The Impact of Managers’ Risk Aversion and Loss Aversion on Audit Quality Demand

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ABSTRACT

We use experimental economic markets to investigate the impact of risk aversion and loss aversion on managers’ demand for audit quality. We posit that managers’ audit quality preferences are influenced by contextual factors that are often not considered or are difficult to isolate in prior research. We specifically predict and find evidence that risk aversion significantly reduces managers’ average demand for audit quality, and that risk aversion and loss aversion and their interaction reduce managers’ likelihood of hiring the best available auditor in the market. In supplemental analyses, we show that our results are robust to several alternative economic and psychological explanations.
1. Introduction

We use experimental economics markets to investigate the impact of risk aversion and loss aversion on managers’ audit quality demand. This research is part of a broader effort to examine factors that impact the demand for audit quality (DeFond and Zhang 2014). Prior archival research primarily tests the hypothesis that higher agency costs increase demand for audit quality as a way to reduce information asymmetry and avoid investors’ price-protecting behavior (Jensen and Meckling 1976; DeFond and Zhang 2014). This research provides mixed evidence that agency costs drive demand for higher audit quality. For example, some studies support the assertion that agency costs increase the demand for audit quality (e.g., Godfrey and Hamilton 2005; Lennox 2005), while other studies provide mixed results (e.g., DeFond 1992), find support that is limited to specific institutional settings (e.g., Bernard et al. 2000; Wang et al. 2008), or find evidence that does not support or is contrary to this hypothesized relationship (e.g., Simunic and Stein 1987; Beatty 1989; Barton 2005).

Archival studies face challenges in developing clean empirical proxies for underlying theoretical constructs. In the case of audit demand, DeFond and Zhang (2014, 295) link agency costs to firm riskiness and complexity, noting “intuitively, riskier and more complex firms face larger agency problems”, which leads to the prediction that firms exhibiting high levels of these factors “are likely to demand higher quality auditing.” Our experimental approach allows us to focus on risk as a potential driver of audit demand while holding agency costs constant. We also incorporate loss aversion as a potential explanatory factor given its theoretical proximity to risk aversion. In supplemental analyses, we examine whether individual trait differences play a role in managers’ demand for audit quality by measuring and testing individual risk aversion, Dark Triad traits, guilt proneness, and prosocial behavior tendencies.
Prior experimental audit market studies suggest managers’ demand for audit quality varies but do not directly examine factors that impact manager demand for audit quality. This research consistently finds that a subset of managers demands less than the highest audit quality despite facing high levels of risk and constant agency costs, and higher-quality auditing yielding higher earnings on average. For example, prior studies find that accounting uncertainty leads managers to reward auditors who impair their independence (Mayhew et al. 2001), and that managers continue hiring incumbent auditors despite frequent objectivity violations (Mayhew and Pike 2004). Kowaleski et al. (2018) find that auditors cater to managers’ desired audit quality, especially when providing consulting services, and that managers appear to prefer lower-quality auditors in approximately half of their sessions. Hurley and Mayhew (2019) show that many managers regularly avoid hiring a guaranteed high-quality auditor when one is added to a market. In each of these settings, managers often hire lower-quality auditors despite the fact they can increase their average earnings by hiring a higher-quality auditor.

These experimental findings mirror archival research that finds evidence of managers who prefer lower-quality auditors (DeFond and Subramanyam 1998; DeFond et al. 2000; Abbott et al. 2013; DeFond et al. 2019). Taken together, it appears that managers often differentially respond to contextual factors in their demand for audit quality. We study manager risk aversion and loss aversion as two such factors that explain managers’ demand for audit quality.¹

A company’s auditor choice is a decision enacted by company management and its audit committee. Prior research shows managers strongly influence the hiring decision, despite the regulatory requirement that audit committees hire auditors (e.g., Cohen et al. 2010; Fiolleau et al. 2013). We simplify this decision and operationalize it as one made by an individual manager,

¹ We examine risk in the context of individual risk aversion as a mechanism that can influence individuals’ decision making, compared to archival studies that use coarse proxies for overall firm risk.
rather than by a group. This design choice is grounded in prior research, which we discuss in more detail in Section 3.1.

Our study focuses on biases arising from individuals’ aversion to risk and the potential for losses. We choose to study manager risk aversion and loss aversion for several reasons. First, risk and the potential for losses are contextual factors that are ubiquitous in the operation of all companies. For example, risk maps into choices that managers make on a daily basis including inherent risk in project choices or investment opportunities, research and development, and earnings or operational volatility. Similarly, loss aversion maps into meeting or beating analysts’ earnings estimates and other targets, budgets, and reporting net income as opposed to a net loss. As a result, our findings generalize to a comprehensive array of settings and contexts. Second, Titman and Trueman (1986) explicitly incorporate managers’ risk aversion into signaling theory and suggest that it impacts the demand for audit quality. To date, there is limited empirical evidence testing their prediction. Third, in attempting to explain some managers’ avoidance of a guaranteed high-quality auditor, Hurley and Mayhew (2019) conjecture that managers’ behavior appears consistent with loss aversion. Our paper directly tests this possibility. Finally, risk aversion and loss aversion are typically studied as first-order effects on investment decisions with risky prospects. By contrast, we examine whether these factors also exert a second-order effect on managers’ demand for audit quality. We predict that managers’ risk aversion and loss aversion, individually and jointly, will increase their desire for flexibility in reporting, leading them to demand less than the highest audit quality. This second order effect appears to mitigate risk aversion such that the level of first-order risky investment does not change across treatments.
Participants in our experimental markets serve as managers and investors, similar to recent research (Kowaleski et al. 2018; Hurley et al. 2019). Managers receive an initial asset value, hire an auditor from a menu of auditors with different quality (i.e., accuracy) levels, choose to invest in one of two projects (Projects A or B) that will change their initial asset value, observe the asset’s final value, and choose the final asset value to report to investors. The auditing role then takes place electronically based upon pre-programmed algorithms for accuracy, rather than as a strategic player. To isolate audit quality demand, all auditors charge the same fee for verification services regardless of accuracy. Investors receive the manager’s report, the auditor and corresponding audit quality chosen by the manager, and the auditor’s report and engage in a first-price sealed-bid auction. We manipulate risk (high or low) within-subjects through the probability and magnitude of potential asset value outcomes. We manipulate the potential for loss (absent or present) between-subjects through the possible asset value changes – only increases or increases and decreases. We also use different starting asset values to hold the expected value constant across all treatments, which controls the economic considerations in the market and limits alternative explanations for our findings.

We find that risk aversion significantly reduces managers’ demand for audit quality. Specifically, higher-risk periods reduce managers’ likelihood of hiring a better auditor by 55.6 percent. Further, we find that risk aversion, loss aversion, and their interaction all significantly reduce managers’ likelihood of hiring the best available auditor in the market. Higher-risk periods and the possibility of a loss, individually and while holding the other constant, reduce managers’ likelihood of hiring the best auditor by 69.9 and 62.3 percent, respectively. The marginally significant interaction of higher-risk periods and the potential for a loss further

2 While we acknowledge that price competition is an important factor in auditing markets and managers’ overall demand for auditing, including it in the current study would confound our construct of interest, managers’ demanded level of audit quality, with one of the agency costs managers face, monitoring fees.
reduces managers’ likelihood of hiring the best auditor. This behavior occurs despite the fact that investing in a more costly project with higher potential asset values and hiring the highest-quality auditor maximizes profit in our setting. Finally, in supplemental analyses, we rule out alternative economic and psychological explanations for our results.

Our study makes multiple contributions to the accounting literature. First, our results suggest that risk aversion and loss aversion significantly impact managers’ demand for audit quality independent of agency costs. These findings answer the call for a greater understanding of the factors that influence the demand for audit quality (DeFond and Zhang 2014; Donovan et al. 2014). Second, our study provides insight into previous research that finds variation in manager demand for audit quality. Both archival and experimental research repeatedly find variation in managers’ audit quality demand. We present evidence that risk aversion and loss aversion play a role in creating this variation in managers’ audit quality preferences.

Third, prior research studies risk aversion as a first-order effect on willingness-to-pay or the willingness to accept a risky gamble (e.g., Holt and Laury 2002; Dohmen et al. 2010). In contrast, we find managers are willing to accept a risky gamble under high risk through their investment choice, but they use audit quality to mitigate that risk. This evidence suggests a second-order effect of risk aversion on audit quality, which increases the robustness of risk aversion and loss aversion as explanatory mechanisms for individuals’ judgments and decisions. Essentially, managers pass this risk on to investors by reducing their demand for audit quality when risk is high. Finally, we provide direct evidence that loss aversion reduces managers’ likelihood of hiring the highest-quality auditor in the market, which appears to explain managers’ reluctance to hire a guaranteed high-quality auditor in Hurley and Mayhew’s (2019) setting.
2. Prior Literature and Hypotheses

2.1 Demand for Audit Quality

Theory suggests that the demand for audit quality is driven by the agency costs faced by the company based on the principal-agent relationship (Jensen and Meckling 1976; Watts and Zimmerman 1983) and factors such as risk and complexity, which are positively associated with agency costs (DeFond and Zhang 2014). However, DeFond and Zhang (2014) document that there is a relatively limited number of prior archival studies on the demand for audit quality, and that these studies face significant methodological limitations (e.g., endogeneity, identifying variations in agency costs, identifying valid proxies for agency costs). Further, archival studies cannot assess whether management or the audit committee is the source of the demand for audit quality and cannot disentangle which factors drive this demand.

Prior research generally tests the hypothesis that higher agency costs, and factors positively associated with agency costs, such as risk and complexity, will increase the demand for audit quality. Existing archival research on the demand for audit quality provides mixed evidence with respect to agency costs and risk uniformly increasing audit quality demand. Firth (1997) finds that higher agency costs decrease managements’ likelihood of purchasing non-audit services from their auditor so as to maintain the appearance of independence. Lennox (2005) finds that managerial retained ownership levels have a significant negative relationship with audit quality proxied by audit firm size. Studies using research and development intensity and investment opportunity sets as proxies for risk find that companies with higher levels of these measures demand industry specialist auditors (Godfrey and Hamilton 2005; Cahan et al. 2008). Prior research also finds that greater information asymmetry increases the likelihood of hiring a

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3 DeAngelo (1981) defines audit quality as the probability that an auditor discovers a breach in the company’s financial records and the conditional probability that the auditor will report a discovered breach. We are interested in the joint impact of these components (i.e., overall audit report accuracy).
Big 4 auditor (Francis et al. 2009; Guedhami et al. 2009). Finally, Abbott et al. (2013) find that agency costs increase the likelihood of companies switching auditors following a GAAP-deficient PCAOB inspection.

While the above studies provide support for the hypothesis that agency costs and risk increase the demand for audit quality, a number of studies provide either mixed evidence of this relationship or evidence contrary to predictions. For example, Francis and Wilson (1988) find evidence linking agency costs and demand for quality-differentiated audits only in their binary auditor size model, but not their continuous quality model, and do not find support for major sources of agency costs (e.g., managerial ownership, changes in leverage). DeFond (1992) finds that changes in management ownership and leverage are associated with audit quality in the predicted direction, but that short-term accruals significantly influence audit quality in the opposite direction of their predictions. Blouin et al. (2007) find that companies with more aggressive accruals followed their Arthur Andersen audit teams to their new firms, contrary to the agency-cost-based hypothesized relationship. Copley and Douthett (2002) find results marginally consistent with the hypothesized relationship; however, these authors use a restricted sample of IPOs and only six percent of their observations are non-Big 6 auditors (cf. Mayhew et al. 2004, 99). Feltham, Hughes, and Simunic (1991) report that two of their three models do not support the hypothesized relationship. Francis et al. (1999) find that firms audited by Big 6 auditors have higher overall accruals, but lower discretionary accruals, the former (latter) of which is consistent (inconsistent) with predictions. Clarkson and Simunic (1994) find support for the hypothesis in a Canadian setting but not a U.S. setting arguably due to higher litigation costs in the U.S. driving up supply-side price (Hogan 1997). However, Lee et al. (1999) provide evidence that Clarkson and Simunic’s (1994) findings are dependent upon the inclusion of
mining firms in their sample. Finally, Barton (2005) does not find evidence consistent with an agency cost explanation, and other studies find that Big 8 auditors audit larger and less risky clients, contrary to the hypothesized relationship (Simunic and Stein 1987; Beatty 1989). Taken together, archival research provides mixed support of the hypothesis that agency costs and risk increase audit quality demand.

Several experimental economics studies find variation in managerial preferences for audit quality at an individual decision-making level although none of the studies focus on managerial demand. For example, prior research finds that a significant subset of managers: prefer to hire auditors who impair their independence (Mayhew et al. 2001; Mayhew and Pike 2004); regularly avoid hiring a guaranteed high-quality auditor (Hurley and Mayhew 2019); and exhibit significant variation in demand for audit quality (Kowaleski et al. 2018). These studies mirror some archival studies that find examples of management demanding lower audit quality (e.g., DeFond and Subramanyam 1998; DeFond et al. 2000; Lennox 2000; Abbott et al. 2013; DeFond et al. 2019) and provide evidence that a subset of managers demand lower audit quality, even when agency costs are held constant and managers face high, constant levels of risk.4

Overall, the prior literature’s mixed findings suggest that other factors impact audit quality demand. We study important contextual factors that impact managers’ decision-making processes and preferences for audit quality, because managers play a significant role in a

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4 Specifically, DeFond and Subramanyam (1998) find that management seeks auditors whose reporting preferences closely align with their own. DeFond et al. (2000) find regulations that increased auditor independence in China, which increased the frequency of modified audit opinions nine-fold, led to a significant decrease in market share for the auditors providing this higher audit quality. Lennox (2000) provides evidence that firms in the UK successfully engage in opinion shopping. Abbott et al. (2013) find that a majority of managers whose auditors receive severe audit deficiencies in PCAOB triennial inspections do not switch auditors. Finally, DeFond et al. (2019) find an increase in the frequency and magnitude of discretionary income-increasing changes in accounting estimates following auditor changes, and that those companies are more likely to subsequently restate earnings, receive fewer going-concern opinions, and experience lower returns.
company’s auditor hiring decision (Cohen et al. 2010; Fiolleau et al. 2013; Almer et al. 2014; Dhaliwal et al. 2015). We use an experimental approach to gain insight into how two factors inherent in every company’s operation, risk and the potential for losses, impact managers’ demand for audit quality. Our experiment controls agency costs and supply-side factors enabling us to unpack the manager’s decision-making process.

2.2 Risk Aversion and the Demand for Audit Quality

Risk aversion – an aversion to risky monetary outcomes even when there is an overall positive expected value – is well-known and researched within the economics literature. Titman and Trueman (1986) model a scenario where a risk-averse owner/manager hires an auditor to credibly convey their private information to investors. They demonstrate that hiring a higher-quality auditor will impact investors in two ways. First, hiring a higher-quality auditor will increase investors’ expectations of the manager’s private information because the auditor provides more precise information and an owner with negative information cannot profitably employ such an auditor. Second, the auditor’s precision will lead investors to place greater weight on the auditor’s report.

However, Titman and Trueman (1986) assert that, because the manager also has ex ante uncertainty about the nature of their information, the increase in audit quality increases the variance in the price the manager is able to obtain from investors. As a result, increased risk in the private information and/or the manager’s risk aversion make higher-quality auditing less attractive due to the potential for credible revelation of unfavorable information. By hiring a higher-quality auditor, the manager more directly links their own compensation to the firm’s risk and receives high (low) earnings when they have favorable (unfavorable) private information. By contrast, a lower-quality auditor provides less-precise information, which enables a manager to
mitigate some of this risk through increased reporting flexibility that allows the manager to smooth both the firm’s and their own earnings. While this flexibility comes at the cost of lower expected earnings for managers who have favorable private information, risk aversion implies that some managers will be willing to incur this cost to reduce their risk. Accordingly, we expect that risk aversion will reduce managers’ willingness to hire a higher-quality auditor when they face greater risk. This expectation is contrary to the hypothesized relationship in prior literature, where increased risk is associated with increased agency costs and therefore expected to increase the demand for audit quality (DeFond and Zhang 2014). However, based upon the ex-ante uncertainty surrounding the manager’s information, we propose the following hypothesis in directional form:

**H1**: Managerial demand for audit quality will decrease as risk increases.

2.3 *Loss Aversion and the Demand for Audit Quality*

Prior literature provides evidence that in addition to risk aversion individuals also exhibit loss aversion, which is a related but distinct concept (Köbberling and Wakker 2005; Novemsky and Kahneman 2005). Loss aversion refers to the tendency of individuals to give disproportionate weight to losses compared to gains when making judgments and decisions among risky choices (Kahneman and Tversky 1979; Kahneman et al. 1991; Tversky and Kahneman 1992). That is, loss aversion implies greater disutility from a loss than utility from an equal-sized gain, and a loss-averse individual is more acutely sensitive to reductions in their utility compared to equal-sized increases (Kahneman et al. 1991; Haigh and List 2005; Novemsky and Kahneman 2005).

In assessing risky prospects, individuals experience gains or losses by comparing outcomes to a reference point, which is determined by past experiences and outcomes (e.g.,
Kőszegi and Rabin 2006) or through salient benchmarks or targets. For example, prior research suggests managers focus on reference points based upon analyst forecasts, earnings benchmarks, and dividend levels and feel compelled to meet or beat these reference points (Burgstahler and Dichev 1997; Das and Zhang 2003; Daniel et al. 2008). Prior literature documents that managers go to significant lengths, including accrual-based and real-activities-based earnings management and expectations management, to meet or beat these targets (Burgstahler and Dichev 1997; Graham et al. 2005, 34-35; Roychowdhury 2006; Kross et al. 2011). While part of this motivation stems from the incentives managers face to meet or beat targets, it is also plausible that managers’ try to avoid the feeling of a loss sensation. This explanation is consistent with prior research, which finds that executives take measures to avoid falling short of targets to avoid decreases (i.e., losses) in stock price and/or reputation (Graham et al. 2005, 27-28). Implicitly, this is consistent with market-level loss aversion, as “there is a reward to meeting or beating analysts’ earnings expectations and a penalty for failing to do so” (Bartov et al. 2002, 175).

In a manner similar to risk-averse managers described above, loss-averse managers can use their auditor choice to mitigate the frequency with which they will experience loss sensations. While this choice comes at the cost of receiving lower earnings when they have favorable private information, we expect managers will demand a lower-quality auditor to increase reporting flexibility when faced with the prospect of a loss in their asset’s value. As such, we posit the following hypotheses in directional form:

**H2**: Managerial demand for audit quality will decrease with the possibility of a loss.

Further, due to the asymmetric sensitivities to losses compared to gains, we expect the effect of an increase in risk on manager demand for audit quality will be larger under a loss frame than under a gain frame. In H1, we expect managers to desire more flexibility in their
reporting when moving from a low-risk to a high-risk scenario. Additionally, according to prospect theory, an individual’s expected utility curve is steeper for losses than for equal-sized gains. As such, when moving from a low-risk to a high-risk scenario, the potential utility at stake changes more when losses are possible than when only gains are possible. In H2, we expect the desire for flexible reporting to be amplified when losses are possible, and we expect this desire to amplify the effect of risk on audit quality demand, as described in the following hypothesis:

**H3:** The decrease in managerial demand for audit quality under higher risk will be greater when there is also a possibility of a loss.

### 2.4 Other Psychological Factors

We also consider trait-level psychological factors that could contribute to variation in managers’ demand for audit quality. Specifically, we collect measures of individuals’ trait-level risk aversion, Dark Triad traits, guilt proneness, and prosocial tendencies in our pre-attendance questionnaire. This data allows us to test the effect of these traits and to rule out alternative explanations for our findings. The Dark Triad traits – Machiavellianism, psychopathy, and narcissism – have been linked to opportunistic behavior (e.g., Murphy 2012; Majors 2016), and share a common core that leads individuals exhibiting these traits to be indifferent regarding harm they cause to others while achieving their goals (Jones and Paulhus 2011). As a result, research suggests managers with high levels of Dark Triad traits will demand the audit quality they perceive as most beneficial without consideration of investors.

Guilt is a moral emotion that encourages individuals to act in ways that are consistent with accepted standards of right and wrong (Cohen et al. 2011), increases disapproval of lying (Cohen 2010), and increases cooperative behavior in interpersonal interactions (Ketelaar and Au 2003; de Hooge et al. 2007). As a result, managers high in guilt proneness may demand higher audit quality to avoid guilt from misleading investors. Finally, prosocial behavior – i.e., behavior
intended to benefit others – captures factors such as altruism and the tendency to anonymously help others (Carlo and Randall 2002). We explore whether prosocial tendencies increase demand for audit quality to benefit investors.

3. Experimental Design and Game Theory

3.1 Market Description and Procedures

We use a 2 x 2 mixed design, with Risk (low versus high) manipulated within-subjects and Potential for Loss (absent versus present) manipulated between-subjects, to test our hypotheses. Each experimental session includes seven to nine student participants randomly and anonymously assigned to the roles of “Decision Maker” (manager) or “Bidder” (investor). We use “Decision Maker”, “Bidder”, and “Verification Service” in our experimental materials instead of “managers”, “investors” and “auditors” to reduce the risk of uncontrolled expectations about how individuals should act in certain roles (Swieringa and Weick 1982) and reduce role-playing or other demand effects (Haynes and Kachelmeier 1998). However, throughout the paper we use the terms “manager,” “investor,” and “auditor” to facilitate reader comprehension.

Prior to participating in the experiment, participants complete a pre-attendance questionnaire online through Qualtrics. We measure participants’ trait risk aversion using real, small-stakes payoffs from the low-payoff condition in Holt and Laury (2002). We include this measure in Appendix A. We also measure participants’ Dark Triad personality traits (Jones and Paulhus 2014), guilt proneness (Cohen et al. 2011), and their tendencies toward prosocial

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5 We obtained institutional review board approval and complied with all human-subjects requirements.
6 Student participants are appropriate for our study because our experiment requires no special expertise and involves responding to economic institutions that are learned within our experimental setting (Libby et al. 2002). Furthermore, prior research finds that professionals are more susceptible to loss aversion than are students (Haigh and List 2005).
7 We measure these items at a separate time as a prerequisite to individuals’ participation in the experiment to reduce the salience of these measures while participants interact in our experimental markets, which could otherwise introduce unintended and uncontrolled behavioral biases.
behavior (Carlo and Randall 2002). We use these measures in our supplemental analyses to rule out alternative trait-level psychological explanations for our results.

Experimental sessions begin with the experimenter reading the instructions aloud as participants read along. Participants then complete a pre-experiment quiz to facilitate their understanding of the experiment. Appendix B presents the pre-experiment quiz and feedback provided based upon participant responses. After completing the pre-experiment quiz, participants are randomly and anonymously assigned to their role as manager or investor and the market begins.

[INSERT FIGURE 1 HERE]

All markets follow the same sequence of actions, which are summarized in Figure 1. In each period, managers have an initial asset value and a choice between two projects (Project A or Project B) that change that value. Managers concurrently choose an auditor to provide verification services from a list of auditors that provide different levels of accuracy, our measure of audit quality. Managers learn the outcome of their project investment (i.e., their true asset value change) and issue a report to investors, which is verified by the manager’s chosen auditor at the stated accuracy level. Investors receive each manager’s reported asset value, the accuracy rate of the manager’s auditor, and the auditor’s agree or disagree report. Investors submit bids for each manager’s asset. The highest-bidding investor pays their bid and receives the true value of the asset. Appendix C presents screenshots of the market as experienced by participants.

We induce risk aversion by manipulating risk. We manipulate risk (low versus high) through the probability of obtaining the high-valued asset from Project A and the value spread between the high- and low-valued asset. In the Low (High) Risk treatments, an investment in
Project A corresponds to a 90 (60) percent chance of obtaining the high-valued asset of E$1,100 (E$1,600) and a 10 (40) percent chance of obtaining the low-valued asset of E$500 (E$200).

We induce loss aversion by manipulating the potential for losses (absent versus present) by fixing managers’ reference points through their initial asset value and allowing their investment choices to change their asset’s value – increases only or increases and decreases. In this way, we test loss aversion in a relative sense without having managers incur absolute losses. Specifically, when loss aversion is absent, managers are endowed with an asset worth E$100 and Project A can increase their asset value by E$1,500 (E$1,000) or E$100 (E$400) in our high (low) risk treatments. When loss aversion is present, managers are endowed with an asset worth E$600 and Project A can increase their asset value by E$1,000 (E$500) or decrease their asset value by E$400 (E$100) in our high (low) risk treatments.⁸

We sequentially list the detailed steps of the market below. The “No Loss Possible” and “Loss Possible” markets only differ with respect to the parameters described in Step 1b below.⁹

1. Each manager begins each period by making two concurrent choices:
   a. The manager chooses an auditor. All auditors cost the manager 50 experimental dollars (hereafter E$) to provide verification services of differing quality: Auditor 1 is 95 percent accurate; Auditor 2 is 80 percent accurate; Auditor 3 is 65 percent accurate; and Auditor 4 is 50 percent accurate. This choice generates our primary measure of demand for audit quality. We hold audit fees constant because our study focuses on the demand for audit quality and using variable audit fees would confound managers’ true demand for audit quality with their response to an agency cost, monitoring fees. We provide only four options to implicitly force managers to choose either a higher or a lower quality audit – that is, we do not allow managers to anchor on the midpoint.
   b. The manager begins with an initial asset value and must choose between two projects – Project A and Project B, which cost E$50 and E$10, respectively. Figure 2

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⁸ The loss aversion manipulation is distinct from the risk manipulation and our loss aversion manipulation does not impact risk aversion. The expected value of an asset from Project A is E$1040 across all conditions, and the spread of possible outcomes are the same across loss aversion treatments within each risk treatment (see Figure 2). The probabilities and outcomes of reaching any end state of wealth are the same in each risk and loss aversion pairing, by definition risk aversion is held constant when we vary loss aversion within the high risk and low risk conditions.

⁹ Our experiments are programmed and conducted with the z-Tree software (Fischbacher 2007).
presents the potential outcomes from each project by market type, which we discuss below:10

i. "No Loss Possible" Markets: Managers begin with an asset valued at E$100. In high (low) risk periods, Project A has a 60 (90) percent chance of increasing the asset value by E$1,500 (E$1,000), and a 40 (10) percent chance of increasing the asset value by E$100 (E$400).11 Project B will always result in the low value change – an increase of E$100 (E$400) in high (low) risk periods.

ii. "Loss Possible" Markets: Managers begin with an asset valued at E$600. In high (low) risk periods, Project A has a 60 (90) percent chance of increasing the asset value by E$1,000 (E$500), and a 40 (10) percent chance of decreasing the asset value by E$400 (E$100). Project B will always result in the lower asset value change – a decrease of E$400 (E$100) in high (low) risk periods.

The investment choice introduces information asymmetry that prohibits investors from calculating and focusing on simple expected values for their bidding, which creates a role for the auditor to add credibility to managers’ reports. Risk is manipulated as high or low based upon the probabilities and asset value changes detailed above. We give managers an initial asset value to create a controlled reference point from which we can manipulate the potential for loss.12 Prior literature indicates that there is no risk aversion beyond loss aversion in balanced (i.e., 50-50) risks (Köbberling and Wakker 2005; Novemsky and Kahneman 2005, 123). By using unbalanced risks in our projects, we allow for both risk aversion and loss aversion to play roles in managers’ decision-making processes. The expected value of Project A is held constant across risk and loss aversion manipulations to increase experimental control and comparability across treatments.

2. The manager learns the true change in the value of their asset based upon their project choice. Managers choose which asset value to report to investors. They may report an asset value that is higher than their true asset value but not lower. For example, if a manager chose Project A in a high-risk period, their asset will be worth E$1,600 or E$200. Managers can report an asset worth E$200 as E$200 or E$1,600; however, if the asset is worth E$1,600 the manager must report the asset as E$1,600. Managers’ ability to misreport creates additional information asymmetry and a role for auditors. We do not allow underreporting, as there is no rational incentive to underreport in our setting.13

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10 As Tversky and Kahneman (1991) note, loss aversion implies the status quo bias. As a result, we force managers to choose between these two projects and do not allow them a status-quo option.
11 Prior literature finds that risk aversion increases as the value of the gamble increases (Kachelmeier and Shehata 1992; Holt and Laury 2002). Thus, our higher potential payoff in the high-risk periods ensures a strong manipulation of risk aversion.
12 Loss aversion is contingent upon reference points that are established based upon expectations (Kőszegi and Rabin 2006, 2007), rather than a neutral status quo (Tversky and Kahneman 1992). Fixing this expectation gives us greater experimental control of our loss aversion manipulation.
13 While our design focuses on overreporting for simplicity, it applies to manager misreporting preferences in general. As such, our findings also generalize to a setting where managers prefer to underreport. Our design also arguably leads managers to contemplate committing fraud, as opposed to GAAP-compliant earnings management. However, these two actions are not meaningfully different from a game-theoretic perspective, given their impact on investors is the same. Prior research indicates that individuals are generally averse to lying (Gneezy 2005; Hurkens and Kartik 2009), and this aversion
3. The manager’s chosen auditor provides its verification services. The auditor learns the true value of the asset based upon its accuracy rate (i.e., 95, 80, 65, or 50 percent). If the audited value matches (does not match) the manager’s report, the auditor issues an Agree (a Disagree) report. Whenever the auditor does not learn the true value of the asset based upon its accuracy (i.e., 5, 20, 35, or 50 percent), they simply issue an Agree report. The auditor role is automated according to the probabilities listed above. We automate the auditor for several reasons: to reduce complexity in the market, to focus on the actions of managers and investors, and to hold constant managers’ available audit quality choices across periods and market sessions. We do not incorporate any types of auditor penalties (e.g., a PCAOB inspection regime or legal liability) because auditors are not human participants in our experiment.

4. Investors receive the following from each manager: the manager’s reported asset value, the accuracy rate of the hired auditor, and the auditor’s Agree or Disagree report. Investors engage in a first-price sealed-bid auction, where they are able to bid any value up to E$1,600 or E$1,100 for high and low risk periods, respectively. Investors then learn whether they are the high bidder for each asset. 14

5. All participants receive their personal earnings summary for the period. Participants remain in the same role throughout the entire market. Managers’ identities to investors are scrambled each period. We scramble manager identities because we are not studying manager reputations, but rather their demand for audit quality.

Each market lasts at least 20 periods. Participants are not told the total periods to reduce end-period effects. 15 Information asymmetry exists during each period; however, market histories update after each period, revealing manager choices other than investment choice in order to facilitate information aggregation. Market history includes manager reported values, true values, auditor hired, auditor report, auditor accuracy, high bid, and high bidder earnings.

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14 Ties in the bidding process are resolved via random number generator. Novemsky and Kahneman (2005, 123) note that loss aversion does not apply to money that is given up in a purchase. Accordingly, we do not expect loss aversion to significantly influence investors’ bidding.

15 We use a random number generator and a 25% chance each period beginning with period 20 is the last period to pre-sequence the number of periods per session in order to hold the distribution of periods constant across loss aversion treatments. We also pre-sequence risk by period within sessions to hold risk balanced.
Managers earn the high bid for their asset, less their investment cost and the cost of the auditor. For winning bids, investors earn the true asset value less their bid. Investors also earn a 2 percent bonus on the cumulative value of assets they acquire throughout the market. Investors are aware they will earn this small return, but we do not inform them of the percentage.

Experimental sessions last approximately 75-90 minutes. Participants earn a $5 show-up fee, up to $3.85 for the pre-attendance risk-aversion question, and their earnings from the market. We convert E$ to U.S. dollars using role-specific conversion rates, based upon pilot testing, to give participants similar earning opportunities. Participants earned $29 per session on average.

Two design choices warrant further discussion. First, we simplify the auditor hiring decision by allowing a manager, as opposed to an audit committee, to control auditors’ hiring and dismissal. Audit committees can play an important role in ensuring audit quality. Research finds that independent, expert, appropriately incentivized, and active audit committees provide stronger monitoring of financial reporting (e.g., Klein 2002; Abbott et al. 2004; Bédard et al. 2004; Agrawal and Chadha 2005; Hoitash et al. 2009; Dhaliwal et al. 2010; Engel et al. 2010). However, evidence suggests that management still retains significant influence over the auditor hiring decision, despite the regulatory requirement that audit committees hire auditors (Cohen et al. 2010; Fiolleau et al. 2013; Dhaliwal et al. 2015). We argue management provides significant input into the audit committee’s auditor hiring decision, thereby retaining non-trivial influence over this decision (e.g., Almer et al. 2014). Further, we operationalize the decision as one made by an individual, rather than by a group. We acknowledge multiple members of management and the audit committee likely contribute to the auditor hiring decision but argue an individual manager can strongly influence the decision.
Second, by scrambling managers’ identities to investors, we do not allow managers to form reputations with investors. This approach allows us to draw cleaner inferences on managers’ demand for audit quality. We are not specifically studying manager reputations and do not expect managerial reputation building to interact with our manipulations. Further, prior literature finds that reputations for honest reporting do not always develop, even with explicit incentives (King 1996), and that managerial reputation building does not significantly influence auditor hiring decisions (Hurley and Mayhew 2019).

3.2 Game Theoretic Equilibria

We leverage game theory to develop general expectations and predictions for participant behavior. The expected value of an asset from investing in Project A is equivalent in all treatments, therefore the following discussion applies to all treatments. Our previous discussion on the demand for audit quality, risk aversion, and loss aversion indicates our specific, testable hypotheses on departures from the game theoretic equilibria.

In prior studies with similar experimental settings, multiple potential equilibria exist, with two end points: the Lemons and Reputation equilibria (e.g., Kowaleski et al. 2018; Hurley et al. 2019). The Lemons equilibrium is the unique single-period equilibrium when the auditor is a human player with an investigation choice. The auditor chooses not to investigate, in order to save costs. Investors in turn, do not rely on the auditor’s report. The manager cannot credibly signal they have a high value asset, and instead invests in Project B to save costs and reports their asset value as High. Investors anticipate the manager will invest in Project B, infer the manager’s report is likely not truthful, and bid less than the low valued asset.

In an experimental setting where auditors have established reputations for accuracy, whether from multi-period play or fixed accuracy levels, investors can rely on the auditor’s report (Mayhew 2001; Hurley and Mayhew 2019). Managers can play the following strategies:
1) a Rip-Off strategy: hire a lower-quality auditor, invest in Project B, and report High; 2) a Smoothing strategy: hire a lower-quality auditor, invest in Project A, and report High; or 3) a High-Quality strategy: hire the highest-quality auditor, invest in Project A, and report High. Investors incorporate the manager’s report, the auditor’s report and the auditor’s accuracy into their bids. The High-Quality equilibrium creates greater market surplus – managers create more high-valued assets through their investing and investors engage in less price-protecting behavior through their bids. This surplus is generally captured by the manager through investors’ bidding, making it the dominant strategy. Although the High-Quality equilibrium generates maximum surplus, prior research finds that managers do not always demand the highest-quality auditor available in the market (Kowaleski et al. 2018; Hurley and Mayhew 2019).

4. Analysis and Results

4.1 Participants, Demographic Information, and Descriptive Statistics

Our participants include 166 undergraduate (85.5 percent) and graduate (13.3 percent) students from a large public university in the Midwestern United States; 1.2 percent indicated “other” as their academic standing. Participants’ mean (median) age is 20.6 (20), 33.1 percent are male, and 18.7 percent have a first language other than English. Of our demographic variables, only age significantly differed between our loss aversion treatments ($t_{(164)} = 2.031, p = 0.044$).

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16 The High-Quality strategy is equivalent to the Reputation strategy in prior market studies (Hurley et al. 2019, Kowaleski et al. 2018) except in one regard. In the Reputation strategy, the auditor player must develop a reputation for accuracy over multiple periods. In the High-Quality strategy, the auditor is not a strategic player and its accuracy level is fixed. The manager’s reliance on the auditor’s reputation for high-quality is equivalent. However, using fixed accuracy levels guarantees the High-Quality strategy is always accessible to the manager, while this was not always true of the Reputation strategy in prior studies due to the endogenous nature of auditor accuracy/reputation in those studies.

17 In untabulated t-tests we confirm that our random assignment was effective for participants’ first language between player roles and between loss aversion treatments (both $p > 0.10$).

18 All p-values are two-tailed unless otherwise noted.
However, age is not significant at conventional levels in any of our analyses (all $p > 0.50$). As a result, we omit age from our analyses and conclude that our random assignment is successful.

Table 1 provides descriptive statistics by treatment and Table 2 provides a breakdown of hiring by auditor accuracy in each treatment. Average demanded audit quality by treatment is as follows: No Loss Possible / Low Risk – 77 percent; No Loss Possible / High Risk – 72 percent; Loss Possible / Low Risk – 75 percent; and Loss Possible / High Risk – 69 percent. Similarly, the percentage of times when managers hired the best available auditor (i.e., 95 percent accuracy) by treatment are as follows: No Loss Possible / Low Risk – 38 percent; No Loss Possible / High Risk – 24 percent; Loss Possible / Low Risk – 28 percent; and Loss Possible / High Risk – 13 percent. The results are generally consistent with H1 through H3, as the lowest demand for audit quality and hiring of the best available auditor are found in our Loss Possible / High Risk treatment. Table 1 also shows more frequent manager misreporting in high risk periods, which is expected given there are more frequent low value assets under high risk.

4.2 The Impact of Risk Aversion and Loss Aversion on Managers’ Demand for Audit Quality

To investigate managers’ demand for audit quality based upon our manipulations of risk and the possibility of a loss we use two different dependent variables. The first dependent variable measures the auditor accuracy chosen by the manager. We use the following multilevel ordered logistic regression as our base model (Model 1):

$$AQDemand = \beta_0 + \beta_1 PeriodRisk + \beta_2 LossPossible + \varepsilon$$

$AQDemand$ is the manager’s chosen auditor from the accuracy set {.50, .65, .80, .95}. $PeriodRisk$ (LossPossible) is a binary variable set to 1 if the observation relates to a period with
high risk (the possibility of a loss), and 0 otherwise. In Model 2, we add the interaction term $\text{PeriodRisk} \times \text{LossPossible}$.\(^{19}\) In Model 3, we control for $\text{ManagerInvestment}$, which is set to 1 (0) if the manager invested in Project A (B). We control for manager investment as managers who invest in Project B are playing a different strategy and do not face the same risks as managers who invest in Project A. In Model 4, we additionally control for $\text{TraitRiskAversion}$ to ensure that it is participants’ reactions to our manipulation of risk, rather than their dispositional aversion to risk, that drive our results. $\text{TraitRiskAversion}$ is a continuous variable between 1 and 10, with higher numbers reflecting greater risk aversion (Holt and Laury 2002).

Our second dependent variable measures whether the manager chooses the highest quality auditor that is available using the following mixed-effects logistic regression (Model 5):

$$HiredBest = \beta_0 + \beta_1 \text{PeriodRisk} + \beta_2 \text{LossPossible} + \varepsilon$$

$HiredBest$ is a binary variable set to 1 if managers hire the 95 percent accurate auditor, and 0 otherwise. All other variables are as previously defined. In Model 6, we add the interaction term $\text{PeriodRisk} \times \text{LossPossible}$. In Model 7, we control for $\text{ManagerInvestment}$, and in Model 8 we control for $\text{TraitRiskAversion}$.

[INSERT TABLE 3 HERE]

Table 3, Panel A shows that in Models 1, 2, 3, and 4 $\text{PeriodRisk}$ is negative and significant ($p < 0.001$) which supports H1 and indicates greater risk significantly reduces managers’ demand for audit quality. Specifically, the odds-ratio for $\text{PeriodRisk}$ (0.444) from Model 1 indicates that higher-risk periods, holding $\text{LossPossible}$ constant, decrease managers’ likelihood of hiring a better auditor by 55.6 percent. $\text{LossPossible}$ is negative, but not significant in any of the models, which does not support H2. Further, the interaction

\(^{19}\) We add the interaction term in a separate model for our tests of $\text{AQDemand (HiredBest)}$ in order to retain interpretability of the coefficients and odds ratios from the main effects in an ordered logistic regression (a logistic regression).
PeriodRisk*LossPossible is not significant in any of the models, which does not support H3. In Models 3 and 4, ManagerInvestment is positive and significant \((p < 0.001)\), indicating that managers who invest in Project A demand significantly higher audit quality than those who invest in Project B. This result is consistent with both High-Quality and Rip-Off equilibria when managers invest in Project A and B, respectively. In Model 4, TraitRiskAversion is negative, consistent with expectations, but is not significant.\(^{20}\)

Table 3, Panel B presents Models 5, 6, 7, and 8, which test our second dependent variable that measures whether the manager hires the best available auditor or not \((HiredBest)\). We find that the coefficient on PeriodRisk is negative and significant in all models \((all \text{ one-tailed } p < 0.001)\). These results support H1 and indicate that increases in risk significantly decrease managers’ likelihood of hiring the best available auditor in the market. Specifically, the odds-ratio for PeriodRisk \((0.301)\) from Model 5 indicates that higher-risk periods, holding LossPossible constant, reduce managers’ likelihood of hiring the best possible auditor by 69.9 percent. Similarly, LossPossible is negative and significant in Model 5 \((one-tailed p = 0.012)\), Model 6 \((one-tailed p = 0.046)\), Model 7 \((one-tailed p = 0.029)\), and Model 8 \((one-tailed p = 0.021)\). These results support H2 and indicate that the possibility of a loss significantly decreases managers’ likelihood of hiring the best available auditor. The odds-ratio for LossPossible \((0.377)\) from Model 5 indicates that the possibility of a loss, holding PeriodRisk constant, reduces managers’ likelihood of hiring the best possible auditor by 62.3 percent. The interaction term

\(^{20}\)In untabulated analyses we re-run Models 1, 2, 3, and 4 for the first half (periods 1-10), second half (periods 11-20), and extra (periods > 20) to investigate learning and/or end-period effects. This analysis reveals virtually identical results to those reported above. The only exception is that LossPossible is negative and marginally significant in all four models \((p < 0.10)\) for the first half of the market but not the second half. This finding supports H2 and is consistent with loss aversion decreasing demand for audit quality, but the effect diminishing as participants update their reference points with experience. Further, controlling for learning and/or end-period effects with a continuous variable Period \((p > 0.40 \text{ in all models})\) does not change our results.
PeriodRisk*LossPossible is negative and marginally significant in Model 6 (one-tailed \( p = 0.051 \)), Model 7 (one-tailed \( p = 0.081 \)), and Model 8 (one-tailed \( p = 0.079 \)), which provides partial support for H3 and suggests the negative effect of either risk or loss aversion becomes more pronounced when the other is also present. ManagerInvestment is positive and significant in Models 7 and 8 (one-tailed \( p < 0.001 \)), consistent with inferences from our tests of AQDemand. TraitRiskAversion is negative and marginally significant in Model 8 (one-tailed \( p = 0.082 \)), indicating that managers with greater trait risk aversion are less likely to hire the best available auditor.\(^{21}\)

Overall, our results are consistent with risk decreasing managers’ average demanded audit quality and likelihood of hiring the best available auditor, supporting H1. Our results for H2 (H3) suggest the possibility of a loss (the interaction of risk and possibility of a loss marginally) decreases managers’ likelihood of hiring the best available auditor but does not significantly affect the average demanded audit quality. It appears that both of these contextual factors influence managers’ demand for audit quality. In the following subsection, we address other economic or psychological factors that may plausibly drive our results.

4.3 Assessing Potential Alternative Explanations for our Findings

When considering the results presented above, there are potential economic- and psychological-based alternative explanations for our findings. We first address economic factors

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\(^{21}\) In untabulated analyses we re-run Models 5, 6, 7, and 8 for the first half (periods 1-10), second half (periods 11-20), and extra (periods > 20) to investigate learning and/or end-period effects. This analysis reveals virtually identical results to those reported above. The only exception is that the interaction term PeriodRisk*LossPossible loses significance in the first and second half analyses. However, we also control for learning and/or end-period effects with a continuous variable Period, which is positive and significant in all three models (two-tailed ps between 0.020 and 0.026). This finding supports (contradicts) a learning (end-period) effects, whereby participants increase their propensity to hire the best available auditor in later periods of the market; however, including Period does not change any of our results in our main analyses.
using data from our market sessions and then address psychological factors using data collected in our pre-attendance questionnaire.

4.3.1 Assessing Alternative Economic Explanations

We first consider whether managers do not demand the highest audit quality available in the market because investors do not appropriately reward higher audit quality with higher bids. To investigate this possibility, we conduct the following mixed-effects linear regression on all High/Agree reports:

\[ \text{HighBid} = \beta_0 + \beta_1 \text{LossPossible} + \beta_2 95\%\text{AccurateAuditor} + \beta_3 80\%\text{AccurateAuditor} + \beta_4 65\%\text{AccurateAuditor} + \epsilon \]

\text{HighBid} is the winning bid for each observation and is our dependent variable. \text{LossPossible} is as previously defined. \text{95%/80%/65%AuditorAccurate} are individual indicator variables capturing the quality of auditor hired by the manager from the set \{.50, .65, .80, .95\}. Because asset values differ significantly based upon \text{PeriodRisk}, we report two separate models. Model 1 reports our analysis for high risk observations where the reported high value asset is E$1,600. Average winning bids for High/Agree reports in high-risk periods are as follows, based upon auditor accuracy: 50-percent accurate = E$1,052.32; 65-percent accurate = E$1,197.55; 80-percent accurate = E$1,468.54; and 95-percent accurate = E$1,566.02. Model 2 reports our analysis for low risk observations where the reported high value asset is E$1,100. Average winning bids for High/Agree reports in low-risk periods are as follows, based upon auditor accuracy: 50-percent accurate = E$872.50; 65-percent accurate = E$926.78; 80-percent accurate = E$1,038.83; and 95-percent accurate = E$1,081.41. Table 4 presents the results of these models.

\[\text{[INSERT TABLE 4 HERE]}\]

\(^{22}\) We only analyze High/Agree reports because Low/Agree reports must be truthful and High/Disagree reports must be untruthful. As a result, investors should incorporate auditor accuracy into their bidding for High/Agree reports, but not for other report types.
In both models, we find that investors reward managers’ auditor choice as expected, with higher levels of auditor accuracy associated with higher winning bids (all one-tailed $ps < 0.001$). In order to assess whether the coefficients for each auditor are significantly different from one another, we conduct an untabulated post-estimation comparison of coefficients with a Bonferroni correction for multiple tests. In this analysis, we verify that all coefficients for AuditorHired are significantly different from one another (all $ps < 0.001$). These analyses contradict the potential explanation that our results arise due to investors not significantly rewarding managers for hiring the best possible auditor, or for hiring higher-quality auditors in general and provide evidence that the market functions as theoretically predicted.\(^{23}\)

A second possibility is that managers do not demand higher-quality auditing because they are able to play alternative strategies that are more profitable than a High-Quality strategy. To address the possibility that managers can be more profitable by playing a Rip-Off or a Smoothing strategy as opposed to a High-Quality strategy, we analyze overall earnings using each manager as an observation ($n = 86$) to address independence concerns. To facilitate this analysis, we classify managers by their strategy based upon their average AQDemand and ManagerInvestment. Specifically, managers whose AQDemand and ManagerInvestment are both greater than 80 percent are classified as playing a High-Quality strategy. Managers whose AQDemand or ManagerInvestment are both less than or equal to 65 percent are classified as

\(^{23}\) We also examine whether investors benefit or are harmed by different levels of audit quality. Using a mixed-effects linear regression for High/Agree reports with InvestorEarnings as the dependent variable and AuditorHired as the independent variable of interest we do not find any significant differences in investor earnings based upon audit quality (all $ps > 0.20$, untabulated). This result holds when controlling for risk, possible loss, and their interaction (all $ps > 0.15$, untabulated). This indicates that investors effectively price audit quality into their bids well when audit quality is perfectly known. However, given that auditing exhibits attributes of credence goods (Causholli and Knechel 2012), it is unlikely that investors can incorporate audit quality into their decision making to this degree in the real world. If investors are unable to effectively incorporate subtle differences in audit quality into their decision making, our findings of variation in manager demand for audit quality can have negative consequences for investors.
playing a Rip-Off strategy, and all other managers are classified as playing a Smoothing strategy. Overall, 19 (22.1 percent) of managers play a High-Quality strategy, 38 (44.2 percent) play a Smoothing strategy, and 29 (33.7 percent) play a Rip-Off strategy. In untabulated analysis, we conduct a linear regression with cumulative market Earnings as our dependent variable, and Strategy as our independent variable. We find that both High-Quality ($t = 4.58, p < 0.001$) and Smoothing ($t = 2.66, p = 0.009$) strategies significantly outperform the Rip-Off strategy. Further, post-estimation tests reveal that the High-Quality strategy significantly outperforms the Smoothing strategy ($F_{(1,83)} = 6.14, p = 0.015$). These results contradict the alternative explanation that managers can be more profitable by playing a Smoothing or Rip-Off strategy rather than a High-Quality strategy.

4.3.2 Assessing Alternative Psychological Explanations

We collect a number of psychological measures in our pre-attendance questionnaire in order to assess alternative explanations for our findings. Our pre-attendance questionnaire was administered separately days before the experiment and was required for eligibility to participate in the market experiment. By collecting this data ahead of time, we reduce the possibility that the questions impact participants’ behavior in the experiment. In addition to the previously discussed trait risk aversion, the questionnaire collects the following for each participant: 1) Dark Triad traits (Jones and Paulhus 2014); 2) guilt proneness (Cohen et al. 2011); and 3) prosocial

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24 We chose 80 percent as the cutoff for a High-Quality strategy because this indicates that managers are hiring a higher-quality auditor a majority of the time and allows for the likelihood that managers will experiment with other strategies throughout the market. Similarly, we chose a 65 percent cutoff for a Rip-Off strategy because this indicates that these managers are hiring a lower-quality auditor a majority of the time and investing less than 65 percent of the time suggests the manager is playing a Rip-Off strategy in a non-trivial number of periods. Nonetheless, we re-run our analyses using 85 (70) and 75 (60) percent for High-Quality (Rip-Off) strategies and find that our results are qualitatively unchanged.

25 We verify that our reported results hold using (1) an untabulated mixed-effects regression with a random slope for session, (2) a linear regression with a control variable for session, and (3) post-estimation tests for each model.
tendencies (Carlo and Randall 2002). In untabulated analyses, we verify that none of these measures differ based upon our loss aversion treatments, indicating successful random assignment to conditions. While this should preclude these factors from driving our results, we run analyses to confirm that this is the case. Specifically, we re-run our tests of \( AQDemand \) and \( HiredBest \) including each measure alone and a model including all measures together.\(^{26}\) This untabulated analysis confirms that the inclusion of any specific measure or all of these psychological measures does not qualitatively change any of our findings.

5. Conclusion

We find that risk aversion reliably reduces managers’ demand for audit quality and their likelihood of demanding the highest-quality auditor. We also show that loss aversion significantly reduces the likelihood of managers hiring the highest-quality auditor, and the interaction of risk aversion and loss aversion leads to a marginally significant further reduction. Importantly, we hold audit costs constant across all auditors and the expected value of the higher-cost project constant across treatments. In supplemental analyses, we rule out alternative economic- and psychological-based explanations for our results. Specifically, our results are not driven by investors not sufficiently rewarding high-quality auditor choice, by managers being more profitable by demanding lower levels of audit quality, or by managers’ individual traits.

As with all research, our study is subject to certain limitations. First, our participants are students who have limited experience in financial markets. However, our experimental design is abstract in nature, captures the basic incentives in financial markets, and does not require specific expertise or training to participate. Given the fundamental nature of risk aversion and loss

\(^{26}\) Dark Triad is the sum of managers’ average responses to each subscale of the SDT, due to their “common core” (e.g., Majors 2016). Guilt proneness is the average response on the two guilt subscales of the GASP: Guilt-Negative Behavior Evaluation and Guilt-Repair (Cohen et al. 2011). Prosocial Tendency is the average response to the Prosocial Tendencies Measure (Carlo and Randall 2002).
aversion, we do not see a plausible reason why our results would not generalize to managers in actual financial markets. Second, we provide managers with a menu of auditors with salient accuracy measures that do not readily exist in the real world, due to the credence attributes of a financial statement audit (Causholli and Knechel 2012). This feature is necessary to study managers’ demand for audit quality and overcomes a limitation of archival research, which cannot meaningfully distinguish between subtle differences in audit quality (DeFond and Zhang 2014). Third, in order to isolate the effects of risk aversion and loss aversion on managers’ behavior, we abstract from several factors that are present in real-world financial markets: manager reputation building and reputation risk, litigation risk, price competition, and regulation. While these factors are likely important determinants of managers’ behavior and choices, we do not see reasons why any of these factors would negatively interact with our manipulations. Indeed, it is likely that factors such as reputation or litigation risks would exacerbate the effects of risk and loss aversion. Finally, we study loss aversion in a relative sense, using a fixed reference point, rather than in an absolute sense where managers experience negative earnings. Accordingly, our results on loss aversion are conservative, given the risk of real losses that managers face in running a firm.

Our study contributes to the accounting literature on managers’ demand for audit quality. First, we provide evidence on the factors influencing the demand for audit quality (DeFond and Zhang 2014; Donovan et al. 2014). We provide empirical evidence that supports the notion that managers do not always demand audit quality in ways that are implied by existing theory. Instead, our evidence suggests that both risk aversion and loss aversion exert influence on

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27 While audit accuracy rates are not available prior to hiring an auditor, many signals exist in the natural setting that firms and investors rely on to make inferences about audit quality, such as: PCAOB inspection results, AAERs, audit fees, office level industry specialization, and individual partner reputations.
managers’ demand for audit quality. This evidence suggests that risk aversion and loss aversion significantly impact the demand for audit quality independent of related agency-cost issues. DeFond and Zhang (2014, 278) suggest that the literature on audit quality demand is relatively small and that researchers must “identify innovative settings to test this theory.” Using experimental economics markets, we create such a setting and provide a strong test of the theory of audit quality demand. Our results suggest future archival research can revisit agency cost explanations for the demand for audit quality in settings that can hold constant or control risk aversion and loss aversion.

Second, we provide insight into the variation in demand for audit quality observed in experimental research and the mixed findings in archival research. While theory indicates that managers should demand high-quality auditing in situations involving high agency costs and/or risk and when the benefits outweigh the costs, managers often opt for lower-quality audits. We provide evidence that contextual factors impact managers’ preferences for audit quality, a critical input into the auditor hiring decision. We use stark parameter manipulations to create settings differing in risk and the potential for losses. This provides a clean test of theory that risk aversion and loss aversion affect manager demand for audit quality.

Third, we find evidence of a second-order effect of risk aversion on audit quality. Under conditions of high risk, managers are willing to accept a risky gamble through their investment choice but reduce their demand for audit quality to mitigate that risk and pass the risk on to investors. Finally, we provide direct evidence that loss aversion reduces managers’ likelihood of hiring the highest-quality auditor in the market, which appears to explain managers’ reluctance to hire a guaranteed high-quality auditor in Hurley and Mayhew’s (2019) setting.
References


Figure 1
Summary of Experiment Steps

Step 1: Manager Choices
  a) Choose Auditor
  b) Choose Project

Step 2: Manager Learns True Asset Value and Chooses Asset Value to Report

Step 3: Verification Performed (automated)

Step 4: Investors Bid on Manager Assets

Step 5: Learn Earnings
### Managers’ Project Choices, Probabilities, and Payoffs by Treatment

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<th>High Risk</th>
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<td><strong>Value</strong></td>
<td><strong>End</strong></td>
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<td>0.4</td>
<td><strong>E$1,000</strong></td>
</tr>
<tr>
<td><strong>Change</strong></td>
<td>- E$100</td>
<td><strong>E$500</strong></td>
<td>1.0</td>
<td><strong>E$1,600</strong></td>
</tr>
<tr>
<td><strong>End Value</strong></td>
<td><strong>E$600</strong></td>
<td><strong>E$500</strong></td>
<td><strong>End Value</strong></td>
<td><strong>E$200</strong></td>
</tr>
<tr>
<td><strong>Value</strong></td>
<td><strong>E$600</strong></td>
<td><strong>E$500</strong></td>
<td><strong>End Value</strong></td>
<td><strong>E$200</strong></td>
</tr>
</tbody>
</table>

- Expected Value of Project A = E$1,040
- Expected Value of Project B = E$500
- Expected Value of Project A = E$1,040
- Expected Value of Project B = E$200

This figure depicts managers’ project choices for each treatment along with the probabilities of each potential change in their initial asset value to yield their final asset value. We include expected values of each project by treatment as well. We did not include the costs of Project A (B) of E$50 (E$10) or auditor fees (E$100) in the calculation of our expected values for the assets themselves.
This table presents descriptive evidence based upon our session/period manipulations of Loss Aversion and Risk. \textit{AQDemand} is the accuracy of the chosen auditor from the set \{.50, .65, .80, .95\}. \textit{HiredBest} is a binary variable set to 1 (0) if the manager hires the 95\% accurate auditor for each observation. \textit{MgrInvestment} is a binary variable set to 1 (0) if the manager invests in Project A (B) for each observation. \textit{Misreport} is a binary variable set to 1 (0) if the reported value does not (does) match the true value for each observation.
Table 2  
Auditor Hiring by Treatment

<table>
<thead>
<tr>
<th>Auditor Acc.</th>
<th>Low Risk</th>
<th></th>
<th>High Risk</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hires</td>
<td>% Hires</td>
<td>Hires</td>
<td>% Hires</td>
</tr>
<tr>
<td>No Loss Possible</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>95%</td>
<td>179</td>
<td>37.53%</td>
<td>113</td>
<td>23.89%</td>
</tr>
<tr>
<td>80%</td>
<td>125</td>
<td>26.21%</td>
<td>131</td>
<td>27.70%</td>
</tr>
<tr>
<td>65%</td>
<td>59</td>
<td>12.37%</td>
<td>90</td>
<td>19.03%</td>
</tr>
<tr>
<td>50%</td>
<td>114</td>
<td>23.90%</td>
<td>139</td>
<td>29.39%</td>
</tr>
<tr>
<td>Loss Possible</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>95%</td>
<td>141</td>
<td>28.14%</td>
<td>63</td>
<td>12.70%</td>
</tr>
<tr>
<td>80%</td>
<td>147</td>
<td>29.34%</td>
<td>139</td>
<td>28.02%</td>
</tr>
<tr>
<td>65%</td>
<td>129</td>
<td>25.75%</td>
<td>171</td>
<td>34.48%</td>
</tr>
<tr>
<td>50%</td>
<td>84</td>
<td>16.77%</td>
<td>123</td>
<td>24.80%</td>
</tr>
</tbody>
</table>

This table presents total hires and percentages of hires for each auditor by session-type.
Table 3
Panel A: Managers' Average Demand for Audit Quality

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PeriodRisk (-)</td>
<td>-0.813***</td>
<td>-0.790***</td>
<td>-0.836***</td>
<td>-0.836***</td>
</tr>
<tr>
<td>LossPossible (-)</td>
<td>-0.347</td>
<td>-0.364</td>
<td>-0.541</td>
<td>-0.557</td>
</tr>
<tr>
<td></td>
<td>[-0.84]</td>
<td>[-0.73]</td>
<td>[-1.05]</td>
<td>[-1.08]</td>
</tr>
<tr>
<td>PeriodRisk * LossPossible (-)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-0.041</td>
<td>0.074</td>
<td>0.073</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[-0.23]</td>
<td>[0.41]</td>
<td>[0.41]</td>
<td></td>
</tr>
<tr>
<td>ManagerInvestment (+)</td>
<td></td>
<td></td>
<td></td>
<td>1.617***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.615***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[10.38]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[10.37]</td>
</tr>
<tr>
<td>TraitRiskAversion (-)</td>
<td></td>
<td></td>
<td></td>
<td>-0.051</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[-0.39]</td>
</tr>
</tbody>
</table>

| N                       | 1,947     | 1,947     | 1,947     | 1,947     |
| Psuedo-R²               | 0.315     | 0.349     | 0.349     | 0.405     |
| By-session random intercept included | YES     | YES       | YES       | YES       |
| By-manager random intercept included | YES     | YES       | YES       | YES       |
| Model Type              | Multilevel Ordered Logistic Regression |

Models (1), (2), (3), and (4) present multilevel ordered logistic regressions in which the dependent variable is AQDemand, defined as the accuracy level of the hired auditor in each observation from the set {.50, .65, .80, .95}. Z-statistics are presented in brackets. PeriodRisk is a binary variable set to 1 (0) if the period is high (low) risk. LossPossible is a binary variable set to 1 (0) if the observation is from a session where losses are (not) possible. ManagerInvestment is a binary variable set to 1 (0) if the manager invested in Project A (B) in each specific observation. TraitRiskAversion is the manager's score on the Holt and Laury (2002) trait risk aversion measure. We allow for by-session and by-manager intercepts. All p-values are one-tailed due to directional predictions. ***, **, and * denote significance at the .01, .05, and .10 levels, respectively.
Panel B: Managers' Demand for the Best Available Auditor

<table>
<thead>
<tr>
<th>Variables</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PeriodRisk (-)</td>
<td>1.201***</td>
<td>-1.000***</td>
<td>-1.041***</td>
<td>-1.040***</td>
</tr>
<tr>
<td></td>
<td>[-8.76]</td>
<td>[-5.50]</td>
<td>[-5.63]</td>
<td>[-5.62]</td>
</tr>
<tr>
<td>LossPossible (-)</td>
<td>-0.976**</td>
<td>-0.921**</td>
<td>-1.037**</td>
<td>-1.107**</td>
</tr>
<tr>
<td></td>
<td>[-2.25]</td>
<td>[-1.68]</td>
<td>[-1.90]</td>
<td>[-2.04]</td>
</tr>
<tr>
<td>PeriodRisk * LossPossible (-)</td>
<td>-0.452**</td>
<td>-0.391*</td>
<td>-0.395*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[-1.64]</td>
<td>[-1.40]</td>
<td>[-1.41]</td>
<td></td>
</tr>
<tr>
<td>ManagerInvestment (+)</td>
<td></td>
<td></td>
<td>1.543***</td>
<td>1.537***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[6.02]</td>
<td>[5.99]</td>
</tr>
<tr>
<td>TraitRiskAversion (-)</td>
<td></td>
<td></td>
<td></td>
<td>-0.193*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[-1.39]</td>
</tr>
</tbody>
</table>

N                               1,947  1,947  1,947  1,947
Psuedo-R²                        0.404  0.405  0.427  0.426
By-session random intercept included YES  YES  YES  YES
By-manager random intercept included YES  YES  YES  YES
Model Type                       Mixed Effects Logistic Regression

Models (5), (6), (7), and (8) present mixed effects logistic regressions in which the dependent variable is HiredBest, defined as a binary variable set to 1 (0) if the manager hired the auditor with 95% accuracy for that observation. Z-statistics are presented in brackets. PeriodRisk is a binary variable set to 1 (0) if the period is high (low) risk. LossPossible is a binary variable set to 1 (0) if the observation is from a session where losses are (not) possible. ManagerInvestment is a binary variable set to 1 (0) if the manager invested in Project A (B) in each specific observation. TraitRiskAversion is the manager's score on the Holt and Laury (2002) trait risk aversion measure. We allow for by-session and by-manager intercepts. All p-values are one-tailed due to directional predictions. ***, **, and * denote significance at the .01, .05, and .10 levels, respectively.
<table>
<thead>
<tr>
<th>Variables</th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1016.371***</td>
<td>847.115***</td>
</tr>
<tr>
<td></td>
<td>[18.25]</td>
<td>[45.95]</td>
</tr>
<tr>
<td>LossPossible</td>
<td>-36.854</td>
<td>-4.756</td>
</tr>
<tr>
<td></td>
<td>[-0.49]</td>
<td>[-0.20]</td>
</tr>
<tr>
<td>95% AccurateAuditor (+)</td>
<td>591.820***</td>
<td>248.540***</td>
</tr>
<tr>
<td></td>
<td>[17.61]</td>
<td>[21.11]</td>
</tr>
<tr>
<td>80% AccurateAuditor (+)</td>
<td>461.865***</td>
<td>191.438***</td>
</tr>
<tr>
<td></td>
<td>[16.03]</td>
<td>[16.08]</td>
</tr>
<tr>
<td>65% AccurateAuditor (+)</td>
<td>194.401***</td>
<td>76.562***</td>
</tr>
<tr>
<td></td>
<td>[7.04]</td>
<td>[5.94]</td>
</tr>
<tr>
<td>N</td>
<td>626</td>
<td>775</td>
</tr>
<tr>
<td>Psuedo-R²</td>
<td>0.341</td>
<td>0.365</td>
</tr>
<tr>
<td>By-session random intercept included</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>By-investor random intercept included</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

This table presents mixed effects linear regressions for all High/Agree reports in which the dependent variable is *HighBid*, defined as the winning bid for the asset in each observation. Due to differences in potential earnings based upon the *PeriodRisk* variable, Model 1 (2) presents the results of our test when *PeriodRisk* is high (low). Z-statistics are presented in brackets. *LossPossible* is a binary variable set to 1 (0) if the observation is from a session where losses are (not) possible. 95/80/65% *AccurateAuditor* are each indicator variables for the auditor hired by the manager in each observation. We allow for by-session and by-investor intercepts. All p-values are two-tailed. ***, **, and * denote significance at the .01, .05, and .10 levels, respectively.
Appendix A
Risk Aversion Measure (Holt and Laury 2002)

INSTRUCTIONS:

Below you will find a series of decisions between Option A and Option B. For each question you must decide whether you would prefer Option A or Option B. Indicate which option you would prefer in each scenario by clicking the button next to that option.

For example, in the first scenario Option A gives you a 10% (1/10) chance of winning $2.00 and a 90% (9/10) chance of winning $1.60, while Option B gives you a 10% (1/10) chance of winning $3.85 and a 90% (9/10) chance of winning $0.10.

Each scenario is constructed this way, with your percent chance of winning the amount listed disclosed as a fraction (e.g., 1/10 = 10%, 2/10 = 20% and so on).

Please evaluate each scenario and choose your preferred Option in each. Upon completing this measure, one scenario will be randomly chosen and a random number generator will determine your winnings from your choices, so it is important to pick your preference in each scenario. Your winnings from this exercise will be added to the winnings you will receive upon participation in the experiment.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Option A</th>
<th>Option B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1/10 of $2.00, 9/10 of $1.60</td>
<td>1/10 of $3.85, 9/10 of $0.10</td>
</tr>
<tr>
<td>2</td>
<td>2/10 of $2.00, 8/10 of $1.60</td>
<td>2/10 of $3.85, 8/10 of $0.10</td>
</tr>
<tr>
<td>3</td>
<td>3/10 of $2.00, 7/10 of $1.60</td>
<td>3/10 of $3.85, 7/10 of $0.10</td>
</tr>
<tr>
<td>4</td>
<td>4/10 of $2.00, 6/10 of $1.60</td>
<td>4/10 of $3.85, 6/10 of $0.10</td>
</tr>
<tr>
<td>5</td>
<td>5/10 of $2.00, 5/10 of $1.60</td>
<td>5/10 of $3.85, 5/10 of $0.10</td>
</tr>
<tr>
<td>6</td>
<td>6/10 of $2.00, 4/10 of $1.60</td>
<td>6/10 of $3.85, 4/10 of $0.10</td>
</tr>
<tr>
<td>7</td>
<td>7/10 of $2.00, 3/10 of $1.60</td>
<td>7/10 of $3.85, 3/10 of $0.10</td>
</tr>
<tr>
<td>8</td>
<td>8/10 of $2.00, 2/10 of $1.60</td>
<td>8/10 of $3.85, 2/10 of $0.10</td>
</tr>
<tr>
<td>9</td>
<td>9/10 of $2.00, 1/10 of $1.60</td>
<td>9/10 of $3.85, 1/10 of $0.10</td>
</tr>
<tr>
<td>10</td>
<td>10/10 of $2.00, 0/10 of $1.60</td>
<td>10/10 of $3.85, 0/10 of $0.10</td>
</tr>
</tbody>
</table>

Note: risk neutral subjects are expected to select Option A for the first four scenarios and then switch to Option B for the remaining six scenarios. As a result, our measure of risk aversion is based upon how many “safe” (Option A) choices participants make. Choosing Option A more (less) than four times is indicative of risk aversion (seeking).
Appendix B
Pre-Experiment Quiz (administered in z-Tree)\textsuperscript{28}

True/False Questions

\begin{tabular}{|c|c|c|}
\hline
\textbf{T} & \textbf{F} & 1) If a decision maker has an asset with a true value of E$500 they can report it as E$1100 if they choose. \\
& & \textit{Your answer is [CORRECT/INCORRECT]! Decision makers can report assets at a value HIGHER than their true value. However, they cannot report assets at a value LOWER than their true value. For example, if a decision maker has an asset with a true value of E$1100, they cannot report it as E$500.} \\
\hline
\textbf{T} & \textbf{F} & 2) If an asset is reported as E$1600 and receives a Disagree report from the verification service, then the asset \textbf{must} be worth E$200. \\
& & \textit{Your answer is [CORRECT/INCORRECT]! An asset that receives a Disagree Report always has a true value less than the reported amount.} \\
\hline
\textbf{T} & \textbf{F} & 3) If an asset is reported as E$1600 and receives an Agree report from the verification service, then the asset \textbf{must} be worth E$1600. \\
& & \textit{Your answer is [CORRECT/INCORRECT]! An asset that receives an Agree Report might have a true value equal to the reported amount or might have a true value less than the reporting amount. The accuracy of the Agree Report depends on the verification service selected. For example, an agree report from a verification service with 80\% accuracy will be correct 80\% of the time and incorrect 20\% of the time.} \\
\hline
\textbf{T} & \textbf{F} & 4) If a decision maker purchases a verification service with an accuracy of 65\% that means the verification service will learn the true value of the asset 65\% of the time. \\
& & \textit{Your answer is [CORRECT/INCORRECT]! A verification service with an accuracy of 65\% has a 65\% chance to learn the true value of the asset and will therefore be accurate 65\% of the time.} \\
\hline
\textbf{T} & \textbf{F} & 5) Decision maker 1 will always be decision maker 1 during all periods. \\
& & \textit{Your answer is [CORRECT/INCORRECT]! Decision makers’ identities are randomly shuffled each period.} \\
\hline
\textbf{T} & \textbf{F} & 6) Decision makers begin each period with a fixed asset value that will change based upon their project choice (Project A or Project B). \\
& & \textit{Your answer is [CORRECT/INCORRECT]! Each period decision makers choose a project that will change their asset value to determine their final asset value and impact their period earnings.} \\
\hline
\textbf{T} & \textbf{F} & 7) Each period the decision maker can select Project A or Project B. Both projects cost the same amount. \\
& & \textit{Your answer is [CORRECT/INCORRECT]! Each period the decision maker does select between Project A or Project B. However, Project A costs E$50 and Project B costs E$10.} \\
\hline
\textbf{T} & \textbf{F} & 8) If the decision maker selects Project A the most their asset value can increase by is E$400. \\
& & \textit{Your answer is [CORRECT/INCORRECT]! In some periods, Project A has a 60\% chance of increasing the asset value by E$1500 [E$1000]; the other 40\% of the time} \\
\hline
\end{tabular}

\textsuperscript{28} Feedback, which is hidden from participants until they have responded, appears in \textit{italics} font below each question.
the asset value increases [decreases] by E$100 [E$400]. In other periods, Project A has a 90% chance of increasing the asset value by E$1000 [E$500]; the other 10% of the time the asset value increases [decreases] by E$400 [E$100]. Project B costs E$10 and will always result in a lower asset value change - an increase [decrease] of E$100 [E$400] or E$400 [E$100], depending on the period.

9) Consider the following scenario: An asset has a reported value of E$1600. Bidder 1 bids E$1485, Bidder 2 bids E$800, and Bidder 3 bids E$985. The asset’s true value is E$1600. Who wins the bid and how much profit or loss does the winning bidder earn? Your answer is [CORRECT/INCORRECT]! Bidder 1 wins the bid because their bid is larger than Bidders 2 and 3. Bidder 1 receives E$115 PROFIT because they receive the asset’s true value of E$1600 and pay their winning bid of E$1485 (E$1600 – E$1485 = E$115).

10) Consider the following scenario: An asset has a reported value of E$1600. Bidder 1 bids E$1485, Bidder 2 bids E$800, and Bidder 3 bids E$985. The asset’s true value is E$200. Who wins the bid and how much profit or loss does the winning bidder earn? Your answer is [CORRECT/INCORRECT]! Bidder 1 wins the bid because their bid is larger than Bidders 2 and 3. Bidder 1 receives a $1285 LOSS because they receive the asset’s true value of E$200 and pay their winning bid of E$1485 (E$200 – E$1485 = - E$1285).
Step 1: Managers choose an auditor and make their project investment decision.

### Appendix C
z-Tree Market Screenshots

**Verification Service Choice**
You must select a verification service.
Verification service costs $50.

Please select a verification service:  
- Service 1: 100% accurate
- Service 2: 80% accurate
- Service 3: 50% accurate
- Service 4: 0% accurate

**Project Choice**
Your asset has a current value of $0.3.
You must select a project. Your project choice will influence the change in your asset value.
Project A costs $50 and has a 0.60 chance of changing your asset value by $400 and a 0.40 chance of changing your asset value by $100.
Project B costs $10 and will change your asset value by $30.

Please select a project:  
- Project A: 50
- Project B: 10

**Your Prior Choices:**

<table>
<thead>
<tr>
<th>Period</th>
<th>Project Choice</th>
<th>Year Tree Asset Value</th>
<th>Year Reported Asset Value</th>
<th>Verification Service</th>
<th>Verification Report</th>
<th>High Bid for Year Asset</th>
<th>Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Project A</td>
<td>1530</td>
<td>1500</td>
<td>AGREE</td>
<td>AGREE</td>
<td>1500</td>
<td>1400</td>
</tr>
<tr>
<td>2</td>
<td>Project B</td>
<td>200</td>
<td>200</td>
<td>DISAGREE</td>
<td>NO</td>
<td>200</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Project B</td>
<td>1000</td>
<td>1000</td>
<td>AGREE</td>
<td>AGREE</td>
<td>1000</td>
<td>100</td>
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<tr>
<td>4</td>
<td>Project A</td>
<td>500</td>
<td>500</td>
<td>DISAGREE</td>
<td>NO</td>
<td>500</td>
<td>-500</td>
</tr>
<tr>
<td>5</td>
<td>Project A</td>
<td>1000</td>
<td>1000</td>
<td>AGREE</td>
<td>AGREE</td>
<td>1000</td>
<td>100</td>
</tr>
<tr>
<td>6</td>
<td>Project B</td>
<td>200</td>
<td>200</td>
<td>DISAGREE</td>
<td>NO</td>
<td>200</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>Project A</td>
<td>1000</td>
<td>1000</td>
<td>AGREE</td>
<td>AGREE</td>
<td>1000</td>
<td>100</td>
</tr>
</tbody>
</table>

**Market history through previous period:**

<table>
<thead>
<tr>
<th>Period</th>
<th>Test Value</th>
<th>Reported Value</th>
<th>Verification Report</th>
<th>Verification Service</th>
<th>Verification Accurate</th>
<th>High Bid</th>
<th>High Bid Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1500</td>
<td>1500</td>
<td>AGREE</td>
<td>AGREE</td>
<td>YES</td>
<td>1500</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>200</td>
<td>200</td>
<td>DISAGREE</td>
<td>NO</td>
<td>NO</td>
<td>200</td>
<td>-10</td>
</tr>
<tr>
<td>3</td>
<td>1000</td>
<td>1000</td>
<td>AGREE</td>
<td>AGREE</td>
<td>YES</td>
<td>1000</td>
<td>100</td>
</tr>
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<td>-500</td>
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<td>AGREE</td>
<td>AGREE</td>
<td>YES</td>
<td>200</td>
<td>-10</td>
</tr>
<tr>
<td>6</td>
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<td>1000</td>
<td>AGREE</td>
<td>AGREE</td>
<td>YES</td>
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<td>100</td>
</tr>
</tbody>
</table>

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Step 2: Managers learn their true asset value and report their asset value to investors.

<table>
<thead>
<tr>
<th>Verification Service Choice</th>
<th>Your Prior Choices:</th>
</tr>
</thead>
<tbody>
<tr>
<td>You must select a verification service.</td>
<td>Period</td>
</tr>
<tr>
<td>Verification service costs 50.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>

**Reported Asset Value Choice**

Your asset has a starting value of $300. Based on your project choice your asset value changed by: $10. Your Project Choice: Project A.

Step 3: Auditors’ verification is carried out electronically between stages in the market.
Step 4: Investors receive information from managers and auditors and engage in a first-price sealed bid auction.