrary, $c^A < \frac{1}{4}d_i$, the auditor strictly prefers to investigate. This should not happen in a PAE. Finally, if $c^A = \frac{1}{4}d_i$, the auditor is indifferent and can verify with any probability $p_i \in [0, 1)$.

Summarizing, the auditor investigates a firm's report if it does not provide a sufficient accurate estimate of the firm's value. This strategy seems to make sense in a principles-based system.

4.2 Problem of The Firm

Suppose the firm has a value v. By reporting $r_0 \in (b_{i-1}, b_i)$ the firm is investigated with probability p_i. If investigated, $\hat{v} = v$ and the firm gets utility $u^F(v, v, 1) = -(c^F + x)$. Without investigation, $\hat{v} = \frac{1}{2}(b_{i-1} + b_i)$, and the firm gets utility

$$u^F(v, \hat{v}, 0) = -\left|\tfrac{1}{2}(b_{i-1} + b_i) - (v + x)\right|$$

Thus, when reporting $r_0 \in (b_{i-1}, b_i)$, the expected utility of the firm is

$$U^F = -p_i(c^F + x) - (1 - p_i) \left| \tfrac{1}{2}(b_{i-1} + b_i) - (v + x) \right|$$

On the other hand, by sending a report $r_0 = \varnothing$, the firm ensures investigation and gets utility $u^F(v, v, 1) = -(c^F + x)$. The incentive of the firm to report $r_0 = \varnothing$ depends on the firm value v. Since the firm wants to overstate its value, it has the strongest incentives to become investigated if its value is the highest in the partition, $v = b_i$. For $v = b_i$, the firm does not send the illegitimate report $r_0 = \varnothing$ only if $\frac{1}{2}d_i \leq c^F$. The following lemma summarizes the conditions for which the firm sends a legitimate report and the auditor does not investigate a legitimate report with certainty.

> **Lemma 1.** In a perfect auditing equilibrium, $d_i \leq 4c^A$ and $d_i \leq 2c^F$ for all intervals.

This lemma has the following simple interpretation. The archetypical principles-based system only works properly if the firm's reports are sufficiently accurate (which is measured by the lengths of the intervals d_i). When reports become less accurate, *i.e.*, when the lengths of the intervals d_i increase, so that either of the conditions of Lemma 1 fail, then either the auditor begins investigating with certainty, or the firm starts sending illegitimate reports $r_0 = \varnothing$. In the latter case, the report is also investigated with certainty.

4.3 Perfect Auditing Equilibria

If the investigation costs c^A and c^F are very large so that the investigation is too costly, our model becomes similar to the model of Crawford and Sobel (1982). Yet, an important difference remains. In our auditing model, the firm can always initiate an investigation by sending an illegitimate report $r_0 = \varnothing$. Consequently, although our model might have some of the cheap talk equilibria of Crawford and Sobel (1982), not all cheap-talk equilibria are necessarily equilibria in our model.

According to Lemma 1, a cheap talk equilibrium of Crawford and Sobel (1982) is a perfect auditing equilibrium only if the lengths of intervals are small relative to the auditing costs. Therefore, our principles-based model represents a robustness check for cheap talk equilibria of Crawford and Sobel (1982) in the presence of an investigation technology, which favors equilibria where more information is transmitted. Since we are interested in the performance of the principles-based system, we first focus on equilibria where investigation does take place. At the end of this section, we also discuss PAE in which the auditor never investigates.

According to Crawford and Sobel (1982), for a given value of x, the cheap talk equilibria may have not more than k intervals, where k is the largest integer satisfying $2k(k-1)x < 1$:

$$k = \max\{n : 2n(n-1)x < 1\}$$

First, we analyze equilibria for low investigation costs of the auditor, if $c^A \leq \frac{1}{2}x$. The following proposition states the result.

Proposition 1. Let the following conditions hold:

$$c^A < \frac{1}{4}\left(\frac{1}{k} + 2x(k-1)\right), c^A \leq \frac{1}{2}x \text{ and } c^A < \frac{1}{2}c^F$$

Then, there exists a generically unique perfect auditing equilibrium in which the length of the first interval is $d_1 < 4c^A$, and all other intervals are of the same length of $4c^A$. In this PAE, the first interval is never investigated, and all other intervals are investigated with sequentially increasing probabilities.

According to Proposition 1, if the auditor's investigation cost c^A is sufficiently low, there is only one option for the principles-based system to work. The set of firm values V is split into intervals in such a way that all of them, except the very first one, have a length equal to $4c^A$. Since the firm only reports to which interval its value belongs to, there is always some uncertainty in the firm's report. In the first interval, the uncertainty is so small that the auditor does not find investigating worthwhile. In all other intervals, the auditor is just indifferent between investigating and not investigating. The way the auditor randomizes between investigating or not is such that it induces the firm to report correctly the interval to which its value belongs. In order to prevent firms with higher values from misreporting, investigation probabilities for each next interval increase.

Figure 1 represents a numerically computed perfect auditing equilibrium for $x = 0.3$, $c^A = 0.1$, and $c^F = 0.6$. The vertical bars denote the interval boundaries, the ladder-like step function $p(v)$ is the probability that firm value v gets investigated. The three dashed Λ-shaped curves represent the utilities for the firm of type v when it reports $r_0 \in (b_{i-1}, b_i)$ for $i = 1, 2, 3$. The curve for $r_0 \in (b_1, b_2) = (0.2, 0.6)$ is made bold. All firms with a value $v_0 \in (0.2, 0.6)$, receive the highest utility when reporting within partition $r_0 \in (0.2, 0.6)$, represented by the bold line. The upper envelope of these curves, represents the firm's utility $u(v)$ in equilibrium.

Let us consider a firm with a fixed value, let us say $v_0 = 0.35$. Figure 1 shows utility levels that the firm gets if it reports intervals $(0, 0.2)$, $(0.2, 0.6)$, and $(0.6, 1)$. The equilibrium is constructed in such a way that the firm always prefers to report the true interval, in this case $r_0 \in (0.2, 0.6)$.

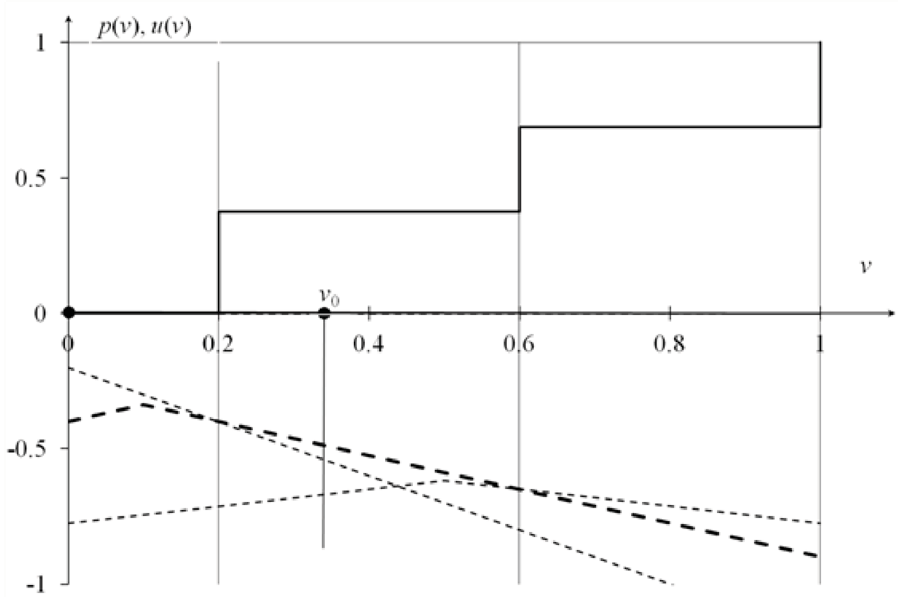

Figure 1: Equilibrium partition, investigation probabilities, and firm's utility for $x = 0.3$, $c^A = 0.1$, and $c^F = 0.6$.

Next, we analyze equilibria for high investigation cost of the auditor, when $c^A \geq \frac{1}{2}x$. The following proposition states the result.

Proposition 2. Let the following conditions hold:

$$c^A < \frac{1}{4}\left(\frac{1}{k} + 2x(k-1)\right), c^A \geq \frac{1}{2}x, \text{ and } c^A < \frac{1}{2}c^F$$

Then, there exists, possibly not unique, a perfect auditing equilibrium in which the first k_1 intervals, $k_1 \geq 1$, are of increasing length, and the remaining $k_2 \geq 1$ intervals are of the same length of $4c^A$. In this PAE, the first k_1 intervals are never investigated, and all the remaining intervals are investigated with sequentially increasing probability. Moreover, if $c^A < x$ then, generically, $k_1 = 1$, and the equilibrium is unique.

According to Proposition 2, if the auditor's investigation costs are larger than or equal to $\frac{1}{2}x$ but smaller than $\frac{1}{2}c^F$, the principles-based system still leads to intuitive strategies. When $c^A \in (\frac{1}{2}x, x)$, proposition 2 just extends the results of proposition 1. However, when $c^A > x$ it becomes different in two main respects. First, the equilibrium may have more than one initial interval where the auditor does not investigate, and, second, equilibria multiplicity may arise. In all other respects, the cases of high and low values of c^A, represented by propositions 1 and 2, are similar.

The following figure represents a numerically computed perfect auditing equilibrium for $x = 0.01$, $c^A = 0.064$, and $c^F = 0.15$. The vertical bars denote the interval boundaries, the ladder-like step function $p(v)$ is the probability that firm value v gets investigated. Seven dashed Λ-shaped curves represent utilities of the firm of type v when it reports $r_0 \in (b_{i-1}, b_i)$ for $i = 1, \ldots, 7$. One such function $r_0 \in (b_1, b_2) = (0.024, 0.088)$ is made bold. The upper envelope of these curves, represents the firm's utility $u(v)$ in equilibrium.

Figure 2 also shows the utility levels that the firm of value $v_0 = 0.35$ receives when reporting a value in the different intervals. It receives the highest utility when it reports $r_0 \in (b_4, b_5) = (0.336, 0.52)$, *i.e.*, the true interval to which its value belongs. One can see that no investigation takes place in the first six intervals, only the remaining seventh interval is investigated with positive probability. This equilibrium is not unique. There is another PAE for the same values of x, c^A and c^F with $n = 4$ partitions, presented in Figure 3. One can clearly see the violation of the single-crossing property in our model, since some of the drawn Λ-shaped utility functions intersect twice.

It is interesting to compare the two PAE presented in Figures 2 and 3. The first PAE of Figure 2, with $n = 7$ is the most informative equilibrium of our auditing model: the number of the reported intervals is maximal. In addition, in this equilibrium, the investigation intensity of the auditor is the lowest: the ex-ante probability that the firm is investigated is $\sum_i d_i p_i \approx 0.024$. The second PAE, with $n = 4$, to the contrary, is the least informative PAE: the number of the reported intervals is minimal. To support this equilibrium, the investigation intensity is much higher: the ex-ante probability that the firm is investigated is $\sum_i d_i p_i \approx 0.40$, *i.e.*, 16 times higher than in Figure 2. Apart from these two extreme PAE, there are two other equilibria with $n = 5$ and $n = 6$ partitions in equilibrium for the same values of x, c^A and c^F.

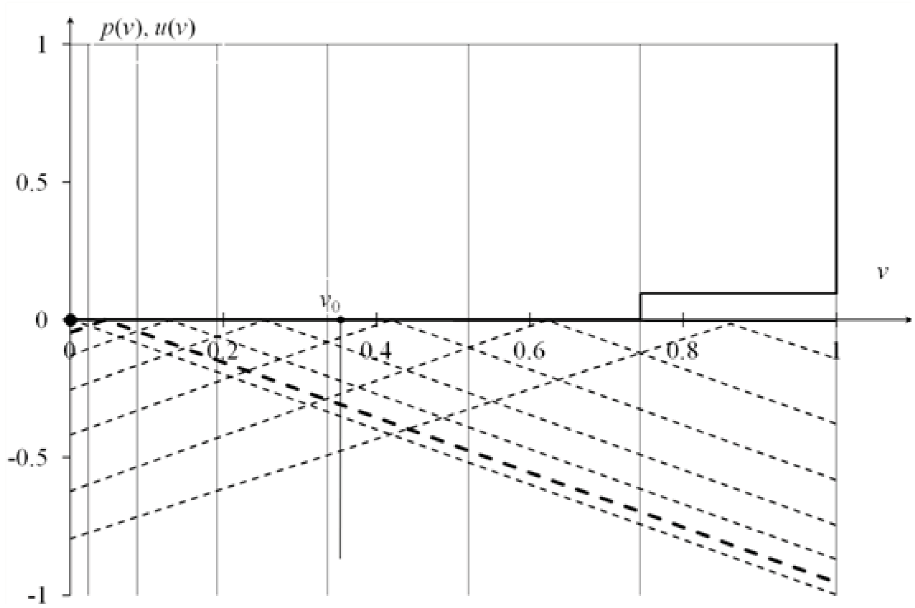

Figure 2: Equilibrium partition, investigation probabilities, and firm's utility for $x = 0.01$, $c^A = 0.064$, and $c^F = 0.15$, for $n = 7$.

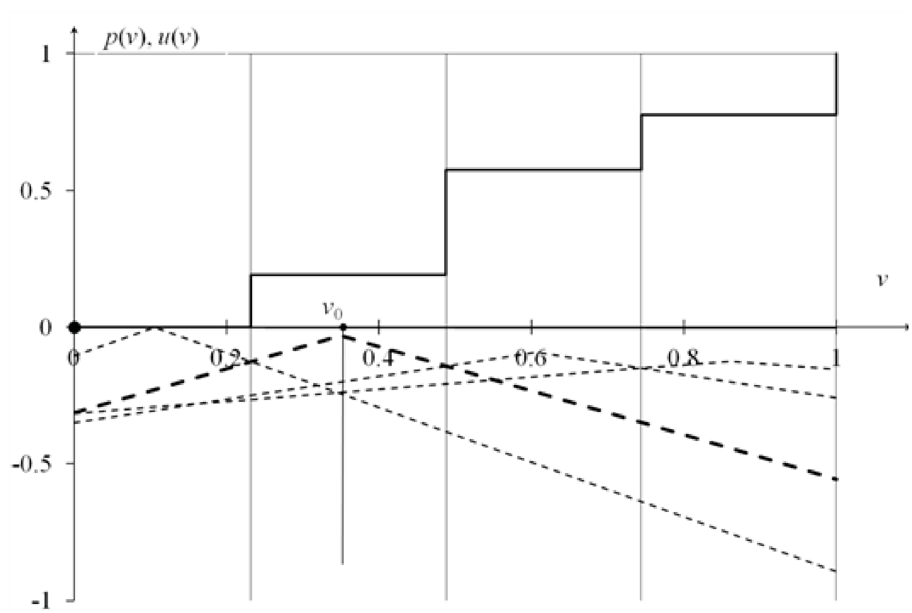

Figure 3: Equilibrium partition, investigation probabilities, and firm's utility for $x = 0.01$, $c^A = 0.064$, and $c^F = 0.15$, for $n = 4$..

In the previous analysis, *i.e.*, in propositions 1 and 2, we have assumed that $c^A < \frac{1}{2}c^F$. We finish this section by analyzing the performance of the principles-based reporting system when this condition fails. Suppose that $c^A > \frac{1}{2}c^F$. In other words, we assume that the cost for the firm c^F becomes very low. Then, only the following two cases are possible. First, it can be that all intervals in equilibrium partitions are smaller than $4c^A$. In this case, no investigation takes place because the auditor strictly prefers not to investigate. Second, it can be that some, in fact, the longest last one, interval is of the length equal to $4c^A$. But then, according to Lemma 1, this is not a perfect auditing equilibrium, since $d_i = 4c^A > 2c^F$. Thus, we get our next result.

Proposition 3. Let $c^A > \frac{1}{2}c^F$. Then, a perfect auditing equilibrium where investigation takes place with positive probability does not exist.

To understand the intuition behind Proposition 3 recall that at the second half of any partition, a firm's report leads the auditor to underestimate its value. The firm, however, wants the auditor to overestimate its value. A direct implication is that these firms want the auditor to learn their real values. The firm can do so by sending an illegitimate report. The wider is an interval, the stronger is the incentive of a firm with v close to the end of the partition to send an illegitimate report. Assume such a firm. In an equilibrium with investigation, the length of the largest interval depends on c^A. A high c^A therefore encourages the firm to send $m = \varnothing$. The cost of sending $m = \varnothing$ equals c^F. Only if c^F is large relative to c^A, the firm with a value close to the end of a partition does not want to send an illegitimate report.

5 Discussion of the Results

In a principles-based reporting system, as usual, the auditor's investigation strategy is conduct a thorough investigation if the benefits exceed the costs. The benefits of the investigation depend on the auditor's belief about the accurateness of a firm's report. In equilibrium, when a firm wants to avoid an investigation and the auditor's costs of an investigation are not too large, the investigation strategy is probabilistic. Moreover, the auditor's investigation decision is contingent on the value reported by the firm. Generally, a higher reported value does not decrease the probability of investigation. We believe that our model yields an intuitive strategy regarding the auditor's investigation decisions.

The firm's partition strategy we have derived, is perhaps somewhat artificial. In particular, the idea that a firm reports different values with equal probability is not very appealing in an environment where the firm wants external parties to overestimate its value. However, as discussed earlier, in cheap-talk games the exact reporting strategy is not important. What matters is that in equilibrium, a firm's report contains information but leaves some uncertainty. So, an auditor who has received a report learns something about the firm's value, but he realizes that the actual value of the firm is possibly different (perhaps likely to be lower, in the case that firms report upper bounds of partitions). Put in this light, we find the predictions of our model regarding the firm's reporting strategy also intuitive.

What does our game tell us about the functioning of a principles-based system? Our results show that a key parameter is c^F, the costs of an investigation borne by the firm. It plays two roles. First, if c^F is very small, no perfect auditing equilibrium exists. A principles-based financial reporting system fails. The reason is that some firms want to be investigated. As a result, they have incentives to send illegitimate reports. Second, c^F is a deterrent. A high c^F weakens a firm's incentive to misreport. The reason is that by exaggerating its value, the firm raises the probability of an investigation and, in turn, of incurring c^F. As far as c^F can be interpreted as an implicit penalty, it is particularly imposed on firms having high values. It is not imposed on firms that misreport most severely. We find this an unjust way of penalizing.

Another important parameter of the model is c^A, the costs of an investigation borne by the auditor. If c^A is large, the auditor only investigates firms that report very high values. The resulting game has multiple equilibria, as is often the case in cheap-talk models. For lower values of c^A, investigation becomes more common. For sufficiently low values of c^A, a unique equilibrium exists in which all, but one, reporting intervals are of equal length.

Although the main objective of our paper is to analyze the performance of a principles-based system, our results may also shed some light on price setting for auditing activities. In our model, the investigation decision is regarded as an expansion of normal auditing activities. There is some literature showing that performing additional auditing activities lead to costs for both the auditor and the firm; see *e.g.*, Johnstone *et al.* (2004), Schadewitz and Vieru (2009), and Zhang *et al.* (2011). This is in line with our model.

The general lesson that can be learnt from our analysis is that a principles-based system does not eliminate firms' incentives to misreport. Through assigning a part of the investigation cost to firms, firms' incentives to misreport can be weakened. As a deterrent, however, c^F is indirect and disproportionably hits firms that have high values.

Despite our results are obtained under very restrictive modeling assumptions, they may hold qualitatively, we believe, in more general settings. For example, our result that in equilibrium, the investigation probability is non-decreasing in the reported value is just the reflection of the firm's incentive to overstate its value and, as such, does not depend on the value distribution and the exact shape of the utility function. The uniqueness of PAE for small c^A follows from the fact that in the limit, when c^A converges to zero, our "cheap-talk with costly verification" model converges to a standard "costly signaling" model, and our PAE becomes a unique perfectly separating equilibrium thereof. In this limit, the value distribution plays no particular role, and the utility function only determines the investigation probabilities. One of our most restrictive assumptions is that we consider an archetype principles-based system by assuming away all fines. Nevertheless, neither of our characterization results change if we assume that a fine is imposed on the firm which sends an illegitimate report. The only consequence of this generalization is that PAE will exist also for small values of c^F, since the fine will play the role of the latter. This can be seen as a simple robustness check of our "perfect auditing equilibrium" concept.

Another restrictive assumption is that by investigating the firm, the auditor learns its true value. It is debatable whether or not the true value of a firm exists. This makes the functioning of a principles-based system even more difficult. In the same vein, we have assumed that the auditor only serves the public interests. In practice, auditors are likely to have alternative motives, especially if they consider firms as clients. In order to address this issue, our model needs an extension to allow for imperfect information transmission from the auditor to the public. Yet another possible generalization of the model is to make it more "rules-based" by allowing for penalties on, *e.g.*, firm's reports that differ significantly from the firm's true value.

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Appendix

Proof of Lemma 1 is in the main text.

Proof of Proposition 1. We prove the proposition by construction. First, we derive some necessary conditions for a PAE. Then, we show that if $c^F > 2c^A$, there always exists a unique partition with the corresponding investigation probabilities, which satisfies all these conditions. We end the proof by arguing that neither the firm nor the auditor has a profitable deviation.

Expected utility of the firm with value v when it reports $r_0 \in (b_{i-1}, b_i)$ and is investigated with probability p_i is given by (2). By continuity, type $v = b_i$ must be indifferent between reporting $r_0 \in (b_{i-1}, b_i)$ and $r_0 \in (b_i, b_{i+1})$, thus $U^F(b_i, i, p_i) = U^F(b_i, i+1, p_{i+1})$. Depending on signs of p_i and p_{i+1}, we distinguish 4 cases.

(a) Case $p_i = p_{i+1} = 0$. The indifference condition implies $\frac{1}{2}d_i + x = |\frac{1}{2}d_{i+1} - x|$. Since $d_{i+1} \le 4c^A$ and $2c^A < x$, it follows that $\frac{1}{2}d_{i+1} - x \le 2c^A - x < 0$, so that the condition becomes $d_i = -d_{i+1}$. Thus, this case never happens.

(b) Case $0 = p_i < p_{i+1} < 1$. First, $d_{i+1} = 4c^A$ due to $p_{i+1} > 0$. The indifference condition implies $\frac{1}{2}d_i + x = p_{i+1}(c^F + x) + (1 - p_{i+1})(x - 2c^A)$, and finally, $p_{i+1} = \frac{\frac{1}{2}d_i + 2c^A}{c^F + 2c^A}$. Since $d_i < 2c^F$, it is always the case that $p_{i+1} \in (0,1)$. Finally, since $d_{i+1} = 4c^A$ and $d_{i+1} < 2c^F$, this case only happens when $c^F > 2c^A$.

(c) Case $p_i, p_{i+1} \in (0,1)$. Since $d_i = d_{i+1} = 4c^A$ in this case, the indifference condition becomes $p_i(c^F + x) + (1 - p_i)(2c^A + x) = p_{i+1}(c^F + x) + (1 - p_{i+1})(x - 2c^A)$, which implies that $(1 - p_{i+1}) = \frac{c^F - 2c^A}{c^F + 2c^A}(1 - p_i)$. Here we note that, first, $p_{i+1} > p_i$, and, second, this case only happens when $c^F > 2c^A$.

(d) Case $1 > p_i > p_{i+1} = 0$. Since $d_i = 4c^A$ in this case, the indifference condition becomes $p_i(c^F + x) + (1 - p_i)(2c^A + x) = |\frac{1}{2}d_{i+1} - x|$. Since $d_{i+1} \leq 4c^A$ and $2c^A < x$, it follows that $\frac{1}{2}d_{i+1} - x \leq 2c^A - x < 0$, so that the condition becomes $d_{i+1} = -2\left(c^F p_i + 2c^A(1 - p_i)\right) < 0$. Thus, this case never happens.

Combining the cases, we conclude, first, that $p_{i+1} > p_i \geq 0$ for all i, and, second, that $p_{i+1} > p_i > 0$ is only possible when $c^F > 2c^A$. This implies that all the intervals in the partition, apart from the very first one, are of length $d_i = 4c^A$, and the investigation probabilities are given by $(1 - p_i) = (\delta_1)^{i-2}(1 - p_2)$, where $\delta_1 = \frac{c^F - 2c^A}{c^F + 2c^A}$, and $p_2 = \frac{\frac{1}{2}d_1 + 2c^A}{c^F + 2c^A} > 0 = p_1$. The number of intervals with investigation $(n - 1)$ must be such that $(n - 1) \cdot 4c^A < 1 \leq n \cdot 4c^A$. Thus, n must be the smallest integer satisfying $n \geq \frac{1}{4c^A}$, and, consequently, $d_1 = 1 - 4c^A(n - 1)$. If it turns out that $n = \frac{1}{4c^A}$, which is a non-generic case, all n intervals are of equal lengths, and the investigation probability p_1 in the first interval is undetermined and leads to equilibrium multiplicity.

In order to prove that the proposed firm's and auditor's strategy form an equilibrium, we show that neither the firm nor the auditor has a profitable deviation. This is true by construction for the auditor. Let the firm of value $v \in (b_{i-1}, b_i)$ report $r_0 \in (b_{j-1}, b_j)$, for some j. We compute the net benefit $D_0 = U^F(v, j, p_j) - U^F(v, i, p_i)$ from the deviation:

$$D_0 = Z_j - Z_i, \text{ where } Z_i \equiv (1 - p_i)\Big((c^F + x) - \left|v - b_i + \tfrac{1}{2}d_i + x\right|\Big) \tag{3}$$

Due to $2c^A \leq x$, it follows that $v - b_i + \frac{1}{2}d_i + x = (v - b_{i-1}) + (x - \frac{1}{2}d_i) > (v - b_{i-1}) > 0$, so that

$$D_0 = (1-p_j)\Big((c^F + x) - \big|v - b_j + x + \tfrac{1}{2}d_j\big|\Big) - (1-p_i)\Big(c^F + \tfrac{1}{2}d_i - (v - b_{i-1})\Big)$$

We will show that, generically, $D_0 < 0$ for all $i \neq j$.

It can be seen that, as a function of x, $D_0(x)$ is non-decreasing and is constant for $x > x_0 \equiv b_j - v - \frac{1}{2}d_j$. Thus, $D_0(x) \leq D_0(x_0) \equiv D_1$, where

$$D_1 \equiv (1-p_j)\Big(c^F + b_j - \tfrac{1}{2}d_j\Big) - (1-p_i)\Big(c^F + \tfrac{1}{2}d_i + b_{i-1}\Big) + v(p_j - p_i)$$

Depending on values of i and j, we consider the following four cases separately.

(a) Case $j > i \geq 2$. In this case, $b_j = b_i + 4c^A(j-i)$, $d_i = d_j = 4c^A$. Hence,

$$D_0 \leq D_1 = (1-p_j)(c^F - 2c^A + b_j) - (1-p_i)(c^F + 2c^A + b_{i-1}) + v(p_j - p_i)$$

Next, as a function of v, $D_1(v)$ is increasing, hence, $D_0 \leq D_1(v) \leq D_1(b_i) \equiv D_2$, where:

$$D_2 = (1-p_i)\Big((\delta_1)^{j-i}\big(c^F + 2c^A(2(j-i)-1)\big) - (c^F - 2c^A)\Big)$$

Finally, as a function of j, $j > i$, $D_2(j)$ is decreasing as its first difference is:

$$D_3(j) \equiv D_2(j+1) - D_2(j) = -4c^A(1-p_i)(\delta_1)^{j-i+1}(j-i) < 0$$

Moreover, as $D_2(i) = 0$ by construction, it follows that $D_2(j) < 0$ for all $j > i$ and, consequently, so is $D_0 < 0$. Thus, this type of deviation is strictly not profitable.

(b) Case $i > j \geq 2$. Similar to the previous case, $D_1(v)$ is decreasing, hence, $D_0 \leq D_1(v) \leq D_1(b_{i-1}) \equiv D_2$, where D_2 is:

$$D_2 = (1 - p_i)\Big((\delta_1)^{j-i}\Big(c^F + 2c^A(2(j-i)+1)\Big) - (c^F + 2c^A)\Big)$$

As a function of j, $j \geq i$, $D_2(j)$ is increasing as its first difference is:

$$D_3(j) \equiv D_2(j+1) - D_2(j) = 4c^A(1-p_i)(\delta_1)^{j-i}(1-\delta_1)(i-j-1) > 0$$

Moreover, as $D_2(i) = 0$, it follows that $D_2(j) < 0$ for all $j < i$ and, consequently, so is $D_0 < 0$. Thus, this type of deviation is strictly not profitable.

(c) Case $j > i = 1$. In this case, $p_1 = 0$, $b_1 = d_1$ and, as in case (a), $D_0 \leq D_1(v) \leq D_1(b_i) \equiv D_2$ where:

$$D_0 \leq D_2 = \Big((\delta_1)^{j-2}\tfrac{c^F + 4c^A(j-1) - 2c^A}{c^F + 2c^A} - 1\Big)\Big(c^F - \tfrac{1}{2}d_1\Big)$$
$$D_3(j) \equiv D_2(j+1) - D_2(j) = -(\delta_1)^{j-2}(1-\delta_1)\tfrac{4c^A(j-1)}{c^F + 2c^A}\Big(c^F - \tfrac{1}{2}d_1\Big) < 0$$

Since $D_2(2) = 0$, it follows that $D_0 \leq D_2 < D_2(2) = 0$.

(d) Case $i > j = 1$. In this case, as in case (b), $D_1(v) \leq D_1(b_{i-1}) \equiv D_2$:

$$D_2 = \Big(c^F + b_1 - \tfrac{1}{2}d_1 - b_{i-1}\Big) - (1-p_i)(c^F + 2c^A)$$
$$D_3(i) \equiv D_2(i+1) - D_2(i) = -4c^A\Big(1 - (\delta_1)^{i-2}(1-p_2)\Big) < 0$$

Since $D_2(2) = 0$, it follows that $D_0 \leq D_2 < D_2(2) = 0$.

Combining the above four cases (a)-(d) we conclude that $D_0 < 0$ for all $i \neq j$, which implies that the firm of any value (except marginal values) is strictly better-off by reporting a value from the same an interval which it's true value belongs to. This ends the proof. $\square$

Proof of Proposition 2. The proof follows the same lines as the proof of Proposition 1 does. First, we derive some necessary conditions for a PAE. Then, we show that if $c^F > 2c^A$, there exists a partition with the corresponding investigation probabilities, which satisfies all these condition. We end the proof by showing that neither the firm nor the auditor has a profitable deviation. Considering a type $v = b_i$, who must be indifferent between reporting $r_0 \in (b_{i-1}, b_i)$ and $r_0 \in (b_i, b_{i+1})$, we distinguish 4 cases.

(a) Case $p_i = p_{i+1} = 0$. The indifference condition implies $\frac{1}{2}d_i + x = |\frac{1}{2}d_{i+1} - x|$. The unique feasible solution is $d_{i+1} = d_i + 4x$, as in CS.

(b) Case $0 = p_i < p_{i+1} < 1$. First, $d_{i+1} = 4c^A$ due to $p_{i+1} > 0$. The indifference condition implies $\frac{1}{2}d_i + x = p_{i+1}(c^F + x) + (1 - p_{i+1})(x - 2c^A)$, and finally, $p_{i+1} = \frac{\frac{1}{2}d_i - 2c^A + 2x}{c^F - 2c^A + 2x}$. Since $d_i < 2c^F$, it is always the case that $p_{i+1} \in (0, 1)$. Finally, since $d_{i+1} = 4c^A$ and $d_{i+1} < 2c^F$, this case only happens when $c^F > 2c^A$.

(c) Case $p_i, p_{i+1} \in (0, 1)$. Since $d_i = d_{i+1} = 4c^A$ in this case, the indifference condition becomes $p_i(c^F + x) + (1 - p_i)(2c^A + x) = p_{i+1}(c^F + x) + (1 - p_{i+1})(2c^A - x)$, which implies that $(1 - p_{i+1}) = \frac{c^F - 2c^A}{c^F - 2c^A + 2x}(1 - p_i)$. Here we note that, first, $p_{i+1} > p_i$, and, second, this case only happens when $c^F > 2c^A$.

(d) Case $1 > p_i > p_{i+1} = 0$. Since $d_i = 4c^A$ in this case, the indifference condition becomes $p_i(c^F + x) + (1 - p_i)(2c^A + x) = |\frac{1}{2}d_{i+1} - x|$. First, it must be that

$\frac{1}{2}d_{i+1} > x$ as otherwise the equation implies $\frac{1}{2}d_{i+1} = -c^F p_i - 2c^A(1-p_i) < 0$. Then $\frac{1}{2}d_{i+1} > x$ implies $d_{i+1} = 2c^F p_i + 4c^A(1-p_i) + 4x$ and, consequently, $d_{i+1} > \min\{4c^A, 2c^F\}$. Thus, this case never happens.

Combining the cases, we conclude that a PAE has the following structure. The first k_1 intervals in equilibrium partition must be cheap talk intervals with increasing lengths $d_i = d_{i-1} + 4x \le 4c^A$ for $i = 2, \dots, k_1$ and zero investigation probabilities $p_i = 0$ for $i = 1, \dots, k_1$. The remaining k_2 intervals must be intervals with constant lengths $d_i = 4c^A < 2c^F$ and increasing investigation probabilities:

$$p_{k_1+1} = \frac{\frac{1}{2}d_{k_1} - 2c^A + 2x}{c^F - 2c^A + 2x}, \text{ and}$$
$$(1-p_i) = (\delta_2)^{i-1}(1-p_{k_1+1}) \text{ for } i = (k_1+2), \dots, (k_1+k_2)$$

where $\delta_2 = \frac{c^F - 2c^A}{c^F - 2c^A + 2x}$. Therefore, the set of the necessary conditions can be written as follows:

$$\begin{cases} k_1(d_1 + 2x(k_1-1)) + 4c^A k_2 = 1 \\ d_1 > 0 \\ p_{k_1+1} \ge 0 \\ d_{k_1} \le 4c^A \end{cases}$$

Since $d_{k_1} = d_1 + 4x(k_1-1)$, $d_{k_1} \le 4c^A$ implies $d_1 \le c^A - x(k_1-1)$. Since $d_1 > 0$, it must be the case that $c^A > x(k_1-1)$, which implies that $k_1 < \min\{1 + \frac{c^A}{x}, k\} \equiv \bar{k_1}$. Using $d_1 = \frac{1}{k_1}\Big(1 - 4c^A k_2 - 2xk_1(k_1-1)\Big)$ from the first equation, and $d_{k_1} = d_1 + 4x(k_1-1)$, we rewrite the above system of inequalities as

$$\begin{cases} k_2 < \frac{1-2xk_1(k_1-1)}{4c^A} \\ k_2 \leq \frac{1+2xk_1(k_1+1)}{4c^A} - k_1 \\ k_2 \leq \frac{1+2xk_1(k_1-1)}{4c^A} - k_1 \end{cases} \tag{4}$$

Thus, any equilibrium is defined by $k_1 = 0, \ldots, \bar{k_1}$ and k_2 satisfying the above inequalities. The equilibrium exists only when $c^F > 2c^A$. When $\frac{c^A}{x} < 1$, it follows that $\bar{k_1} = 1$, and, generically, $k_1 = 1$ (the case $k_1 = 0$ is non-generic and requires $\frac{1}{4c^A}$ to be an integer). In this case, the system becomes

$$\begin{cases} k_2 < \frac{1}{4c^A} \\ k_2 \leq \frac{1}{4c^A} + \left(\frac{x}{c^A} - 1\right) \\ k_2 \geq \frac{1}{4c^A} - 1 \end{cases}$$

so that the second inequality is redundant (due to $\frac{x}{c^A} - 1 > 0$), and the other two inequalities define k_2 uniquely, which, in turn, uniquely defines d_1 and the verification probabilities p_i.

In order to show equilibrium existence, we construct an equilibrium as follows. Let us take $k_1 = 1$. If there is an integer $k_2 \in \left[\frac{1}{4c^A} - 1, \frac{1}{4c^A} - 1 + \frac{x}{c^A}\right]$ we are done. If not, then it must necessarily be the case that $\frac{1}{4c^A} - 1 + \frac{x}{c^A} < \frac{1}{4c^A}$, which implies $x < c^A < 1/4$, $k \geq 2$ and, therefore, $\bar{k_1} = \min\{1 + \frac{c^A}{x}, k\} \geq 2$. Hence, we can take $k_1 = 2$. The rest of the proof is by induction.

Suppose that, for some $t \geq 1$ (induction assumptions): $\bar{k_1} \geq t$, and (5) has no solutions for $k_1 = 1, \ldots, (t-1)$. Let us take $k_1 = t$. The system (5) reads as follows:

$$\begin{cases} k_2 < \frac{1-2xt(t-1)}{4c^A} \\ k_2 \leq \frac{1+2xt(t-1)}{4c^A} - t + t\frac{x}{c^A} \\ k_2 \geq \frac{1+2xt(t-1)}{4c^A} - t \end{cases}$$

If there is an integer $k_2 \in \left[\frac{1+2xt(t-1)}{4c^A} - t, \frac{1+2xt(t-1)}{4c^A} - t + t\frac{x}{c^A}\right]$ we are done. If not, then it must necessarily be the case that $\frac{1+2xt(t-1)}{4c^A} - t + t\frac{x}{c^A} < \frac{1+2xt(t-1)}{4c^A} - t + 1$, which implies $xt < c^A$. On the other hand, the suppositions $c^A < \frac{1}{4}\left(\frac{1}{k} + 2x(k-1)\right)$ and $x < c^A$ imply

$$x < \frac{1}{4t}\left(\frac{1}{k} + 2x(k-1)\right) = \frac{1}{4tk} + \frac{(k-1)}{2t}x$$

and, therefore, $x(2t-k+1) < \frac{1}{2k}$. By the induction assumption, $k \geq \bar{k_1} \geq t$. If it were that $k = t$, the last inequality would imply $x < \frac{1}{2t(t+1)} = x_{t+1}$ and, therefore, $k \geq t+1$, a contradiction. Thus, it must necessarily be the case that $k \geq t+1$, and, hence

$$\bar{k_1} = \min\{1 + \frac{c^A}{x}, k\} \geq \min\{1+t, t+1\} = t+1$$

Therefore, we can take $k_1 = t$.

If the system had no solution, the induction argument would imply that $x < \frac{c^A}{t}$ for all natural t, a contradiction to $x > 0$. Hence, there is at least one solution, hence, equilibrium. The inequality $c^A < \frac{1}{4}\left(\frac{1}{k} + 2x(k-1)\right)$ guarantees that it is not a cheap talk equilibrium, hence, $k_2 \geq 1$.

Finally, similar to the proof of Proposition 1, we show that neither the firm nor the auditor has a profitable deviation. This is true by construction for the auditor. Let the firm of a value $v \in (b_{i-1}, b_i)$ report $r_0 \in (b_{j-1}, b_j)$, for some j. We compute the net benefit $D_0 = U^F(v, j, p_j) - U^F(v, i, p_i)$ from the deviation, which is (3). We consider the following five cases separately. Since the way of reasoning is very similar to that of the proof of Proposition 1, we only provide resulting equations and inequalities.

(a) Case $j > i > k_1$. In this case, $d_i = d_j = 4c^A$, $v < b_i \leq b_{j-1}$, so that:

$$Z_j = (1 - p_j)\Big((c^F - 2c^A + 2x) + (v - b_{j-1})\Big)$$

On the other hand, Z_i is a concave function of v. Thus, $D_0(v) = Z_j - Z_i$ is convex and, therefore, $D_0(v) < 0$ for all $v \in (b_{i-1}, b_i)$ if and only if $D_0(b_{i-1}) < 0$ and $D_0(b_i) < 0$. We will show that this is indeed the case.

Subcase (a).1. At $v = b_i, Z_i = (1 - p_i)(c^F - 2c^A)$ so that:

$$D_0 = (1 - p_i)\Big((\delta_2)^{j-i}((c^F - 2c^A + 2x) - 4c^A(j - i - 1)) - (c^F - 2c^A)\Big)$$

Considering D_0 as a function of j and denoting $D_1(j) \equiv \frac{1}{(1-p_i)}(\delta_2)^{i-j}D_0(j)$ yields:

$$D_1(j) = (c^F - 2c^A + 2x) - 4c^A(j - i - 1) - (\delta_2)^{i-j}(c^F - 2c^A)$$

One may see that $D_1(i + 1) = 0$, and $D_2(j) \equiv D_1(j + 1) - D_1(j) < 0$:

$$D_2(j) = -4c^A - (\delta_2)^{i-j-1}(1 - \delta_2)(c^F - 2c^A) < 0$$

Hence, $D_1(j) < 0$, and so is $D_0(j) < 0$.

Subcase (a).2. At $v = b_{i-1}, Z_i = (1 - p_i)(c^F - 2c^A + 2x)$ so that:

$$D_0 = (1 - p_i)\Big((\delta_2)^{j-i}\Big((c^F - 2c^A + 2x) - 4c^A(j - i - 1)\Big) - (c^F - 2c^A + 2x)\Big)$$

In a similar way, we denote $D_1(j) \equiv \frac{1}{(1-p_i)}(\delta_2)^{i-j} D_0(j)$, which yields:

$$D_1(j) = (c^F - 2c^A + 2x) - 4c^A(j - i - 1) - (\delta_2)^{i-j}(c^F - 2c^A + 2x)$$

$$D_2(j) \equiv D_1(j+1) - D_1(j) = -4c^A - (\delta_2)^{i-j-1}(1-\delta_2)(c^F - 2c^A + 2x) < 0$$

Hence, $D_1(j) < 0$, and so is $D_0(j) < 0$. Therefore, $D_0(v) < 0$ for all $v \in (b_{i-1}, b_i)$.

(b) Case $i > j > k_1$. In this case, $d_i = d_j = 4c^A$, $v > b_{i-1} \geq b_j$, so that:

$$Z_j = (1 - p_j)(c^F - 2c^A - v + b_j)$$

As in the previous case, Z_i is a concave function of v. We will show now that $D_0(b_{i-1}) < 0$ and $D_0(b_i) < 0$ so that the convex function $D_0(v) = Z_j - Z_i < 0$ for all $v \in (b_{i-1}, b_i)$. We consider two subcases.

Subcase (b).1. At $v = b_i, Z_i = (1 - p_i)(c^F - 2c^A)$ so that:

$$D_0 = (1 - p_i)(\delta_2)^{j-i}\Big(c^F - 2c^A + 4c^A(j - i) - (\delta_2)^{i-j}(c^F - 2c^A)\Big)$$

As a function of j, $D_1(j) \equiv \frac{1}{(1-p_i)}(\delta_2)^{i-j} D_0(j)$ is increasing as

$$D_2(j) \equiv D_1(j+1) - D_1(j) = 4c^A - (\delta_2)^{i-j-1}(1-\delta_2)(c^F - 2c^A)$$

$$D_2(j) = 2(2c^A - x) + \tfrac{4x^2}{c^F - 2c^A + 2x} + \big(1 - (\delta_2)^{i-j-1}\big)(1-\delta_2)(c^F - 2c^A) > 0$$

Together with $D_1(i) = 0$, this implies that $D_1(j) < 0$ for $j < i$, and, therefore, $D_0 < 0$.

Subcase (b).2. At $v = b_{i-1}$, $Z_i = (1-p_i)(c^F - 2c^A + 2x)$ so that:

$$D_0 = (1-p_i)(\delta_2)^{j-i}\Big(c^F - 2c^A + 4c^A(j+1-i) - (\delta_2)^{i-j}(c^F - 2c^A + 2x)\Big)$$

As a function of j, $D_1(j) \equiv \frac{1}{(1-p_i)}(\delta_2)^{i-j}D_0(j)$ is increasing as

$$D_2(j) \equiv D_1(j+1) - D_1(j) = 4c^A - (\delta_2)^{i-j-1}(1-\delta_2)(c^F - 2c^A + 2x)$$
$$D_2(j) = 2(2c^A - x) + (1-(\delta_2)^{i-j-1})(1-\delta_2)(c^F - 2c^A + 2x) > 0$$

Since $D_1(i-1) = 0$, this implies that $D_1(j) < 0$ for $j < i$, and, therefore, $D_0 < 0$. Thus, $D_0 < 0$ in both subcases.

(c) Case $i, j \leq k_1$. This case corresponds to the pure cheap talk model, and the result is well known: die to the single-crossing property, when the firm has no incentives to deviate locally (marginally), neither it has incentives to deviate globally. We prove it here as follows. Since $p_i = p_j = 0$, we have:

$$D_0 = \left|v - b_i + \tfrac{1}{2}d_i + x\right| - \left|v - b_j + \tfrac{1}{2}d_j + x\right|$$

Subcase (c).1. If $j > i$ and $v \leq b_i - \frac{1}{2}d_i - x$ then $D_0 = (b_i - \frac{1}{2}d_i) - (b_j - \frac{1}{2}d_j) < 0$.
Subcase (c).2. If $j > i$ and $v \geq b_i - \frac{1}{2}d_i - x$ then $D_0 = 2v - b_i + \frac{1}{2}d_i + 2x - b_j + \frac{1}{2}d_j < 2b_i - b_i + \frac{1}{2}d_i + 2x - b_j + \frac{1}{2}d_j = -(j-i-1)(2x(j+i-1) + d_1) \leq 0$.
Subcase (c).3. If $j < i$ and $v \leq b_i - \frac{1}{2}d_i - x$ then $D_0 = -2v + b_i - \frac{1}{2}d_i - 2x + b_j - \frac{1}{2}d_j < -2b_{i-1} + b_i - |\frac{1}{2}d_i - 2x + b_j - \frac{1}{2}d_j = -(i-j-1)(d_1 + 2x(i+j-3))$.
Subcase (c).4. If $j < i$ and $v \geq b_i - \frac{1}{2}d_i - x$ then $D_0 = \Big(b_j - \frac{1}{2}d_j\Big) - \Big(b_i - \frac{1}{2}d_i\Big) < 0$.
Thus, in all subcases, $D_0 < 0$.

(d) Case $i \leq k_1 < j$. In this case, $Z_j = (1 - p_j)(c^F + 2x + v - b_j + 2c^A)$, Z_i is concave in v. Hence, $D_0(v) = Z_j - Z_i$ is convex in v. Therefore, $D_0(v) < 0$ for all $v \in (b_{i-1}, b_i)$ if and only if $D_0(b_{i-1}) \leq 0$ and $D_0(b_{i-1}) \leq 0$. We will show that this is indeed the case.

Subcase (d).1. At $v = b_i$, $Z_i = \left(c^F - \frac{1}{2}d_i\right)$ so that:

$$D_0(b_i) = (1 - p_j)(c^F + 2c^A + 2x - b_j + b_i) - \left(c^F - \tfrac{1}{2}d_i\right)$$

Let us consider $D_0(b_i)$ as a function D_1 of (i, j), $D_1(i, j) \equiv D_0(b_i)$. First of all,

$$D_1(i + 1, j) - D_1(i, j) = (1 - p_j)d_{i+1} + 2x > 0$$

so that $D_1(i, j) \leq D_1(k_1, j)$. Let us consider $D_2(j) \equiv \frac{(\delta_2)^{k_1+1-j}}{c^F - \frac{1}{2}d_{k_1}} D_1(k_1, j)$:

$$D_2(j) = \tfrac{c^F + 2c^A + 2x - 4c^A(j - k_1)}{c^F - 2c^A + 2x} - (\delta_2)^{k_1+1-j}$$

Its first difference $D_3(j) \equiv D_2(j + 1) - D_2(j)$ is:

$$D_3(j) = -\tfrac{4c^A}{c^F - 2c^A + 2x} - (\delta_2)^{k_1-j}(1 - \delta_2) < 0$$

Since $D_2(k_1 + 1) = 0$, it follows that $D_2(j) \leq 0$ for $j > k_1$, and $D_0(b_i) \leq 0$.

Subcase (d).2. At $v = b_{i-1}, Z_i = (c^F + x) - |\frac{1}{2}d_i - x|$.

Subcase (d).2.1. Let $d_i \leq 2x$. Then, $i = 1, b_i = d_i, Z_i = c^F + \frac{1}{2}d_i$, so that:

$$D_0(b_{i-1}) = (1 - p_j)(c^F + 2x - b_j + 2c^A) - (c^F + \tfrac{1}{2}d_1) \equiv D_1(j)$$

First, $D_1(k_1+1) = -\frac{1}{2}(d_1 + d_{k_1}) - b_{k_1}\frac{c^F - \frac{1}{2}d_{k_1}}{c^F - 2c^A + 2x} < 0$. Second, let us consider

$$D_2(j) \equiv (\delta_2)^{k_1+1-j} D_1(k_1, j) \text{ and its first difference } D_3(j) \equiv D_2(j+1) - D_2(j)$$
$$D_3(j) = -4c^A\Big(1 - p_{k_1+1}\Big) - (\delta_2)^{k_1-j}(1-\delta_2)\Big(c^F + \tfrac{1}{2}d_1\Big) < 0$$

Hence, $D_2(j)$ is decreasing and $D_2(j) < 0$, and so is $D_0(b_{i-1}) < 0$.

Subcase (d).2.2. Let $d_i \geq 2x$. Then, $Z_i = c^F + 2x - \frac{1}{2}d_i$, so that:

$$D_0(b_{i-1}) = (1-p_j)(c^F + 2x + b_{i-1} - b_j + 2c^A) - (c^F + 2x - \tfrac{1}{2}d_i) \equiv D_1(i, j)$$

First, $D_1(i+1, j) - D_1(i, j) = (1-p_j)d_i + 2x > 0$ so that $D_1(i, j) \leq D_1(k_1, j)$. Next, we consider $D_2(j) \equiv (\delta_2)^{k_1+1-j} D_1(k_1, j)$ and its first difference $D_3(j) \equiv D_2(j+1) - D_2(j) : D_3(j) = -4c^A\big(1-p_{k_1+1}\big) - (\delta_2)^{k_1-j}(1-\delta_2)\Big(c^F - \frac{1}{2}d_{k_1} + 2x\Big) < 0$. Hence, $D_1(k_1, j) < 0$, $D_1(i, j) < 0$, and $D_0(b_{i-1}) < 0$.

Thus, in all subcases, $D_0(b_{i-1}) < 0$ and $D_0(b_i) < 0$. This implies $D_0 < 0$.

(e) Case $j \leq k_1 < i$. In this case, $Z_j = \big(c^F - v + b_j - \frac{1}{2}d_j\big)$, and $D_0(v) = Z_j - Z_i$ is strictly decreasing in v. Therefore, $D_0(v) < D_0(b_{i-1}) \equiv D_1(i, j)$ for all $v \in (b_{i-1}, b_i)$:

$$D_1(i, j) = \big(c^F - b_{i-1} + b_j - \tfrac{1}{2}d_j\big) - (1-p_i)(c^F - 2c^A + 2x)$$

Since $D_1(i, j+1) - D_1(i, j) = \frac{1}{2}(d_{j+1} + d_j) > 0$, $D_1(i, j) \leq D_1(i, k_1)$. Next,

$D_1(k_1+1, k_1) = 0$. Finally, considering $D_2(i) \equiv D_1(i+1, k_1) - D_1(i, k_1)$ yields:

$$D_2(i) = -2(2c^A - x) - 2xp_{k_1+1} - \big(1 - (\delta_2)^{i-k_1-1}\big)(1-\delta_2)\big(c^F - \tfrac{1}{2}d_{k_1}\big) < 0$$

Hence, $D_1(i, k_1) < 0$, $D_1(i, j) < 0$, and $D_0 < 0$.

Combining the above five cases (a)-(e) we conclude that $D_0 < 0$ for all $i \neq j$ and $v \in (b_{i-1}, b_i)$. This implies that the firm of any value (except a zero measure of marginal values) is strictly better-off by reporting a value from the same an interval which it's true value belongs to. This ends the proof. □

Proof of Proposition 3 is in the main text.