

An equilibrium analysis of optimal audit contracts*

NAHUM MELUMAD *Stanford University*

LYNDA THOMAN *Purdue University*

Abstract. The nature of optimal equilibrium contracts for auditors hired by firms to certify the validity of firms' financial reports is studied in this paper. Financial reports may affect the interest rates at which firms can borrow funds; hence, without auditing, firms might be inclined to present favorable, if not altogether accurate, financial information. We observe that an optimal audit contract that allows auditors' contracts to be contingent on the audit report can take different forms depending on the parameter values; only in rare cases is an optimal contract independent of the audit report. Specifically, in some cases, an optimal contract is characterized by a payment for a favorable report that is larger than the payment for an unfavorable report. In other cases, the conclusion is reversed. We note, in contrast to the spirit of agency models, that an audit contract need not function in equilibrium as a motivational device inducing the auditor to work; in some cases, it serves as a means to transfer signaling costs from low-risk firms to high-risk firms. We also provide a rationale for mandating noncontingent audit contracts. In some circumstances equilibria in which auditing is informative cannot exist when contingent contracting is allowed; once contracts are required to be noncontingent, however, there exist equilibria in which auditing is informative.

Résumé. Les auteurs étudient la nature des contrats d'équilibre optimaux relatifs aux services de vérificateurs visant l'attestation de la validité des états financiers des entreprises. Les rapports financiers peuvent influencer sur les taux d'intérêt auxquels les entreprises peuvent emprunter; sans la vérification, les entreprises pourraient donc avoir tendance à présenter de l'information qui leur est favorable, faute d'être absolument exacte. Les auteurs remarquent qu'un contrat de vérification optimal conditionnel au contenu du rapport du vérificateur peut revêtir diverses formes, selon la valeur des paramètres; ce n'est qu'en de rares cas que le contrat optimal n'est pas conditionnel au rapport des vérificateurs. De façon spécifique, la rétribution est parfois plus élevée pour un rapport favorable que pour un rapport défavorable. Dans d'autres cas, c'est le contraire qui se produit. Les auteurs notent que contrairement au principe des modèles mandant-mandataire, il n'est pas nécessaire que le contrat de vérification se trouve en situation d'équilibre pour servir à la motivation du vérificateur; dans certains cas, il sert de mécanisme de transfert des coûts « indicateurs » des entreprises présentant un faible risque aux entreprises ayant un

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risque élevé. Les auteurs exposent également les principes de l'adjudication de contrats de vérification non conditionnels. Dans certains contextes, les équilibres pour lesquels la vérification est informative ne peuvent exister si l'on permet que les contrats soient conditionnels; dès qu'on exige que les contrats soient non conditionnels, cependant, on obtient des équilibres pour lesquels la vérification est informative.

Introduction

Recently the Federal Trade Commission has forced the accounting profession to reexamine and defend its long-standing ban on contingent fees. This has renewed the debate among accountants regarding the appropriate structure for their fees.¹ To facilitate a normative discussion of the merits of the arguments for and against contingent fees, we believe an understanding of the nature of "optimal" audit contracts is necessary. In this paper, we embed the auditor-client relationship in a market setting and investigate the properties of optimal audit contracts, taking into account market interactions among firms, auditors, debt suppliers, and the courts.

The main results emerging from this study, which allows the audit contracts to depend on the audit report, are the following:

- 1 An optimal audit contract can take many forms. In some cases, the payment for reporting the firm to be a low-risk firm exceeds the payment for reporting the firm to be high risk; in other cases, the opposite relationship occurs. Only in rare cases would a flat contract emerge as the optimal contract. The nature of the optimal audit contract critically depends on the specification of the off-the-equilibrium-path beliefs. If these beliefs change, a new equilibrium contract with a different structure emerges.
- 2 In equilibrium, an optimal audit contract need not function as a motivational tool inducing the auditor to work; rather, it might serve as a device to transfer signaling costs from low-risk firms to high-risk firms (or more generally, from those firms that must incur signaling costs to separate themselves from firms mimicking their type to the group of mimics).

The paper also discusses a possible rationale for the observed requirement of noncontingent fees for audit services.

Most studies of contracting in the accounting literature have assumed the agency paradigm.² The analysis of optimal contracts in a market setting differs in some important ways.³ First, in a principal-agent setting, when the principal tries to minimize the costs of motivating the agent to take the desired action, the effect

1 The ruling banning contingent audit fees is outlined in AICPA (1989, ET §302.01, p. 4681). For recent news articles on this topic, see "Accounting Group to Consider Dropping Ban on Contingent Fees and Commissions," *The Wall Street Journal* (August 25, 1988), and "Nation's Accountants Vote to End Bans against Certain Fees and Commissions," *The Wall Street Journal* (August 31, 1988).

2 See, for example, Antle (1982), Baiman, Evans, and Noel (1987), and Baiman, Evans, and Nagarajan (1988), who study contracting between a firm owner and an auditor in an agency framework.

3 Other papers studying auditing in a market setting, but which model the auditor as a mechanistic monitor, are Titman and Trueman (1986) and Datar, Feltham, and Hughes (1987). Obviously, in these settings the question of optimal contracts is moot.

of the agent's alternative actions outside the agency relationship is exogenously specified. In contrast, our model includes players who are not parties to the contract, yet their actions and beliefs affect the nature of the optimal action as well as the optimal audit contract. The optimality of an action and a contract can be judged only after taking into account the equilibrium strategies and beliefs of all players. Changing an auditor's contract, in addition to affecting his action choice, influences other players' choices and beliefs. A priori, it is not clear what auditor's action is the desired equilibrium action. Second, in the agency setting, the principal and the agent, the two parties to the contract, are antagonists; the principal wants the agent to work while the agent prefers to shirk. In a market setting, the firm and the auditor may not have conflicting interests; if the firm can get the report it desires without the auditor working, then neither party would want the auditor to work.

Our setting includes firms of different risk types that need funds to carry out profitable projects. Both the owner and manager of the firm are assumed to want to maximize the firm's revenues. Thus, any agency problem within the firm is suppressed so that we can focus on the firm's interactions with parties external to it. Lenders of capital are willing to make loans at an individualized interest rate reflecting their beliefs about the borrowing firm's degree of risk. Since at this stage a firm has no means to provide credible information about its risk type to creditors, all firms would pay interest rates reflecting the average risk; consequently, some of the less-risky firms may seek an opportunity to signal their risk levels. We assume that auditing is the only mechanism that firms can use to differentiate themselves. When employing an auditor, the firm offers a contract that specifies the payment to the auditor as a function of the audit report. In designing the audit contract, the firm takes into account (1) the auditor's beliefs as to the firm's type when it offers that particular contract, (2) the action the firm wants the auditor to take—work at discovering the firm's true risk type and then report truthfully; shirk and report the firm as a low risk, or shirk and report the firm as a high risk, and (3) the least cost contract for inducing the desired action, given the auditor's beliefs.

In our model, no firm is required to hire an auditor. The hiring decision is a strategic choice. This framework allows us to consider a setting in which demand for auditing arises endogenously, rather than through exogenous regulation. As shown by Melumad and Thoman (1990), mandated auditing is a special case of the nonmandated audit setting. Thus, the results in this paper also hold for an environment in which auditing is mandatory. Furthermore, most firms filing quarterly data with the SEC involve their auditors even though it is not required.

Without a court system in our model, no contract can induce the auditor to work, and the audit reports would be uninformative; we label such auditors *ineffective*. Thus, we add a court system that can be used by firms and/or lenders to sue an auditor perceived to have provided inaccurate information. In this setting, the different audit actions involve distinct expected legal costs

for the auditor, depending on the auditor's beliefs as to the type of firm being audited. For example, if the auditor believes he is auditing a high-risk firm, he may fear that he will be sued successfully by the lender if he reports the firm to be low-risk. Thus, in constructing the least cost contract to induce the auditor to take a particular action, a firm must take into account the auditor's expected legal risks. It is conceivable that, if he were to ignore the monetary incentives of the contract, the auditor, given his beliefs and his expected legal threats, would maximize his utility by working and reporting truthfully.

With the addition of the court system, we find that there exist many equilibria in which an auditor is employed by every firm, works hard at uncovering the truth about the firm's risk type, and reports findings truthfully; we label such auditor *effective*. For a given set of parameter values, however, there may be many optimal equilibrium contracts supporting an effective auditing equilibrium. With each perturbation of the auditor's beliefs about the contracts not offered in equilibrium, a different equilibrium contract is possible. Some of these contracts give the auditor more than his market alternative, some specify large payments for a low-risk report, and others promise small payments for a low-risk report.

Consider the following restriction on an auditor's beliefs about contracts not offered in equilibrium: If a low-risk firm would benefit from offering an off-the-equilibrium-path contract every time a high-risk firm benefits, the auditor cannot believe that only a high-risk firm would offer the contract. By imposing this simple type of restriction on beliefs, we are able to (1) find a unique equilibrium contract, (2) demonstrate that the auditor earns exactly his market alternative, and (3) show that there cannot exist equilibria in which auditors are hired but no information is provided about the firms' types by either the auditor or the court system. The shape of the optimal equilibrium contract is largely determined by the actions of the low-risk firms and depends critically on the legal threats the auditor faces. Sometimes the legal threats are not sufficient to motivate the auditor to work and be truthful. In such cases, if the auditor is to be induced to work, the contract must provide the proper incentives. Of more interest are cases in which legal threats by themselves are sufficient to induce the auditor to work. In these cases, the contract designed by the low-risk firms serves as a device for transferring some of their signaling costs to the high-risk firms. The signaling problem is caused by high-risk firms trying to mimic low-risk firms; hence, for these equilibria, the contract is used to assign the signaling costs more "fairly."

In our model, all projects are socially desirable in that they would be pursued even if lenders observe the risk characteristics of the different firms. This setting assumes that the auditor's role is to facilitate the credible communication of the firms' private information and to transfer some of the signaling costs and risk premiums from good to bad firms. An alternative modeling approach would assume that high-risk projects are pursued if loans are priced according to the average risk but not if the true risk is observed. In this case, the auditor screens out socially undesired projects. We have chosen the former modeling alternative

since we believe it is descriptive of a large portion of audits. We expect, however, our results regarding the differential nature of equilibrium contracts to hold for the alternative model.

In our model, the normative criterion for ranking alternative contractual arrangements is *ex post* fairness (i.e., the extent to which the resulting payoffs approximate perfect observability payoffs).⁴ Clearly in our world, a purely utilitarian regulator would find it desirable to prohibit auditing altogether because this would minimize the dead-weight losses associated with the audit. Similarly, prior to observing their types, firms would prefer not to have audit possibilities.⁵ One might argue, however, there exists no credible mechanism enabling firms to commit *ex ante* not to use a signaling opportunity once they learn their type.⁶

Three recent papers studying audit contracts in settings other than the agency framework are Sarath and Wolfson (1989), Dye, Balachandran, and Magee (1987), and Bachar and Darrough (1989). Sarath and Wolfson study strategic auditing in a framework characterized by the "market for lemons" phenomenon. In their model, the auditor's optimal contract is a flat fee; the optimality of this contract, however, depends on firms not knowing their types at the time of contracting with their auditors. Dye et al. consider the auditing profession's preferences with respect to contingent contracting. They conclude that auditors would not want payment to be conditioned on the report since contingent contracting causes distortions in reporting which, in turn, reduces expected payments to the auditors. Bachar and Darrough allow for a continuum of firm types and exogenous specification of the value of a particular report to a firm. They compare the equilibria that emerge when contracts are restricted to be flat to the equilibria emerging when linear contingent contracts are allowed; they demonstrate that the introduction of contingent contracts may lead to improvements in audit efficiency.

This paper proceeds as follows. In the next section, we present the model and discuss the game among the firms, auditors, creditors, and the court system. Next we analyze the equilibria of the game. Using the sequential equilibrium as our equilibrium concept, we first demonstrate the existence of pure strategy sequential equilibria in which the auditor is effective and note the multitude of optimal contracts that are possible for a given set of parameter values. By imposing a restriction on the off-the-equilibrium-path beliefs, we derive then the unique equilibrium contract. We identify parameter values for which the contingent contract is used to motivate the auditor to work as well as parameter values

4 Melumad and Thoman (1990, hereafter referred to as M-T) use a model similar to the one of this paper to address some welfare issues; in particular, they address the effect of changing the legal damages assessed, the auditor's market alternative, and the quality of the audit.

5 Note that the same issue arises in virtually all signaling models of this sort (including the classic Spence (1973) education model).

6 Even if a commitment device exists, its credibility might be questioned if other players cannot observe whether the firm has already been informed about its own type.

for which the audit contract is used to transfer signaling costs from the low-risk firm to the high-risk firm. Finally, we examine possibilities for “bribing” the auditor when contingent contracting is allowed. The next section discusses some extensions of the model: the impact of changing the court’s technology, allowing for multiple firm types, and additional signaling opportunities. A discussion of a possible rationale for the ban on contingent audit contracts concludes the paper. Appendix A provides a summary of the notation, and the proofs of the results are in Appendix B.

The model

We assume there exists a set of firms each having access to a single project expected to generate monopoly profits. It costs N dollars to undertake a project. No firm has internal resources to invest but can obtain loans in the credit market.

If a firm’s project is successful, the firm earns R dollars; an unsuccessful project causes bankruptcy. Not all firms are equally likely to succeed. The probability of remaining solvent divides firms into two risk classes: a fraction t of the firms are low-risk or “good” (G) and are solvent with probability p_G ; the remaining $(1 - t)$ firms are high-risk or “bad” (B) and are solvent with probability p_B where $p_G > p_B$. This distribution of firms across risk classes is commonly known, but only the firm itself knows its own risk class.

The debt market is competitive; hence, given that r is the risk-free rate of interest, lenders expect repayment of $(1 + r)$ for every dollar lent.⁷ We set $r = 0$ with no loss of generality. The exact interest fee that a firm is expected to pay when it is solvent depends on a lender’s assessment of the firm’s probability of bankruptcy. We assume that every firm wants to undertake its project, independent of the lender’s assessment. In particular, firms are assumed to be risk neutral, and the expected return on any project exceeds its costs even if lenders know that the firm is “bad.”

In this simplified setting, low-risk firms cannot credibly differentiate themselves from high-risk firms (i.e., a high-risk firm can claim to be of the low-risk class with no fear of detection).⁸ Thus, some firms may wish to hire auditors to attest (with some level of accuracy) to their true risk type. In assuming that all projects are profitable even when borrowing costs accurately reflect the firms’ probabilities of bankruptcy, we have eliminated any role for the auditor to improve social welfare. Thus, our model is in the spirit of Spence (1973) in which

7 Given the simple return structure and the assumption of competitive capital markets, debt or equity financing of the project would lead to the same payments being made to the creditor. Hence, assuming that the project is funded via a loan is without any loss of generality in our model.

8 The only publicly observed variable on which potentially separating contracts could be conditioned is the firm’s financial condition at the end of the period (i.e., R or 0). Any contract specifying a nonpositive payment in the bankrupt state and a positive payment when solvent is strictly more costly for the good than the bad firm. Since all feasible contracts must be of this form, it is impossible to find a contract that is strictly more costly for the bad than the good firm. For a more detailed discussion of this point, see M-T.

the signal allows types to be differentiated but does not cause any participant to be eliminated from the market. This modeling seems relevant to a large portion of all audits when the audit report provides information used by creditors to set the terms of the loan.

When a firm employs an auditor, the firm provides the auditor with confidential financial information about its risk characteristics. In our simplified framework, this information is the claim or message that it is of the low- or high-risk class. Since bad firms want to pass as good ones, we assume that all firms claim to be in the low-risk class.⁹ The auditor, in turn, investigates the firm's message and subsequently issues a public report as to the firm's risk class. We call the output of the auditor's investigation the auditor's *findings* and say the auditor is *truthful* when the report duplicates the findings. The term *findings* is not meant to describe the auditor's work papers or any other real-world institution but is a semantic label useful in describing the audit technology.

The auditor is assumed to be a risk-neutral, utility-maximizing agent who strategically decides (1) whether to work hard in his investigation of the firm's claim and (2) the type of report to issue. If the auditor works and the firm has misrepresented its type, the auditor's findings contradict the firm's message with probability z , $0 < z < 1$. Thus, there is some probability that the auditor will not detect a false claim even when he works. If the firm is honest, no error exists for the auditor to detect; hence, his findings are identical to the message. Finally, if the auditor shirks, he learns nothing, and his findings again duplicate the firm's message.¹⁰ The mechanics of this audit technology are assumed to be commonly understood.

The assumption that the auditor investigates a message sent by the firm plays no immediate role in this model because we constrain the message to be of a single type. This modeling, however, is descriptive of the audit process in which the firm provides its auditor with financial statements that the auditor is to audit. This modeling also justifies our assumption that auditors make only type II errors. An auditor may discover a discrepancy in a firm's financial statements and persuade the firm to make a correction, but it is unlikely the auditor could convince the firm to change a correct statement to a false one.

The auditor's market alternative is $K^* - x$, where x is the personal cost of effort; thus, if the auditor works, he expects payment of K^* dollars.¹¹ To simplify

9 The message or claim that a firm sends its auditor is an equilibrium choice. In this paper, we assume that all firms claim to be good to simplify the model. M-T, in a framework similar to the one of this paper, show that all firms send the identical "good" message in equilibrium as long as auditing is moderately accurate. If the number of firm types is larger than two, however, we can no longer assume that all firm types would want to claim to be the best or least risky type. This issue is briefly discussed in a later section.

10 This assumption is consistent with the definition of audit risk adopted by the AICPA: "This definition of audit risk does not include the risk that the auditor might erroneously conclude that the financial statements are materially misstated. In such a situation, he would ordinarily reconsider or extend his auditing procedures. . . . These steps would ordinarily lead the auditor to the correct conclusion (AICPA (1989) AU§312.02, pp. 231-237).

11 A legend for the notations used throughout the paper is provided in Appendix A.

the notation, but with no loss of generality, we normalize the auditor's utility with zero payment and no effort exerted to equal x ; thus an auditor willing to be employed must expect to have K^* units of utility after being employed whether he works or shirks. The auditor is paid immediately after issuing his report. The firm must borrow all audit fees since it does not have any resources of its own.

When a firm employs an auditor, the firm specifies the terms of the audit contract. We allow the contract to be conditioned on the contents of the audit report.¹² Thus, a contract specifies two payments, one to be made if the report is good and a second if the report is bad. Letting K_i be the fee paid to the auditor when his report is i ($i = g(b)$ stands for a good (bad) report), a contract C between a firm and its auditor can be represented as the pair (K_g, K_b) . The contract between the firm and its auditor is not publicly observable.¹³

The contract offered by a firm may provide the auditor with information as to the type of firm he will be auditing (i.e., for each possible contract, the auditor has beliefs as to the probability a firm offering that contract is good). Let $c = c(C)$ be the function specifying those beliefs for an auditor. Note that these beliefs may affect the auditor's strategic choices; in turn, firms anticipate auditors' beliefs when selecting a contract.

Similarly, lenders have beliefs about a firm's type depending on its audit choice and the report when audited. Let g , b , and n represent lenders' probability assessments that a firm is good when the firm gets a good, bad, and no report, respectively. The size of the loan cannot affect lenders' beliefs.¹⁴ Letting Q_j be the interest factor for a firm thought to be good with probability j , the competitive debt market assumption implies:

$$Q_j = \frac{1}{jp_G + (1-j)p_B}, \quad j = g, b, n.$$

Note that firms' decisions to employ an auditor will be affected by their perceptions of lenders' beliefs.

Since working is costly for the auditor, absent any litigation threats, it is impossible for firms to construct contingent contracts that induce their auditors

12 The only other commonly observed variables are (1) the firm's financial position at the end of the period and (2) any litigation results. For simplicity, we ignore these variables in the contract, but we argue they would not be relevant in the equilibria we derive in the fourth section. That section demonstrates that a good firm has the power to set the contract and would never want a nonpositive payment to be made in the case of bankruptcy. Thus, the optimal contract would specify no payment when the firm is bankrupt. Conditioning payment on the outcome of a good firm's suit against its auditor could be accounted for in this model by changing the size of the damages collected.

13 We therefore avoid the issue of firms signaling their types to lenders via their choices of audit contracts. We discuss the implications of relaxing this assumption in the fourth section.

14 We assume that the debt market is perfectly competitive. Thus, a firm can borrow money in any increment and disguise the amount it truly needs by applying to several lenders and/or lending out any excess funds. We discuss the implications of relaxing this assumption in the fourth section.

to work, and, if auditors shirk, their reports cannot be informative.¹⁵ Thus, we introduce a court system that a lender, or the firm itself, can use to sue an auditor thought to have issued an incorrect report. The threat of third-party suits produces equilibria in which the audit report is informative.

When an auditor is sued, the court looks for discrepancies between the audit report and the firm's true type. Courts, however, are not infallible. If the audit report is accurate, the court's findings agree with the report, but if the audit report is incorrect, the court will sometimes uncover the mistake. Thus, paralleling the audit technology, courts look for errors in a document, and only if a mistake is there can one be uncovered. The probability the court will find the error, however, depends on whether the auditor shirks or works, and when the auditor works, whether he truthfully reports his findings. We assume it is easier for the courts to find mistakes when the auditor shirks or misrepresents his findings than it is when the auditor works and reports truthfully. Letting y_w be the probability of the court uncovering an error in the report when the auditor works and reports his findings truthfully, and letting y_0 be the probability given any other auditor action, we assume $0 < y_w \leq y_0 < 1$.¹⁶ The impact of modifications in this court technology is discussed further in the fourth section.¹⁷ Finally, it is assumed that there is no moral hazard on the part of the court since the litigation proceedings and the court's verdict are open to public scrutiny.

When the court discovers an error in the audit report, the auditor is assessed a penalty that is paid to the plaintiff, the size of which may depend on the nature of the case. If a lender sues an auditor and wins, a monetary award of A_1 is paid by the auditor to the lender; if a firm successfully sues its auditor, the award is A_2 . In addition to paying the damage award, the auditor may face criminal charges and/or public dishonor when he is sued successfully. Let D_1 represent the cash equivalent of the pecuniary damages (i.e., A_1) plus the nonpecuniary damages the auditor suffers if he loses to a lender, and let D_2 be his total damages (i.e., A_2 plus nonpecuniary damages) if he loses to a firm. If the court does not uncover an error, no penalties or awards are assessed. Throughout the paper, we assume the loser pays all litigation expenses, L . Finally, once a case is tried, the judgment is final; no party can appeal the court decision.

Courts hear cases only if a party can claim to have been damaged; the damage-assessment concept we adopt is an ex post one. Hence, if a firm receives a favorable report and then goes bankrupt, the lender has grounds for claiming

- 15 Even if firms could perfectly observe the auditor's work choice and condition payment to their auditors on whether they worked, in addition to the report, firms would not induce their auditors to work. Whatever report type a firm desires, it can get it more cheaply from a shirking auditor. Thus, although a firm could force its auditor to work via the contract, this would not be an equilibrium choice.
- 16 As alluded to in the text, the technology for the courts is similar to the technology of the auditors; in both cases, the investigator tries to find an error in the information he is presented (i.e., in the report or in the claim).
- 17 See the fourth section for a discussion of the court technology and the concept of due diligence.

damages. The lender could not claim to be damaged if he were repaid. Note that lenders never sue firms since a firm has no resources when there are grounds for a suit; thus, lenders turn to auditors. However, since the audit fee must give the auditor at least his market alternative, any expected damage payment will be reflected in the promised payments in the audit contract. If firms did have resources and could be sued directly, this would reduce the bad firms' incentives to hire auditors and attempt to pass as good firms.

The firm itself may also have cause for suing its auditor if it believes the report does not represent its true risk type (i.e., if an audit report causes the good firm to pay the higher interest rate, the good firm can claim to have suffered damages). No firm would have grounds to sue if it paid the lower interest rate. One may claim that the assumption that firms taking legal action against their auditors is not descriptive of reality; however, these threats will be relevant in our equilibria only as off-the-equilibrium-path behavior. Thus, our model is consistent with the nonobservance of firms suing their auditors.¹⁸

If a firm sues its auditor, a lender can condition payment on the outcome of the court case since the court's proceedings are public. Let the subscripts jk ($j, k = g, b$) represent lenders' beliefs that a firm with a j -report and a k -ruling is good. Thus, there are prices Q_{jk} in addition to prices Q_j ($j = g, b, n$), which are charged firms that have not sued their auditors. Since we are interested only in effective-auditing equilibria, the new prices Q_{jk} are off-the-equilibrium-path prices and can easily be specified in a manner to support the equilibrium.

The time line for the model is as follows:

- 1 Anticipating lenders' and auditors' beliefs and actions, each firm decides whether to hire an auditor and the form of the contract if one is hired.
- 2 Given his beliefs as to the type of firm that would offer the specified contract, the auditor makes his work and reporting choices. If the auditor chooses to work, he updates his beliefs regarding the firm's type and computes the probability of being sued before making his report selection.
- 3 The auditor issues his report.
- 4 Given the report and the anticipated loan prices, the firm decides whether to sue its auditor. If the auditor is sued and found guilty, he pays damages to the firm.
- 5 A lender forms beliefs as to the probability that the firm is good conditioned on the firm's hiring decision, the auditor's report, the firm's suit choice, and the court's findings. The lender then prices the loans for firms using the appropriate interest factor. Firms get their loans and pay their auditors.

18 We adopt the above limitations on the types of suits heard by the courts to (1) reflect reality, (2) prevent the courts from being used as a signaling mechanism, and (3) simplify the exposition. Limiting suits to cases in which there are ex post damages simplifies the exposition by making the auditor the sole defendant in a court case. This allows us to avoid questions of how damage payments are to be split between a firm and its auditor. In M-T, we allowed damages to be assessed ex ante; the spirit of the results is unaffected by these assumptions.

- 6 The project is carried out, leaving the firm either solvent or bankrupt; the lender is repaid if the firm is solvent.
- 7 If the firm is bankrupt after having received a good report, the lender decides whether to sue the auditor.
- 8 If the lender initiates a suit, the court conducts an investigation, and legal fees and damages are assessed appropriately.

Equilibria of the model

Equilibrium concept

Our equilibrium concept is that of the sequential equilibrium, a refinement of the Nash equilibrium, developed by Kreps and Wilson (1982). A sequential equilibrium, in addition to specifying a strategy for each player, includes a system of beliefs. For the beliefs and strategies to form a sequential equilibrium, the following are required:

- 1 *Sequential rationality*: Starting from each information set, the strategy of each player must be optimal for the remainder of the game, assuming that the player is evaluating the payoffs according to his beliefs over the nodes in that information set and over his expected strategies for the other players in the game, and
- 2 *Consistency*: Beliefs are consistent with the hypothesized equilibrium strategies and satisfy Bayes' rule whenever it applies.¹⁹

In our analysis, we restrict attention to pure strategy equilibria. Our goal is to gain insights into the nature of optimal audit contracts rather than characterize all possible equilibria. Obviously, allowing mixed strategies would add new equilibria but would not eliminate those identified here.²⁰ We focus on pure strategy equilibria in which all firms hire auditors. Such pure strategic equilibria represent the only effective auditing equilibrium class prevailing under mandated audit.

Sequential equilibria and optimal audit contracts

In deciding whether to hire an auditor, the firm compares the benefits it would receive through a reduction in its borrowing expenses with the costs of employing the auditor. Alternative audit contracts, however, may change the benefits and costs associated with hiring the auditor. The benefits are a function of the particular auditor's action induced by the contract, while the costs are directly specified by the contract. Thus, before determining whether the firm wishes to hire an auditor, it first must determine the best contract to motivate each possible

19 The consistency requirement in Kreps and Wilson (1982) also includes some technical constraints on the off-the-equilibrium-path beliefs. In this model, however, these technical constraints impose almost no restrictions on the beliefs that one can assume. A sequential equilibrium differs from the familiar Bayesian-Nash equilibrium in that (1) beliefs are defined for every information set, including those that may not be reached along the equilibrium path, and (2) strategies must be optimal starting from *any* information set.

20 For a characterization of alternative equilibria, including mixed strategy equilibria, which emerge in a similar setting, see M-T.

auditor action (when it is possible to motivate that action). The optimal contract and optimal auditor action are then jointly determined.

Consider the auditor's expected utility as a function of his action choices. With the addition of a court system, it is clear that the auditor's utility will depend on the amount of litigation initiated by firms and lenders. Assume that both firms and lenders sue their auditors when they can claim to have been damaged. Later we will confirm the existence of parameters that induce these suits and cause firms to structure their contracts so as to motivate their auditors to work. The following table gives the auditor's expected utility when the contract $C = (K_g, K_b)$ is offered; $c = c(C)$ represents the auditor's beliefs as to the probability that the firm offering this contract is good, and both lenders and good firms sue when damaged:

TABLE 1

Auditor's expected utility with litigation threats (given lenders sue the auditors when the report is good and firm is bankrupt, and good firms sue the auditors when the report is bad)

Action	Expected utility
(1) Work and report actual findings	$[c + (1 - c)(1 - z)]K_g + (1 - c)zK_b - (1 - c)(1 - z) \times (1 - p_B)y_w(D_1 + L)$
(2) Work and report opposite of findings	$[c + (1 - c)(1 - z)]K_b + (1 - c)zK_g - (1 - c)z(1 - p_B) \times y_o(D_1 + L) - cy_o(D_2 + L)$
(3) Work and report good	$K_g - (1 - c)(1 - p_B)(1 - z)y_w(D_1 + L) - (1 - c) \times (1 - p_B)zy_o(D_1 + L)$
(4) Work and report bad	$K_b - cy_o(D_2 + L)$
(5) Shirk and report good	$K_g - (1 - c)(1 - p_B)y_o(D_1 + L) + x$
(6) Shirk and report bad	$K_b - cy_o(D_2 + L) + x$

Given that the auditor is liable, it is possible to motivate him to work and report his findings. Hence, for some parameter values, auditors provide useful information about firms' risk classes.

Proposition 1: When litigation is possible, for some parameter values there exist sequential equilibria in which auditing is effective. These equilibria are characterized by the following strategies: (1) all firms hire auditors, (2) auditors work and truthfully report their findings, (3) a lender sues an auditor whenever a firm with a good report is bankrupt, and (4) off-the-equilibrium path, a good firm, but no bad firm, sues its auditor if it gets a bad report.

Proof: See Appendix B.

What parameter values and off-the-equilibrium-path beliefs induce firms to pick contracts that motivate auditors to work and honestly report their findings? Assume that the unique equilibrium contract is $C^* = (K_g^*, K_b^*)$; to be consistent $c = c(C^*) = t$.²¹ First, for the firm to be willing to hire the auditor, the personal cost of effort, x , must be relatively small. Second, an auditor must believe that

21 We have not eliminated the possibility that more than one contract might be offered in equilibrium; since we are only trying to demonstrate the existence of a pooling effective auditing equilibrium, we assume a unique contract to simplify the exposition.

any firm trying to motivate him to always issue a good report with a contract different from C^* is a bad firm; specifying the off-the-equilibrium-path beliefs to include the belief that anyone offering a contract other than C^* is truly bad accomplishes this goal. Third, a bad firm must not want to "bribe" the auditor to always give it a good report. By offering a contract other than C^* , the bad firm identifies itself as a high-risk firm; however, if firms need to borrow large sums, N , relative to the expected damages the auditor incurs when found guilty by the courts, D_1 , it may be to a bad firm's advantage to reveal itself to its auditor as bad and "bribe" the auditor to always report it to be a good firm. The auditor will require the bad firm to pay him enough to cover all legal costs associated with reporting a bad firm as good, but if N is large relative to D_1 , the bad firm may wish to offer such a contract. Restricting the size of N relative to D_1 eliminates any incentives to bribe the auditor. Finally, when comparing the payments K_g^* and K_b^* , neither must be so large that the auditor always wants to shirk and just report the firm as good or bad.

Although the above restrictions ensure that the optimal contract will induce the auditor to work, will firms want to hire auditors, and will auditors be willing to accept the contract? Since the auditor is working, the benefits from hiring him are certain; the costs depend on K_g^* and K_b^* . These payments must be large enough that the auditor ends up with K^* when he expects to incur litigation damages D_1 . Thus, K^* must be small and D_1 not too large.

Finally, what parameter values induce the litigation assumed above? If litigation costs, L , are small relative to the lender's and firm's damage awards, A_1 and A_2 respectively, then the required suits will occur.²² We demonstrate in Appendix B that there exist sets of parameters that satisfy all of the above requirements.

From the above discussion and the observations made in the prior section, we conclude that perfect separation is not possible even with litigation threats. If firms were separated with only good firms employing auditors, a lender would never sue. An auditor can always minimize his costs and avoid being sued by the firm via shirking and issuing the report associated with the lower interest factor. But since the auditor is shirking, a bad firm would also want to hire the auditor.

Corollary 1: When litigation is possible, separating contracts for the firms is not feasible.

Corollary 1 implies that the only pure strategy, effective auditing equilibria are those in which all firms have auditors.

22 Although we argued above that litigation is necessary for auditing to be effective in equilibrium and the proposition states that both lenders and good firms sue, we note that suits by firms are not necessary. By making K_g^* large enough to cover the expected value of the auditor's damage expenses plus his market alternative, and setting K_b^* equal to the auditor's market alternative, effective auditing equilibria can exist. On the other hand, litigation threats by lenders are necessary; without them, the bad firm would always want to bribe its auditor to give it a good report.

Corollary 2: Proposition 1 identifies the only class of pure strategy, effective auditing equilibria.

In the above discussion, the only restriction imposed on the contract is that neither K_g^* nor K_b^* must be so large as to motivate the auditor to always report good or bad. Therefore, it is evident that numerous different contracts are consistent with an effective auditing equilibrium. For example, suppose $C^* = (\hat{K}, \hat{K})$ is the optimal contract, $c(C^*) = t$, and auditors believe that a firm offering any other contract is truly bad. Consider the contract $\hat{C} = (\hat{K} + \epsilon, \hat{K} + \epsilon)$. The beliefs $c(\hat{C}) = t$ and any other contract that indicates the firm is bad are also consistent with a similar effective auditing sequential equilibrium for some $\epsilon > 0$ and the same set of parameter values as above. Thus, the equilibrium contract can generate above normal profits for the auditor that “competitive forces” cannot bid away. Similarly, the belief $c(\hat{K} + \epsilon_1, \hat{K} - \epsilon_2) = t$, for appropriately chosen ϵ_1 and ϵ_2 , $\epsilon_1, \epsilon_2 > 0$ (or $c(\hat{K} - \epsilon_3, \hat{K} + \epsilon_4) = t$, for appropriately chosen ϵ_3 and ϵ_4 , $\epsilon_3, \epsilon_4 > 0$) and the beliefs that all other contracts indicate the firm to be bad give rise to an effective auditing equilibrium.

The problem with the sequential equilibrium concept in this model lies in the tremendous power possessed by off-the-equilibrium-path beliefs. In fact, off-the-equilibrium-path beliefs dictate the nature of the equilibrium contract. In addition, the off-the-equilibrium-path beliefs that sustain some equilibria and their equilibrium contracts do not seem justifiable. In the above illustration, to sustain the contract $\hat{C} = (\hat{K} + \epsilon, \hat{K} + \epsilon)$ as the equilibrium contract requires believing any firm that offers the contract $C^* = (\hat{K}, \hat{K})$ is bad, but is it reasonable to believe that only a bad firm would offer a cheaper contract when all firms would benefit from doing so? A final unappealing feature of the sequential equilibrium definition in this model is that equilibria in which the auditor’s expected utility exceeds his market alternative cannot be ruled out even though auditors operate in a competitive market. We address these problems next.

Calculated beliefs equilibria and optimal audit contracts

To limit the number of equilibrium contracts, we introduce a simple, plausible restriction on the beliefs that players hold off-the-equilibrium-path. This refinement, which we name *calculated beliefs*, first limits the auditor to earning exactly his market alternative, and second, results in a unique equilibrium contract for each set of parameters.

We proceed by defining the belief refinement. We show that a single contract is offered in equilibrium except for a knife-edge set of parameters. This allows us to prove that the auditor earns exactly his market alternative. We next demonstrate that calculated beliefs give the good firm power to dictate the form of the contract; in particular, the unique calculated beliefs, effective auditing contract specifies the smallest feasible payment for a good report that induces the auditor to work. Thus, we are able to examine the shape of the contract and the manner in which it facilitates the equilibrium. When examining the equilibrium, we also

explore the impact of restricting the contract to a constant payment. Finally, we discuss the case in which flat contracts might allow effective auditing equilibria to exist where contingent contracts would not.

Consider the following restriction on beliefs held by players off-the-equilibrium-path. In determining beliefs for an action not taken or a contract not offered in equilibrium, the utility of the good and bad firm when taking the off-the-equilibrium-path action or offering the off-the-equilibrium-path contract is computed for all possible beliefs and optimal responses to those beliefs. This utility is then compared to each firm type's equilibrium level of utility to derive the set of beliefs for which each firm type would be better off deviating to the off-the-equilibrium-path action or contract. If it is observed that for all beliefs where the bad (good) firms would want to deviate, the good (bad) firms would also want to deviate, off-the-equilibrium-path beliefs cannot be below (above) the player's priors. Beliefs satisfying these conditions will be called *calculated beliefs*.²³

This belief refinement prevents one from adopting arbitrary off-the-equilibrium-path beliefs. For example, one cannot assume that a firm offering a contract other than the equilibrium contract is necessarily bad. Priors in this problem reflect the distribution of good and bad firms (i.e., priors on any contract and any action are that the firm is average or t). Thus, if every time the bad firm wanted to offer an off-the-equilibrium-path contract, the good firm would also want to offer the contract, no player can believe that a firm offering the off-the-equilibrium-path contract is good with probability less than t . Similarly, no player can assume that firms that do not hire auditors are necessarily bad. If, for every belief about a nonhiring firm's type that leads a bad firm not to hire an auditor, a good firm also does not want to hire an auditor, no player can believe a nonhiring firm is good with probability less than t .

Calculated beliefs reduce the set of parameters for which auditors are hired in equilibrium. The hiring equilibria eliminated, however, are ones in which neither the auditor nor the court system provides information about firms' risk classes. These equilibria are supported by off-the-equilibrium-path beliefs that a firm that does not hire an auditor must be bad, but if beliefs are calculated beliefs, a nonhiring firm must be thought average since for the same set of beliefs both firm types are better off not employing an auditor.²⁴ The belief that a nonhiring firm is average is inconsistent with firms employing noninformative, yet costly, auditors; hence these ineffective auditing equilibria cannot be supported.²⁵

23 Our restriction is closely related to the "divine" beliefs refinement of Banks and Sobel (1987). Their refinement, however, cannot immediately be applied to a game as complex as the one here. We have not adopted the term *divine* because we do not presume to know how to apply this term to our setting.

24 For exactly the same set of lenders' beliefs about a nonhiring firm, both good and bad firms would prefer to not hire (i.e., for those beliefs where the bad (good) firm would prefer not to hire, the good (bad) firm would prefer not to hire). Thus, off-the-equilibrium path beliefs about a nonhiring firm cannot be above or below t ; they must be t .

25 Although auditors provide no information, it is possible that good firms might want to hire

Proposition 2: There do not exist pure strategy, calculated beliefs, ineffective auditing equilibria in which no information about a firm's risk characteristics is provided by the auditor or the courts.

Proof: Follows from the discussion above.

Although calculated beliefs will not support hiring an auditor when all firms would be better off not hiring an auditor, calculated beliefs will support equilibria in which the auditor provides meaningful information about firm types.

Proposition 3: When litigation is possible, for some parameter values there exist calculated beliefs equilibria in which auditing is effective and all firms hire auditors. The equilibrium strategies are the same as those of proposition 1. The set of parameter values supporting these calculated beliefs equilibria is a subset of the one corresponding to proposition 1.

Proof: See Appendix B.

Without the calculated beliefs refinement, we have observed that it is possible to have effective auditing equilibria in which the auditor's expected utility exceeds his market alternative. Requiring beliefs to be calculated beliefs eliminates the possibility of auditors earning above normal profits. The following lemma facilitates the proof by noting that, except for a knife-edge set of parameters, there exists a single equilibrium contract.

Lemma 1: The set of pure strategy equilibrium payoffs when auditing is effective and there is a single equilibrium contract includes the set of all pure strategy, effective auditing equilibrium payoffs. Generically, the contract is unique.²⁶

Proof: See Appendix B.

Focusing on the single, effective auditing, equilibrium contract, it is easy to show that if a contract gives the auditor above normal profits, it cannot be an equilibrium contract. The argument is loosely as follows. Suppose, to the contrary, that the effective auditing contract allows the auditor to earn more

auditors, sue them, and then rely on the court system to provide information about types. In the limited set of parameter values where this is possible, for those lenders' beliefs about a nonhiring firm where a good firm does not want to hire, the bad firm also does not want to hire, but not vice versa. Thus, the belief that a nonhiring firm is bad is a calculated belief and supports an equilibrium in which ineffective auditors are hired.

²⁶ In this context generic means that the property holds for all but a negligible subset of the parameter space. Specifically, if

$$C = (K_g, K_b) \text{ and } K_b = K_g + \frac{(1-z)(1-p_B)y_w(D_2+L)}{z}$$

is an equilibrium contract; then the second contract $C' = (K_g, K'_b)$, where $K_b < K'_b$, is also an equilibrium contract. Some of the good firms and no bad firms would offer C' ; some of the good firms and all of the bad firms would offer C , and all firms have exactly the same auditing expenses.

than his market alternative. Consider a second contract that reduces the payments for both a good and a bad report by ϵ . For a sufficiently small ϵ , this second contract would also induce the auditor to work while giving him at least his market alternative, and calculated beliefs require any firm offering this contract be thought at least average. Thus, all firms would prefer to offer this second contract.

Lemma 2: In any pure strategy, calculated beliefs, effective auditing equilibrium, the auditor expects to earn exactly his market alternative.

Proof: See Appendix B.

Let ED_g be the expected legal costs an auditor incurs when he works and reports honestly, and every firm hires an auditor (i.e., the costs associated with reporting undetected bad firms as good);

$$ED_g = (1 - t)(1 - z)(1 - p_B)y_w(D_1 + L).$$

Lemma 2 implies that an equilibrium contract must satisfy:

$$K_g[t + (1 - t)(1 - z)] + K_b(1 - t)z - ED_g = K^*. \quad (1)$$

To determine the exact shape of the equilibrium contract, we next argue that the unique effective auditing equilibrium contract is the contract that, in addition to giving the auditor his market alternative, specifies the lowest possible payment for a good report that induces the auditor to work. This result depends on the following intuition. Suppose that the equilibrium contract is $C' = (K'_g, K'_b)$, where $c(C') = t$, the auditor is willing to accept the contract, and the auditor works hard to produce his reports. Suppose there exists a second contract $C'' = (K'_g - \epsilon, K'_b + \delta)$ where δ assures the auditor his market alternative, and the contract motivates the auditor to work, when $c(C'') = t$. Since the cost of getting a good report is smaller with C'' than with C' , any time a bad firm would benefit from offering C'' in place of C' , so would the good firm. Thus, for beliefs to be calculated beliefs, any firm offering C'' must be thought at least average. Clearly if $c(C'') = t$, good firms would prefer to offer C'' in place of C' , and thus C' could not be the equilibrium contract.

If payment for a good report were too small, the auditor would prefer to shirk and always report the firm as bad. Thus, the minimum payment for a good report consistent with effective auditing is that payment that makes the auditor indifferent between working or shirking while reporting bad. Let ED_b represent the expected net costs an auditor incurs when he shirks and reports all firms to be bad (i.e., the expected legal costs from reporting good firms as bad less the personal cost of effort he saves);

$$ED_b = ty_0(D_2 + L) - x.$$

From Table 1, when the firm offering the contract is thought to be average (i.e., $c = t$), the auditor is indifferent to working with truthful reporting and shirking with bad reports if:

$$K_b - K_g = \frac{ED_b - ED_g}{1 - z(1 - t)} \quad (2)$$

We note that both ED_g and ED_b are uniquely determined by the exogenously given parameters when all firms offer the same contract, and thus equations (1) and (2) uniquely determine the equilibrium contract.²⁷

Lemma 3: The unique, calculated beliefs, effective auditing equilibrium contract is

$$\left(K^* + \frac{ED_g - z(1 - t)ED_b}{1 - z(1 - t)}, K^* + ED_b \right).$$

This contract offers the auditor exactly his market alternative.

Proof: See Appendix B.

Clearly, the shape of the optimal contract depends on the relative magnitudes of ED_g and ED_b . Consider the factors affecting their relative sizes. The values of the parameters t, z, x, A_1 , and A_2 are key in determining which expected damage payment is larger. For example, if the firm population is dominated by bad firms, the auditor would put a high probability on the firm being bad even if his investigation could not prove it, and ED_g might be greater than ED_b . Similarly, if the auditor knows that his investigation technology is inaccurate, he might put little weight on his findings, and again ED_g might be greater than ED_b . If the personal cost of effort were large, ED_g would be larger than ED_b . Finally, the relative magnitudes of D_1 and D_2 are key in determining the relative sizes of ED_g and ED_b . It is conceivable that the court damages and penalties in an investor's suit might be much larger than the damages awarded in a firm's suit, and thus ED_g would be greater than ED_b . We have assumed that courts assess damages on an ex post basis. When a firm sues its auditor, the firm can claim only to have been charged an excessive interest rate; when a lender sues, however, he can claim to have lost the entire amount of his loan since he invested, on the basis of the auditor's report, in a risky firm that subsequently went bankrupt. On the other hand, if both parties are judged to be equally damaged and penalized in a like fashion, ED_b might be greater than ED_g .

Next consider the shape and use of the optimal contract. Suppose $ED_g \geq ED_b$. It is apparent that the implicit incentives created by litigation threats are insufficient to induce the auditor to work and report honestly (i.e., if the audit fee were

²⁷ We emphasize that within the class of pure strategy, effective auditing equilibria, the terms ED_g and ED_b are exogenously determined. For example, suppose $t = 0.5$, $y_w = y_0 = z = 0.9$, $P_B = 0.8$, $x = 1$, and $L = 0$. If it is judged that a lender who lost his capital was more severely damaged than a firm that paid too high an interest rate (e.g., $D_1 = 1000$ while $D_2 = 10$), then the expected damages associated with issuing a good report might be greater than the expected damages associated with issuing a bad report (i.e., for the given parameter values $ED_g = 15.5$ while $ED_b = 6.8$). On the other hand, if it is judged that the lender and firm were equally damaged (e.g., $D_1 = D_2 = 100$), then the expected damages for reporting the firm good would be smaller (i.e., for the given parameter values $ED_g = 1.5$ while $ED_b = 77.0$).

independent of the report, the auditor would always shirk and report the firm as bad). Therefore, the explicit incentives created by the contract must sufficiently reward a good report to make the auditor willing to be truthful when he finds the firm to be good (i.e., the fee for a good report must be sufficiently larger than the fee for a bad report so that equation (2) is satisfied). In other words, when there exist strong “implicit” incentives to shirk and report conservatively, the effective auditing equilibrium contract involves a larger payment for a good than for a bad report; this payment structure prevents the auditor from always reporting the firm to be bad. We note that if contracts were restricted to be flat, an effective auditing equilibrium could not exist. Thus, it is interesting to observe that, at least in some cases, allowing contracts to be contingent promotes effective auditing.

Proposition 4: If $ED_g > ED_b$, the unique calculated beliefs, effective auditing equilibrium contract is characterized by a payment for a good report that is larger than the payment for a bad report; for these parameter values, no effective auditing equilibria would exist if audit contracts were not allowed to be contingent on the report. If $ED_g = ED_b$, the unique effective auditing equilibrium contract is a noncontingent contract.

Proof: Immediate from Lemma 3.

Next, suppose $ED_g < ED_b$ (i.e., the implicit incentives due to suing threats do not motivate the auditor to underreport). In this case, implicit legal threats are sufficient to make the auditor effective, and the contract does not have to be used as a motivational tool to make the auditor work. Nevertheless, a contingent contract might be desired from the standpoint of the good firms since the contingent audit contract can function as a device to transfer some of the signaling costs from good firms to bad ones. It is the good firms that are trying to distinguish themselves from the bad firms by hiring costly, imperfect auditors to signal their type to lenders. From the above argument, it is evident that the good firms have some ability to affect the form of the equilibrium contract, and the good firm would like payments for good reports to be small. If, for the same set of parameter values, we were restricted to a world of flat contracts, effective auditing equilibria would still exist, but the good firm would be strictly better off if contingent contracts were allowed.

Proposition 5: If $ED_b > ED_g$, the unique, calculated beliefs, effective auditing equilibrium contract is characterized by a higher payment for a bad report than for a good report. Effective auditing equilibria exist with both contingent contracting and flat fees, but good firms are strictly better off with contingent contracting.

Proof: Immediate from Lemma 3.

Up to this point, contingent contracts have been demonstrated to be benefi-

cial. In some cases (proposition 4), they result in effective auditing equilibria that could not exist under flat audit contracts; in other cases (proposition 5), they reduce the expected costs to the good firms at the expense of the bad firms. We now show that contingent contracts might also lead to undesirable consequences; the mere allowance of contingent contracts could preclude auditing from being effective even though effective auditing equilibria would exist if only flat contracts are allowed.

Proposition 6: For some parameter values, calculated beliefs, effective auditing equilibria cannot exist when contingent audit contracts are allowed; yet, when noncontingent audit contracts are mandated, effective auditing equilibria do exist.

Proof: See Appendix.

The intuition behind this proposition is as follows. As discussed above, if the funds required to carry out the project, N , are relatively large when compared to the damages the auditor suffers, D_1 , the bad firm has an incentive to reveal its type to the auditor while “bribing” him to give it a good report. That is, the bad firm finds it profitable to offer, in exchange for a good report, an amount sufficient to cover all of the auditor’s expected legal costs when he reports a bad firm as good. Because good firms would also get good reports, the auditor would be uninformative. Proposition 2 above states, for many cases in which the auditor is ineffective, a pure strategy equilibrium in which auditors are employed does not exist; the only pure strategy equilibrium to prevail is a no-hiring equilibrium.

Extensions: Due diligence, generalizing to multiple firm types, and additional signaling opportunities

Due diligence

In our model, an audit failure, or an incorrect report, could occur for any of the following reasons: (1) the auditor did not work and consequently failed to discover a lie in the firm’s message, (2) the auditor did not truthfully report his findings, or (3) although the auditor worked hard and reported truthfully, he failed to uncover an error in the firm’s message. Currently in the U.S. legal system, due diligence is an adequate defense for the auditor (i.e., an auditor will not be punished if he can demonstrate the audit failure occurred for reason (3) above). To parallel this defense criterion, we have assumed that the probability of conviction when the auditor works and reports his findings truthfully, y_w , is smaller than the probability of conviction when the auditor shirks or lies, y_0 . This modeling captures the notion that due diligence can be a defense, and yet by assuming that y_w is greater than zero, we maintain the notion that the courts are fallible. Thus, an honest, hard-working auditor still faces some probability

of having made an error in the report and not being able to provide sufficient evidence of hard work to clear himself.²⁸

With Statement of Auditing Standards No. 53, which took effect with audits of financial statements for periods that began January 1, 1989, the responsibility of the auditor to detect fraud has been expanded. In particular, SAS No. 53 (AICPA 1989, AU§316.05, p. 240) states:

The auditor should assess the risk that errors and irregularities may cause the financial statements to contain a material misstatement. Based on that assessment, the auditor should design the audit to provide reasonable assurance of detecting errors and irregularities that are material to the financial statements.

With this increase in responsibility, due diligence may become more difficult to prove. Plaintiffs may convincingly argue that a material error in the statement provides evidence of an improperly designed audit. In our model, as due diligence becomes more difficult to establish, y_w approaches y_0 . Although this may reduce the size of the parameter set supporting effective auditing, the qualitative results of our paper are unchanged.

Generalizing to multiple firm types

The above model is highly stylized. Results established in a setting with only two types (and hence only two possible reports) may seem critically dependent on the assumed binary structure. We now briefly discuss an extension of the model that allows for three types: good, medium, and bad, where p_G , p_M , and p_B represent the respective solvency probabilities for each firm type ($p_G > p_M > p_B$), and t_G , t_M and $1 - t_G - t_M$ represent the respective fractions of the total population composed of that firm type. Assume that the auditor still looks for errors in the financial information provided by the firm. That is, if the auditor works and the firm has made a false claim as to its type, the auditor would discover the firm's true type with probability z , but with probability $(1 - z)$, the auditor's findings would be consistent with the firm's claim.²⁹ The auditor's contract now consists of a three-tuple (K_g, K_m, K_b) or a payment for each report type.

28 In our model, suing behavior is a choice variable (i.e., a firm sues an auditor only if it expects to gain from the suit). We also observe that the auditor will not work if he does not face some legal threats. Thus, if auditing is to be effective, an auditor who both works and reports his findings accurately (i.e., uses due diligence) must sometimes be sued and have to pay damages. Although this may not seem fair to the particular hard-working auditor who is inappropriately punished, we note the importance of these losses to the maintenance of an effective auditing system.

29 With more than two types, the assumption that all firms claim to be the lowest risk type to their auditors is no longer innocuous. For example, suppose with three types, the good and medium firms have similar, small probabilities of bankruptcy while the bad firms are bankrupt frequently. In addition, suppose that there are many bad firms. If all firms were to claim to be good, it is possible that the interest factor for a good report would be *higher* than the interest factor for a medium report. Hence, neither good nor medium firms would want to claim to be good to their auditors; each would prefer to claim that it was a medium firm. An equilibrium can exist, however, when some firms claim to be good and some medium, and the firms are distributed across the two messages so that the interest factors for good and medium reports are the same.

The amount of litigation the auditor faces when he takes different actions is important to the determination of the optimal contract. To simplify the exposition and notation, in this section we set $y = y_w = y_0$, and assume that the parameters of the setting lead to an equilibrium wherein (1) a lender sues the auditor whenever a firm that received a good report goes bankrupt; (2) a good firm sues its auditor whenever it does not get a good report, and (3) a medium firm sues its auditor whenever it gets a bad report. It can readily be shown that if the auditor works hard and tells the truth in an effective auditing equilibrium, the following restrictions on the relative sizes of the payments must be met (in the special case where the auditor is indifferent between working and shirking plus reporting the firm as medium):

$$K_g - K_m \geq (1 - t_G)(1 - p_B)y(D_1 + L) - t_G y(D_2 + L) \text{ and} \quad (3)$$

$$K_m - K_b \geq +t_M y(D_2 + L).^{30} \quad (4)$$

In the absence of any refinement of beliefs, numerous different contracts could be consistent with an effective auditing equilibrium. The auditor could earn above normal profits, and the price for a good report could be the smallest, largest, or middle payment of the three payments specified in the contract. As in the two type case, off-the-equilibrium-path beliefs play a strong role in dictating the nature of the equilibrium contract.

If beliefs were required to be calculated beliefs, appropriately defined, above normal profits for the auditor could be eliminated, and the better firms would have some power to dictate the nature of the contract. Thus, where possible, the contract would be used to transfer some of the signaling costs from the better firms to the bad firms. For example, when $(1 - t_G)(1 - p_B)y(D_1 + L) < t_G y(D_2 + L)$ (i.e., the legal repercussions from shirking and reporting conservatively are larger than the litigation penalties associated with honest reporting), the good firms would pay smaller auditing fees than the medium (and possibly bad) firms. On the other hand, the contract might be necessary as a motivational device to induce the auditor to work hard and report honestly. For example, when $(1 - t_G)(1 - p_B)y(D_1 + L) > t_G y(D_2 + L)$ (i.e., the auditor would always report conservatively in the absence of monetary incentives), large payments for a good report can induce honest reporting. This suggests that the insights of this paper apply to the more general multitype setting.

30 If the equilibrium contract is to induce the auditor to work as opposed to shirk and always make a good report, the following inequality must be met: $-z(1 - t_G)K_g + z t_M K_m + z(1 - t_M - t_G)K_b \geq x - z[(1 - t_G)(1 - p_B)y(D_1 + L)]$. If the auditor is indifferent between working and shirking plus reporting the firm as medium, the following inequality must be met: $[t_G + (1 - z)(1 - t_G)]K_g - (1 - z t_M)K_m + z(1 - t_M - t_G)K_b \geq (1 - z)[(1 - t_G)(1 - p_B)y(D_1 + L)] - t_G y(D_2 + L) + x$. If the auditor is to work as opposed to shirk and always make a bad report, the following inequality must be met: $[t_G + (1 - z)(1 - t_G)]K_g + z t_M K_m - [1 - z(1 - t_M - t_G)]K_b \geq (1 - z)[(1 - t_G)(1 - p_B)y(D_1 + L)] - t_G y(D_2 + L) - t_M y(D_2 + L) + x$. Inequalities (3) and (4) are easily derived from these conditions.

Additional signaling opportunities

In our model, we have shown that perfect separation is not possible, so one might ask whether firms would look for additional signals of their risk type. We note that the search for cheaper and/or better signals is relevant to all signaling models whether or not perfect separation is attained. Thus, all signals are subject to a cost-benefit analysis in which the costs include the largest net benefits of employing any other possible signal.

Our model assumes that the amount borrowed and the audit contract cannot be used as signals. We have justified the assumption that the lender cannot make inferences about the firm's type from the size of the loan (see footnote 14) by arguing that a firm can disguise the amount it borrows by soliciting several lenders and loaning out any excess funds. The assumption precluding public knowledge of the contract seems descriptive. We now consider the effect of relaxing these two assumptions.

First, we discuss the impact of allowing lenders' beliefs to be conditioned on the amount borrowed, assuming full disclosure of all loans. In this case, firms with bad reports are known to be bad, and there is no additional information content in the loan size, but the amount borrowed by a firm with a good report might be informative. In the effective auditing equilibria of propositions 5 and 6, all firms with good reports borrow the same amount; hence, conditioning beliefs on the amount borrowed would not affect the equilibria. On the other hand, in the pure strategy, ineffective auditing equilibrium in which a bad firm has incentives to bribe its auditor, conditioning beliefs on the amount borrowed may change the equilibrium. Since the bad firm does not have any resources of its own, it could finance its bribing in one of two ways. First, if the auditor insisted on payment prior to the project being undertaken—an assumption maintained in the above model—borrowing the extra funds to bribe the auditor would reveal it as a bad firm to the lender; thus, all incentives to bribe the auditor would be removed, and an effective auditing equilibrium could result. Second, if the auditor were willing to delay receipt of part of his fees until completion of the project, the bad firm might still have incentives to try to bribe the auditor. Bribing, however, would be more expensive because the auditor would charge an interest rate corresponding to a bad firm instead of the rate for a good report. Consequently, ineffective auditing would still exist, but for a smaller set of parameter values. Thus, if lenders' beliefs could be conditioned on the amount borrowed, incentives for bribing would be reduced, and, in a normative sense, contingent contracting would become more attractive. Whether lenders find the size of the loan to be informative is an empirical question.

Next suppose that the contract between the firm and the auditor were publicly available, enabling lenders to condition their beliefs about a firm's type on the observable contract. We first note that perfect separation is still not attainable. If the auditor knows that only good firms are offering the contract, the auditor will report either good or bad. If he reports bad, neither firm type would want to use the contract; if he reports good, both firm types would offer the contract.

On the other hand, some separation of the good firms from the bad might be possible. To sustain such an equilibrium, there must be enough bad firms in the market to make the auditor want to work to find them, and the fee for a bad report must be sufficiently high to make bad firms indifferent to employing auditors. Demonstrating the existence of this type of equilibrium is beyond the scope of this paper.

Possible rationale for banning contingent contracts

The results of this paper suggest that when audit contracts are unconstrained, flat audit contracts do not in general emerge as the equilibrium contracts. Thus, an intriguing question is why flat contracts are mandated. In this section, we discuss two possible explanations for this phenomenon. The first is based on an extension of the basic model in which we investigate the effect of contingent contracting on firms' profits. The second argument is based on a normative legal criterion referred to as *enforcement independence*.

Demand for audit services

Through an extension of the basic model, we argue that allowing contingent audit contracts may reduce the demand for auditors' services and consequently the profits of the auditing industry. (This argument is similar to that of Dye et al. (1987); the two models, however, are quite distinct.)

In the basic model of this paper, auditors always earn their market alternative and thus do not care about the size of their clientele. We now consider the following modification of the model. Let auditors have increasing marginal costs of accepting additional clients.³¹ In addition, assume that there are barriers to entry into the auditing industry. With these two assumptions, auditors can command positive profits that increase with the number of clients.³² If bribing auditors is perceived to be a realistic possibility, our model would predict that contingent contracting would most likely result in no auditors being employed; if contracts were required to be flat, however, auditors would be employed. On the other hand, if auditors are perceived to have very strong incentives to report conservatively, then contingent contracting would lead to more employment than flat contracts.³³

So far we have considered a setting in which auditing is demanded by all firms. The world, however, is one in which auditing is mandated for some firms. Thus, we potentially have three sets of firms that hire auditors:

31 The increasing marginal costs could be explained by increasing travel time to reach a client as the number of clients increase, or increasing bureaucratic costs, and so on.

32 In this case, a pooling equilibrium, in which all firms employ auditors, would exist if all the conditions for proposition 2 are satisfied when the market alternative K^* is replaced with $K^* + eM/F$, where M is the number of clients, F is the number of auditors, and e is the rate at which costs increase with additional clients. Clearly, if e is very small, the equilibria of this paper, as well as the equilibria of M-T where contingent contracting is not allowed, would still exist.

33 For a related result in a significantly different setting, see Dye et al. (1987).

group I—firms that are required to hire auditors and would have done so without regulation, group II—firms that are required to hire auditors but would not have done so without regulation, and group III—firms that are not required to hire auditors but would continue to do so with or without regulation. An equilibrium in which at least groups I and II hire may look different from the model of this paper. If some, but not all, firms demand auditors, yet all must hire, obtaining an equilibrium requires that the bad firms mix on the action choices: (1) hire and pretend to be good and (2) hire, reveal self as bad, but bribe the auditor to give it a good report. Thus, in equilibrium when contingent fees are allowed, some, but not all, bad firms might be bribing auditors. Note that if flat fees were imposed, bribing would not be possible, and flat fees would result in more informative audit reports. Assuming that the informativeness of the reports affects the demand for auditing services of nonregulated firms (i.e., group III), auditors might prefer a flat fee structure. On the other hand, if the parameters support underreporting, then only with contingent fees will the auditor be truthful. Here the demand for auditing services would increase with contingent contracts.

Thus, our model indicates circumstances in which the accounting profession might prefer contingent contracting over flat contracting and vice versa; neither type of contract is preferred in all circumstances.

The enforcement inconsistency problem

We now propose an alternative reasoning based on a normative legal criterion of *enforcement consistency*. Throughout the paper, we have implicitly assumed *enforcement independence* (i.e., on one hand, courts enforce audit contracts as written while, on the other hand, courts penalize auditors for audit failures). This implies that courts, when trying an auditor for an audit failure, do not take into account the nature of the audit contract. For example, the contract might be one that induces the auditor to always report good irrespective of his findings, and by assumption, this contract is legally binding. But, at the same time, when there is an audit failure, the auditor might be penalized for following the directives of a legally binding contract. Such a feature is obviously disturbing from a normative standpoint.

In an attempt to avoid the above enforcement inconsistency problem, legislators (i.e., the “game designers”) could choose one of two alternatives: (1) enforce the audit contracts as stated and not penalize an auditor for an audit failure or (2) allow litigation against an auditor for an audit failure and not enforce contracts inducing an auditor to be ineffective. These two alternatives, however, are problematic in their own right. The first option implies that auditing would never be effective because all equilibria would involve either no auditing or ineffective auditing. The second alternative is difficult to implement for the following reason. Contracts that induce auditors to perform ineffectively are indistinguishable from contracts that induce auditors to be effective. A contract’s provisions per se do not reveal the nature of the resulting equilibrium. It is

possible that a contract pays an auditor a higher amount for a good report than for a bad report, yet auditing is effective in equilibrium (recall proposition 4). On the other hand, a similar contract (or even the identical one) could result in ineffective auditing. Only given the model's parameters, as well as the specific equilibrium strategies and beliefs, can one determine the nature of the audit contract.

The above reasoning leads us to suggest that it is perhaps the enforcement inconsistency problem that is behind the insistence on, and the mandating of, flat contracts.³⁴

Appendix A: Summary of notation

General

- N = the dollars required for a firm to begin the project
- R = revenues the firm earns if it completes the project and remains solvent
- G = the good (low-risk) firm
- B = the bad (high-risk) firm
- p_G = probability for the good firm of being solvent
- p_B = probability for the bad firm of being solvent
- t = the fraction of good firms in the population
- z = probability that the auditor correctly detects a lie in the firm's message
- x = auditor's personal cost of effort; also auditor's utility when his compensation and effort are both zero
- K^* = minimum audit fee when auditor works (therefore $K^* - x$ is auditor's market alternative)
- C = (K_g, K_b) is the auditor's contract where K_i is the fee paid to the auditor when his report is i ($i = g(b)$ stands for a good (bad) report)
- y_w = probability that the court detects an error in the report when the auditor has worked and truthfully reported his findings
- y_0 = probability that the court detects an error in the report when the auditor has *not* worked and/or truthfully reported his findings
- A_1 = monetary damages paid by the auditor to the lender if the lender sues and wins
- A_2 = monetary damages paid by the auditor to the firm if the firm sues and wins
- D_1 = pecuniary plus nonpecuniary damages the auditor suffers if he loses a suit to a lender (i.e., A_1 plus the nonpecuniary losses)
- D_2 = pecuniary plus nonpecuniary damages the auditor suffers if he loses a suit to a firm (i.e., A_2 plus the nonpecuniary losses)
- L = legal fee required to bring a suit

³⁴ In addition, it is interesting to note that an enforcement inconsistency-based argument could be used to justify banning contingent audit-related fees while allowing contingent fees for nonaudit-related services in spite of the fact that the economic essence of nonaudit fees is indistinguishable from that of audit-related fees.

Beliefs

Lenders

- g = prob (firm is good | firm hired an auditor and the report is good)
- b = prob (firm is good | firm hired an auditor and the report is bad)
- n = prob (firm is good | firm did not hire an auditor)
- jk = prob (firm is good | firm got report j , sued its auditor and got a k -ruling),
 $j = B, G; k = B, G$

Auditors

$c = c(C)$ = prob (firm is good | firm offered contract C to auditor)

Interest factors (the price of borrowing one dollar)

- Q_j = interest factor for a firm thought to be good with belief probability j
- Q_g^* = the perfect observability interest factor for a good firm
- Q_b^* = the perfect observability interest factor for a bad firm

Appendix B: Proofs

Proposition 1: In the following, we demonstrate the existence of effective auditing, pooling equilibria—in which all firms hire auditors, auditors work and report truthfully, lenders sue auditors of bankrupt firms who get good reports, good firms sue their auditors if they get a bad report,

$$g = \frac{t}{t + (1 - t)(1 - z)}, \quad b = n = 0, \quad Q_{bg} = Q_g^*, \quad Q_{bb} = Q_b^*$$

(where Q_j^* is the perfect observability price corresponding to type j), and $c(C) = t$ for the equilibrium contract and 0 otherwise—and indicate the restrictions on the parameter values that support the equilibria.

Requiring all firms to hire auditors, auditing to be effective, and the message to be good implies $Q_b = Q_b^*$ and $Q_g > Q_b$. In turn, all firms hire auditors and auditing is effective if:

- (i) good firms (and good firms alone) sue when the report is bad (condition A);
- (ii) lenders sue when the report is good and the firm is bankrupt (condition B);
- (iii) auditors work hard and report honestly (conditions $C1 - C2 - C3$ or $C1' - C2' - C3$);
- (iv) auditors are willing to accept the contract (condition D);
- (v) good and bad firms want to hire auditors (condition E), and
- (vi) neither firm type wants to offer a different contract (condition F).

The costs relevant to a firm's suit choice when its report is bad are:

TABLE A-1: Firm's suit decision (given a bad report)

Firm type	Expected costs if firm goes to court	Expected costs if firm does not go to court
Good	$p_G[y_o Q_{bg}(N + K_b - A_2) + (1 - y_o)Q_{bb}(N + K_b + L)]$	$p_G Q_b(N + K_b)$
Bad	$p_B Q_{bb}(N + K_b + L)$	$p_B Q_b(N + K_b)$

In equilibrium, $b = 0$ and therefore $Q_b = Q_b^*$. Further, any time the court's findings differ from the report, the firm's type is revealed with certainty; hence, $Q_{bg} = Q_g^*$. If auditing is effective, then $Q_{bb} = Q_b^*$. Hence, the bad firm would never sue, and the good firm sues if:

$$p_G[y_0 Q_g^*(N + K_b - A_2) + (1 - y_0)Q_b^*(N + K_b + L)] < p_G Q_b^*(N + K_b), \text{ or}$$

$$A_2 > \frac{L(1 - y_0)Q_b^* - y_0(Q_b^* - Q_g^*)(N + K_b)}{y_0 Q_g^*}. \quad (\text{condition A})$$

Next consider a lender's suit choice when the report is good and the firm is bankrupt, and the lender correctly believes that the auditor worked and reported his findings. A lender's expected award from suing is the product of (i) the probability that the firm is bad given that it received a good report and was bankrupt, (ii) the probability that the court will discover the audit failure, and (iii) the legal fees and awards that are paid when an audit failure is discovered, or

$$\left[\frac{(1 - t)(1 - z)(1 - p_B)}{(1 - t)(1 - z)(1 - p_B) + t(1 - p_G)} \right] y_w(A_1 + L).$$

It costs L to initiate a suit; hence, a lender will sue when the report is good and the firm bankrupt, when

$$\left[\frac{(1 - t)(1 - z)(1 - p_B)}{(1 - t)(1 - z)(1 - p_B) + t(1 - p_G)} \right] y_w(A_1 + L) > L. \quad (\text{condition B})$$

Given that good firms sue when the report is bad and that lenders sue when the report is good and the firm is bankrupt, consider the auditor's work and reporting decisions. The relevant costs are summarized in Table 1 in the text where $c = t$. If the personal cost of effort is sufficiently high, that is,

$$x \geq (y_0 - y_w)(1 - t)(1 - p_B)(1 - z)(D_1 + L), \quad (\text{condition C1})$$

then (5) dominates action (3). Working and telling the truth (i.e., (1)) dominates shirking and making a good report (i.e., (5)), when:

$$K_b - K_g \geq \frac{x - (y_0 - y_w)(1 - t)(1 - p_B)(1 - z)(D_1 + L)}{(1 - t)z} - (1 - p_B)y_0(D_1 + L). \quad (\text{condition C2})$$

On the other hand, if the personal cost of effort is small, or

$$x < (y_0 - y_w)(1 - t)(1 - p_B)(1 - z)(D_1 + L), \quad (\text{condition C1}')$$

action (3) dominates action (5). Working and telling the truth (i.e., (1)) dominates working and reporting all firms to be good when:

$$K_b - K_g \geq -(1 - p_B)y_0(D_1 + L). \quad (\text{condition C2}')$$

Independent of the size of the personal cost of effort, action (6) dominates action (4), and at least one of (5) or (6) also dominate (2). Thus, in addition to conditions $C1 - C2$ or $C1' - C2'$, for effective auditing to be assured, working and reporting honestly (i.e., (1)), must dominate shirking and issuing a bad report (i.e., (6)), or

$$K_b - K_g \leq \frac{ty_0(D_2 + L) - (1-t)(1-z)(1-p_B)y_w(D_1 + L) - x}{t + (1-t)(1-z)}. \quad (\text{condition C3})$$

Let $ED_b = ty_0(D_2 + L) - x$ and $ED_g = (1-t)(1-z)(1-p_B)y_w(D_1 + L)$. Condition C3 can be written:

$$K_b - K_g \leq \frac{ED_b - ED_g}{1 - z(1-t)}$$

which is equation (2) of the paper with strict equality. Finally, the contract must be acceptable to the auditor:

$$[t + (1-t)(1-z)]K_g + (1-t)zK_b - (1-t)(1-z) \times (1-p_B)y_w(D_1 + L) \geq K^*. \quad (\text{condition D})$$

This is equivalent to equation (1).

In equilibrium, competitive lenders' prices reflect the legal fees paid and damage awards received, in addition to the payments that lenders expect to collect from the firm:

$$Q_g(N + K_g) \left[\frac{tp_G + (1-t)(1-z)p_B}{t + (1-t)(1-z)} \right] - L \left[\frac{t(1-p_G) + (1-t)(1-z)(1-p_B)}{t + (1-t)(1-z)} \right] + (A_1 + L)y_w \left[\frac{(1-t)(1-z)(1-p_B)}{t + (1-t)(1-z)} \right] = N + K_g$$

or,

$$Q_g = \frac{t + (1-t)(1-z)}{tp_G + (1-t)(1-z)p_B} + L \left[\frac{t(1-p_G) + (1-t)(1-z)(1-p_B)(1-y_w)}{[tp_G + (1-t)(1-z)p_B](N + K_g)} \right] - A_1 y_w \left[\frac{(1-t)(1-z)(1-p_B)}{[tp_G + (1-t)(1-z)p_B](N + K_g)} \right].$$

Only bad firms get bad reports, and all firms not hiring are believed to also be bad:

$$Q_b = \frac{1}{p_B} \text{ and } Q_n = \frac{1}{p_B}.$$

If the bad firm wants to hire an auditor, it is in the good firms' interest to do so as well. The bad firm hires when:

$$Q_g(N + K_g)(1-z) + Q_b(N + K_b)z \leq Q_n N. \quad (\text{condition E})$$

Finally, both firms must want to offer the equilibrium contract. In particular, the bad firm does not want to offer a contract $(K^* - x + y_0(1 - p_B)(D_1 + L), 0)$, which will identify it as a bad firm to the auditor but guarantee that it gets a good report. Note that this contract earns zero profits for the auditor because it pays all expected court costs related to reporting a bad firm as good. The bad firm will not offer this contract when:

$$Q_g[N + K^* - x + y_0(1 - p_B)(D_1 + L)] \geq Q_g(N + K_g)(1 - z) + Q_b(N + K_b)z. \quad (\text{condition F})$$

To meet the above conditions, the values for the parameters must be restricted as follows. Conditions A and B are satisfied if L is small relative to A_1 and A_2 . Condition D is satisfied if the auditor's market alternative, K^* , is small. Conditions E and F restrict the size of the loan. Condition E indicates that the loan must be sufficiently large to make it worthwhile for the bad firm to employ the auditor on the "off chance" that the auditor will give the bad firm a good report. On the other hand, condition F restricts the loan from being too big; if the loan were very large, the bad firm would "bribe" the auditor to give it a good report even though the auditor knows the firm is bad. Finally, conditions C1 and C2 restrict the relative sizes of the contingent payments.

As an example, let $x = L = 0$, $A_2 > 0$, and let the contract specify the payments:

$$K_g = K^* + \left[\frac{(1 - t)(1 - z)}{t + (1 - t)(1 - z)} \right] (1 - p_B)y_w(D_1 + L) \text{ and } K_b = K^*.$$

For small K^* , conditions A, B, C1', C2', C3, and D are satisfied. (Note that if $x = (y_0 - y_w)(1 - t)(1 - p_B)(1 - z)(D_1 + L)$, $L = 0$ and $A_2 > 0$, the conditions A, B, C1, C2, C3, and D are satisfied.) When $A_1 = D_1$, condition E is met if:

$$\frac{K^*[(1 - z)p_B + zp_G]}{(1 - z)t(p_G - p_B)} \leq N.$$

Given that $y_0 \geq y_w$, a sufficient condition for condition F is:

$$\frac{D_1 y_0 (1 - p_B) [p_B (t + (1 - t)(1 - z)) - (p_g - p_B) z (1 - z)(1 - t)]}{[t + (1 - z)(1 - t)] z (p_G - p_B)} - K^* \geq N.$$

For small K^* , large D_1 , and $p_B > 0.5$, both conditions are simultaneously satisfied.

Proposition 3: To conditions (A) through (F) above, we must add the requirement that the good firm wants to hire an auditor rather than not hire and be considered average. This condition is met if:

$$Q_g(N + K_g) \leq \left(\frac{1}{tp_g + (1 - t)p_b} \right) N \quad (\text{condition G})$$

Given that the parameter restrictions and the contract specified in the proof of proposition 1, condition G is satisfied when:

$$\frac{K^*[t + (1-t)(1-z)][tp_G + (1-t)p_B]}{tz(1-t)(p_G - p_B)} \leq N.$$

For sufficiently small K^* , it is possible to satisfy conditions (A) through (G).

Lemma 1: Suppose the two contracts $C_1 = (K_{1g}, K_{1b})$ and $C_2 = (K_{2g}, K_{2b})$ are offered in equilibrium, and both induce the auditor to be effective; let $c_1 = c(C_1)$ and $c_2 = c(C_2)$ represent the auditor's beliefs. Suppose $K_{1g} > K_{2g}$. When auditing is effective, all good firms get good reports; hence, all good firms offer contract 2. All bad firms would also offer contract 2 since any auditor accepting contract 1 from a bad firm would give the firm a bad report knowing the client is bad. Thus, both contracts would not be offered in equilibrium.

Suppose next that $K_{1g} = K_{2g}$ and $K_{1b} > K_{2b}$. Good firms are then indifferent between the two contracts. Clearly, all bad firms would offer contract 2 since auditors accepting both contracts are effective. For auditors to be indifferent between the two contracts,

$$K_{1g} = [c_2 + (1 - c_2)(1 - z)] \left[K_{2g} - \frac{(1 - c_2)(1 - z)(1 - p_B)y_w(D_2 + L)}{c_2 + (1 - c_2)(1 - z)} \right] + (1 - c_2)zK_{2b}.$$

But since $K_{1g} = K_{2g}$,

$$K_{2b} = K_{2g} + \frac{(1 - z)(1 - p_B)y_w(D_2 + L)}{z}.$$

An auditor accepting contract 2 expects to collect K_{2g} from a good firm and to collect:

$$(1 - z)[K_{2g} - (1 - p_B)y_w(D_2 + L)] + z \left[K_{2g} + \frac{(1 - z)(1 - p_B)y_w(D_2 + L)}{z} \right] = K_{2g}$$

from a bad firm. Hence, with contract 2, the auditor breaks even (or earns the same positive return) on each firm, independent of its type, and thus the same equilibrium payoffs are generated when contract 2 is offered by all firms.

Lemma 2: Consider an auditor's best response to his beliefs c , $c \in [0, 1]$, about a firm offering the arbitrary contract $C = (K_g, K_b)$. From the proof of proposition 1, his undominated strategies are (1) work and report his findings, (2) shirk and make a bad report, and either (3) shirk and report good or (4) work and make a good report. From Table 1, the auditor will tell the truth as opposed to shirk and make a bad report when:

$$K_b - K_g \leq \frac{cy_0(D_2 + L) - (1 - c)(1 - z)(1 - p_B)y_w(D_1 + L) - x}{c + (1 - c)(1 - z)}. \quad (\text{L2} - 1)$$

If $x \geq (y_0 - y_w)(1 - c)(1 - p_B)(1 - z)(D_1 + L)$, the auditor will tell the truth as opposed to shirk and report good when:

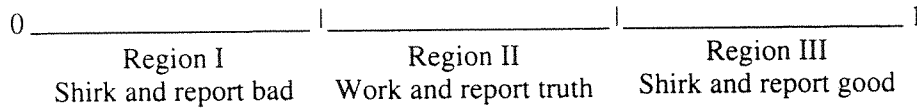
$$K_b - K_g \geq \frac{x - (y_0 - y_w)(1 - c)(1 - p_B)(1 - z)(D_1 + L)}{(1 - c)z} - (1 - p_B)y_0(D_1 + L) \quad (L2 - 2)$$

If $x < (y_0 - y_w)(1 - c)(1 - p_B)(1 - z)(D_1 + L)$, the auditor will tell the truth as opposed to work and report good when:

$$K_b - K_g \geq -(1 - p_B)y_0(D_1 + L) \quad (L2 - 2')$$

(Implicitly we assume if the auditor is indifferent to working and shirking, he works.)

Define c^* as the belief that makes auditors indifferent between shirking and issuing a good report and working and issuing a good report (i.e., $x = (y_0 - y_w)(1 - c^*)(1 - p_B)(1 - z)(D_1 + L)$). If inequality $L2 - 2$ is (not) satisfied for any $c \in [c^*, 1]$, then $L2 - 2'$ also holds (is violated) for any $c \in [0, c^*]$. The existence of an effective auditing equilibrium, therefore, requires the auditor to be willing to work and report the truth for some $c \in [c^*, 1]$, and for no $c \in [0, 1]$ would working and issuing a good report be a dominant strategy. Also note that: (1) the right-hand side of each of inequalities $L2 - 1$ and $L2 - 2$ is increasing in c ; (2) for $x > 0$ as c approaches 1, inequality $(L2 - 2)$ is always violated; (3) inequality $(L2 - 1)$ is more likely to be violated for small values of c , but it may hold for all $c \in [0, 1]$, and (4) if the contract is to stimulate effective auditing, (i.e., the auditor to work), this will be for mid range (and possibly small) values of c . Thus, as c increases from 0 to 1, given the existence of an effective auditing equilibrium, one could expect the following actions from the auditor:



Region I may not exist, but if it does, it will appear in the order indicated.

Suppose contract $C' = (K'_g, K'_b)$ is an equilibrium contract that induces effective auditing and permits the auditor to earn monopoly profits. Consider the off-the-equilibrium-path contract $C'' = (K'_g - \epsilon, K'_b - \epsilon)$ where $\epsilon > 0$ and ϵ is small enough to guarantee that the auditor works and receives at least his market alternative when $c(C'') = t$; it is clear that such a contract exists since the auditor's reporting incentives are unchanged when the same amount is subtracted from payments for both good and bad reports. We know region II exists for the off-the-equilibrium-path contract C'' since the auditor is effective

for $c = t$. (The existence of region I is uncertain.) For C'' if the auditor shirked and reported bad, both firm types would be better off with the equilibrium contract C' . If the auditor worked and reported truthfully, both firm types would be better off with C'' . If the auditor shirked and reported good, then both firm types would be better off with C'' . (The existence of effective auditing requires that all costs associated with a good report (i.e., $Q_g(N + K_g)$) be smaller than all costs associated with a bad report (i.e., $Q_b(N + K_b)$). Thus, on regions II and III, both the good and bad types would prefer the off-the-equilibrium-path contract. Since for all beliefs in which the bad firm wants to deviate, so does the good firm and vice versa, calculated beliefs indicate $c(C'') = t$. For these beliefs, C' cannot be supported as an equilibrium contract since all firms would want to offer contract C'' , and it would be accepted by the auditors.

Lemma 3: Consider the contract $C^* = (K_g^*, K_b^*)$ where

$$K_g^* = K_g^* + \frac{ED_g - z(1-t)ED_b}{1 - z(1-t)}$$

and $K_b^* = K_b^* + ED_b$. Clearly, the contract motivates the auditor to work and is acceptable to him for $c(C^*) = t$. From lemmas 1 and 2 and the requirement that auditing be effective, the only other possible equilibrium contract is $\hat{C} = (K_g^* + \epsilon, K_b^* - d(\epsilon))$ where $d(\epsilon)$ is defined so as to ensure that the auditor receives exactly his market alternative and the auditor works when $c(\hat{C}) = t$. Note that $d(\epsilon)$ is a strictly increasing function of ϵ . Suppose \hat{C} is the equilibrium contract, and consider the off-the-equilibrium-path contract $C' = (K_g^* + \epsilon/2, K_b^* - d(\epsilon/2))$. For $c(C') = t$, the auditor would work; thus, region II, as defined in the proof of lemma 2 above, would exist. If the auditor shirked and made a bad report, both firms would be better off with \hat{C} ; if the auditor shirked and made a good report, both firms would be better off with C' . If the auditor worked, the good firm would be better off with C' and the bad firm with \hat{C} . Thus, whenever the bad firm would want to deviate, so would the good firm. Calculated beliefs would indicate a firm offering C' could not be thought good with probability less than t . But these beliefs cannot support \hat{C} as an equilibrium contract since the good firm would prefer to offer C' , which is also acceptable to the auditor.

Next we must show that calculated beliefs do not rule out C^* being an equilibrium contract. Consider the off-the-equilibrium-path contract $C'' = (K_g^* - \epsilon, K_b^* + f)$. We check three alternative values for f : (1) Suppose f is sufficiently large so that for some beliefs $c > t$, the auditor wants to work; by the above argument $c(C'') = t$ would be a calculated belief. But neither firm type would deviate to C'' since both know that if the auditor believes $c(C'') = t$, the auditor will report them bad; hence C^* can be supported as an equilibrium contract. (2) Suppose $f > 0$, and f is such that the auditor never works, then $c(C'') = t$ is the only calculated belief. Either no firm type would want to deviate to C'' , or the contract would not be acceptable to the auditor. (3) Suppose $f < 0$; again, either no firm wants to offer the contract or the contract would not be acceptable to the auditor.

Next consider the contract $C''' = (K_g^* + \delta, K_b^* - e)$. Calculated beliefs would indicate that any firm offering this contract could not be greater than average. Hence $c(C''') = 0$ is a calculated belief, and no firm would want to offer the contract, or the contract would be unacceptable to the auditor.

Proposition 6: In the case of a flat contract (i.e., $C = (K, K)$), an effective auditing equilibrium with calculated beliefs exists when conditions A-E and G are satisfied. (If the contract is flat, one cannot bribe the auditor, so condition F is not relevant.) Let $L = x = 0$, $A_1 = A_2 > 0$, and $D_1 = D_2 \geq A_1$, and $t > 0.5$, then conditions A-C are satisfied. We use condition D to define K:

$$K = K^* + (1 - t)(1 - z)(1 - p_B)y_w(D_1 + L)$$

By selecting N very large, conditions E and G are satisfied. If contracts are contingent, condition F must also be satisfied for an effective auditing equilibrium to exist. For very large N , independent of the equilibrium contingent contract, condition F will not hold.

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