Why have a PCAOB? The Difference between Auditors and Inspectors in Solving Agency Problems *

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Abstract

This paper uses an analytic model to compare three strategies for mitigating the agency problem between an owner and a manager. The first strategy is to hire a single auditor to monitor the manager. The second strategy is to hire multiple auditors to monitor the manager. The third strategy is to hire an auditor to monitor the manager, and an inspector to monitor the auditor. The model shows that the multiple-auditor model is never as profitable as the single auditor strategy because multiple auditors free ride on each others' efforts. Thus the multiple-auditor strategy is never used. Compared to the single auditor strategy, the auditor-inspector strategy leads to higher quality financial reporting but lower quality auditing by offering the manager higher rents, which makes the manager more likely to work. Overall, the auditor-inspector (single-auditor) strategy is more profitable for the owner when human capital costs are low (high).

Keywords: auditor, inspector, PCAOB, regulation, agency problem

JEL Codes:

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1 Introduction

Financial statements allow investors and the board to assess managerial performance, potentially alleviating the agency problem between ownership and management. Audits, conducted by certified public accountants, are intended to give investors confidence that the financial statements are accurate.

Hiring an auditor may partially alleviate the agency problem between ownership and management, but it introduces an agency problem between the ownership and the auditor. That is, the equity holders do not know if the auditor is doing a good job. The Public Company Accounting Oversight Board (PCAOB) regularly inspects US auditors in order to provide investors with more confidence in the capital markets by alleviating the agency problem between ownership and the auditor.

However, PCAOB inspections are costly to perform, and it is not obvious whether they are the most efficient way to resolve the agency problem between management and ownership. If the goal is to help ownership effectively monitor and incentivize management, why add an inspector who primarily monitors the auditor? Why not instead pay a second auditor to directly monitor the manager? Or, alternatively, why hire a second auditor or an inspector it all? Inspectors and auditors are costly, and there may be cases where hiring an inspector or second auditor is not worth the expense.

In this paper, I use an analytic model to show that hiring two auditors is never as profitable as hiring a single auditor. This is because when there is more than one auditor, each auditor attempts to free-ride on the other auditor's effort. Auditors are motivated to work because they want to avoid the liability risk from from negligently signing off on misstated financial reports. If a company has two audits, each auditor knows that any existing misstatements might be caught by the other auditor. As long as one auditor catches the misstatement, it will have to be corrected, and neither auditor faces the risk of signing off on a misstated report.

After showing that the two-auditor model is never as profitable as the single-auditor model, I ask if and when it is profitable to hire an inspector. Using an analytic model, I compare a single-auditor regime to an auditor-inspector regime. I show that the single-auditor regime is more profitable for companies engaged in complex, high effort cost projects, while the auditor-inspector model is more profitable for companies engaged in less complex, lower effort cost projects. For companies with low complexity projects, hiring an inspector improves profitability, but leads to no change in financial reporting quality and a decrease in audit effort. For these companies, hiring an inspector mitigates the agency problem between ownership and management, but the benefit is not apparent from looking at financial reporting quality or audit effort.

When there is an auditor but no inspector, the owner can only induce full managerial effort by giving the manager the firm. That is, to get the manager to always work, the owner has to set the wage equal to the full revenue of the project. This is not profitable for the owner.

By adding an inspector, the owner can induce full managerial effort without giving away the firm. All he has to do is pay the manager a wage in excess of the effort cost: then the manager will always work because he does not want to risk losing this excess wage.

However, inducing the manager to always work comes with costs and benefits. The benefit is that since the manager works more often, he produces revenues more often. This directly increases the owner's profits. If the manager works twice as often, he produces revenue twice as often (i.e., the relationship between revenues and the managerial effort is linear). Importantly, the amount of revenue increase does not depend on effort cost. The downside of inducing more managerial effort are more complicated. First, because the manager works more often, he receives his wage more often as well, which is costly to the owner. This effect is linear, with slope equal to the manager's wage (which is at least as high as the effort cost, or else the manager would never work). When effort cost is high, paying the wage more frequently eats into the owner's revenues more severely than when effort cost is low.

Additionally, inducing the manager to work more makes it harder to induce audit effort. This is because as the manager works more, he is less likely to lie about working, which means the auditor faces less liability risk from shirking. Moreover, the resulting decrease in audit effort is steeper when effort cost is high. It might help to think of this in reverse: when effort cost is cheap, a change in auditor liability would not change effort level very much. In the extreme case where effort is free, change in auditor liability would have no effect on audit effort.

The lower audit effort hurts the owner in two ways. First, the inspector is more likely to catch the auditor shirking, which means the inspector is more likely to collect his bonus, which is costly to the owner. Second, the manager knows he is less likely to be audited, so it becomes less risky for the manager to shirk. Thus, to maintain the managerial effort, the owner must increase the manager's wage. Note that the wage increase is larger when cost of effort is high (for example, suppose you halve the chance of the manager being audited. To keep him from lowering his effort levels after this change, you would have to increase his wage by 100%. Since wage is higher when effort cost is higher, the wage increase must also be higher when cost of effort is higher).

The main take-away here is that having an inspector makes it possible to induce full managerial effort. The costs of inducing full managerial effort depend on effort cost, but the benefits of inducing full managerial effort do not depend on effort cost. Thus, hiring an inspector to achieve full managerial effort is worth the expense only when task complexity, and hence effort costs, are low. When effort cost is low, inducing full managerial effort increases revenues while creating only a modest increase in payments to the manager and the inspector. In contrast, when effort cost is high, inducing full managerial effort requires a much steeper increase in payments to the manager and the inspector, but the increase in revenue is the same as in the low-effort-cost case.

For an easy example, consider students taking college courses. Consider entry-level courses, where the subject matter is not very complex and so the cost of effort to taking or teaching these classes is relatively low. Compare this to graduate courses, where the subject is more complex, and the effort cost for taking or teaching the course is high. In both types of courses, students either learn or don't learn the material. Absent any form of assessment, all students will claim to have learned the material. Thus, the instructor gives an assessment, perhaps an exam or an essay, to determine whether the students indeed learned the material. Designing and grading the assessment is costly for the instructor. Importantly, designing and grading these assessments is more difficult for graduate courses than for entry-level courses. Within the university, there are administrators who inspect the teaching effort of course instructors. They do might do this by issuing uniform exams across all sections of a class, by conducting class-room observations, or by looking at teaching ratings. Importantly, assessing the teaching quality in a graduate course is more difficult than assessing the teaching quality of an entry-level course. As a result, we should expect that compared to graduate classes, entry-level classes have: (1) a greater likelihood of the instructor assigning exams or essays to assess student learning, (2) a greater likelihood that university administrators conduct uniform exams, teaching observations, or student evaluations, and (3) a greater likelihood that students learn the material [1].

The remainder of the paper is organized as follows. Section 2 describes the key institutional features which motivate the model assumptions. Section 3 presents the base model for the single-auditor regime. Section 4 models the two-auditor regime and shows that the two-auditor regime is never as profitable as the single-auditor regime. Section 5 presents the audit-inspector model, and discusses the relative merits of the audit-inspector and single-auditor regimes. Section 6 concludes.

2 Institutional Features

The Sarbanes-Oxley Act established the Public Company Accounting Oversight Board (PCAOB) in 2002. The following year, the PCAOB began inspecting auditors of SEC-registered clients. Large audit firms with over 100 clients are inspected annually; small audit firms with fewer than 100 clients are inspected every three years.

Following the inspection of an auditing firm, the PCAOB prepares an inspection report with two parts. The first part lists deficiencies related to specific audit engagements of the firm. This first portion is made publicly available 30 days after the end of the inspection

[1] assuming rational agents...

process. The second part lists control weaknesses faced by the audit firm as a whole. The audit firm has a year to correct these deficiencies before any uncorrected deficiencies are made public by the PCAOB.

The PCAOB inspectors do not investigate every engagement for each audit firm they inspect. Instead, the PCAOB chooses a sample of a firm's audits to examine. The PCAOB uses a risk-based process for individual engagements within a firm. However, the PCAOB has not disclosed the procedures it uses to determine which audits are "risky," so audit firms cannot perfectly predict which engagements will be inspected.

There is relatively little evidence on the incentives facing PCAOB inspectors. However, prior research suggests that strict regulators are more likely to have lucrative industry jobs after leaving their regulatory posts (Che 1995, DeHaan et al. 2015, Hendricks et al. 2018). Thus, the PCAOB inspector conceivably faces career concern incentives to be strict. To credibly signal that he is strict, a PCAOB inspector detects as many audit deficiencies as possible. Each audit deficiency he detects makes him appear slightly stricter, increasing his expected lifetime earnings after leaving the PCAOB.

2.1 Auditors

In the U.S., the audit committee of a publicly traded company hires an auditor on behalf of the company's shareholders. The company pays the auditor an audit fee which, in general, is not contingent on the results of the audit. Only one audit firm can assume primary responsibility for a given company's audit. Moreover, within an audit firm, a single audit partner takes primary responsibility for any given engagement.

While the audit fee is generally not tied to the auditor's performance, there are consequences if the performance is poor. An auditor who, by acting fraudulently or negligently, allows a client to misstate their financial reports, can be held liable for losses to the client's stakeholders. If the auditor shirks but no misstatements or stakeholder losses occur, then the auditor has no liability. Likewise, if a misstatement occurs, but is not the result of fraud or negligence on the auditor's part, the auditor is not held responsible.

In addition to the specter of stakeholder lawsuits, auditors face the possibility of fines from the PCAOB. The PCAOB can fine any "registered public accounting firms and persons associated with those firms for noncompliance with the Sarbanes-Oxley Act of 2002, the rules of the PCAOB and the Securities and Exchange Commission, and other laws, rules, and professional standards governing the audits of public companies." [2] Thus, the auditor can face fines for supplying insufficient audit effort even if there are no resulting misstatements.

Note that the PCAOB has a variety of explicit standards to determine whether an auditor provided sufficient audit effort. The PCAOB can rely on PCAOB rules, SEC rules, laws, and professional standards in evaluating the auditor's work. Likewise, the auditor can use these rules, laws, and standards to guide their efforts throughout the audit process. While these laws, rules, and standards undoubtedly involve considerable subjectivity, they are nevertheless more objective and explicit than the laws, rules, and standards governing the efforts of managers.

To put it another way: two firms in different lines of business will require entirely different types of effort from their management. A regulator could never write one set of rules and standards to guide the managers of both firms. However, the audits of these two

[2] https://pcaobus.org/Enforcement/Pages/default.aspx

unlike firms will be fundamentally similar and will be governed by the same broad set of standards that guide all public company audits.

3 Single-Auditor Regime

The single-auditor strategy is modeled as a game with three players: a manager (M), an owner, and an auditor (A).

Timing: The game occurs in two stages. In the first stage, the owner makes an offer w, f which is a wage and audit fee. In the second stage, all players observe the wage and audit fee and decide whether to play the game. If the manager and the auditor decide to play, they each simultaneously choose their actions.

Effort: The manager chooses between two actions: shirk or work. Working is costly, with effort cost K. Shirking is cost-less. The manager will claim to have worked regardless of whether he worked or shirked. The auditor can also choose between two actions: shirk or audit. Auditing is costly, with effort cost K, and shirking is cost-less. Note that auditing effort and managerial effort carry the same cost.

Revenues: The firm produces revenue $X > 0$ if the manager works and revenue of 0 if the manager shirks. Without loss of generality, assume X = 1.

Report: If the manager works, he generates a high report regardless of whether the auditor audits. If the manager shirks, he only generates a high report if the auditor shirks.

Payoffs: The manager only gets paid his wage w when he has a high report. The auditor receives her audit fee f regardless of whether she audits or shirks.

Auditor Liability: If the auditor shirks and the manager shirks, the auditor faces a penalty $1 + f$. The penalty represents a legal liability, reputation cost, SEC fines, or possible client loss. The penalty is equal to the audit fees plus the value of the project whose existence to which the auditor erroneously attested.

Owner's Profits: The owner's profits are the revenues, less the audit fees, less the wage paid to the manager. In the case where the auditor pays the penalty, the owner is not the recipient. Instead, the auditor's penalty represents a dead-weight economic loss.

There are two reasons for modeling the auditor penalty as a dead-weight loss. First, in real life, equity holders do not receive compensation equal to the full penalty faced by a shirking auditor. For example, equity holders in a firm with misstated earnings do not directly benefit from subsequent damage to their auditor's reputation. Neither do equity holders directly benefit when the auditor faces criminal charges or is barred from practice, even though both of these events directly harm the auditor. Even in the case where the auditor is fined or pays a settlement in a class action, not all of the money goes back to the harmed equity holders. The second reason is that if the owner receives the auditor's penalty, the owner would be less averse to having an accounting misstatement. Given that we are interested in the agency problem between the auditor and the owner, it is essential that the owner be averse to misstatements.

Recall that the effort cost of the auditor equals the effort cost of the manager. The equal cost effort across players corresponds to an assumption that audit work is as costly as an equal amount of management work. Thus, if the auditor always works, it is just as costly (in terms of effort) as if the manager always works. This assumption does not preclude the possibility that the manager works more than the auditor. For example, the manager could have a pure strategy of always work, while the auditor has a mixed strategy of working and shirking. Thus, it is possible for total managerial effort cost to be higher than the total audit effort cost.

3.1 Solution to Single-Auditor Model

Assume the owner knows the cost of effort when he makes his wage and audit fee offer w, f in stage one. Moreover, assume the wage offer, audit fee offer, cost of effort, and penalty value are all public information at the beginning of stage two. Finally, assume all players are risk neutral with reservation utility 0, and that this is common knowledge. Thus, we can think of the owner as designing a 2x2 game for the manager and auditor with the following payoff matrix:

	A Shirks	A Audits
M Shirks	$(w, -1)$	$(0, f - K)$
M Works	$(w - K, f)$	$(w - K, f - K)$

Table 1

The manager designs the game by choosing w, f to maximize his expected profits. To solve the model, start by analyzing the game at stage 2 for a given w, f and then work back to stage 1.

Starting at stage 2, note that the game in Table 1 does not have a Nash equilibrium in pure strategies. Thus, consider mixed strategy Nash equilibria $M, A \in [0, 1]$ where the manager shirks with probability M and the auditor shirks with probability A. The mixed strategy Nash equilibrium for a given w, f is $A = max(0, \frac{w-K}{w}); M = min(1, \frac{K}{f+1})$ [3].

Knowing this, the owner sets w, f in stage 1 to maximize his expected profits. He must

[3] see proof in appendix

set w, f high enough that the manager and auditor can both obtain their reservation utilities by playing the game. This implies $w, f \geq K$ [4]. The owner optimally sets $w = f = K$. As a result, the manager plays the mixed strategy $M = \frac{K}{K+1}$, and the auditor plays the strategy $A = 0$. That is, the manager works $\frac{1}{K+1}$ of the time, and the auditor always audits. Note that the manager is more likely to work when the cost of effort is low. The auditor's effort is invariant to the cost of effort.

The owner's expected profits from this game are $\frac{-K^2-2K+1}{K+1}$, which is positive as long as $K < \sqrt{2}$. The manager and the auditor both have expected utility of 0, meaning they are indifferent between playing the game and not playing the game: they do not extract any rents from the owner.

4 Two-Auditor Model

Now turn to the model with two auditors and no inspectors. The two auditor strategy is a game with four players: an owner, a manager (M), auditor 1 (A1), and auditor 2 (A2).
Timing: As before, the game consists of two stages with the owner making an offer w, f in stage 1 and the remaining players choosing their actions simultaneously in stage 2.

Effort: The manager chooses between two actions: shirk or work. Working is costly, with effort cost K. Shirking is cost-less and the manager reports that he worked even if he shirked. The first auditor chooses to audit or to shirk, where auditing is costly with effort cost K and shirking is costless. The second auditor also chooses to audit or to shirk. Because all players choose their actions simultaneously, the auditors cannot coordinate their choices

[4] see proof in appendix

with each other.

Revenues: As before, the firm produces revenue $X > 0$ if the manager works and revenue of 0 if the manager shirks. We assume X = 1 without loss of generality.

Report: If the manager works, he generates a high report regardless of the auditors' actions. If the manager shirks, he only generates a high report if both of the auditors shirk. Only one auditor has to work in order for the manager to be caught shirking.

Payoffs: The manager only gets paid his wage w when he has a high report. The auditors each receives their audit fee f regardless of whether they audited or shirked. Note that both auditors receive the same audit fee.

Auditor Liability: The auditors are both subject to a penalty if the manager shirks without being caught. Thus, if both auditors shirk and the manager shirks, the auditors face a penalty of $1 + f$ each. The penalty equals the audit fees plus the value of the project whose existence to which the auditor erroneously attested. Importantly, if one auditor catches the manager shirking, neither auditor faces the penalty. The underlying assumption is that if one auditor catches the manager shirking before the release of the financial statements, the manager has to correctly report that he shirked. Then neither auditor faces the reputation risk of signing off on a misstated financial report, and, consequently, neither auditor can be sued for financial losses incurred due to a misstated report.

Owner's Profits: The owner's profits are the revenues, less the auditors' fees, less the wage paid to the manager. In the case where the auditors pay the penalty, the owner is not the recipient. Instead, the auditors' penalties represent a dead-weight economic loss.

4.1 Solution to Two Auditor Model

As before, the owner knows the cost of effort before he makes his wage and audit fee offers in stage one. In stage 2, the wage offer, audit fee offer, cost of effort, and penalty value are all public information. All players remain risk neutral with reservation utility 0, which remains common knowledge.

Thus, in stage one, the owner's choice of w, f amounts to designing a three-way game between the manager and the two auditors. For a given w, f, the payoff matrix for the resulting three-way game is:

	A2 Shirks		**A2 Audits**	
	A1 Shirks	A1 Audits	A1 Shirks	A1 Audits
M Shirks	$(w, -1, -1)$	$(0, f-K, f)$	$(0, f, f-K)$	$(0, f-K, f-K)$
M Works	$(w-K, f, f)$	$(w-K, f-K, f)$	$(w-K, f, f-K)$	$(w-K, f-K, f-K)$

Table 2

The manager designs the game by choosing w, f to maximize his expected profits. Start by analyzing the game at stage 2 for a given w, f and then work back to stage 1. Consider mixed strategy Nash equilibria $M, A_1, A_2 \in [0,1]$ where the manager shirks with probability M, auditor 1 shirks with probability A_1 and auditor 2 shirks with probability A_2. For a given w, f, the manager, and the auditors choose the following mixed strategies [5]: $A_1 = A_2 = max(0, \sqrt{\frac{w-K}{w}}), M = min(1, \frac{K\sqrt{\frac{w}{w-K}}}{f+1})$. Intuitively, the manager is more likely to shirk when the cost of effort is high. Also, as the wage increases, the manager is less likely to shirk, and the auditors are less likely to audit.

Knowing that his choice of w, f in stage 1 determines the equilibrium strategies

[5] see proof in appendix

M, A_1, A_2 of the manager and the auditors in stage 2, the owner chooses w, f to maximize his expected profits. The owner must choose w, f high enough that the manager and both auditors find it optimal to play the game; that is, the owner must ensure that the manager and auditors win at least their reservation utility in expectation. This implies the participation constraints $f, w \geq K$ [6].

It is not possible to find a closed-form solution for the owner's optimal choice of w, f in terms of K. Consequently, it is also impossible to find a closed form expression for the owner's expected profits in terms of K. However, because K only ranges over the closed and bounded set $[0, 1]$, the Heine-Borel theorem guarantees that I can find arbitrarily accurate numerical approximations for w, f, and the owner's expected profits in terms of K. I provide plots of these numerical approximations in the back of the paper.

Looking at the plots, note that the owner's profits are always lower in the two-auditor case than in the single-auditor case because the auditors are more likely to shirk in the two-auditor case. Intuitively, this is because each auditor faces a lower liability-risk from shirking, because there is a chance that the other auditor will audit, thus absolving both auditors from any risk.

The fact that the auditors sometimes shirk in the two-auditor case also means that the agency problem between the owner and the manager is more severe than in the single-auditor case. In fact, we can see that in the two auditor case the manager extracts rents, whereas the manager cannot extract rents in the single-auditor case. Moreover, despite extracting rents, the manager is more likely to shirk in the two-auditor case than in the single-auditor case.

[6] see proof in appendix

The poor performance of the two-auditor strategy may explain why we rarely see this strategy used in practice. For example, the SEC and PCAOB are relatively strict that only one audit firm take primary responsibility for any given engagement, even if a second audit firm provided substantial consulting support. Moreover, within an audit firm, only one audit partner assumes responsibility for any given client. The general idea that agency problems are more straightforward to solve when responsibility is cleanly assigned to individual actors has been around for generations and is quite intuitive.

5 Auditor-Inspector Model

Given the poor performance of the two-auditor strategy, we now focus on comparing the single-auditor regime to the auditor-inspector regime. To do so, we first model the auditor-inspector regime.

The auditor-inspector regime is a game with four players: an owner, a manager (M), an auditor (A), and an iNspector (N).

Timing: As in the single-auditor and two-auditor models, the game consists of two stages. In stage one, the owner makes an offer w, f, B, where B is the bonus paid to the inspector for detecting a deficient audit. In stage two, the remaining players choose their actions simultaneously.

Effort: Inspecting is costly with effort cost K, and shirking is cost-less. As before, The manager chooses to shirk or work. Working is costly with effort cost K and shirking is cost-less. The manager always reports that he worked, even if he shirked. Also as before, the auditor chooses to audit or to shirk, where auditing is costly with effort cost K and shirking is cost-less. Note that the inspector, the manager, and the auditor all have the same cost of effort.

Revenues: As before, the firm produces revenue of X assumed to equal 1 if the manager works and revenue of 0 if the manager shirks.

Report: If the manager works, he generates a high report regardless of the auditor or inspector's actions. If the manager shirks, he only generates a high report if both the auditor and the inspector shirk. The underlying assumption is that if an inspector catches a shirking auditor, the auditor has to correct any audit deficiencies. As a result, the auditor catches the manager shirking and the manager does not receive the wage.

Payoffs: The manager only gets paid his wage w when he has a high report. The auditor receives her audit fee f regardless of whether she audits or shirks. The inspector receives a bonus B whenever he catches the auditor shirking. Otherwise, the inspector receives 0.

Auditor Liability: There are two cases where the auditor is subject to a penalty. First, the auditor is penalized if she shirks when the manager shirks. Second, the auditor is penalized when she is caught shirking by the inspector. In either case, the value of the penalty is $1 + f$ which equals the audit fee f plus the value of the productive project $X = 1$. The underlying assumption is that negative audit inspection results are harmful to auditor reputation, open the door to shareholder lawsuits, and can result in fines from the PCAOB.

Owner's Profits: The owner's profits are the revenues, less the bonus paid to the inspector, less the audit fees, less the wage paid to the manager. In the case where the auditors pay the penalty, the owner is not the recipient.

Related to the auditor-inspector model, Ewert and Wagenhofer (2016) study a game with a manager, an auditor, and an enforcer (similar to an inspector). Their model differs from the present study in that it focuses on how enforcement affects auditing, assuming the enforcer's behavior is exogenously given. In contrast, the present study assumes the inspector's behavior is endogenously determined by his incentives and his interactions with the auditor.

Ye and Simunic (2017) also provide a model where the inspector's behavior is endogenously determined. In their model, an entrepreneur seeks to sell a project to the stock market, and hires an auditor to provide assurance on the quality of his project. However, the entrepreneur does not choose whether to engage in productive effort. The quality of the entrepreneur's project is exogenously given and the entrepreneur only makes decisions about disclosure and auditing. Thus, accounting informs stock prices but does not serve a corporate governance role in the Ye and Simunic Model. In contrast, the present study focuses on how accounting and auditing can address the principal-agent problem between an owner and a manager. As a result, the manager must face decisions about productive effort, not just disclosure.

5.1 Solution to Auditor-Inspector Model

In the first stage, the owner chooses w, f, B which is the wage, the audit fees, and the inspector's bonus. The owner's choice of w, f, B is publicly known, giving rise to the following 2x2x2 game between the manager, the auditor, and the inspector in the second stage:

A naive grid search algorithm testing a billion possible constellations of w, f, B, K on the space $[0, 1]^4$ confirms that for all K, the owner always optimally chooses w, f, B such

	A2 Shirks		Inspector Inspects	
	A Shirks	A Audits	A Shirks	A Audits
M Shirks	$(w, -1, 0)$	$(0, f-K, 0)$	$(0, -1, B-K)$	$(0, f-K, -K)$
M Works	$(w-K, f, 0)$	$(w-K, f-K, 0)$	$(w-K, -1, B-K)$	$(w-K, f-K, -K)$

Table 3

that the manager always works. Thus, consider only Nash equilibria where the manager manipulates with probability $M = 0$. As a result, all possible mixed strategy Nash equilibria are characterized by $A, N \in [0, 1]$ where the auditor shirks with probability A and the iNspector shirks with probability N. Moreover, since we only consider equilibria where the manager always works, we must have that the managers expected utility from working is greater than his expected utility from shirking, i.e., $w - K > ANw$

For a given w, f, B the auditor will choose the mixed strategy $A = \frac{K}{B}$ and the inspector will choose the mixed strategy $N = \frac{1+f-K}{f+1}$. These mixed strategies, along with the constraint that the manager, auditor, and inspector must obtain at least their reservation utility in expectation, imply the participation constraints: $f \geq K, w \geq \frac{K}{-AN+1}$ [7].

The owner, knowing that his choice of w, f, B in the first stage determines the manager's, auditor's, and inspector's strategies in the second stage, chooses w, f, B to maximize his expected profits. His optimal choices are $w = \frac{K}{1-AN}$, $f = K$, and $B = 1$ [8]. We can see that the participation constraints for the manager and the auditor are binding: the owner sets the wage and the audit fees to the lowest possible values that induce the manager and auditor to play the game. Setting $B = 1$ means that when the inspector catches the auditor shirking, the inspector gets a bonus equal to the full value of the valuable project. This large

[7]see appendix for proof
[8]see appendix for proof

bonus for the inspector is optimal because it makes the auditor less likely to shirk (since $A = \frac{K}{B}$ in equilibrium). Since the auditor is less likely to shirk, it is less costly to induce the manager to work. Furthermore, the bonus B is unlikely to be paid out when it is large because the likelihood of the inspector inspecting while the auditor shirks is low for large B.

Given the owner's profit-maximizing choice of w, f, B, the manager always works in equilibrium, the auditor shirks with probability K, and the inspector shirks with probability $\frac{1}{1+K}$. Hence, as the cost of effort increases, the auditor is less likely to audit and the inspector is more likely to inspect. The auditor and the inspector both have expected utility of 0 in equilibrium: they do not extract any rents. The manager, however, does extract rents: he has expected utility K^2 in equilibrium.

5.2 Comparison of Profitability

For the audit-inspector model, the owner's expected profits as a function of K are $\frac{-K^3-4K^2-K+1}{K+1}$. The owner's profits are positive as long as $K \lesssim 0.377$. Thus, the cost of having a single player work with probability 1 must be less than 0.377 for the project to be profitable. In a first-best world, the project would be profitable as long as the cost of effort was less than 1.

For the single-auditor model, the owner's expected profits are $\frac{-K^2-2K+1}{K+1}$, which is positive as long as $K < \sqrt{2}$. Thus, the cost of having a single player work with probability 1 must be less than 0.414 for the project to be profitable. It follows that there are some projects which would be profitable for the single-auditor model, but which would not be profitable for the auditor-inspector model. Thus, switching to the auditor-inspector model might cause companies to forego some projects that have higher human capital costs.

Does this mean we should never employ the auditor-inspector model? No. There are cases where the auditor-inspector model is more profitable than the single-auditor model. For example, when the cost of effort is low (specifically, for $0 \leq K \lesssim 0.303$), the owner has higher profits using the auditor-inspector strategy than using the single-auditor strategy [9]. For a moderate cost of effort (specifically, for $0.303 \lesssim K \leq \sqrt{2}$), the owner is better off using the single-auditor strategy. For high cost of effort (specifically, for $K > \sqrt{2}$), it is not optimal for the owner to go into business.

If we imagine a regulator whose goal is to maximize business owners' profits, we should see mandated inspections only when the cost of human capital is high. Note that in the US, SOX mandated that publicly traded companies switch from the single-auditor model to the auditor-inspector model in 2002. Technological innovations during the tech boom in the 1990s lead to a sharp rise in US labor productivity, consistent with model predictions that the auditor-inspector model is optimal when effort costs decrease.

5.3 Comparison of Rents and Social Welfare

For the two-auditor model, neither the auditors nor the manager extract rents. Thus, the social welfare is simply the owner's profits, $\frac{-K^2-2K+1}{K+1}$. For the auditor-inspector model, the manager extracts rents K^2, but neither the auditor nor the inspector extract rents. The social welfare is then the manager's rents plus the owner's profits, which sum to $\frac{-3K^2-K+1}{K+1}$. Hence, the social welfare under the auditor-inspector model is greater than under the single-auditor model.

The fact that the auditor-inspector model provides greater social welfare suggests a

[9] see appendix for proof

reason for a benevolent regulator to mandate audit inspections. However, mandated audit inspections may still harm social welfare, depending on who chooses which projects to implement. For example, if the owner chooses which projects to implement, then he only implements projects when human capital costs are less than 0.37 under the audit-inspection regime. If the owner could choose to use the single-auditor model, he would still implement projects even when the human capital costs were as high as 0.414.

Thus, while mandatory audit inspections make some projects more profitable and more socially beneficial, mandatory inspections also cause some projects to be foregone. The net effect on social welfare depends on the distribution of projects in the economy.

5.4 Comparison of Financial Reporting Quality

Define financial reporting quality is "bad" if the manager, the auditor(s) and the inspector all shirk. Otherwise, define financial reporting quality to be "good." Thus, if the manager works, financial reporting quality is good. If the manager shirks but the auditor catches him, financial reporting is still good. If the manager shirks and the auditor shirks, but the auditor is caught by the inspector, financial reporting quality is still good. The financial reporting is good in the sense that it accurately reports when the manager did or did not work.

For the single-auditor model, the auditor always audits. Hence, the financial reporting quality is always good. For the auditor-inspector model, the manager always works, which means he never lies about shirking. Thus the financial reporting quality is always good for the auditor-inspector model as well.

Importantly, there is no difference in financial reporting quality between the single-auditor and auditor-inspector models. The benefits of adding an inspector do not come in the form of higher financial reporting quality. Instead, they come in the lower agency costs between the owner and the manager, which is much harder to measure empirically.

Researchers who aim to document causal effects of the PCAOB inspection regime may be better served to look at measures of the agency problem between owners and managers, rather than at earnings quality measures like abnormal accruals. Additionally, critics of the PCAOB inspection regime should keep in mind that the benefits of PCAOB inspections may not manifest directly in the form of improved financial reporting quality.

5.5 Comparison of Audit Quality

Define audit quality as the fraction of the time the auditor audits as opposed to shirking. Given that the auditor always audits in the single-auditor regime, we have perfect audit quality in that setting. In the audit-inspector regime, the auditor shirks with positive probability. Hence, audit quality is lower in the audit-inspector regime. The result, while counter-intuitive, arises from two facts. First, the manager knows that his manipulation will fail not just if the auditor audits, but also if the inspector inspects. Second, the auditor knows the manager is less likely to manipulate and rationally chooses to audit less frequently.

Many papers have investigated the effects of PCAOB inspections by studying measures which capture audit quality and financial reporting quality jointly. Abnormal accruals and market response to earnings, for example, both reflect combinations of audit and financial reporting quality (Gaynor et al 2016). Prior studies document lower abnormal accruals (e.g. Krishnan et al 2017, Carcello et al 2011) and greater market responses to earnings

(Gipper et al 2016) under the PCAOB inspection regime. Results along these lines are generally interpreted as an increase in some combination of auditing or financial reporting quality.

Model results from the present study provide an alternative explanation for increases in ERCs and decreases in abnormal accruals. Specifically, the present study suggests PCAOB inspections do not directly increase audit or financial reporting quality, but rather increase firm profits. Profitable firms have larger earnings response coefficients than unprofitable firms (Hayn 1995, Basu 1997). As a result, PCAOB inspections could indirectly strengthen market reactions to earnings through the channel of increasing firm profits. Changes in abnormal accruals may also be driven by changes in firm profits, depending on the abnormal accrual specification used. Researchers aiming to attribute changes in abnormal accruals to PCAOB induced changes in auditing or financial reporting quality should choose specifications that correct for changes in firm performance.

Again, it is important to note that audit inspections may be profitable to business owners and society at large, even if researchers cannot observe increases in audit quality or financial reporting quality.

6 Conclusion

This paper models three strategies for mitigating the agency problem between ownership and management. The first strategy is to hire a single auditor. The second strategy is to hire two auditors. The third strategy is to hire an auditor and an inspector.

The models show that the two-auditor regime is never more profitable than the single-auditor regime because in the two-auditor regime, auditors free-ride on each other's effort. The model shows that the auditor-inspector regime is more profitable than the single-auditor regime when human capital costs are low. Moreover, the auditor-inspector regime leads to higher social welfare for any given project the owner chooses to implement.

Most importantly, the model shows that any benefits of the audit-inspection regime are unlikely to show up in the form of increased financial reporting quality or increased audit quality. Instead, the benefits take the form of decreased agency costs between ownership and management. Empirical researchers may benefit from looking more closely at measures of agency cost when testing the effects of PCAOB inspections.

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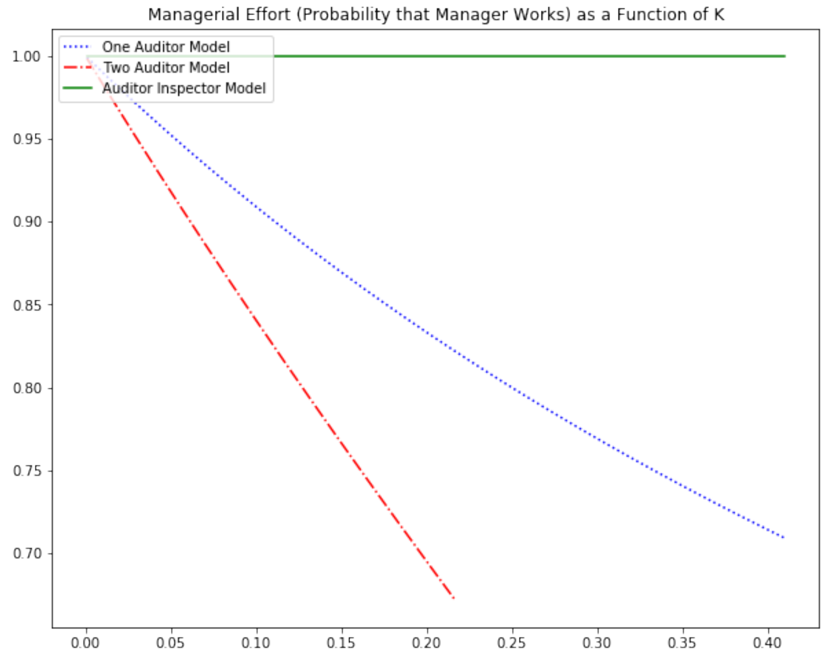
Figures

Figure 1: Manager's Effort and Wage



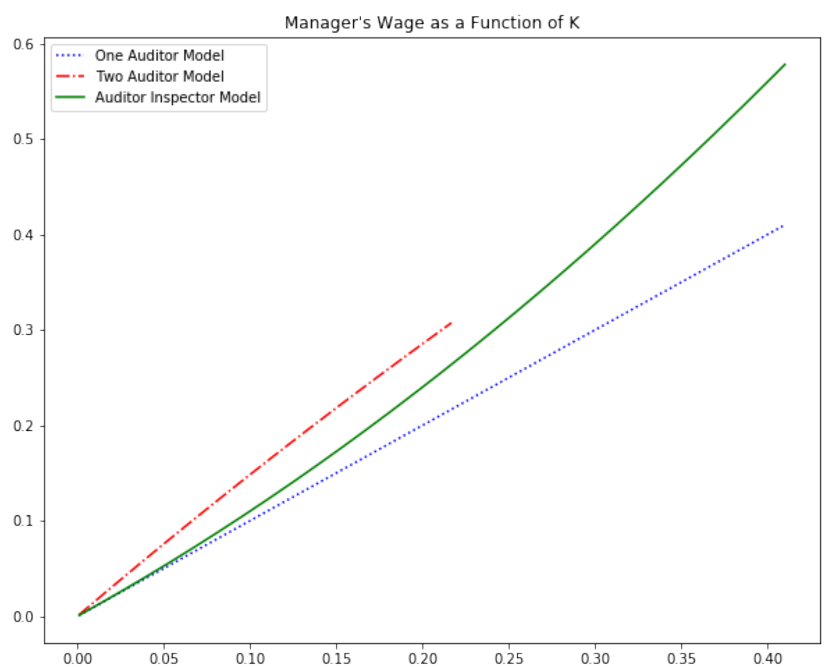


Figure 2: Audit Effort (Same as Audit Quality)

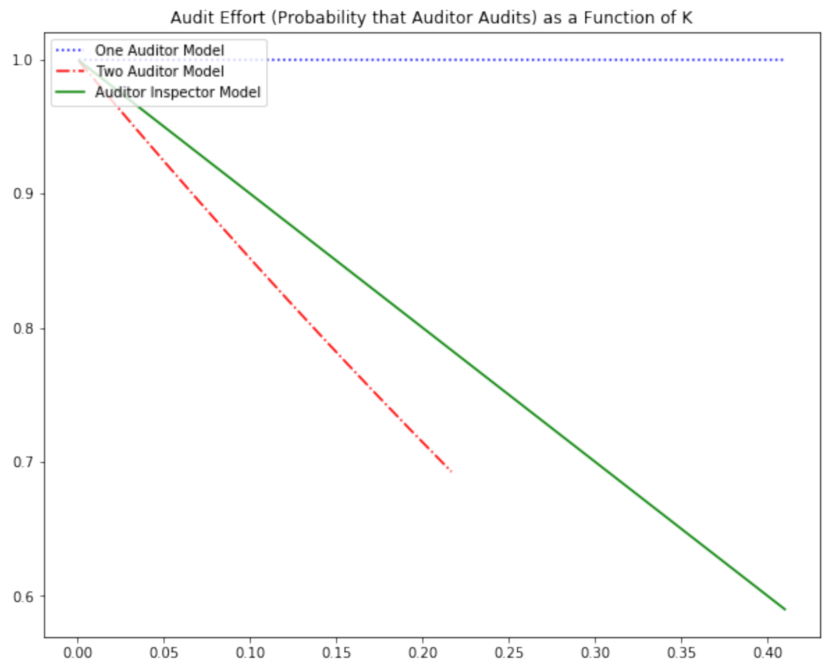
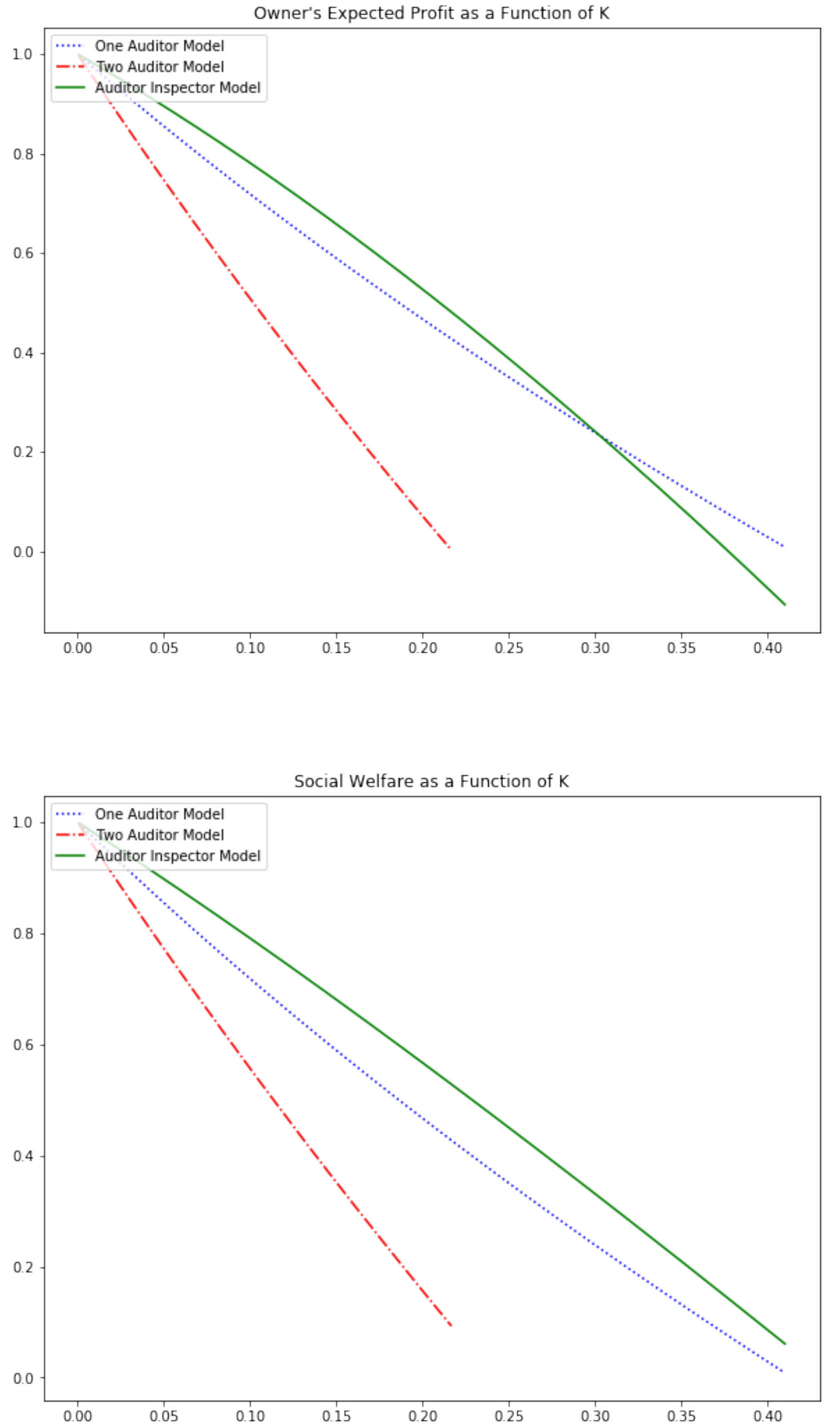


Figure 3: Owner's Profits and Social Welfare



7 Appendix A

7.1 Single Auditor Model

Definition 7.1. Let w be the wage offered to the Manager. Let f be the audit fees offered to the auditor.

Definition 7.2. Let $A \in [0, 1]$ be the auditor's strategy. When the auditor chooses strategy A, he shirks with probability A and audits with probability $1 - A$.

Definition 7.3. Let $M \in [0, 1]$ be the manager's strategy. When the manager chooses strategy M, he works with probability $1 - M$ and shirks with probability M.

Remark. For a given w, f, the auditor's utility is $U_a(w, f, M, A) = (K+(-f-1)M)A-K+f$.

Remark. For a given w, f, the manager's utility is $U_m(w, f, M, A) = ((A-1)w+K)M-K+w$.

Remark. For a given w, f, M, A, the owner's utility is $U_{owner}(w, f, M, A) = (-1 + (1 - A)w)M - f - w + 1$.

Proposition 7.1. *There are no equilibria in pure strategies.*

Proof. We can't have an equilibrium where the manager always shirks and the auditor always shirks. If the manager always shirked, the auditor would always prefer to audit because $f - K \geq 0$ and $0 > -1$, leading to a contradiction.

We can't have an equilibrium where the manager always shirks and the auditor always audits. If the auditor always audited, it would never be in the manager's interest to shirk because $w - K > 0$, creating a contradiction.

We can't have an equilibrium where the manager always works and the auditor always shirks. If the auditor always shirked, the manager would always have an incentive to shirk because $w > w - K$, leading to a contradiction.

Lastly, we can't have an equilibrium where the auditor always audits and the manager always works. If the manager always worked, the auditor would always have an incentive to shirk because $f > f - K$, creating a contradiction.

Proposition 7.2. *There exists a mixed equilibrium where the auditor chooses strategy* $A = 0$ *and the manager chooses strategy* $\frac{K}{K+1}$

Proof. A mixed equilibrium M, A must satisfy $\frac{\partial U_a}{\partial A} = 0$, $\frac{\partial U_m}{\partial M} = 0$, and $M, A \in [0, 1]$. Solving these conditions yields $A = max(0, \frac{-(K-w)}{w})$ and $M = min(1, \frac{K}{f+1})$.

Because the auditor and manager both have reservation utilities of 0, the owner must offer w, f such that $U_a(w, f, M = \frac{K}{f+1}, A = \frac{-(K-w)}{w}) \geq 0$ and $U_m(w, f, M = \frac{K}{f+1}, A = \frac{-(K-w)}{w}) \geq 0$. These conditions together imply participation constraints $w, f \geq K$.

The owner's utility is then $U_{owner}(w, f, M = \frac{K}{f+1}, A = \frac{-(K-w)}{w}) = \frac{K^2-K-(f+1)(f+w-1)}{f+1}$. Maximizing by choice of w, f gives $w = f = K$ at the optimum. Back substituting yields $A = 0$ and $M = \frac{K}{K+1}$.

7.2 Two-Auditor Model

Definition 7.4. Let w be the wage offered to the Manager. Let f be the audit fees offered to each of the auditors.

Definition 7.5. Let $A_1 \in [0, 1]$ be the first auditor's strategy. Let $A_2 \in [0, 1]$ be the second auditor's strategy. When the auditor i chooses strategy A_i, he shirks with probability A_i

and audits with probability $1 - A_i$.

Definition 7.6. Let $M \in [0,1]$ be the manager's strategy. When the manager chooses strategy M, he works with probability $1 - M$ and shirks with probability M.

Remark. For a given w, f, the first auditor's utility is $U_{a1}(w, f, M, A_1, A_2) = (-M(f+1)A_2 + K)A_1 - K + f$. The second auditor's utility can be found symmetrically.

Remark. For a given w, f, the manager's utility is $U_m(w, f, M, A_1, A_2) = (A_2 A_1 w + K - w)M - K + w$.

Proposition 7.3. *If there exists a mixed equilibrium, it satisfies* $A_1 = A_2 = \sqrt{max(0, \frac{w-K}{w})}$ *and* $M = min(1, \frac{\sqrt{\frac{w}{w-K}}K}{f+1})$

Proof. A mixed equilibrium M, A_1, A_2 must satisfy $\frac{\partial U_{a1}}{\partial A_1} = 0$, $\frac{\partial U_{a2}}{\partial A_2} = 0$, $\frac{\partial U_m}{\partial M} = 0$, and $M, A_1, A_2 \in [0,1]$. Solving this system yields the result.

Proposition 7.4. *We must satisfy the participation constraints* $w, f \geq K$ *in order to induce the manager and the auditors to play the game.*

Proof. Given that all players have reservation utility of 0 by assumption, we must have $U_{a1}(w, f, M, A_1, A_2) \geq 0$, $U_{a2}(w, f, M, A_1, A_2) \geq 0$, and $U_m(w, f, M, A_1, A_2) \geq 0$ in order for the game to occur. Substituting in $A_1 = A_2 = \sqrt{max(0, \frac{w-K}{w})}$ and $M = min(1, \frac{\sqrt{\frac{w}{w-K}}K}{f+1})$ and solving the resulting system for w, f yields the participation constraints.

Remark. For a given w, f, the owner's utility is $U_{owner}(w, f, K) = (K-1)\frac{\sqrt{\frac{w}{w-K}}K}{f+1} - 2f - w + 1$ (obtained by substituting in $A_1 = A_2 = \sqrt{max(0, \frac{w-K}{w})}$ and $M = min(1, \frac{\sqrt{\frac{w}{w-K}}K}{f+1})$).

Remark. Setting $\frac{\partial U_{owner}}{\partial w} = 0$ and $\frac{\partial U_{owner}}{\partial f} = 0$, we can find two analytic solutions for f in terms of w and K. Setting those two solutions for f equal to each other, allows us to solve for

w, but the solution cannot be written in closed form. We can find an approximate numerical solution for w for any given value of K. Since $K \in [0, 1]$ by assumption, I calculate the numerical value of w for 1,000 values of K evenly spaced on the interval [0,1]. Then, I plug these estimates back into the formula for f in terms of w and K to get a numerical estimate for f. This procedure reveals a corner solution with $f = K$. The owner's utility can be rewritten then as $U_{owner}(w, f, K) = (K-1)\frac{\sqrt{\frac{w}{w-K}}K}{K+1} - 2K - w + 1$.

The first order condition with respect to w; still cannot be solved analytically, so I again numerically solve for w; at 1,000 different values of K. Since w is a continuous function of K and since M, A_1, A_2 and the utility functions of all players can be written as continuous closed form expressions of w, K, numerical estimates of w are sufficient to solve every other variable of the model. Moreover, the domain of $w(K)$ is $[0, 1]$ is compact, so for any given accuracy level $\varepsilon > 0$, I can accurately estimate M, A_1, A_2, and the utility functions of all the players at all (of infinitely many) values K by numerically solving for w at only finitely many values of K and then interpolating (by the fact that all compact sets have a finite subcovering, and by the Heine-Borel theorem which states that a continuous function on a compact domain has a compact image). Thus, I provide graphs of M, A_1, A_2, w, and the utility functions of all the players as a function of K. I also provide graphs of the same functions for the one-auditor model for comparison.

7.3 Auditor-Inspector Model

Definition 7.7. Let w be the wage offered to the manager. Let f be the audit fees offered to the auditor. Let B be the bonus offered to the inspector for detecting audit deficiencies.

Definition 7.8. Let $A \in [0,1]$ be the auditor's strategy. When the auditor chooses strategy A, he shirks with probability A and audits with probability $1 - A$.

Definition 7.9. Let $M \in [0,1]$ be the manager's strategy. When the manager chooses strategy M, he works with probability $1 - M$ and shirks with probability M.

Definition 7.10. Let $N \in [0,1]$ be the iNspector's strategy. When the inspector chooses strategy N, he inspects with probability $1 - N$ and shirks with probability N.

Remark. I numerically the model for over a billion possible constellations of w, f, B, K evenly spaced of the four dimensional unit cube. In every case, the owner optimally set w, f, B, K such that the manager always worked. I therefore simplify the mathematical analysis by considering only equilibria where the manager always works.

Remark. For a given w, f, B, assuming $M = 0$, the manager's utility is $U_m(w, f, B, M, A, N) = -K + w$.

Remark. For a given w, f, B, assuming $M = 0$, the auditor's utility is $U_a(w, f, B, M, A, N) = (N(f + 1) + K - f - 1)A - K + f$.

Remark. For a given w, f, B, assuming $M = 0$, the inspector's utility is $U_n(w, f, B, M, A, N) = -(N - 1)(AB - K)$.

Proposition 7.5. *If there exists a mixed equilibrium, it must satisfy* $A = \frac{K}{B}, N = \frac{f+1-K}{f+1}$

Proof. A mixed equilibrium A, N must satisfy $\frac{\partial U_n}{\partial N} = 0$, $\frac{\partial U_a}{\partial A} = 0$, and $N, A \in [0,1]$. Solving this system, and noting that $B > K$ and $F + 1 - K > f + 1$ yields the result.

Proposition 7.6. *We must satisfy the participation constraints* $f \geq K$ *and* $w \geq \frac{K}{1-AN}$ *in order to induce the manager and the auditors to play the game.*

Proof. Given that all players have reservation utility of 0 by assumption, we must have $U_n(w, f, B, M, A, N) \geq 0$ and $U_a(w, f, B, M, A, N) \geq 0$ in order for the game to occur. Substituting in $A = \frac{K}{B}, N = \frac{f+1-K}{f+1}$ and solving the resulting system for f, w yields the participation constraints.

Proposition 7.7. *There exists a mixed equilibrium where the auditor chooses strategy $A = K$ and the inspector chooses strategy $N = \frac{1}{K+1}$*

Proof. Plugging $A = \frac{K}{B}, N = \frac{f+1-K}{f+1}$ into the owner's utility and taking the first order conditions in w and f shows us that both participation constraints are binding. Plugging the participation constraints into the owner's utility yields a function of B, K. Maximizing by choice of B shows that $B = 1$ at the optimum. Plugging $B = 1$ into the equilibrium conditions $A = \frac{K}{B}, N = \frac{f+1-K}{f+1}$ yields the result.