Accounting audits: On financing risk in the presence of agency conflicts

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Abstract

This paper examines how accounting audits impact investment decisions in the presence of agency conflicts. Investors choose between a short-term risk-free asset and a long-term risky project. The manager in charge of the latter has incentives to inflate interim payoffs to be able to continue a project that destroys value. An accounting audit mitigates this problem by allowing for *intermediate* project valuation, and therefore, for investors to cut off financing to such project before it becomes too unprofitable. This reduces initial concerns with agency conflicts, even if the incentives of the manager to inflate payoffs remain unchanged, and boosts investors financing of the risky project. These results are particularly relevant for new and innovative firms.

Keywords: Accounting audits; Agency conflicts; Investment; Optimal contract

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1 Introduction

There is a large body of literature suggesting that an accounting audit improves investment efficiency not only because it helps investors select projects with a positive net present value but also because it allows them to reduce the incidence of agency conflicts with managers in charge of these projects, such as "empire building".[1] The aim of this paper is to combine these two roles and examine the impact of an accounting audit - through the work of an auditor - on investment decisions in the presence of agency conflicts between investors and managers.

The paper shows that an accounting audit changes investment decisions in that investors are more likely to finance long-term risky projects run by managers with empire building motivations instead of less risky assets with shorter maturities, even if this entails some expected losses. The project requires multiple investment and financing rounds but agency conflicts prevent investors from learning about its true quality until it is completed as the manager will inflate payoffs, if required, to ensure continuing financing. The audit, however, allows for *intermediate* project valuation and therefore for investors to cut losses by refusing to provide additional financing if the project turns out to be unprofitable. Agency conflicts become less of a concern to investors, even if managers incentives to manipulate payoffs are not eliminated and the misalignment of their interests with investors remains unchanged. This result highlights a role of accounting audits with meaningful consequences to firms that has not been covered by the literature, which is to support business experimentation and to allow for investors to take calculated risks. This is of particular relevance to new and innovative firms, as well as to firms with poor corporate governance mechanisms.

In the model I develop below, investors choose between buying a short-term risk-free asset and financing a long-term risky project that be discontinued at an intermediate date. The risky project is run by a manager with empire building motivations whose ability is such that he is either expected to generate or destroy value while running the project, and consequently, it represents a better or worse alternative to the risk-free asset. If a manager is shown to destroy value, investors prefer to cut off financing at the intermediate date in favor

[1] E.g. Hope and Thomas [2008], Biddle, Hilary and Verdi [2009] or Loktionov [2009] look at these issues from an empirical perspective.

of the risk-free asset. To guarantee renewed financing, a manager who destroys value pretends to generate value.

Investors base the intermediate date financing decision on accounting information which is attested to by an auditor, whose services are available for a fee. One important part of the paper concerns the modeling of the auditor's problem as a principal-agent model of information acquisition and transmission. Once the auditor is hired, he produces a report indicating his opinion about the project's accounts, and consequently, as to whether it is run by a manager who generates or destroys value. To do so, the auditor needs to exert effort which is not perfectly observable. I derive the optimal contract between the auditor and investors, which consists of a set of fees that induce effort exertion by the auditor and truthful reporting to investors. An interesting feature of the audit procedure is that mistakes may arise when the auditor fails to identify a manager who destroys (but pretends to generate) value. In the optimal contract an auditor is rewarded for effort exertion. Specifically, an auditor is rewarded with a positive fee if and only if his report is confirmed by facts. Otherwise, the auditor gets nothing. Hence, an auditor may get nothing despite exerting effort. Under these circumstances, to convince the auditor to exert effort investors need to compensate him (in expected terms) for the possibility that he gets nothing if he makes a mistake by paying him a high fee if he produces a correct report. A similar argument explains why a non-zero fee that rewards an auditor for a correct report increases if such report becomes less likely given what is publicly known ex-ante about the manager's ability.

Another important part of the paper concerns the modeling of investor's decisions regarding the use of their funds at the initial date and how these decisions are revised at the intermediate date. Investors always balance a potential agency cost associated with a manager trying to push forward a project that destroys value against a potential gain associated with a manager pursuing a project that generates value, both relative to the risk-free asset. Without an accounting audit, investors rely exclusively on the prior belief about the manager's ability at both dates. Because of the manager's empire building incentives, no additional reliable information is obtained at the intermediate date and investors have nothing to gain from altering their initial investment decisions. With the accounting audit, however, investors extract new information about the manager's ability and may conclude that it is better to cut off financing at the intermediate date in favor of the risk-free asset. As a consequence, they become more likely to finance the long-term project at the initial date and therefore to explore its potential upside relative to the risk-free asset. This result is stronger when the probability of a mistake by the auditor decreases, the auditor's cost of effort decreases and when the payoff differential from having a manager that generates value increases.

Finally, the paper discusses how these results apply to the financing of new and innovative firms. Using the language of the model, these would be situations in which investors are very uncertain about the ability of managers or how that ability matches what is required to fully explore the potential of a specific project. Another group of firms that benefits from accounting audits is those with poor governance mechanisms. For example, firms in which the directors that form the board have been appointed by the manager or are experts in a business field without links to the project. They are less likely to be good monitors of the manager or at identifying his ability.

This paper is related to the literature on information acquisition and transmission in principal-agent models. In Demski and Sappington [1987], the principal must choose from a range of available projects whose payoffs depend on an unknown state of the world. The risk-averse agent acquires a costly private signal about the state. They study the properties of optimal contracts for information acquisition and subsequent project selection in a series of examples and under fairly general information structures. A more recent paper by Gromb and Martimort [2007] takes a setting with a simpler information structure and risk-neutral agents with limited liability and looks at the optimal organization of expertise in a situation in which experts advise on whether a firm should pursue a certain project. Other papers that look specifically at information acquisition and transmission for auditors and derive the auditor's optimal contract are, for example, Dye, Balachandran and Magee [1990] and Baiman, Evans and Noel [1987]. While these papers share some important features with mine, there is one crucial difference which assigns different characteristics to the optimal contract. The model below considers that an auditor only makes mistakes when he incorrectly identifies a manager that destroys value while he always correctly identifies a manager that generates value. The motivation behind this assumption is the underlying agency conflict. Given this, managers often try to disguise (or hide) unfavorable information but they rarely do the same with favorable information. Hence, it is possible that an auditor fails to identify potential problems with a firm but he is less likely to fail spotting successful developments.

This paper is also related to the broad literature that examines how accounting impacts corporate policies and strategies. In this literature, some papers present audit and accounting quality as a vehicle to reduce asymmetric information between firms and potential investors, which affects firms' financing and capital structure choices (e.g., Biddle and Hilary [2006] and Chang, Dasgupta and Hilary [2009]). Other papers look at its impact on investment as a way to overcome agency conflicts (e.g., Biddle, Hilary and Verdi [2009], Hope and Thomas [2008] and Loktionov [2009]). These are empirical papers hence, the contribution of the model below is to provide a formal way to look at the implications and trade-offs at stake when assessing the impact of accounting on investment decisions in the presence of agency conflicts. Another related paper is Kedia and Philippon [2009], which develops a model and provides empirical evidence of the economic consequences of fraudulent accounting in terms of investment and hiring decisions and the effects of these decisions on firm productivity.

The rest of the paper is organized as follows: Section 2 presents the model, Section 3 characterizes investment decisions at the intermediate date, Section 4 derives the auditor's optimal contract, Section 5 derives the investment choices at the initial date and discusses the impact of the accounting audit, Section 6 discusses the results and Section 7 concludes.

2 The model

2.1 General setup

In the model, there is a risk-neutral auditor and an homogeneous group of risk-neutral investors. Time consists of three dates: 0 (initial), 1 (intermediate), and 2 (final). For simplicity, the risk-free rate is equal to zero. At date 0, investors hold one monetary unit, which they can use to buy a short-term risk-free asset available in infinite supply that matures at date 1 (and reinvest at this point until date 2) or finance a long-term risky project. The project is run by a penniless manager on behalf of investors, and is divided in two stages, each stage requiring investment of $\frac{1}{2}$.[2] The auditor is hired by investors at the end of the first stage to attest the project's accounts to that date.

Investors allocate funds to both assets to maximize expected profit. They also aim at minimizing audit costs while still learning as much as possible from the audit by agreeing to an expected fee that induces information acquisition and revelation by the auditor. The auditor's initial wealth is normalized to zero and he aims at maximizing the expected fee net of audit costs while still acquiring and revealing information truthfully.[3] As a result, investors offer a contract to the auditor that consists of contingent fees based on observed variables. It is assumed that they can precommit to implementing the agreed-upon contract.

2.2 Investors

When financing the first stage of the risky project, investors use the remaining $\frac{1}{2}$ to invest in the risk-free asset until date 1. This is when the first stage is completed, at which point they either use the $\frac{1}{2}$ recovered from the risk-free investment to take the project into the second stage, or instead cut off financing and invest in the risk-free asset for an extra period. They invest in the second stage if, given what they learn from the first stage, that maximizes expected profits relative to investment in the risk-free asset. Investors base their decision on accounting information which is attested to by the auditor. This is because all payoffs related to the risky project are not perfectly observable by investors unless at liquidation when its assets are sold at the market value. All payoffs and further details about the game are presented in Section 2.3.

[2]One can think of the first stage as a research and development phase, and of the second stage as the implementation phase that generates the bulk of the cash-flows of the project.

[3]The "zero initial wealth" assumption produces similar results to assuming auditor's limited liability. Alternatively, I could give the auditor a positive initial wealth and specify that he is liable whenever it is obvious that he makes a mistake. This would not change the qualitative results of the model.

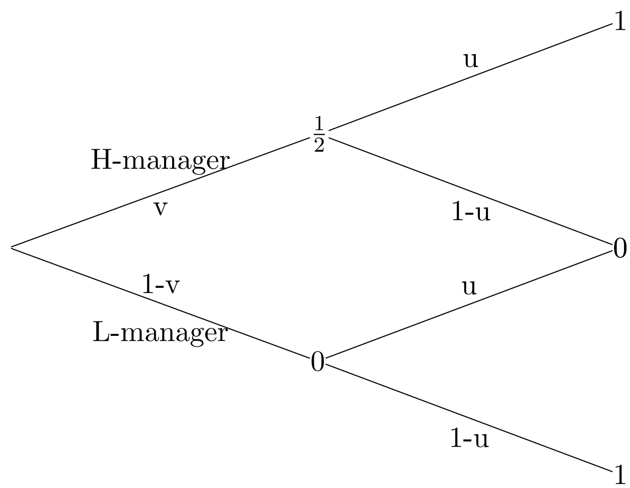

Figure 1: Sequence of payoffs of the risky project.
This figure illustrates the sequence of payoffs in the first and second stages of the risky project depending on the ability of the manager that runs the project. The letters v and u represent unconditional probabilities attached to the payoff at each node.

2.3 Project, information structure and implicit agency conflict

When investors choose the risky project at date 0, the first stage is completed at date 1. Its payoff depends directly on the ability of the manager, who is in charge of implementing it.[4] The ability of the manager can be high (H) or low (L) with probability v and $1-v$, respectively. An H-manager generates a (net) payoff of (0) $\frac{1}{2}$ whereas an L-manager generates a (net) payoff of (-$\frac{1}{2}$) 0 during the first stage of the project. In other words, no value is generated in the first stage of the project and some value may be destroyed with an L-manager. The project continues into the second stage if investors provide an additional $\frac{1}{2}$ at date 1. The second stage payoffs are 1 or 0 with probabilities $u > \frac{1}{2}$ and $1-u$, respectively, if the project is run by H-manager, and probabilities $1-u$ and u, respectively, if the project is run by an L-manager. Once again, this means that an H-manager is expected to generate value with the second stage of the project and an L-manager is expected to destroy value with the second stage of the project. Figure 1 illustrates the sequence of payoffs in both stages.

At date 1, investors hire an auditor to perform an audit and verify the firm's accounting figures. In what follows, I am going to describe the audit procedure as a principal-agent model with information acquisition and transmission. The auditor exerts costly unobservable effort

[4]For this reason, I may refer to the ability of the manager and the payoff of the project interchangeably.

ψ which allows him to privately observe an informative signal $s \in \{l, h\}$ about the first stage payoff as measured by the manager's ability. A private signal h implies that the project is run by an H-manager and a private signal l implies that the project is run by an L-manager. I denote the variable $\theta \in \left(\frac{1}{2}, 1\right)$ as the quality of this private signal defined by the following probabilities conditional on the true manager's ability:

$$Pr\left(l \mid L\right) = \theta \; and \; Pr\left(h \mid H\right) = 1. \tag{1}$$

This means that an auditor always recognizes when the project is run by an H-manager but only recognizes θ% of the times when a project is run by an L-manager. Therefore, mistakes arise from incorrectly identifying an L-manager as an H-manager and the probability of making a mistake is equal to $1-\theta$.[5] The private signal s is assumed to be soft information which means that the auditor can fully manipulate it when reporting to investors. There are two types of report: an h-report indicates the auditor's opinion that the project is run by an H-manager and an l-report indicates the auditor's opinion that the project is run by an L-manager.

This information structure is not necessary to generate the main results described below and it is used solely to illustrate the (unmodeled) agency conflicts between manager and investors which occur when the former does not act in the best interest of investors (e.g., Jensen and Meckling [1976]). Specifically, an L-manager is expected to destroy value in both stages (and hence, should not expect to be compensated for undertaking the project) but he has incentives to overstate the first stage payoff or delay its announcement anyway due to his preferences for empire building (e.g., Jensen [1986]). He derives private benefits or perks when the second stage of the risky project is undertaken. Hence, an L-manager tries to disguise (or hide) his ability whereas an H-manager has no need to do so.[6]

[5] A similar information structure is used by Dye [1993], for example.

[6] The manager problem is left unmodeled but the underlying assumption is that the manager's preferences are such that it is not possible to write a contract that prevents manipulation and/or leads the manager to reveal his ability. This may be because it is too expensive (the private benefits from continuation derived by the manager are too large to overcome), or because the manager's ability is unknown even to himself at date 0 (and he learns about it after the first stage). In this way, I can focus on the incentives of the auditor alone without having to consider what happens to the manager. Also note that if paying the manager could prevent manipulation, then the accounting audit would be useless.

At date 2, all payoffs are perfectly observable. The auditor is paid a fee depending on the report produced at date 1 and how it matches the realized payoff, according to the optimal contract. I assume that investors also bring assets in place into the game that are sold at date 2. The idea is that these assets in place have a constant market/liquidation value of A, which is large enough to cover any losses or expenses incurred by investors. This is for simplicity and without loss of generality. In this way, I can ignore issues related bankruptcy and default. I also take into account the liquidation value of the assets in place when there is investment in the risk-free asset.

The following bullet-point scheme presents a brief outline of the model.

- Date 0:
  - Investors decide between investing 1 in the risk-free asset (with the risk-free rate normalized to 0) or allocating $\frac{1}{2}$ to the risky project and $\frac{1}{2}$ to the risk-free asset.
- Date 1:
  - If they choose the risk-free asset only, it matures and yields 1 that is reinvested until date 2.
  - If they also choose the risky project, the first stage is completed and an auditor is hired. The risk-free asset matures and yields $\frac{1}{2}$.
  - The auditor exerts effort, gathers a private signal s and produces a report to investors.
  - Investors use $\frac{1}{2}$ to finance the second stage of the risky project, or cut off financing to the risky project and invest in the risk-free asset.
- Date 2:
  - Assets mature/are liquidated and all payoffs are realized and perfectly observable.
  - The auditor receives the appropriate fee depending on how the report produced matches the realized payoff.

Table 1: Summary of notation

$\frac{1}{2}$	Investment amount required at each stage of the risky project
$H,\ L$	Manager's ability (High or Low)
υ	Probability of an H-manager
u	Probability of payoff 1(0) for an H(L)-manager at the second stage
ψ	Effort cost of an auditor
$s \in \{l, h\}$	Auditor's private signal
θ	Prior probability that an auditor correctly recognizes an L-manager
A	Liquidation value of assets in place

This completes the description of the basic model. Table 1 summarizes the notation introduced above.

3 Investment decision at date 1

In this section, I examine how investors choose between providing and cutting off additional financing to complete the risky project. They aim at making an efficient investment decision at date 1. This means that they would like to invest $\frac{1}{2}$ in the second stage of the risky project instead of in the risk-free asset if this strategy generates a positive net present value. At this point, it is important to bear in mind that the risk-free asset always yields a return equal to the risk-free rate that is normalized to zero. In addition, it is worth noticing that it is never optimal to invest in first stage of the risky project with the intention of switching to the risk-free asset at date 1 because the expected payoff of the first stage alone is equal to $-\frac{(1-\upsilon)}{2} < 0$ and is always dominated by investment in the risk-free asset.

3.1 Perfect information

As illustrated by Figure 1, the payoffs of the second stage are always equal to 1 or 0 but the probabilities attached to each payoff depend on the manager's ability. An H-manager is expected to generate value and an L-manager is expected to destroy value. Because $u > \frac{1}{2}$, an H-manager generates an expected profit in the second stage $u - \frac{1}{2}$, whereas an L-manager generates an expected loss in the second stage, $(1 - u) - \frac{1}{2}$. Furthermore, investing in the risk-free asset yields a zero net payoff. Therefore, investors would like to finance the risky project if the risky project is run by an H-manager and invest 1 in the risk-free asset if the risky project is run by an L-manager.

3.2 Imperfect information and no accounting audit

Given that an L-manager always overstates the payoff of the first stage (and pretends to be an H-manager) to ensure continuation, investors obtain no additional information at date 1 about the manager's ability. Hence, they never change their mind about the risky project: they either invest 1 at date 0 in the risk-free asset (and reinvest at date 1) or divide 1 between the risk-free asset and the risky project and see that the the project is completed. The risky project expected payoff at date 1 is equal to:

$$vu + (1-v)(1-u) - \frac{1}{2}$$

which needs to be positive if the risky project is chosen at date 0. This happens for the second stage when

$$v \geq v_{na} \equiv \frac{1}{2}.$$

3.3 Imperfect information and accounting audit

In this case, investors hire an auditor who can make mistakes as he cannot distinguish perfectly between an H and L-manager but whose private signal is informative about the manager's ability. For this reason, the auditor's report has an impact on investors' decision at date 1.

3.3.1 Posterior Beliefs

The probability of the private signal $s \in \{l, h\}$ is given by $p(s)$ and the probability that the project is run by an H or L-manager conditional on private signal s is given by $p(. \mid s)$. Specifically,

$$p(h) = v + (1-v)(1-\theta) \quad or \quad p(l) = (1-v)\theta$$

and

$$p\left(H \mid h\right) = \frac{v}{v + \left(1 - v\right)\left(1 - \theta\right)} \quad or \quad p\left(H \mid l\right) = 0.$$

In addition, it is useful to define the following equivalence, which is used below:

$$p(l) = p\left(L\right) - p(h)p\left(L \mid h\right) = \left(1 - v\right)\theta. \tag{2}$$

3.3.2 Investors' decision

The auditor's report induces the following investment decision. Given the posterior beliefs derived above, an l-report implies that the project is run by an L-manager for sure and it generates losses in the second stage. This means that investors always choose to cut off financing to the second stage and invest in the risk-free asset. An h-report implies an expected profit of:

$$p(H \mid h)u + p(L \mid h)\left(1 - u\right) - \frac{1}{2} \tag{3}$$

from continuation of the risky project, as opposed to a profit of 0 from investing in the risk-free asset.[7] This means that only when

$$v \geq v_a \equiv \frac{1 - \theta}{2 - \theta} \tag{4}$$

is expression (3) positive or equal to zero. There is a threshold on v because investors anticipate that an h-report might be incorrect, in which case the project is run by an L-manager and generates losses in the second stage. Hence, they need to be relatively sure that this is not the case to keep financing running into the risky project. As $\theta\left(\frac{1}{2}, 1\right)$, it is straightforward to show that $v_{na} > v_a$, meaning that, in the presence of an accounting audit, continuation occurs for a wider range of v's: shareholders do not need to be as sure about the H-manager to start with because an h-report provides an additional source of information. In addition, when

[7]Including the liquidation value of the assets in place has no effect in the investors' decision as they would compare $p(H \mid h)\left(A + u - \frac{1}{2}\right) + p(L \mid h)\left(A + (1 - u) - \frac{1}{2}\right)$ against $A + 0$. By Assumption 1, $A > (1 - u) - \frac{1}{2}$. The auditor's fee also needs to be paid off (out of A if necessary) but this happens regardless of what investors do, and once more, has no impact on post-audit investment decisions.

$v < v_a$ investors always choose the risk-free asset from date 0 as they know they would cut off financing to the risky project at the intermediate stage and, as stated in the introduction to this section, it is never optimal to invest in the first stage of the project alone.

4 The auditor's problem

This section characterizes the optimal contractual relationship between investors and the auditor. Specifically, I derive the fees that investors pay the auditor.

4.1 Auditor's optimal contract

A contract consists of monetary transfers from investors to the auditor, which I call fees. The fees are based on the auditor's report of the private signal gathered during the audit process and on the ex-post correctness of such report. Formally, a contract is a set of fees denoted by $\{f(\widehat{s}, \Phi)\}$ where $\widehat{s} \in \{h, l\}$ is the report and Φ is the manager's ability as measured by the realized payoff of the first stage of the risky project, i.e. $f(l, L)$ and $f(h, H)$ are the fees if the auditor's report is correct, and $f(l, H)$ and $f(h, L)$ are the fees if the auditor's report is incorrect.

The purpose of these fees is to reward an auditor for effort exertion given all the information that is available about the project at the time he gathers the private signal. If investors could perfectly observe the auditor's effort, the incentive problem could be solved with a flat fee equal to the effort cost. The intuition is the following. In such situation, an auditor receives either 0 if he does not exert effort, or the effort cost otherwise. The auditor maximizes the expected fee net of the cost of effort so he makes zero profits in both cases. However, when indifferent between exerting effort or not, I assume that an auditor chooses to exert effort. Consequently, a flat fee equal to the effort cost guarantees effort exertion. Here, however, effort exertion is not perfectly observable and the auditor may be tempted not to gather private information and instead report the signal implying the highest expected fee. For this reason, he must be given incentives not only to gather information, but also to report the private signal accurately. Hence, investors offer the auditor a contingent contract to motivate the desired level of audit effort, with fees dependent on the ex-post correctness of the audit report. The first-best contract is the least (expected) cost contingent contract that rewards an auditor when he is correct.

The optimal contract is derived as follows. There are two adverse selection incentive constraints. On the one hand, the auditor should not prefer reporting l after having observed h:

$$p\left(H \mid h\right) f\left(h, H\right) + p\left(L \mid h\right) f\left(h, L\right) \geq p\left(H \mid h\right) f\left(l, H\right) + p\left(L \mid h\right) f\left(l, L\right). \tag{5}$$

The auditor knows that an h-signal is not always correct and does not necessarily imply that the project is run by an H-manager. Therefore, the left-hand-side (LHS) of the constraint is the expected fee of reporting h if the project is run by an H or L-manager. Likewise, the right-hand-side (RHS) of the constraint is the expected fee of reporting l if the project is run by an H or L-manager. On the other hand, the auditor should not prefer reporting h after having observed l:

$$f\left(l, L\right) \geq f\left(h, L\right). \tag{6}$$

The auditor knows that, in contrast to an h-signal, an l-signal is always correct and implies that the project is run by an L-manager. Therefore, an l-report is correct for sure (LHS) whereas an h-report is incorrect for sure (RHS).

The contract must also satisfy a moral hazard incentive constraint to induce the auditor to gather the private signal. If the auditor does not gather information, he can pretend he did and report the signal yielding the highest expected fee. In a Bayesian-Nash equilibrium, an auditor anticipates that he gathers information and reports it truthfully. Thus, the moral hazard constraint is:

$$\begin{aligned} &p(h)\left[p\left(H \mid h\right) f\left(h, H\right) + p\left(L \mid h\right) f\left(h, L\right)\right] + p(l) f\left(l, L\right) \\ &\qquad - \psi \geq \max \left\{ \begin{array}{l} p\left(H\right) f\left(l, H\right) + p\left(L\right) f\left(l, L\right), \\ p\left(H\right) f\left(h, H\right) + p\left(L\right) f\left(h, L\right) \end{array} \right\}. \end{aligned}$$

The LHS represents the expected fee of an auditor that exerts effort, gathers and truthfully reports either an h-private signal or an l-private signal. The RHS considers the two options available to the auditor when effort is not exerted: to send an l-report or an h-report. Note that the expectations on the RHS are based on the prior probability v alone. Using the posterior probabilities derived in Section 3.2.1., the moral hazard constraints can be rewritten as follows:

$$p(h)\left[p\left(H \mid h\right) f\left(h,H\right)+p\left(L \mid h\right) f\left(h,L\right)\right]-\psi \geq p\left(H\right) f\left(l,H\right)+\left(p\left(L\right)-p(l)\right) f\left(l,L\right) \quad (7)$$

and

$$p\left(l\right) f\left(l,L\right)-\psi \geq \left(p\left(L\right)-p(h)p\left(L \mid h\right)\right) f\left(h,L\right). \quad (8)$$

Constraint (7) assures that the auditor has no incentives to produce an l-report without private information. Correspondingly, constraint (8) assures that the auditor has no incentive to produce an h-report without private information. Both constraints guarantee that manipulating the report once the auditor is informed is irrelevant as otherwise remaining uninformed would have been be optimal.

Using expression (2), the moral hazard constraints (7) and (8) imply the adverse selection constraints (5) and (6), therefore the latter can be ignored. As a result, expected fees are derived from the moral hazard constraints (7) and (8). In addition, the auditor's zero wealth assumption and participation constraints must be satisfied. A zero wealth assumption implies that all fees need to be positive or equal to zero which means that the participation constraints are automatically satisfied and are omitted henceforth. Hence, to implement the first-best decisions at minimum cost, investors solve the following problem:

$$\min_{\{f(.)'s\}} p(h)\left(p\left(H \mid h\right) f\left(h,H\right)+p\left(L \mid h\right) f\left(h,L\right)\right)+p(l) f\left(l,L\right)$$

$$\text{subject to (7), (8) and all } f\left(.\right) \geq 0.$$

where $p(h)\left(p\left(H \mid h\right) f\left(h,H\right)+p\left(L \mid h\right) f\left(h,L\right)\right)+p(l) f\left(l,L\right)$ is the expected fee of an auditor that exerts effort to gather the private signal, which he truthfully reports. Note that $f(l, H)$ is not included in the expected fee because it is obvious that no effort has been exerted: When exerting effort, the private signal structure defined by expression (1) guarantees that an H-manager is never mistakenly identified as an L-manager. Using this, it follows immediately from constraint (7) that $f(l, H)$ should be set to zero as doing so relaxes the constraint without affecting the expected fee. In this case, the auditor could be penalized but the zero-wealth assumption determines that the minimum fee cannot be less than zero. In addition, the optimal $f(h, L)$ is also zero as both constraints (7) and (8) are relaxed while being able to keep the expected fee constant by increasing $f(h, H)$. The constraints become:

$$
\begin{aligned}
p(h)p(H \mid h) f(h, H) - \psi &\geq (p(L) - p(l)) f(l, L) \\
p(l) f(l, L) - \psi &\geq 0
\end{aligned}
\tag{9}
$$

The optimal $f(l, L)$ and $f(h, H)$ follow easily from here. The main results are summarized in the following proposition:

Proposition 1 *The auditor optimal fees $f(l, H)$ and $f(h, L)$ are equal to zero. The remaining fees are equal to:*

$$
f(l, L) = \frac{\psi}{\theta(1 - v)} \text{ and } f(h, H) = \frac{\psi}{\theta v}.
$$

The first result of interest is that an auditor is not rewarded for a mistake, in which case the optimal fee is set equal to zero. Moreover, a higher effort cost, ψ, increases the (non-zero) fees required to reward an auditor for effort exertion. In contrast, a higher quality of the private signal, θ, decreases (non-zero) fees because it lowers the incentives that an auditor needs to exert effort. Finally, a higher prior probability of an H-manager, v, lowers $f(h, H)$ and increases $f(l, L)$, i.e. decreases the reward for confirming that the project is run by an H-manager and increases the reward for correctly contradicting this. This reflects the fact that because of moral hazard, an auditor exerts effort only if he receives a (relatively) higher fee whenever he correctly contradicts the most likely outcome given that he knows that if he is wrong he receives nothing. This fee structure makes sure that the auditor does not prefer to remain uninformed and simply report the most likely outcome. A similar reasoning explains why $f(l, L)$ is higher than $f(h, H)$ if v exceeds $\frac{1}{2}$, i.e. a higher fee is received whenever an h-report is expected but a correct l-report is produced than when an h-report is expected but a correct h-report is produced. These results are summarized in the following lemma:

Lemma 1 *The optimal fees $f(h, H)$ and $f(l, L)$ are: increasing in the effort cost, ψ; decreasing in the quality of the private signal, θ; and decreasing and increasing in the prior probability of an H-manager, v, respectively. Moreover, when $v > \frac{1}{2}$ then $f(l, L) > f(h, H)$.*

The last result is also related to the notion of conformism to prior beliefs discussed in the literature on experts' advice (e.g., Prat [2005] and Otavianni and Sorensen [2006]) or rating agencies (e.g., Mariano [2012]). The idea in this literature is that an agent that makes mistakes chooses to ignore the private signal and bias his reports towards what is *a priori* expected in an attempt to mimic the behavior of an "able" agent. The results derived in this section go in the same direction: For an auditor that makes mistakes not exerting effort and conforming to the prior belief about the manager's ability may be the safest option to avoid mistakes and a zero fee. Thus, the optimal contract needs to reward him whenever he exerts effort and correctly contradicts such prior belief.

5 Investment decision at date 0

In the analysis that follows, I examine how the accounting audit impacts how often investors choose to finance the risky project at date 0. In particular, I will show that financing of the risky project occurs more frequently with an accounting audit. Hence, I need to find situations for which a risky project is *not* undertaken *unless* there is an audit. This requires looking at the expression for the total expected profit, which includes the payoffs from both stages. Figure 1 summarizes the payoffs depending on the manager's ability, and Section 3.3 describes the expected profit and the investment decisions regarding the second stage. I denote investors' total expected profit from the risky project as $\pi(audit)$ if they hire an auditor, which I will compare to the total expected profit $\pi(no\ audit)$ if they do not hire an auditor. Investment in the risk-free asset alone yields a total profit that is equal to the liquidation value of assets in place A.

I now need to consider whether the probability that the project is run by an H-manager satisfies (4) because this affects investors' choices as explained in Section 3.3. In particular, if $v < v_a$, investors always invest in the risk-free asset from date 0 as they would always cut off financing to the second stage regardless of the auditor report. Hence, in the region of interest $v \geq v_a$ as I need to have continuation of a risky project at date 1 following an h-report. More formally, I need to show that there is a v, with $v \geq v_a$ for which the following two condition are satisfied: condition (1) $\pi\,(audit) > A$ meaning that not only there is continuation at date 1 but also that the risky project is chosen at date 0 to start with, and condition (2) $\pi\,(no\ audit) < A$ meaning that even if there was continuation at date 1, the risky project is not chosen at date 0 to start with. The total expected profit $\pi\,(audit)$ is defined as:[8]

$$\pi\,(audit) = A + p\,(h)\left[p(H \mid h)\left(\frac{1}{2} + u - f\,(h,H)\right) + p(L \mid h)\,(1-u)\right]$$
$$p\,(l)\,p(L \mid l)\left(\frac{1}{2} - f\,(l,L)\right) - 1.$$

Investors receive the liquidation value of the assets in place and incur a total investment cost at date 0 equal to 1.[9] Inside the square brackets is the expected (gross) profit if the auditor produces an h-report. An h-report implies that investors provide additional financing to the second stage of the risky project. A correct h-report generates $\frac{1}{2} + u - f\,(h,H)$, which is the sum of the profit of the first stage of the risky project with the expected profit of the second stage of the risky project net of the fee to the auditor. An incorrect h-report generates $(1-u)$, which is the expected payoff of the second stage of the risky project. Inside the last round brackets is the profit if the auditor produces an l-report. An l-report implies that investors choose to invest in the risk-free asset at date 1. Hence it, generates $\frac{1}{2} - f\,(l,L)$, which is the

[8]For simplicity, the manager's compensation is not considered in the model, and therefore, it is not included in the expression. However, an obvious way to include it would be to consider that he is paid a fixed amount independent of his ability and of the auditor's report plus a percentage of the investors' expected profit as a bonus. Doing so would not change the qualitative results presented below.

[9]The additional investment of $\frac{1}{2}$ at date 1 is covered by the proceeds from the risk-free asset at the same date.

payoff from investing in the risk-free asset net of the fee to the auditor. Substituting the fees and using the fact that, $p(h)\,p(H\,|h) = v$, $p(h)\,p(L\,|h) = (1-v)(1-\theta)$, $p(l)\,p(H\,|l) = 0$ and $p(l)\,p(L\,|l) = (1-v)\,\theta$, the expression simplifies to:

$$\pi\,(audit) = A + v\left(\frac{1}{2} + u - \frac{\psi}{\theta v}\right) + (1-v)(1-\theta)(1-u) + (1-v)\theta\left(\frac{1}{2} - \frac{\psi}{\theta\,(1-v)}\right) - 1.$$

Given this, it is straightforward to show that $\pi\,(no\ audit)$, can be written as:

$$\pi\,(no\ audit) = A + v\left(\frac{1}{2} + u\right) + (1-v)(1-u) - 1.$$

Hence, the values of v that satisfy conditions (1) and (2) - $\pi\,(audit) > A$ and $\pi\,(no\ audit) < A$, respectively - are summarized in the following proposition. Regarding the notation used below, $v_{(1)}$ refers to the threshold that satisfies condition 1 and $v_{(2)}$ refers to the threshold that satisfies condition 2. It can be shown that the expression regarding v_a is subsumed by condition (1). All proofs are relegated to the Appendix.

Proposition 2 *Investors provide financing to the risky project more frequently with than without an accounting audit when the following two conditions are satisfied:*

$$\begin{aligned} v &> v_{(1)} \equiv \frac{u + \psi + \psi/\theta - \theta\,(u - 1/2)}{u + (1-\theta)\,(u - 1/2)} \\ v &< v_{(2)} \equiv \frac{u}{2u - 1/2}. \end{aligned}$$

Note that for $\theta = 0$ and $\psi = 0$, then $v_{(1)} = v_{(2)}$. Figure 2 illustrates this result. It plots the probability of an H-manager (*x-axis*) against total expected profit (*y-axis*) taking into account the investors optimal decisions at each date. When the probability of an H-manager is lower than 0.57 (approximately) investors always by choose to buy the risk-free asset. As the probability increases there is an interval between 0.57 and 0.69 (both approximately) for which there is investment in the risky project only when there is an accounting audit.

From the plot it is abvious that some conditions need to be satisfied for the interval to exist. A sufficient condition for this to happen is given by Lemma 2 and is related to the

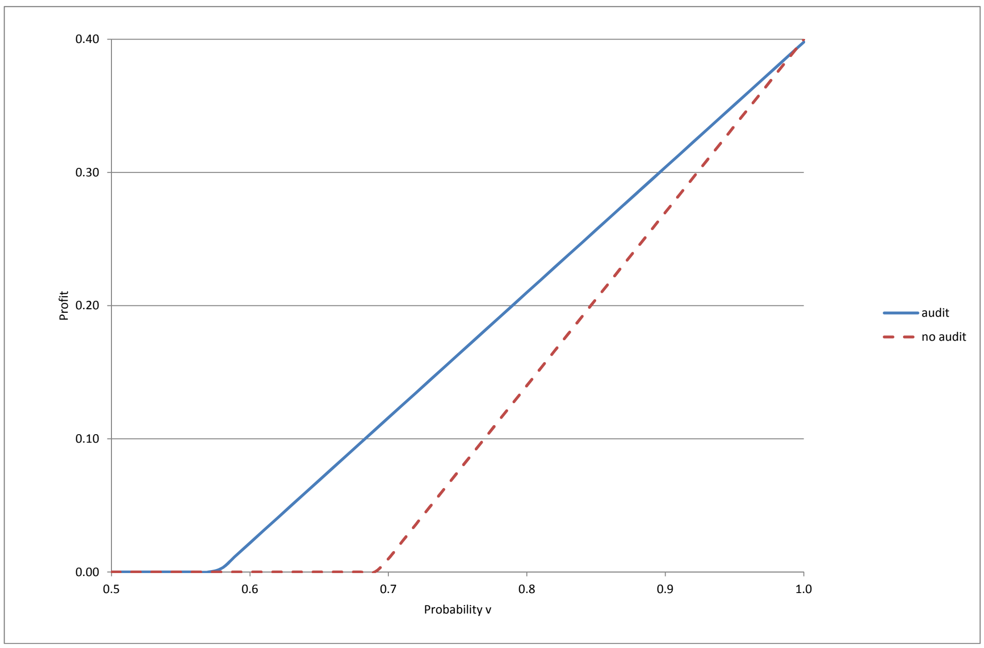

Figure 2: Numerical plot of the investors' total expected profit as a function of the probability of an H-manager v using the following parameter values: $\psi = 0.001$, $\theta = 0.9$ and $u = 0.9$.

auditor's cost of effort.

Lemma 2 *Investors provide financing to the risky project more frequently with than without an accounting audit when the auditor's cost of effort is lower than*

$$\psi < \psi_{max} \equiv \frac{\theta \left(u - 1/2\right)^2}{\left(1 + \frac{1}{\theta}\right)\left(2u - 1/2\right)}.$$

The auditor cannot be too expensive to hire, otherwise the additional cost wipes out the informational benefit of the audit. Also notice that in Figure 2 the audit always dominates the no audit scenario. When this does not happen, investors simply do not hire an auditor in which case an audit would have no effect on investment decisions.

The comparative statics results of the thresholds $v_{(1)}$ and $v_{(2)}$ are formalized by the following lemma:

Lemma 3 *The region that satisfies conditions (1) and (2) decreases with the cost of effort ψ and increases with the probability of correctly identifying and L-manager θ.*

6 Discussion

6.1 Innovation

The results derived above are particularly relevant to the financing of new and innovative firms. Using the language of the model, these would be situations in which investors are very uncertain about the ability of managers or how that ability matches what is required to fully explore the potential of a specific project. Figure 2 illustrates clearly this point: it is precisely for lower levels of v that a risky project would not be undertaken without an accounting audit.

6.2 Corporate governance

Another group of firms that benefits from accounting audits is those with poor governance mechanisms. Some relevant aspects of corporate governance are overall board of directors' characteristics - including the size of the board, if the CEO holds the chairman position, if the directors are appointed by the CEO or the number of other directorships each director holds, - which determine the power of investors vis-à-vis management. A bigger, more independent and less 'busy' board of directors is more likely to be better at monitoring the manager and makes it more difficult for him to disguise unfavorable information.[10] Therefore, firms that lack such characteristics benefit the most from an accounting audit.

7 Conclusions

The objective of this paper is to examine how accounting audits impact investment decisions in the presence of agency conflicts between investors and managers. To address this issue, I develop a model in which a group of investors chooses between buying a short-term risk-free asset and financing a long-term risky project. The project requires multiple investment and financing rounds but agency conflicts prevent investors from learning about its true quality until its completion as the manager will inflate payoffs, if required, to ensure that investors keep pouring funds into it. Investors rely on an auditor to attest the firm's accounts and provide additional information about the project. The paper solves for the optimal contract that induces effort exertion by the auditor and truthful reporting to investors. The optimal fees are such that an auditor is rewarded if his report is shown to be correct. In addition, he receives a higher fee when he produces a correct report that appears ex-ante less likely given what is known ex-ante about the project and its manager.

The paper then shows that an accounting audit changes investment decisions in that investors become more likely to finance long-term risky projects run by managers with empire building motivations, even if this means suffering some losses in the process. This is because an accounting audit allows for *intermediate* project valuation and therefore for investors to cut losses by refusing to provide additional financing if the project turns out to be unprofitable. As a consequence, agency conflicts become less important to investors. In some sense, an accounting audit provides a way to support business experimentation and makes it possible

[10] Fich and Shivdasani [2006] provide empirical evidence on the effects of busy boards on monitoring and firm's performance.

for investors to take calculated risks. This is of particular relevance to new and innovative firms, as well as to firms with poor corporate governance mechanisms.

A Appendix

A.1 Proof of proposition 2 and lemma 2

The thresholds are obtained by solving conditions (1) and (2) with respect to v. Note that $v_{(1)}$ exceeds v_a because v_a is the value of v that makes:

$$v_a u + +(1 - v_a)(1 - \theta)(1 - u) - \frac{1}{2} = 0,$$

whereas $v_{(1)}$ is the value of v that makes condition (1) equal to zero. Condition (1) can be rewritten as:

$$\left[vu + +(1 - v)(1 - \theta)(1 - u) - \frac{1}{2}\right] + [v + (1 - v)\theta - 1]\frac{1}{2} - \frac{\psi}{\theta} - \psi > 0.$$

It is straightforward to show that evaluated at v_a, it cannot be satisfied as the expression in the first square brackets equals zero and the remaining components of the expression are negative. Given that condition (1) is increasing in v, $v_{(1)}$ needs to exceed v_a for an equality to be obtained.

For the two intervals to intersect, $v_{(1)}$ needs to be lower than $v_{(2)}$. I derive next a sufficient condition for this to occur by just solving for the cost of effort parameter ψthat makes $v_{(1)} <$ $v_{(2)}$:

$$[\psi + \psi/\theta - \theta(u - 1/2)](2u - 1/2) < -u\theta(u - 1/2)$$

which simplifies to:

$$\psi < \psi_{max} \equiv \frac{\theta(u - 1/2)^2}{\left(1 + \frac{1}{\theta}\right)(2u - 1/2)},$$

which for $\theta = 1$ and $u = 1$ generates the maximum value of $\frac{1}{4}$.

A.2 Proof of lemma 3

I derive next the comparative statics results for the thresholds $v_{(1)}$ and $v_{(2)}$. It is straightforward to show that $\frac{dv_{(1)}}{d\psi} > 0$ whereas $\frac{dv_{(1)}}{du}$ and $\frac{dv_{(1)}}{d\theta}$ are derived as follows. Taking the derivative

$$\frac{dv_{(1)}}{du} = \frac{(1-\theta)\,(u + (1-\theta)\,(u - 1/2)) - (2-\theta)\,(u + \psi + \psi/\theta - \theta\,(u - 1/2))}{(u + (1-\theta)\,(u - 1/2))^2},$$

and using the fact that $u + (1-\theta)\,(u - 1/2)$ can be written as $u - \frac{1}{2} + u - \theta\,(u - 1/2)$, the numerator becomes

$$(1-\theta)\,(u - 1/2) - (u - \theta\,(u - 1/2)) - (2-\theta)\,(\psi + \psi/\theta)\,,$$

which is equal to the following expression that is always negative

$$-1/2 - (2-\theta)\,(\psi + \psi/\theta) < 0.$$

Hence, $\frac{dv_{(1)}}{du} < 0$. In addition,

$$\frac{dv_{(1)}}{d\theta} = \frac{\left(-\frac{\psi}{\theta^2} - \left(u - \frac{1}{2}\right)\right)(u + (1-\theta)\,(u - 1/2)) + \left(u - \frac{1}{2}\right)(u + \psi + \psi/\theta - \theta\,(u - 1/2))}{(u + (1-\theta)\,(u - 1/2))^2}$$

and by rearranging the numerator, it becomes

$$-\frac{\psi}{\theta^2}\,(u + (1-\theta)\,(u - 1/2)) - \left(u - \frac{1}{2}\right)(u - 1/2) + \left(u - \frac{1}{2}\right)(\psi + \theta\psi/\theta^2)$$

which is equal to the following expression that can be shown to be negative for the parameter values considered by the model

$$-\frac{\psi}{\theta^2}\,(u + (1-\theta)\,(u - 1/2)) - \left(u - \frac{1}{2}\right)(u - 1/2 - \psi) + \frac{\theta\psi}{\theta^2}\left(u - \frac{1}{2}\right) < 0.$$

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