Governance, Reputation, Crises and Recovery: An Experiment

Thomas H. Noe
Saïd Business School and Balliol College
University of Oxford
Oxford, England, OX1 1HP

Michael J. Rebello
School of Management
University of Texas at Dallas
Richardson, Texas 75080-3021

Thomas A. Rietz
Henry B. Tippie College of Business
University of Iowa
Iowa City, IA 52242

This version: October 13, 2024

Abstract

We model and experimentally test the relationship between firm governance and reputation. We also consider how corporate reform after reputation damage affects this relationship. Our model shows that conditions for establishing a reputation depend on whether control of firm operations is delegated to professional managers. Moreover, although the option to reform always dilutes firms' incentive to commit to reputable behavior, delegation ameliorates the dilution. We assess the external validity of our model through a laboratory experiment. The results of this experiment are directionally consistent with the model's predictions.

JEL Classification Codes: C7, C9, D82, G31, G32, L15
Keywords: corporate governance, stakeholders, adverse selection, reputation, experiment

---

We thank the Oxford University Centre for Corporate Reputation for financial support. For comments and suggestions, we thank participants at the 2021 American Finance Association Meeting, the 46th Annual Meeting of the European Finance Association, the 2020 Financial Management Association Conference, the 2019 Society for Experimental Finance Conference, Copenhagen, and the 2019 Econometric Society North American Summer Meetings. Previously this paper was titled *Governance, Stakeholder Welfare, Crises and Recovery: An Experiment*. All errors are our own.

Corresponding Author: Thomas Rietz, Thomas-Rietz@uiowa.edu, 319-335-0856

> The incentives of individuals not to milk the firm's reputation has not been clarified; it must be the case that somehow the incentives of the stock-holding layer trickles down through the rest of the hierarchy.
>
> –Holmstrom and Tirole (1989)

1 Introduction

By some estimates, reputation accounts for more than 60% of a firm's value and is its most valuable asset (Gaines-Ross, 2008). Economists have argued that reputation underpins a range of firm policies including responses to competitive threats, product quality, dividend payments, and the financing mix (e.g., Kreps and Wilson, 1982a; Milgrom and Roberts, 1982; John and Nachman, 1985; Diamond, 1989; Maksimovic and Titman, 1991; Mailath and Samuelson, 2001; Cripps et al., 2004). The models they employ to illustrate these arguments rely on the assumption that firms' owners control reputation management, i.e., owners directly set the policies that impact firm reputation.[1]

The assumption that owners control reputation management fits firms like Bechtel, Cargill, Comcast, or Tesla that are controlled by hands-on "mavericks," i.e., non-financial or inside blockholders (Amel-Zadeh et al., 2022). The assumption clearly doesn't fit firms like Boeing, Volkswagen, Kobe Steel and Wells Fargo, which have had their reputations damaged by policies set by professional managers. In these firms, like the majority of large firms in the U.S. and overseas, reputation management is the purview of professional managers with small or negligible ownership stakes (McMillan, 2011; Economist Intelligence Unit, 2005). Ownership effectively resides with large institutional investors like BlackRock and Fidelity, referred to as "common" or "universal" owners, that hold substantial stakes in many firms and are not intimately involved in reputation management.

The extensive principal-agent literature suggests firms delegating management to professionals can have a profound effect on firm behavior (e.g., Myerson, 1982; Shleifer and Vishny, 1997; Cole and Kocherlakota, 2001). This raises a long-standing question, whose importance is evidenced by the opening quotation: Do standard reputation models, which focus on worlds where owners make the policy decisions that determine firm reputation, accurately describe our world, where, for the most part, these decisions are delegated to professional managers?

In this paper, we provide a partial answer to this question by modeling reputation for professionally managed firms, comparing the results of this exercise with reputation for owner managed firms, and testing for the robustness of our comparisons to rational expectations behavior with a laboratory experiment. We perform these comparisons in two settings: a no-reform setting in which, as in classic reputation models, the revelation of opportunistic behavior permanently impairs future reputation, and a reform setting, which aims to capture the extensive reform programs

[1] More generally, reputation models have been employed to model the actions of economic agents in incomplete information settings by many authors (e.g., Mailath and Samuelson, 2001; Cripps et al., 2004; Liu, 2011; Cremer, 1986; Tirole, 1996; Morrison and Wilhelm, 2004; Levin and Tadelis, 2005). See Bar-Isaac and Tadelis (2008) for a survey of reputation models. The framework has also been deployed to examine the sustainability of pro-social behavior (e.g., Bénabou and Tirole, 2006), which is consistent with a broader definition of quality in our model and experiment.

real-world firms undertake in response to the revelation of their opportunistic behavior.[2] Our model predicts, and our experiment confirms, that (a) delegation to professional managers fundamentally changes the conditions under which firms act reputably; (b) the presence of an opportunity to reform dilutes the ex ante incentive to act reputably; and (c) professional management ameliorates the dilution of ex ante incentives produced by the ability to reform.

Our model embeds two different "ownership structures" into the incomplete-information reputation framework developed by Kreps and Wilson (1982a) and Milgrom and Roberts (1982) (henceforth KWMR) and frequently employed in experiments (e.g., Camerer and Weigelt, 1988; Neral and Ochs, 1992; Brandts and Figueras, 2003; Noe et al., 2012). We consider a firm whose value depends on its reputation with customers for producing high quality goods.[3] Customers and other "outsiders" believe that the firm might be a "committed type" that always implements a particular policy, similar to the "tough monopolist" type in Kreps and Wilson (1982a) or the "honest firm" type in Maksimovic and Titman (1991). Consistent with the public assertions of most firms, the committed type always implements a "reputable" operating policy, a policy that always results in high quality goods.[4]

The firm's type is tied to that of an informed "insider" who sets its operating policies. If not the committed type, the insider might opportunistically adopt an inferior operating policy that sometimes results in low-quality output. Outsiders, including customers, do not know whether the insider is committed. They learn about the insider's commitment by observing the quality of the firm's goods. Their initial beliefs about the insider's type reflect their "base level of trust" in the firm's commitment to the reputable policy.

One ownership structure we consider, which we refer to as "owner management," is pervasive in reputation models. Under this ownership structure, firm value flows entirely to an owner, who is the insider that sets operating policy. The second ownership structure, which we refer to as "professional management," captures two stylized facts about common/universal owners: (i) they delegate day-to-day operations to professional managers; and (ii) they are less familiar with their firms' operations than firm managers. Under this structure, a manager is the insider that controls operating policy and captures the private benefits from risky operating policies. The owner is an outsider and can

[2]The reform programs involve extensive overhauls of internal control systems (Farber, 2005; Gaines-Ross, 2008; Chakravarthy et al., 2014; Economist, 2018). For example, the New York Times (Nov. 10, 2017) describes Kobe Steel's reform as follows: *Kobe Steel without input from regulators or other outside parties, concluded that the company had erred by elevating the pursuit of short-term profit over the maintenance of scrupulous quality standards. That failing, it said, was exacerbated by lax oversight by senior executives and an "insular" corporate culture that discouraged employees from questioning improper but long-established practices ... The report published on Friday outlined several changes the company plans to make to prevent cheating, including automating record keeping for product tests and requiring multiple employees to verify that test results are accurate.* See Table A.1 in Appendix A for several additional examples of reform programs.

[3]The features that determine "quality" depends on the firm's circumstances. For example, if the customers are other firms, the features could be the adherence to these firms' supplier codes of conduct. Alternatively, if the customers are retail consumers, the features might also include sustainable production practices or the goods' carbon footprint.

[4]Firms often point to some aspect of their culture or internal control systems, the sorts of systems that they overhaul when they reform, to support assertions that they are committed to producing high quality goods. For example, Toyota publicized its "Toyota Way" corporate culture to underline its commitment to high quality (Liker, 2004). A lack of commitment to high quality is often revealed by evidence of low quality, and judging by the extensive value losses firms experience in these instances, preserving the perception that there is even a small probability that a firm is committed to reputable policies is valuable (Peltzman, 1981; Jarrell and Peltzman, 1985; Barber and Darrough, 1996; Karpoff and Lott, 1993; Alexander, 1999; Murphy et al., 2009; Karpoff et al., 2008; Karpoff, 2011).

only affect the quality of goods indirectly by setting governance policies, e.g., manager compensation, to influence managerial behavior.

Under each governance structure, we consider the impact of reform if the firm's reputation is damaged. Reputation damage results from the production of a low quality good, which we refer to as "revelation" because it reveals an absence of commitment to quality. Successful reform completely blocks insider opportunism and ensures high quality goods in the future. While reform can restore some outsider trust in the firm's commitment to reputable policies, it is costly and its success is uncertain.

Under owner management, as is typical in the KWMR framework, ex ante, the firm would like to commit to reputation-ensuring policies. However, the operating policies that affect the firm's reputation are set ex post. When setting these policies, ensuring the reputation is only optimal for uncommitted insiders when the benefits of current opportunism are less than the expected future cost of reduced goods' prices following revelation. Price reductions are larger when the base level of trust is larger. Hence, a high base level of trust encourages insiders to eschew opportunism.

Under professional management, the owner faces a very different problem. To maintain the firm's reputation, the owner must bear the cost of incentivizing the manager to eschew opportunism. When the manager is committed, even without compensation incentives the manager will choose reputation-ensuring safe policies. Thus, the owner's gain from providing reputation-assuring compensation is lower when the base level of trust is higher. Hence, a low base level of trust encourages owners to ensure reputable behavior and protect the firm's reputation through compensation.

Reform decreases the anticipated cost of opportunism under both ownership structures, and weakens the owner's ex ante incentive to prevent/eschew opportunism. However, the ex ante incentive effect varies across the ownership structures. Under owner management, because firm value flows entirely to the owner, the owner internalizes both the cost of revelation and the benefits of reform. Under professional management, the owner ties managerial compensation to goods' prices, which reflect goods' quality via rational expectations. Because the professional manager is replaced when prices reveal that consumers expect only low quality goods, the professional manager will not internalize the gains from reform. Consequently, delegating to a manager separates the agent whose actions affect reputation from the benefits of corporate reform. Since these benefits reduce the cost of opportunism, delegation can mitigate the pernicious ex ante effects of corporate reform and promote commitment to reputation assuring policies.

All agents in our model are rational. They clearly distinguish any difference, however subtle, in the incentives for opportunism under the two governance structures. All agents also accurately infer the ex ante incentive effects of reform. Moreover, the incentive for the owner to commit the firm to non-opportunistic ex post behavior arises because the firm's actions, including opportunism, induce price responses from customers that are based on their rational expectations assessments of the future quality of goods based on observed outcomes. It is unclear whether this level of rationality describes real-world behavior. In fact, considerable evidence suggests that actual agents frequently forecast future events using behavioral backward-looking adaptive expectations (e.g., Camerer and Weigelt, 1988; Brandts and Figueras, 2003). This evidence raises the question of external validity: does the model capture significant features of reputation formation in actual markets?

Answering the external validity question with field data requires measuring firm policies, customer expectations, managerial commitment, and outsider trust, which is difficult, if not impossible, and, in addition, tackling thorny issues related to endogeneity.[5] However, we can accurately make these measurements in a laboratory setting while controlling confounding factors. Further, in the laboratory, we can set governance policy (e.g., managerial contracts) and reform to match our model. Then, we can explore whether operating decisions and customer behavior respond as predicted to ownership structure and reform, and isolate behavioral biases in customer beliefs and manager behavior. Therefore, we conduct a laboratory experiment and test whether (i) ownership structure affects opportunism; (ii) reform weakens the ex ante incentive to prevent opportunism; (iii) customers recognize how ownership structure affects opportunism; and (iv) whether the incentives resulting from actual customer responses are sufficient to drive the actions predicted by our model.

Like prior reputation experiments using the KWMR framework, we find that subject behavior deviates from rational-expectations predictions. Experience weighted attraction models similar to Erev and Roth (1998) and Camerer et al. (2002) explain how subject behavior evolves with experience.[6] Despite the deviations from predicted behavior, we find that (i) reputable firm actions are commonly observed; (ii) customers punish firms when opportunism is revealed; and (iii) reform raises the likelihood that firms will act opportunistically. The important insights of our model survive the behavioral deviations: When the model predicts that the likelihood of reputable actions is lower under owner management, owner management actually does result in significantly more opportunism. Moreover, when the model predicts ownership structure will not affect the level of reputable actions, there are not significant differences between opportunism levels under owner and professional management.

Related literature

Our model of owner management closely matches the KWMR framework on which much research on reputation is based, including many models linking the quality of goods with firm reputation,[7] and models of the sustainability of pro-social behavior (e.g., Bénabou and Tirole, 2006), which is consistent with our broader definition of quality. Our experimental implementation of owner management also closely matches experiments using the KWMR framework

[5] Governance structures vary across firms, industries, and countries, and are not randomly assigned. The structures may be chosen for their reputational effects, but myriad other factors also matter. While some of these factors may be observable, others, such as the managerial human capital of owners, may not. Econometric fixes may not resolve ownership structure endogeneity (Coles et al., 2012).

[6] Such adaptive learning is commonly observed in experimental settings (e.g., Part 4.3 in Plott, 1982).

[7] See, for example, Maksimovic and Titman (1991); Mailath and Samuelson (2001); Cripps et al. (2004); Liu (2011); Cremer (1986); Tirole (1996); Morrison and Wilhelm (2004); Levin and Tadelis (2005).

(e.g., Camerer and Weigelt, 1988; Neral and Ochs, 1992; Brandts and Figueras, 2003; Noe et al., 2012).[8]

Our model of professional-management represents a fundamental departure. First, the firm's rents from reputation are owned by uninformed outsiders who can only use governance policy to indirectly affect the informed insider's actions, which do directly determine the firm's reputation. Second, the insiders have no personal reputation, no ownership claim to the rents produced by firm reputation, and can be costlessly replaced at any time. These model features reflect principal-agent models in which an uninformed principal (outside owner) sets policies to incentivize an informed agent (professional manager) to maximize the principal's welfare (e.g., Myerson, 1982; Shleifer and Vishny, 1997; Cole and Kocherlakota, 2001). However, in contrast to typical principal-agent models, the effects of the agent's actions are not exogenously specified. Rather, as in typical reputation models, the effects are produced by the behavior of outsiders (customers) who have incomplete information about the firm. Our model and experiment show that incorporating this principal-agent problem into a reputation framework fundamentally changes the calculus of reputation.

2 The model

We model a firm that operates for two periods.[9] Agents are risk-neutral and patient. The firm has an owner and an operator. At the start of each period, the owner supplies capital, denoted by $e > 0$, to an operator who uses the capital to produce a good. The good is sold to customers for the numeraire good, cash. There is no storage technology, thus cash and any good produced in a period must be consumed during the period.

Quality A good's quality, denoted by q_t in period $t = 1,2$, is either high, h, or low, l. All agents observe q_t only at the end of period t. Hence, the quality of a good produced in period t, the period t good, is common knowledge at the end of period t. Quality is neither verifiable nor contractible.

Prices Customers assign value $v_t = 1$ to a quality h good and $v_t = 0$ for a quality l good in period $t = 1,2$. They set the period t good's price, $p_t \in \mathbb{R}_+$, at the beginning of the period. The price equals customers' expectation of the good's value. Goods' prices are verifiable and contractible.

Operating policy In period $t = 1,2$, the operator sets an operating policy, o_t. The policy is hidden from other agents, whom we refer to as outsiders. There are two possibilities: The "safe" policy, denoted by s, and the "mixed" policy, denoted by m. Policy s costs e to implement and always produces a high-quality good. Policy m costs $e-c$, where $c \in (0, e-c)$, and triggers a draw by nature from a Bernoulli distribution, $\tilde{n}_t$, $t = 1,2$, that determines the good's quality: With probability δ, $\tilde{n}_t = 1$ and $q_t = h$; with probability $1-\delta$, $\tilde{n}_t = 0$ and $q_t = l$. Draws $\tilde{n}_1$ and $\tilde{n}_2$ are independent.

[8] In these experiments, reputations and trust arise from supposedly "rational" behaviors. This contrasts with experimental "trust games" where behavior is not explained by self-interested rational choice of (e.g., Berg et al., 1995).

[9] As shown by Noe et al. (2024), in settings like the ones we consider, increasing the number of periods, by increasing the potential expected loss from opportunistic behavior, can make it easier to sustain equilibria in which firms produce high-quality goods due to reputational concerns.

Operator type There are two types of operators: committed and normal. A *committed* operator is non-strategic and always sets policy s. A normal operator chooses strategically between acting reputably and setting policy s, and acting opportunistically by setting policy m and consuming the cost savings.[10] Operator type is the operator's private information. Outsiders assign prior probability $\rho_1 \in (0,1)$ to the operator being committed. Thus, ρ_1 is a measure of outsiders' base level of trust in the firm's commitment to policy s.

Revelation Only a normal operator can produce a low quality good, and we will refer to the operator as being "revealed" (to outsiders) if $q_1 = l$. The operator remains "unrevealed" otherwise. Since nothing happens after period 2, revelation is only meaningful in period 1.

Reform If the operator is revealed, the firm reforms at the start of period 2. Reform imposes a cost on the owner equal to R and is publicly observable. Reform is an attempt to make the operator in period 2 commit to the safe operating policy s. The period 2 operator behaves like a committed type if and only if reform succeeds. Reform succeeds with probability r and fails with probability $1-r$. Only the period 2 operator observes whether reform succeeds.

We impose the following restriction on the effectiveness of reform, which ensures that, after selling customers low quality goods, reform cannot completely restore customers' trust in the firm's commitment to high quality.

Assumption 1 $0 < r < \rho_1$.

2.1 Professional management

Our objective is to compare outcomes under two governance structures: professional management and owner management. We will start by describing professional management, under which the operator and owner are different agents. The operator is a professional, and the reservation payoff of a professional operator is 0.[11]

Governance policy The owner starts the game by setting governance policy, and this policy is common knowledge at the start of period 1. Governance policy fixes payments to the period 1 operator. We denote the payment in period t by $b_t \geq 0$, $t = 1,2$. The period 2 payment must be honored even if the operator is replaced in period 2.[12] Formally, governance policy is a vector $g = (B_1, B_2)$, where $B_t : p_t \to \mathbb{R}_+$, $t = 1,2$, is a weakly increasing map from the period t good's price, p_t, into payment b_t in period t. We denote the set of feasible governance policies by $\mathcal{G}$. As will be apparent later, because goods' prices in period 2 depend on operator actions in period 1 but not actions in period 2, no governance policy will be adopted for a replacement operator hired in period 2.

[10] We tie the adoption of opportunistic policies to the operator's type to simplify the model. We will obtain identical equilibrium outcomes if we tie the operator's ability to act opportunistically to a firm monitoring systems. In fact, a large literature models monitoring systems that increase the costs of opportunism (Johnson et al., 2000; Shleifer and Wolfenzon, 2002)

[11] This assumption favors owner management. If the operator's reservation value exceeded her rents from opportunism, the reservation constraint, not the incentive constraint, would be the binding constraint in the model. Thus, the owner of the professionally managed firm could ensure high-quality output in the first period without conceding rents to the operator.

[12] Paying an operator after replacement is akin to a "golden handshake." Later, we show that, in equilibrium, a replaced period-1 operator receives no payment.

Operator replacement The period 1 operator is replaced if and only if the firm reforms. Thus, once outsiders observe the period 1 good's quality they know whether reform will be attempted and the operator will be replaced. The replacement is a normal type, whose characteristics and preferences are the same as the period 1 normal operator's. The replacement behaves like a committed type if and only if reform succeeds.

Normal operator strategy Before setting the operating policy, in period 1 an operator observes the governance policy and the period 1 good's price. In period 2, the operator has also observed o_1, q_1, and p_2. Since the policy-realized quality pair (s,l) is impossible when $o_t = s$, we can denote a normal operator's period t histories by $h_t^o \in \mathcal{H}_t^o$, $t = 1,2$, where

$$\begin{aligned} \mathcal{H}_1^o &:= \mathcal{G} \times \mathbb{R}_+, \\ \mathcal{H}_2^o &:= \mathcal{H}_1^o \times (\{s,m\} \times \{h,l\}) \backslash \{(s,l)\}) \times \mathbb{R}_+. \end{aligned} \tag{1}$$

Each period, the normal operator maximizes the expected value of payments under the governance policy and gains from opportunism, which we denote by the functions $v_t^{\mathrm{po}}(o_t, g|h_t^o)$, $t = 1,2$, and describe fully in equations (B.1) and (B.5) in Appendix B, respectively. A normal operator's strategy, is an ordered pair $o := (o_1, o_2)$, where $o_t : \mathcal{H}_t^o \to \{s,m\}$, $t = 1,2$.

Goods' prices Outsiders observe governance policy and, at the end of a period, the quality of the period's good. Thus, we can represent customers' histories at the start of each period, when they set prices, by $h_t^c \in \mathcal{H}_t^c$, $t = 1,2$, where

$$\begin{aligned} \mathcal{H}_1^c &:= \mathcal{G}, \\ \mathcal{H}_2^c &:= \mathcal{H}_1^c \times \{h,l\}. \end{aligned} \tag{2}$$

Let $P = (P_1, P_2)$ represent the vector of pricing functions, where $P_t : h_t^c \to p_t$, $t = 1,2$. Prices also depend on customers' belief about the operator's type and, in period 2, their belief about the success of reform. We denote these beliefs by μ_t, where $\mu_t : h_t^c \to [0,1]$, $t = 1,2$.

Owner payoff The risk-neutral owner's payoff is expected revenue (prices of goods), minus investment costs, expected reform costs, and expected operator payments. Since the owner fixes governance policy at the start of the game, these expectations are based on the base level of outsider trust, ρ_1. We denote the owner's payoff by the function $v^{\mathrm{PM}}(g, P, o)$, which we describe fully in equation (B.9) in Appendix B.

Definition 1 [Equilibrium: Professional Management] For for each fixed governance policy, g, let SE(g) represent the set of sequential equilibria (Kreps and Wilson, 1982b) in the subgame rooted at g, i.e., the set of ordered triples (P^*, o^*, μ^*) that satisfy, under governance policy g, the following conditions for being a pure-strategy sequential equilibrium:

(a) Customers' rational expectations: $P^*(h_t^c) = \mathbb{E}[\tilde{v}_t | h_t^c]$, for all $h_t^c \in \mathcal{H}_t^c$, $t = 1,2$.

(b) Operator sequential rationality: $o_t^*(h_t^o) \in \operatorname{argmax}_{o_t \in \{s,m\}} [v_t^{\mathrm{po}}(o_t, g|h_t^o)]$, $\quad h_t^o \in \mathcal{H}_t^o$, $t = 1,2$.

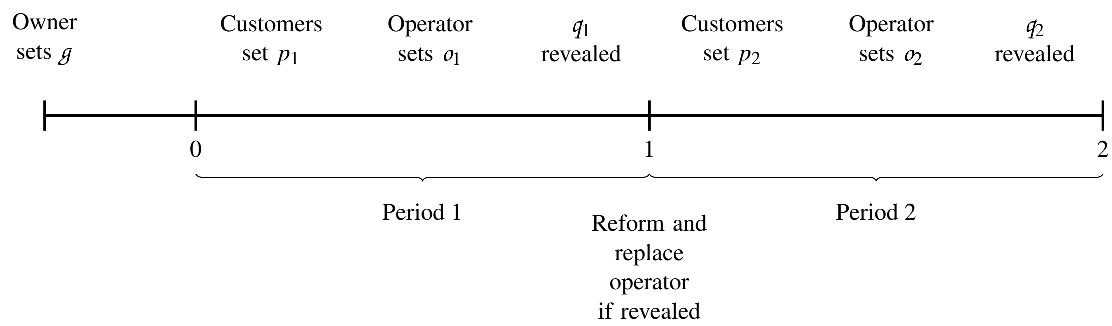


Figure 1: *Professional management timeline.* This figure shows the sequence of actions under professional management.

(c) Belief consistency: Customer beliefs are determined by Bayes rule for all histories reached on the equilibrium path. For histories off the equilibrium path, beliefs must be the limit of some sequence of purely mixed normal operator strategies that reach the history.

An equilibrium is an ordered quadruple, (g^*, P^*, o^*, μ^*), satisfying the following condition:

(d) Governance optimality: The governance policy maximizes the owner's payoff over all pure strategy sequential equilibria induced by feasible governance policies, i.e.,

$$g^* \in \{g \in \mathcal{G} : v^{\text{PM}}(g, P^*, o^*) = \max\{v^{\text{PM}}(g', P^*, o^*) : g' \in \mathcal{G} \text{ and } (P^*, o^*, \mu^*) \in \text{SE}(g')\}\}.$$

2.2 Owner management

Under owner management, the owner and the operator are the same agent.

Governance policy There is no governance policy.

Operator replacement The owner internalizes the benefit of reform. We capture this in the simplest possible way by assuming that the owner remains the operator even after reform.[13]

Operator and customer histories We can represent operator and customer histories by replacing g with $\{\varnothing\}$ in expressions (1) and (2), respectively. Thus, with a slight abuse of notation, even under owner management, we will denote an operator and customer history at $t = 1, 2$ with h_t^o and h_t^c, respectively.

Normal operator strategy The operator is the owner and thus captures the firm's profit rather than payments from a compensation contract. The normal owner-operator seeks to maximize the expected value of this payoff, which

[13]Clearly, putting a professional manager in place as the operator instead of the owner after reform, while depriving the owner-manager of the rents from failed reform, will change the governance structure. It is possible that the owner could sell the firm to another owner-manager as part of the reform. However, since the replacement owner-manager would anticipate capturing the rents from diversion after failed reform, the sale price would reflect these rents and transfer them to the original owner manager. Incorporating the sale option would thus offer little new insight.

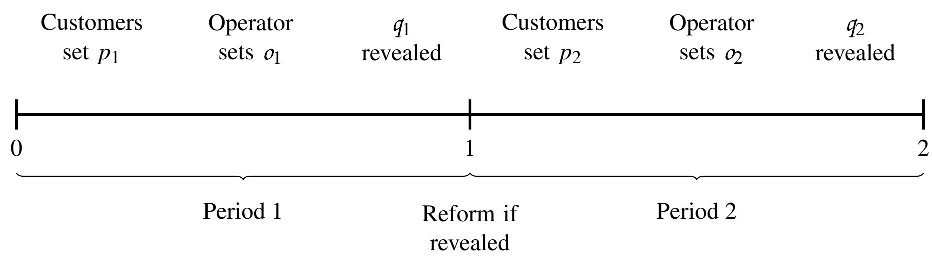


Figure 2: *Owner management timeline.* This figure shows the sequence of actions under owner management.

we denote by $v_t^{oo}(o_t, p_t | h_t^o)$, $t = 1,2$, and describe fully in expressions (B.2) and (B.12) in Appendix B. A normal owner-operator's strategy, is an ordered pair $o := (o_1, o_2)$, where $o_t : \mathcal{H}_t^o \to \{s,m\}$, $t = 1,2$.

Definition 2 [Equilibrium: Owner Management] An equilibrium is an ordered triple, (P^*, o^*, μ^*) consisting of a price function, P^*, operator strategies, o^*, and customer beliefs, μ^*, that constitute a pure strategy Sequential Equilibrium (SE), i.e.,

(a) Customers' rational expectations: Customer beliefs satisfy condition (a) of Definition 1.

(b) Operator sequential rationality: $o_t^*(h_t^o) \in \mathrm{argmax}_{o_t \in \{s,m\}}[v_t^{oo}(o_t, p_t | h_t^o)], h_t^o \in \mathcal{H}_t^o$, $t = 1,2$.

(c) Belief consistency: Customer beliefs satisfy condition (c) of Definition 1.

2.3 Reputation equilibria

As we will show later, in an equilibrium, only in period 1 will the operator choose policy s. We will refer to equilibria in which the operator acts in this way as "reputation equilibria." We will refer to all other equilibria, in which the operator sets policy m in period 1, as "no-reputation equilibria."

Definition 3 [Reputation equilibria] Under both professional and owner management, a *reputation equilibrium* is an equilibrium in which $\tilde{q}^* = h$ with probability 1 in period 1; a *no-reputation equilibrium* is an equilibrium in which $\tilde{q}^* \neq h$ with positive probability in period 1.

3 Preliminary results

We will first provide results that greatly simplify the remainder of our analysis, starting with a characterization of the operator's period 2 best response. All derivations not in the body of the paper are provided in Appendix B.

Lemma 1 *Under both professional and owner management, in all equilibria, the normal operator will select policy m in period 2, i.e, in all equilibria, $o_2^*(h_2^o) = m$, for all $h_2^o \in \mathcal{H}_2^o$. In fact, m is the strictly dominant strategy at all period 2 operator histories.*

Lemma1 shows that, under both owner and professional management, in period 2, from the operator's perspective, the m policy strictly dominates the s policy at all period 2 histories. Hence, belief consistency and rational expectations ensure that equilibrium goods' prices in periods 1 and 2 are entirely determined by the operator's period 1 policy decision and the parameters of the model.

Next consider equilibrium prices. To simplify expressions in the subsequent analysis, we will define notation to represent prices when the normal operator is expected to act opportunistically. We use F to represent these "floor" prices, subscripted differently for each possibility. Floor prices exceed δ, expected quality under the mixed policy, because of customers' trust in the firm's commitment to the safe policy. We start by describing prices and outsider beliefs in no-reputation equilibria, in which the operator sets policy m in period 1.

Lemma 2 *Under both professional and owner management, in any equilibrium in which $o_1^*(\hbar_1^o) = m$, (a) $\mu_1^*(\hbar_1^c) = \rho_1$ and $P_1^*(\hbar_1^c) = F_1$, where*

$$F_1 := \rho_1 + \delta\,(1-\rho_1),\ \textit{and} \tag{3}$$

(b) $\mu_2^*(\hbar_1^c, h) = \frac{\rho_1}{\rho_1+\delta\,(1-\rho_1)}$ and $P_2^*(\hbar_1^c, h) = \frac{\rho_1}{\rho_1+\delta\,(1-\rho_1)} + \delta\left(1 - \frac{\rho_1}{\rho_1+\delta\,(1-\rho_1)}\right) = F_2$, where

$$F_2 := 1 + \delta - \frac{\delta}{F_1}. \tag{4}$$

In no-reputation equilibria, the operator remains unrevealed with probability δ. In this event, Lemma 2 shows that the period 2 goods price is F_2. This price is strictly higher than the period 1 good's price, F_1 because

$$F_2 = 1 + \delta - \frac{\delta}{F_1} = F_1 + (1-F_1)\,\frac{F_1 - \delta}{F_1} > F_1. \tag{5}$$

Now consider prices and outsider beliefs in reputation equilibria, in which $o_1 = s$. In these equilibria, the period 1 good's quality is always high and the operator remains unrevealed. In contrast to no-reputation equilibria, the period 2 goods price, which equals F_1 described in Lemma 2, is lower.

Lemma 3 *Under both professional and owner management, in any equilibrium in which $o_1^*(\hbar_1^o) = s$, (a) $\mu_1^*(\hbar_1^c) = \rho_1$ and $P_1^*(\hbar_1^c) = 1$; (b) $\mu_2^*(\hbar_1^c, h) = \rho_1$ and $P_2^*(\hbar_1^c, h) = F_1$ (defined by equation* (3)*).*

Lemma 4 below describes the period 2 good's equilibrium price following reform. This price is lower than the period 2 equilibrium prices after histories in which the operator remains unrevealed described in Lemmas 2 and 3. Thus, in any equilibrium, the firm's revenue falls after revelation.

Lemma 4 *Under both professional and owner management, in any equilibrium, if $\hbar_2^c = (\hbar_1^c, l)$, then (a) $\mu^*(\hbar_2^c) = r$,* *and (b) $P_2^*(h_2^c) = F_r$, where*

$$F_r := r + \delta\,(1-r). \tag{6}$$

4 Governance structure and reputation equilibria

We will start by characterizing reputation equilibria under professional management. Then, we will derive conditions for reputation equilibria under owner management. We will conclude this section by comparing the viability of reputation equilibria under the two governance structures.

4.1 Professional management and reputation equilibria

Lemmas 1, 3 and 4 show that, in a candidate reputation equilibrium, $P_1^*(h_1^c) = 1$, $P_2^*(h_1^c, h) = F_1$, $P_2^*(h_1^c, l) = F_r$, and $o_2^*(h_2^o) = m$, for all $h_2^o \in \mathcal{H}_2^o$. For a fixed governance policy g, an equilibrium under professional management is a reputation equilibrium in the subgame rooted at g if and only if it is rational for the normal operator to set policy s in period 1 on the equilibrium path, i.e., $o_1^*(h_1^{o*}) = s$, where $h_1^{o*} = (g, P^*(h_1^c))$. Governance policy must provide the appropriate operator incentives.

Lemma 1 shows that the governance policy can only influence the operator's period 1 action, o_1. Since the only public indicator of the operator's period 1 behavior is revelation, in a reputation equilibrium, the governance policy must reward the operator for remaining unrevealed. Moreover, the reward must be bigger than c, the operator's gain from acting opportunistically in period 1. Consider governance policies that meet the following condition,

$$B_2(F_1) - B_2(F_r) \geq c\,\frac{\delta}{1-\delta}, \tag{7}$$

which we will refer to as the *reputation condition*. We will use $\mathcal{G}_{\mathcal{R}}$ to denote the set of governance policies that satisfy condition (7). Note that Assumption 1 ensures that $F_1 > F_r$. Thus, a monotone non-negative payment contract satisfying $B_2(F_1) > B_2(F_r)$ exists and $\mathcal{G}_{\mathcal{R}}$ is not empty. The following lemma describes the implication of governance policies that satisfy the reputation condition.

Lemma 5 *In any subgame starting with $g \in \mathcal{G}$, if either (a) $B_2(F_2) > B_2(F_1)$ and the reputation condition is satisfied or (b) the reputation condition is satisfied with strict inequality, all equilibria of the subgame are reputation equilibria.*

The owner's welfare depends both on the operator's actions and the cost of the governance policy, i.e., expected compensation payments to the operator. Thus, across all governance policies that engender the same operator equilibrium behavior, the owner's welfare is maximized by minimizing expected compensation. So, we first consider the optimal choice between governance policies that lead to the same operator equilibrium behavior.

Solving the trivial problem of minimizing expected operator compensation subject to $g \in \mathcal{G}_{\mathscr{R}}$ yields a unique solution: $B_1(1) = 0$, $B_2(F_r) = 0$ and $B_2(F_1) = b^*$, where

$$b^* := c\,\frac{\delta}{1-\delta}. \tag{8}$$

Under this solution the reputation condition is satisfied with equality. Many period 2 operator contract designs can satisfy condition (8). For example, the step contract: $B_2(p_2) := b^*\,\mathbb{1}[p_2 \geq F_1]$ and the option contract: $B_2(p_2) := \frac{b^*}{F_1 - F_r}\,\max[p_2 - F_r, 0]$.

Lemma 5 shows that setting a governance policy with $B_2(F_2) > B_2(F_1)$ amounts to taking out a free insurance policy against equilibrium multiplicity. We assume that the owner takes out such a policy in the form of an efficient reputation-assuring governance policy, which we define as follows:

Definition 4 A governance policy, g, is an *efficient reputation-assuring policy* whenever (a) $B_1(p_1) = 0$ for all $p_1 \in [0,1]$, (b) B_2 is non-negative and weakly increasing, and (c)

$$B_2(F_r) = 0, \quad B_2(F_1) = b^*, \quad B(F_1) < B(F_2).$$

The step contract we described earlier does not satisfy this definition but the option contract does. Note that all efficient reputation-assuring contracts are payoff equivalent, i.e., when g satisfies Definition 4 the payoffs to the operator and the owner along the equilibrium path are the same. Under these contracts, the owner's expected payoff is

$$1 - e + (F_1 - e - b^*)\,. \tag{9}$$

If the owner doesn't choose a policy from $\mathcal{G}_{\mathscr{R}}$, the operator will pick policy m in period 1. Let $\mathcal{G}_{\neg\mathscr{R}}$ represent the set of governance policies that induce the operator to set $o_1 = m$. Now consider governance policies $g \in \mathcal{G}_{\neg\mathscr{R}}$ keeping in mind that the owner's welfare is maximized by minimizing expected compensation. Let g_0, denote the governance policy with $B_1(p_1) = 0$ and $B_2(p_2) = 0$, for all feasible (p_1, p_2). The only subgame sequential equilibria following g_0 is the no-reputation equilibrium. Obviously, this governance policy minimizes expected operator compensation. Other governance policies also minimize operator compensation subject to $g \in \mathcal{G}_{\neg\mathscr{R}}$, and make no payments to the operator, e.g., $B_1(p_1) = 0$, $B_2(p_2) = \max[p_2 - 1, 0]$. We call any governance policy that provides no compensation to the operator along the equilibrium path a *no expected compensation policy*. Under all such policies, all equilibria are no-reputation equilibria, and the owner's expected payoff is

$$F_1 - e + (1 - F_1)\,(F_r - e - R) + F_1\,(F_2 - e)\,. \tag{10}$$

The owner will pick a governance policy that maximizes the owner's welfare. A comparison of the expected payoffs described in expressions (9) and (10) provides conditions for the existence and uniqueness of reputation equilibria, which we describe in the following proposition.

Proposition 1 *Let $\pi_1 = 1 - e$ denote the period 1 profit if the good's price is 1, and $\pi_r = F_r - e - R$ denote the period 2 profit if the firm is reformed. Then, under professional management: (a) If*

$$\rho_1 \leq 1 - \frac{b^*}{\delta + \pi_1 - \pi_r} \times \frac{1}{1-\delta}, \tag{11}$$

a reputation equilibrium, (g^*, P^*, o^*, μ^*), exists. (b) If the inequality in condition (11) *is strict a reputation equilibrium, (g^*, P^*, o^*, μ^*), exists and all equilibria are reputation equilibria.*

Condition (11) is intuitive. Reputation-assuring compensation yields two benefits. First, it eliminates the possibility of revelation. This results in a direct gain to the owner that is inversely related to the floor price F_1. Hence, low values of outsiders' base level of trust tend to support reputation equilibria. Second, reputation-assuring compensation has an informational effect. When outsiders observe such compensation the period 1 good's price equals one, and the firm earns a profit of π_1 in period 1. This increases the range of values of the base level of outsider trust that support reputation equilibria. The cost of offering reputation-assuring compensation is b^*, and the range of the base level of outsider trust that support reputation equilibria shrinks at this cost rises.

4.2 Owner management and reputation equilibria

Under owner management the analysis of reputation equilibria is much simpler than under professional management for two reasons. First, there is no governance policy because the owner of the firm is the operator. Second, the technique for identifying reputation equilibria under professional management can be applied verbatim after replacing the professional operator's payoff with the owner-operator's payoff.

To review, all components of equilibria, i.e., the operator's date 2 strategy, customer beliefs, and prices in period 1 and period 2, are determined by the period 1 policy the operator sets, either s or m, and the period 1 good's quality. Since the period 1 price is set before the operator sets the period 1 policy, the difference between the operator's period 1 payoffs under policies s and m does not depend on the period 1 operator history, $\hbar_1^o$. The choice is driven purely by the effect it has on the likelihood of revelation and the operator's period 2 expected payoff.

To see this consider a candidate reputation equilibrium. Lemmas 1, 3 and 4 show that, in a candidate reputation equilibrium, $P_1^*(\hbar_1^c) = 1$, $P_2^*(\hbar_1^c, h) = F_1$, $P_2^*(\hbar_1^c, l) = F_r$, and $o_2^*(\hbar_2^o) = m$, for all $\hbar_2^o \in \mathcal{H}_2^o$. The candidate is a reputation equilibrium if and only if it is rational for the normal owner operator to set policy s in period 1 on the equilibrium path, i.e., $o_1^*(\hbar_1^{o*}) = s$. As is the case under professional management, the owner-operator's incentives vis-a-vis the period 1 operating policy depend on the effect the policy choice has on the likelihood of revelation.

By setting $o_1 = s$, the operator's completely avoids revelation and receives an expected payoff equal to

$$1 - e + (F_1 - e + c)\,. \tag{12}$$

Setting $o_1 = m$ risks revelation with probability $1-\delta$ and yields the expected payoff

$$1 - e + c + \delta\,(F_1 - e + c) + (1-\delta)\,(F_r - e + c - R - rc)\,. \tag{13}$$

The following proposition describes the condition under which the operator's best response is $o_1 = s$ and the candidate is a reputation equilibrium. The proposition also demonstrates that the same condition that ensures that setting $o_1 = s$ is a best reply for the operator ensures the equilibrium is unique.

Proposition 2 *Let $g = (1-r)\,c$ represent the owner-operator's expected post-reform gain from opportunism, and π_1 and π_r satisfy the definitions in Proposition 1. Then, if*

$$\rho_1 \geq 1 - \frac{\pi_1 - b^* - (\pi_r + g)}{1-\delta}, \tag{14}$$

a unique equilibrium exists and that equilibrium is a reputation equilibrium.

Condition (14) is different from condition (11) for existence of reputation equilibria under professional management in two significant ways. First, under professional management, increasing the gains from opportunism increases the reputation-assuring compensation required to induce the operator to act reputably. This cost is traded off against another expected cost: the cost to the uninformed owner of revelation. Under owner management, only incentives when the operator is normal determine the viability of reputation equilibria. In this case, the owner gains from diversion. Thus, the gain from opportunism represents a temptation, not a cost, under owner management.

The primary difference between the equilibrium conditions under owner and professional management is the role of outsiders' trust in the operator's commitment. The owner-operator's incentive to eschew opportunism in period 1 arises because opportunism risks revelation and losing profits in period 2. Period 2 profits depend on the price of the good in period 2 when the operator is unrevealed, which depends on ρ_1. Thus, a higher base of outsider trust expands the region of the parameter space over which reputation equilibria can be sustained. In contrast, under professional management, if ρ_1 is higher, failing to provide reputation-assuring compensation is less likely to result in revelation. Hence, the owner sees less value in paying compensation, making it less likely the owner will pay to maintain trust. Hence, while the interval of base trust levels that support reputation equilibria under owner management is an upper interval, under professional management, reputation equilibria are sustained by a lower interval of the base level of trust.

4.3 Professional management versus owner management

Clearly, the conditions for reputation equilibria under professional and owner management are different. Reform plays a fundamentally different role under the two governance structures, particularly because the cost of failed reform is lower for an owner manager.

To see this note that increasing the effectiveness of reform, r, benefits the owner under both governance structures as it increases F_r, the period 2 good's price after reform. Increasing r also imposes a cost only on the normal owner operator, albeit a cost smaller than the benefit: increasing r reduces the expected gain from opportunism. Thus, relatively ineffective (low r) reform is more valuable to an owner under owner management than under professional management. Because reform is never so effective that it completely restores outsiders' trust to its pre-revelation level (Assumption 1), reform will not be extremely effective unless the customers' base level of trust, and thus F_1, is very high. These results imply that, as long as the outsiders' base level of trust is not too high and reform is fairly effective, the operator is more likely to eschew reputable behavior in period 1 under owner management.

Proposition 3 *When*

$$\rho_1 < 1 - \frac{\pi_1 - (\pi_r + g)}{(1-\delta)(1+\delta+\pi_1-\pi_r)}, \tag{15}$$

then, if a reputation equilibrium exists under owner management, a reputation equilibrium exists under professional management.

Proposition 3 implies that professional management is more likely to support reputation equilibria when customers' base level of trust, ρ_1, is low. Because the right-hand side expression in condition (15) is increasing in the gain from diversion post reform, g, the larger the expected scope for opportunism by the operator at an owner-managed firm, the larger the range of customers' base level of trust over which professional management can better support reputation equilibria. Similarly, the right-hand side of condition (15) is decreasing in, $\pi_1 - \pi_r$. This expression represents the loss in profit produced by a loss of trust because of reform. Thus, when reform is fairly cheap and effective, the set of base levels of outsider trust over which professional management can better support reputation equilibria will be larger.

5 Reform and reputation equilibria

We want to examine how reform impacts the viability of reputation equilibria. This entails comparing the results we have derived in our baseline setting with reform with conditions for reputation equilibria in a "no-reform setting" where reform is not possible. We assume that, following revelation, in this no-reform setting, the firm shuts down after the good's price is set in period 2. This truncates at p_2, all period 2 histories that include $q_1 = l$ and does not add any new histories.

Under professional management, in the baseline setting, the operator is replaced as part of reform. Similarly, in the no-reform setting, the operator is not retained because the firm shuts down. Thus, under professional management, the optimal reputation-assuring compensation and operator's payoff function does not change when we switch to the no-reform setting.

In the baseline setting, the owner profits from the firm's operation after reform. In contrast, in the no-reform setting, the firm shuts down following revelation and the owner subsequently earns a payoff of zero. Thus, under both professional and owner management, switching to the no-reform setting changes the owner's payoff function.

In the no-reform setting, after revelation, the period 2 good's price is based on its expected quality conditioned on reform not being attempted. Because histories including $q_1 = l$ can only be reached if the operator is normal, rationality implies that customer beliefs along any history in which includes $q_1 = l$ the operator is certainly normal, i.e., $\mu_2^* = 0$. Using the same logic as used to establish Lemma 4, these beliefs imply that, in the no-reform setting $P_2^*(\hbar_1^c, l) = \delta$ in any equilibrium.

5.1 Professional management and reform

In reputation equilibria, revelation and reform are not on the equilibrium path. Moreover, the optimal reputation-assuring governance policy does not change when we switch to the no-reform setting. Hence, the owner's expected payoff from picking the optimal reputation-assuring governance policy continues to be represented by (9). The owner's expected payoff contingent on a no expected compensation policy is now

$$F_1 - e + F_1\,(F_2 - e)\,. \tag{16}$$

A little bit of algebra produces the following corollary to Proposition 1.

Corollary 1 *Under professional management, in the no-reform setting, a reputation equilibrium exists if and only if*

$$\rho_1 \leq 1 - \frac{b^*}{\delta + \pi_1} \times \frac{1}{1-\delta}. \tag{17}$$

Thus, the set of parameter values that support reputation equilibria in the setting with reform is a proper subset of the set of parameter values that support reputation equilibria in the no-reform setting.

Corollary 1 shows that reform weakens the owner's incentive to adopt reputation-assuring compensation. The reason is that, by generating profit π_r after revelation, reform lowers the owner's loss from revelation. Hence, under professional management, reform shrinks the interval over which the owner is willing to bear the cost of reputation-assuring compensation and reputation equilibria are sustainable. Higher profitability of reform has a similar effect.

5.2 Owner management and reform

Once again, the owner's expected payoff from setting $o_1 = s$ in a reputation equilibrium continues to be represented by (12) because revelation and reform are not on the equilibrium path. The owner-operator's expected payoff contingent on switching to $o_1 = m$ is given by

$$1 - I + \delta \left(F_1 - I \right). \tag{18}$$

Comparing these two payoffs leads immediately to the following corollary to Proposition 2

Corollary 2 *Under owner management, in the no-reform setting, reputation equilibria exist if and only if*

$$\rho_1 \in \left[1 - \frac{\pi_1 - b^*}{1 - \delta}, 1 \right]. \tag{19}$$

Thus, the set of parameter values that support reputation equilibria in the setting with reform is a proper subset of the set of parameter values that support reputation equilibria in the no-reform setting.

Corollary 2 shows that, as is the case under professional management, an increase in π_r reduces the interval of outsider prior beliefs about operator commitment over which reputation equilibria are sustainable. However, there is an additional impediment under owner management. Under professional management the gain from opportunism post reform, g, is not captured by the owner, but rather by a (replacement) operator and thus does not enter into the owner's calculus. Under owner management this gain is captured by the owner and increases the owner-manager's temptation to divert.

6 Experiment design and implementation

Our model predicts that professional management and owner management will support reputation equilibria under markedly different conditions, and the ex ante effects of reform will also be quite different under the two governance structures. Since these differences are predicated on rational behavior, it is unclear whether they will occur in the real world, where behavioral biases may be important. Tests on real world firms will be complicated because of the need to construct precise measures of outsider trust in firms, the effectiveness of reform, and, to assess the effect of reform, a counterfactual in which reform is not possible. Therefore, as a first step, we turn to an experiment in a laboratory, a setting in which behavior can be biased and constructing measures of outsider trust, reform effectiveness as well as counterfactuals is straightforward.

6.1 Experiment design

According to Proposition 3, when the base level of outsider trust (ρ_1) is relatively low, both professional and owner management support reputation equilibria for some values of ρ_1, and changing (only) ρ_1 can result in only professional management supporting reputation equilibria. Thus, by varying only ρ_1 in an experiment we can assess whether the two governance structures will impact firm behavior differently in the way our model predicts, and whether the differences will disappear when our model predicts they should. We undertake this exercise using the two parameter sets presented in Table 1, that differ only in their values for ρ_1. We also assess the impact of reform by running treatments in which reform is not possible. To ensure "salience," i.e., that subjects' payoffs vary meaningfully with their choices (e.g., Plott, 1982), we scale up cash flow parameters by a factor of 1,000, so a cash flow of 1 in the model equals 1,000 francs in the experiment.

Table 1: *Parameters used in the experiment.*

Parameter	ρ_1	I	c	δ	R	r	Value l	Value h
Parameter Set I	0.125	51	60	0.05	10	0.1	0	1000
Parameter Set II	0.250	51	60	0.05	10	0.1	0	1000

For Parameter Set I, under professional management, our model predicts a reputation equilibrium. Under owner management, the model predicts a mixed strategy equilibrium in which the operator sometimes acts opportunistically in period 1. Thus, for these parameter values, the operator should risk losing outsider trust by adopting a mixed strategy under owner management but not under professional management.[14]

For Parameter Set II our model predicts a reputation equilibrium under both owner and professional management. Hence, our model predicts different outcomes under the two governance structures for Parameter Set I but not for Parameter Set II. For both parameter sets, our model predicts that both governance structures will support reputation equilibria when reform is not possible. Table 2 details these predictions.[15]

In period 2, the operator's policy choice cannot impact either outsider trust or firm reputation. Under both governance structures, the dominant strategy for a normal-type operator is to act opportunistically if unrevealed or if (revealed and) reform fails. In prior reputation experiments, experienced subjects nearly always follow the dominant strategy in the final period when, as is the case in our setting, there is no incentive to eschew opportunism (e.g., Brandts and Figueras, 2003, p. 96). We have no reason to believe that subjects would not behave opportunistically in period 2, the final period, as they do in the prior experiments.[16] Hence, to simplify and speed up the experiment, in all treat-

[14] When the reputation equilibrium conditions in Proposition 2 and Corollary 2 are not satisfied, for the parameter values we use in the experiment, the equilibrium is a mixed strategy equilibrium in which the owner-manager randomizes between reputable and opportunistic behavior in period 1. The expressions defining the operating strategies are somewhat complex. However, since they are required for predicting the outcomes of the experiment, we develop these equilibria in Lemma B-6 in Appendix B.

[15] To see the links to our model, consider the predictions for Parameter Set I under professional management if reform is not possible. By equation (3), $F_1 = [0.125 + 0.05 \times (1 - 0.125)] \times 1,000 = 168.75$. Further, $e = 51 + 60 = 111$, $\pi_1 = 1000 - 111 = 889$, and $b^* = \frac{60 \times 0.05}{1 - 0.05} = 3.16$. Then, by Corollary 1, ρ_1 supports a reputation equilibrium and the manager is paid reputation-assuring compensation because $0 < \rho_1 = 0.125 < 1 - \frac{3.16}{0.05 + 889} \times \frac{1}{1 - 0.05} = 0.9663$. In the equilibrium, $p_1 = 1,000$, $p_2 = 1,000 \times [0.125 + (1 - 0.125) \times 0.05] = 168.75$ if the firms is unrevealed, and $p_2 = 1,000 \times 0.05 = 50$ if the firm is revealed. Similar calculations yield the other predictions in the table.

[16] Subjects in our experiment are quite opportunistic even in period 1, when they have an incentive to avoid opportunism.

Table 2: *Equilibrium predictions.*

	Parameter Set I			Parameter Set II	
	w/o Reform	w/ Reform		w/o Reform	w/ Reform
Operator	Owner or Prof.	Prof.	Owner	Owner or Prof.	Owner or Prof.
Reputation equilibrium	Yes	Yes	No	Yes	Yes
Probability of reputable behavior	1.000	1.000	0.802	1.000	1.000
Period 1 Price	1,000	1,000	835.3	1,000	1,000
Period 2 Price | Unrevealed	168.75	168.75	192.2	287.5	287.5
Period 2 Price | Revealed	50	145	145	50	145

ments, for normal-type operators, we set the period 2 operating policy to match the dominant equilibrium strategy.[17] This reduces strategic uncertainty for subjects and should promote convergence of behavior (Lucas, 1986; Van Huyck et al., 1990).

Under professional management, unlike owner management, the owner must pick a governance policy. For both parameter sets, our model predicts (i) the owner will adopt reputation-assuring compensation to incentivize the operator to act in the owner's interest, and (ii) this will curb operator opportunism. To simplify the experiment and ensure that the operator's incentives under both governance structures exactly mirror the incentives in our model, in professional management treatments we exogenously set a reputation-assuring period 2 bonus for the operator.[18] The bonus we set ensures that, for both parameter sets, all equilibria remain reputation equilibria under professional management. Thus, the modification does not alter predicted operating policies or prices, and it has no effect on our predictions about customer or operator behavior. Hence, we are able to test our model's predictions about (i) the effects of different incentives for operators under owner management and professional management *when governance policies are in place to curb opportunism*; (ii) outsider recognition of the differences in operator incentives; (iii) penalties outsiders impose for revelation; (iv) the ex ante and ex post effects of reform. We cannot, however, assess our model's prediction that, under professional management, owners will actually adopt governance policies that curb operator opportunism.

Although fixing compensation policy narrows the scope of our experiment, this simplification yields several benefits by eliminating the need for a (third) subject to play the owner' and set governance policy, the only endogenous action an owner takes in our model. First, our experiment design matches prior experiments based on the KWMR reputation framework because subjects only play two roles—insider (operator) and outsider (customer)—and take only

[17] Fixing some (computerized) decisions to correspond to equilibrium strategies to isolate and study other decisions in games has a long history (e.g., Liberman, 1962; Messick, 1967; Fox, 1972; Shachat and Swarthout, 2008).

[18] We set the bonus to 30 instead of the equilibrium value under an efficient reputation ensuring policy of 3.16, given by equation (8) for two reasons: (a) To ensure that the operator's payoff varies meaningfully with her choices (Plott, 1982). (b) To ensure uniqueness while using a simple compensation policy. Under the owners' optimal reputation-ensuring policy, the operator is indifferent between the mixed and safe operating policies. As Lemma 5 shows, when the operator indifferent between the two policies, the trust equilibrium is the unique equilibrium only when compensation varies with prices in period 1 that are off the equilibrium path. To ensure a unique prediction, if we set the bonus equal to 3.16 instead of the simple bonus payment for being unrevealed we employ in the experiment, we would need to introduce a bonus schedule for operators dependent on (off-equilibrium) prices in period 1, which might puzzle or confuse subjects.

one type of action in each role.[19] Second, complexity and subject decision costs fall, which ought to lower subject errors (Smith and Walker, 1993) and make it easier to diagnose differences between model predictions and experimental behavior (Davis and Holt, 1993). Third, we can implement the professional and owner management treatments in essentially the same setting, maximizing the likelihood that governance structure-induced incentive differences drive outcomes rather than differences in the design of the treatments or subject instructions (Zizzo, 2010). Finally, operator payoffs vary with prices in exactly the same way as in the model, allowing us to isolate the interplay between outsider beliefs and operator choices and examine whether this interplay varies with governance structure and reform as predicted.

6.2 Subject pool, instructions, and payments

Subjects were drawn from a volunteer pool of undergraduate business and MBA students at the University of Iowa. There were 18 to 24 subjects in each session. Sessions lasted at most two hours and subjects were paid a $5 show-up fee. The experimental currency was "francs," which were converted to dollars at known exchange rates (depending on the treatment and subject's role). Subject payments (including the show-up fee) ranged between $10.31 and $32.00. They averaged $21.45 with a standard deviation of $4.37. Expected profits across roles were equalized by allowing customers to keep some of an endowment they received each period and setting different exchange rates for operators across the treatments.

Upon arrival, subjects sat at separate computer terminals and received a set of instructions (provided in Appendix C), forms to record profits by period, and receipts to be filled in during the session. The instructions clearly explain to subjects the choices they get to make in the experiment (shown in Appendix C). The instructions also clearly show the implications of the remaining actions in the model for the game and for subject payoffs. The instructions were read aloud and all questions were answered in public before each session. At the beginning of each session, each subject was randomly assigned a role ("Green" player (customer) or "Blue" player (operator)) and remained in their roles throughout the session.[20] The experiments were programmed in Z-Tree (Fischbacher, 2007).

Each session consisted of 24 "rounds." Each round consisted of two-periods. To start a round, subjects were randomly assigned to groups consisting of one customer and one operator (with random rematching to start each new round). Each round, each operator was randomly assigned a set of operating policies or "methods." All operators could use a safe policy (called "Method 1: Sure" in the experiment) that always produced a high quality good (a

[19] Except for the number of periods in the game, our experiment is comparable to the experiments in Camerer and Weigelt (1988), Neral and Ochs (1992), Brandts and Figueras (2003), and Noe et al. (2012). In Camerer and Weigelt (1988), Neral and Ochs (1992), and Brandts and Figueras (2003) outsiders make lending decisions which serve as an *indicator of sufficient reputation* rather than set a precise measure, a good's price, as they do in our experiment and in Noe et al. (2012).

[20] While we will refer to subjects as customers and operators, following the standard in the literature (see e.g., Plott, 1982), these terms were not used during the experiment to avoid value-laden connotations. The neutral language allows us to test our hypothesis without bringing in external preconceptions and framing effects that can make preferences deviate from those induced by the payoffs and contracts in the game. For example, if we refer to producing a low-quality good as "reputation damage," subject behavior may be influenced by their experiences with reputation damage in other contexts in unpredictable ways, which can complicate strategic decision making by other subjects.

"round item" in the experiment) worth 1,000 francs to the customer. A fraction of operators (7/8 or 3/4 depending on the parameter set) could alternatively employ a mixed policy (called "Method 2: Mixed" in the experiment) that cost 60 francs less but produced a high quality good only 5% of the time and a low quality good (a "square" item worth 0 francs to the customer) 95% of the time. Effectively, an operator who could (not) use the mixed policy was the normal (committed) type, and each operator's type was randomly assigned each round. All subjects knew the assignment rules and fractions of each operator type.[21]

In the first period of each round, the operator chose an available operating policy in "Stage I" and customers set a price in "Stage II" using a modified Becker et al. (1964) procedure that we will describe shortly.[22] In the second period, customers set prices in Stage II and, as described previously, operating policy was fixed in Stage I to match the operator's dominant strategy. Operator payoffs were based on the first period price set by customers and the predicted equilibrium price for period 2. Customer payoffs in each round were determined by the prices they paid and the quality of goods they purchased.

For each parameter set, we ran an owner management with reform treatment and professional management with reform treatment. Each treatment consisted of two sessions. To assess the effect of reform, we ran an owner management treatment in which reform was not possible. We did not run a professional management without reform because the operator's incentives are insensitive to the possibility of reform: The operator receives no bonus and is replaced after he is revealed whether or not reform is possible. However, our design is effectively a 2 (parameter set) $\times$ 2 (governance structure) $\times$ 2 (reform opportunity) design relative to operator choices and goods prices. Table 3 summarizes our design. We will use the labels in the table to identify the experiments, dropping the parameter set suffix when the discussion applies to both parameter sets.

Table 3: *Experimental design.*

	Parameter Set I			Parameter Set II		
Governance structure	Label	Sessions	Obs.	Label	Sessions	Obs.
Owner Management	OM-I	2	264	OM-II	2	264
Owner Management w/ Reform	OMR-I	2	264	OMR-II	2	264
Professional Management (w/ or w/o Reform)	PM-I	2	228	PM-II	2	264

6.3 The procedure for setting goods' prices

Embedding a competitive goods market in the experiment for each of two periods would be time consuming and costly. Thus, following Noe et al. (2012), we use a modified Becker et al. (1964) procedure (hereafter "BDM

[21]Throughout each session, computer screens at the front and sides of the room displayed (1) the probability the Blue players (operators) had been assigned only safe or both safe and mixed policies, (2) the probability that each policy produces each item type, and (3) the period 2 operating policy that was fixed based on period 1 quality and available operating policies.

[22]While the decisions were made in stages each period, no information is passed from one stage to the next.

procedure") to set goods' prices. This procedure, which is designed to elicit the highest price a customer is willing to pay for a good, requires just one customer to simulate a competitive price.[23]

In the BDM procedure, the customer first specifies the most she is willing to pay. Once this "limit price" is set, the experimenter randomly draws a "discounted price" between 0–1,000 francs from a uniform distribution. The experimenter then buys the good from the firm at the limit price. The experimenter resells the good to the customer at the discounted price only if the limit price exceeds the discounted price. Otherwise, the experimenter keeps the good. When a customer purchases the item, she receives a payoff equal to her endowment plus the value of the item minus the discounted price. When the experimenter keeps the good, the customer receives only her endowment. In either case, she receives an ex post report showing the quality of the item and the discounted price. In the following analysis we report customer limit prices. This price setting procedure was clearly explained to subjects in the instructions (shown in Appendix C).

7 Evidence from our experiments

Prior experiments using the KWMR reputation framework document significant deviations from equilibrium predictions (e.g., Camerer and Weigelt, 1988; Neral and Ochs, 1992; Noe et al., 2012), and Brandts and Figueras (2003) suggest that the deviations increase when games are shorter. Thus, we do not expect subject behavior to conform exactly to the predictions in Table 2 in our two-period game. What we want to know is whether our model's predictions about reputation/trust effects of governance structure and reform hold, *at least qualitatively*, even when behavior is biased. We will describe the evidence in the following order: Operator policy choices in period 1, period 1 goods' prices, and period 2 goods' prices. To simplify the exposition, we will refer to operators' period 1 policy choices, simply as policy choices.

7.1 Adoption of the reputable policy

Our model predicts that the frequency of reputable policy choices will be lower in the owner-management treatment with reform (OMR-I) with Parameter Set I relative to the other treatments using the same parameters (OM-I and PM-I). This will not be the case for Parameter Set 2. The policy choices in the experiment qualitatively match these predictions, indicating that governance structure and reform systematically affect behavior in a manner that is qualitatively similar to what our model predicts.

Figure 3 graphs the percentage of times normal-type operators make reputable policy choices in each treatment. Reputable policies are chosen systematically less frequently than predicted in all the treatments. When our model predicts mixed equilibria (treatment OMR-I) with reputable policies chosen about 80% of the time, the policies are

[23] On average, the BDM procedure elicits risk neutral valuations (Berg et al., 2005) which, in our context, correspond to competitive prices. The procedure was fast to implement, it avoided complications from auction procedures (e.g., overbidding, as in Kagel and Levin, 1993), and did not require pre-specifying a limited set of allowable prices (e.g., Forsythe et al., 1999). Recent experiments on financial decision making that use the BDM procedure include Frydman and Nave (2017) and Fuster et al. (2020).

Figure 3: *Frequency of reputable behavior.* This figure presents the frequency with which normal-type operators make reputable policy choices (in period 1).

chosen only about 50% of the time in our experiment. Similarly, while our model predicts reputable policy choices 100% of the time in the remaining treatments, we observe such policies only a maximum of 73% of the time, which occurs in treatment OM-I. Reform lowers the incidence of reputable policies significantly by owner managed firms under Parameter Set I from 73% (OMR-I) to 50% (OM-I). Under Parameter Set II, the corresponding drop is from 68% (OMR-II) to 57% (OM-II), which is both smaller and statistically insignificant.

Prior experiments, which closely match our owner-manager treatments without reform, also produce low rates of reputable behavior when the equilibrium prediction is 100% reputable behavior. For example, in Noe et al. (2012) the frequency of reputable behavior is around 60%. In longer games, Camerer and Weigelt (1988) report reputable behavior with a frequency of under 80% when subjects are relatively inexperienced. Thus, while reputable policies are chosen in our experiment with a low frequency, this is not unexpected. Moreover, in Appendix E, we show that, over time, operators in our experiment gravitate towards choosing reputable policies when our model predicts a reputation equilibrium.

Consider differences across treatments, which can speak to our model's predictions about the impact of governance structure and reform. Table 4 presents the frequencies with which normal operators make reputable policy choices in each treatment as well as formal tests of the differences across treatments. To minimize the confounding effects of subject learning, we present and compare policy choices in the second half of each session.[24] The observed variation across treatments is consistent with our model's predictions about the effect of governance structure, and the impact

[24]Using the entire data set leaves the results essentially unchanged, but there is some adjustment as subjects learn about the game. As a result, we are more comfortable using statistical tests based on the later periods in the experiment. In Appendix E we provide insights into the impact of subject learning.

of reform in weakening commitment to maintain stakeholder trust, particularly under owner management.

Result 1 The variation in reputable policy choices across treatments conforms with our model's predictions about the effects of governance structure and reform.

Table 4: *Incidence of reputable policy choices.* In this table we present the frequency with which normal-type operators choose the reputable policy (in period 1) during the second half of each session. ***, ** and * denote t-test significance at the 99%, 95% and 90% levels of confidence respectively. DoF indicates Degrees of Freedom = the number of combined observations - 2.

		Parameter Set		Parameter Set I vs II			
Governance structure		Parm. I	Parm. II	Difference	t-Stat.	p-Value	DoF
OM		75.42%	68.37%	-7.06%	-1.15	0.25	214
OMR		48.67%	58.43%	9.75%	1.38	0.17	200
PM		71.43%	66.04%	-5.39%	-0.83	0.41	202
OM	Difference	-26.75%***	-9.94%				
vs	t-Stat.	-4.35	-1.41				
OMR	p-Value	0.00	0.16				
	DoF	229	185				
OM	Difference	-4.00%	-2.33%				
vs	t-Stat.	-0.66	-0.35				
PM	p-Value	0.51	0.73				
	DoF	214	202				
OMR	Difference	22.76%***	7.61%				
vs	t-Stat.	3.43	1.09				
PM	p-Value	0.00	0.28				
	DoF	209	193				

Our model predicts that operators will act least reputably in treatment OMR-I, and there should be no difference in operator behavior across the remaining treatments. Consistent with these predictions, we find no significant differences between the frequencies of reputable policy choices between Parameter sets I and II for treatments OM and PM. While, consistent with our expectations, such policies are adopted more frequently in treatment OMR-II than in OMR-I, the difference is not statistically significant.

We find stronger support for our model's predictions when we focus on comparisons across treatments based on the same parameter set. Consistent, with the prediction that the operator will make reputable policy choices less frequently in treatment OMR-I than in treatments OM-I and PM-I, operators act reputably only 48.7% of the time in treatment OMR-I, which is statistically significantly lower than in treatment OM-I (t=4.35, p-value=0.00) and in treatment PM-I (t=3.43, p-value=0.00). Under Parameter Set II, consistent with the prediction that the operator will make reputable policy choices regardless of governance structure and reform, in treatment OMR-II, the frequency of reputable policy choices is (58.4%) which is not statistically significantly different than the frequencies in treatments OM-II (68.4%) or PM-II (66.0%).

Thus, professional management tends to promote more reputable policy choices than owner management when our model predicts that it will, and governance structure has little effect on policy choices when our model predicts that it won't. Moreover, reform tends to undermine the ex ante incentive to make policy choices that maintain customer trust as our model predicts it will.

7.2 Period 1 goods' prices

A good's price in our model reflects customers' expectation of the good's quality, i.e., the probability that it is high quality. It measures firm reputation. According to our model, in the owner-management treatment with reform using Parameter Set I (OMR-I), the period 1 good's price should equal 835.3. In the remaining treatments, the period 1 good's price should equal 1,000. These predictions are based on the anticipation of the universal adoption of reputable policies except in treatment OMR-I. Clearly, in our experiment, reputable policies are chosen less frequently than predicted.

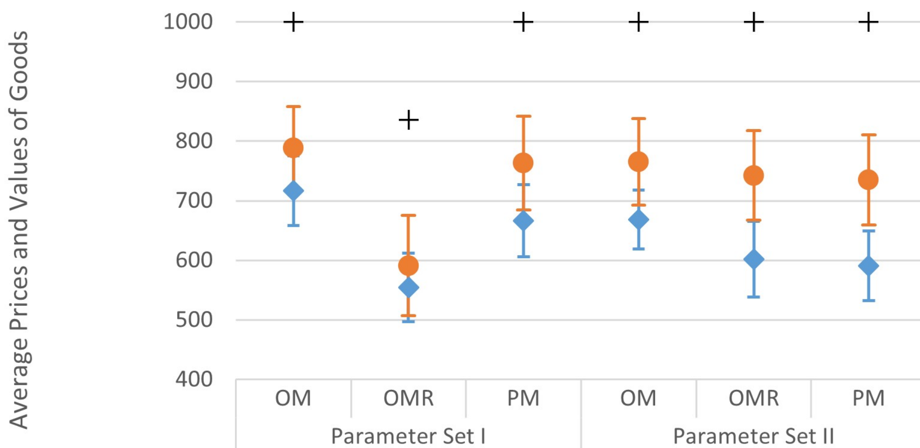
Figure 4 shows period 1 limit prices set by customers (diamonds) under each treatment, average actual values of the goods (circles), and the values for the goods predicted by our model (crosses). The figure also shows 95% confidence interval bars for limit prices and goods' actual values. To limit confounding effects arising from subject learning, the figure shows prices in the second half of the experiment.[25]

Prices are much lower than their predicted values. Consider prices in treatments for which the predicted value is 1,000. The OM treatments produce the highest average prices, 717 francs in OM-I and 668 francs in OM-II. Now consider treatment OMR-I, for which the predicted value is 835.3 francs. Once again, prices in the experiment are much lower, averaging only 555 francs. The difference between experimental prices and predicted prices are all highly statistically significant with t-statistics ranging from 9.52 to 13.78. Thus, period 1 firm reputation in the experiment tends to be lower than our model predicts.

The reputation shortfall is consistent with customers (correctly) anticipating operator behavior that is less reputable than predicted. Note, however, that the price averages are well above period 1 floor prices for both Parameter Set I (168.75) and Parameter Set II (287.5). Thus, customers appear to anticipate that normal-type operators will behave reputably sufficiently frequently to ensure that they set prices that are high enough to make firms profitable in period 1.

The discounts relative to predicted values are not unprecedented or unanticipated. They mirror outsider responses in prior experiments where the insiders are predicted to act reputably 100% of the time but fail to do so. For example, in the first period of the Noe et al. (2012) experiment, which closely matches our owner-management treatment without reform, the average price for goods is 651 compared to the predicted price of 1,000. While outsiders' willingness to lend in Camerer and Weigelt (1988) serves as an indicator of sufficient reputation rather than a precise reputation measure like goods' prices, as few as 70% of lenders make loans compared to a 100% predicted rate in early periods of their experiment.

[25] As with our analysis of policy choices, using the entire data set leaves the results essentially unchanged. In Appendix E we provide insights into subject learning.



	OM	OMR	PM	OM	OMR	PM
	Parameter Set I			Parameter Set II		
◆ Prices	717	555	666	668	602	590
● Actual Values	788	591	763	765	742	735
+ Equilibrium Values	1000	835	1000	1000	1000	1000

Figure 4: *Period 1 values and limit prices established by customers in the second half of each session.*

From Figure 4 it is clear that customers also generally under-price goods, i.e., prices are markedly lower than the goods' actual values. Average underpricing ranges from 36 francs in treatment OMR-I to 144.38 in treatment PM-II. For Parameter Set I-based treatments, with the exception of PM-I, underpricing is not statistically significant. In PM-I underpricing is only marginally significant with a t-statistic of 1.82. For Parameter Set II treatments, underpricing is highly statistically significant, with t-statistics ranging from 2.03 for OM-II to 3.08 for PM-II. In analysis presented in Appendix E, we find that the impact of underpricing of goods on the profitability of reputable policy choices can help explain the systematic deficiency in the reputable operator behavior. Both prices and the frequency of reputable policy choices appear to evolve toward equilibrium predictions.

To formally examine the effect of governance structure and reform on prices, we compare period 1 goods' prices across treatments in the second half of the experiments. The results are presented in Table 5. Period 1 good's prices in treatment PM-II appear low: Contrary to our model's predictions they are significantly lower than in treatments PM-I and OMR-II, though the difference with treatment PM-I is only marginally significant. Overall, the remaining price differences tend to match our model's predictions.

Result 2 Consistent with our model's predictions, period 1 prices are significantly lower under owner-management with reform than in other treatments. Thus, customers do anticipate that governance structure and reform affect incentives to act reputably in a manner that qualitatively aligns with the model's predictions.

For Parameter Set II, we expect the period 1 good's price to be unaffected by governance structure or reform. Consistent with this prediction, we find that prices in treatment OMR-II (601.7 francs) are not significantly different from prices in OM-II (668.3 francs) or PM-II (590.5 francs). For Parameter Set I, we expect prices to be lower in

Table 5: *Customer conjectures of period 1 good quality.* In this table we present period 1 prices for goods in the second half of the experiment. ***, ** and * denote t-test significance at the 99%, 95% and 90% levels of confidence respectively. DoF indicates Degrees of Freedom = the number of combined observations - 2.

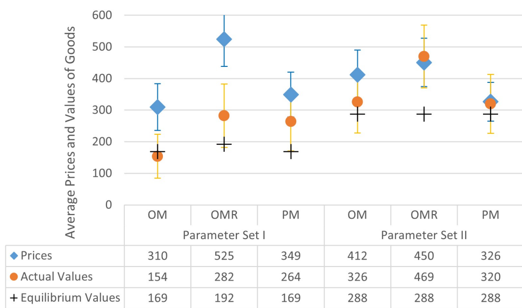
		Parameter Set		Parameter Set I vs II			
Governance structure		Parm. I	Parm. II	Difference	t-Stat.	p-Value	DoF
OM		716.73	668.27	-48.46	-1.24	0.22	262
OMR		554.75	601.66	46.91	1.07	0.29	262
PM		666.39	590.47	-75.92*	-1.77	0.08	244
OM	Difference	-161.98***	-66.61				
vs	t-Stat.	3.87	-1.61				
OMR	p-Value	0.00	0.11				
	DoF	262	262				
OM	Difference	-50.35	-77.80**				
vs	t-Stat.	-1.17	-1.99				
PM	p-Value	0.24	0.05				
	DoF	244	262				
OMR	Difference	111.64***	-11.19				
vs	t-Stat.	2.62	-0.25				
PM	p-Value	0.01	0.80				
	DoF	244	262				

treatment OMR-I than in treatments OM-I and PM-I. Consistent with this prediction, the average price in OMR-I is 554.8 francs, which is statistically significantly lower than the average price of 716.7 francs in OM-I (t=3.87, p-value=0.00) as well as the average price of 666.4 francs in PM-I (t=2.62, p-value=0.01). Moreover, as our model predicts, prices are not significantly different between treatments OM-I and OM-II and prices are lower in treatment OMR-I than in OMR-II, though the different is not statistically significant. Thus, judging by the overall pattern of price differences across treatments, it appears that customers recognize the effects our model predicts that governance structures and reform will have on operators' incentives to act reputably.

7.3 Period 2 goods' prices

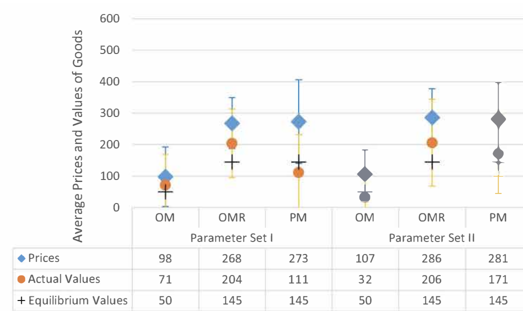
Period 2 goods' prices reflect customer trust after observing the quality of period 1 goods and reform. In the experiment, just like in our model, these are floor prices because the period 2 operating policy is always opportunistic if the operator is the normal type unless reform succeeds. The sensitivity of the prices to revelation and reform inform us about how much customers penalize opportunistic policy choices, and the extent to which reform mitigates the penalty. We find that the impact of revelation and reform on period 2 goods' prices is qualitatively similar to our model's predictions: Prices drop significantly after revelation, and reform significantly moderates the price drop. The implied reward for maintaining customer trust tends to significantly exceed the reward predicted by our model.

Figure 5 shows period 2 limit prices set by customers (diamonds), goods' actual values (circles), and goods' predicted values (crosses) in the second half of each session. The figure also shows 95% confidence interval bars for limit prices and goods' actual values. The prices in Panel A are conditioned on the operator remaining unrevealed.



	Parameter Set I			Parameter Set II		
	OM	OMR	PM	OM	OMR	PM
◆ Prices	310	525	349	412	450	326
● Actual Values	154	282	264	326	469	320
+ Equilibrium Values	169	192	169	288	288	288

A. Unrevealed operators



	Parameter Set I			Parameter Set II		
	OM	OMR	PM	OM	OMR	PM
◆ Prices	98	268	273	107	286	281
● Actual Values	71	204	111	32	206	171
+ Equilibrium Values	50	145	145	50	145	145

B. Revealed operators

Figure 5: *Period 2 values and limit prices established by customers in the second half of each session.*

The prices in Panel B reflect the effect of revelation, both after reform and when reform is not possible.

From the figure it is clear that, like in period 1, prices tend to differ from both predicted values and goods' actual values. However, in contrast to period 1, prices tend to exceed both these benchmarks. Thus, unlike period 1, in period 2, customers appear to expect operators to behave *more* reputably than they actually do or are predicted to.

Consider the difference between predicted values and prices in the experiment. For unrevealed firms, with the exception of PM-II, the average gap ranges from 124 to 332 francs and is highly statistically significant. In PM-II, the gap is only 39 francs. Prices for goods from revealed firms are also uniformly higher than predicted values. With the exception of OM-I and OM-II where the gap is close to 50 francs, the gap ranges from 123 to 141 francs and is statistically significant.

Next consider the gap between prices and goods' actual values.[26] For unrevealed firms, prices exceed goods' values except in OMR-II, where goods are underpriced by 19 francs. The overpricing is most marked and is statistically significant in OM-I (156 francs) and OMR-I (243 francs). Otherwise it ranges from 7 to 86 francs. Goods from revealed firms are uniformly overpriced. The overpricing ranges from 26 to 162 francs but is never statistically significant. Thus, it appears that customers tend not to make significant pricing errors when firms are revealed, or have reformed after being revealed. Only when customers face unrevealed firms do they misprice goods significantly. Moreover, the underpricing we observe in period 1 does not carry over to period 2 prices.

In Table 6, we compare period 2 prices for revealed and unrevealed firms. Consistent with the model's prediction, period 2 good's prices are always higher for unrevealed firms. The difference ranges from 45 francs in PM-II to 305 francs in OM-II. Only in PM-I and PM-II is the difference not statistically significant. Thus, as predicted by our model, firms are rewarded by customers with higher goods' prices in period 2 when they maintain customers' trust. With the exception of PM-II, the reward in the experiment is larger than predicted by our model. In OMR-I the reward is also statistically larger. Thus, firms tend to receive at least the predicted period 2 reward for maintaining customers' trust.

[26]Because of relatively small sample sizes, the average realized values of goods in the experiment do not exactly match their expected values under the model parameters.

Table 6: *The penalty for being revealed.* This table presents the differences between period 2 prices for revealed and unrevealed firms in the second half of the experiment as well as the predicted values of the difference. ***, ** and * denote significance at the 99%, 95% and 90% levels of confidence respectively.

		Parameter Set I			Parameter Set II		
		OM	OMR	PM	OM	OMR	PM
Unrevealed Prices		309.75	524.68	349.28	411.60	450.45	326.25
Revealed Prices		97.86	268.17	273.26	106.71	286.06	281.00
Predicted Difference		118.75	47.20	23.75	237.5	142.5	142.5
Observations		132	132	114	120	132	132
Unrevealed vs	Difference	211.89**	256.51***	76.02	304.89***	164.39*	45.25
Revealed Prices	t-statistic	2.75	4.06	1.01	4.26	2.29	0.71
Actual Difference vs	Dif. vs Pred.	93.14	209.31***	52.27	67.39	21.89	-97.25
Predicted Difference	F-statistic	1.46	11.00	0.49	0.89	0.09	2.36

Result 3 Consistent with our model's prediction, customers reward firms that maintain their trust and remain unrevealed by setting higher period 2 goods' prices than for revealed firms.

For unrevealed firms, the average period 2 price significantly exceeds the 111 franc cost of the reputable policy (t-test p-values range from 5.77 to 10.40 will all p-values < 0.00005). When reform is possible, post-reform prices also always significantly exceed the expected cost of reform and operating the firm (t-test p-values range from 2.24 to 4.87 with all p-values < 0.05). Thus, consistent with our model assumption, a firm can operate profitably in period 2 if the operator is unrevealed or reforms after revelation.

In contrast, for a revealed firm, if reform is not possible, as is the case in treatments OM-I and OM-II, period 2 prices to not significantly exceed the 51 franc cost of the opportunistic policy (t-test values are 0.97 and 1.43 with p-values of 0..3403 and 0.1626). In fact, the median period 2 price for such firms is zero under both parameter sets and prices are lower than the cost of the opportunistic policy about 3/4 of the time. Thus, consistent with our assumption in the model, a firm that cares about profitability will not operate after its operator is revealed and reform is not possible.

Our model also predicts that (i) reform will increase the period 2 price for a revealed operator by resetting outsider trust; and (ii) in treatment OMR-I, in which operators are predicted to act opportunistically in period 1, period 2 prices will be higher for unrevealed operators than in OM-I, in which operators are predicted to always act reputably in period 1. We present tests of these predictions in Table 7. For both parameterizations, period 2 prices for revealed operators are higher in the OMR and PM treatments in which reform occurs than in the OM treatments in which reform is not possible. Thus, consistent with prediction (i), reform successfully resets customer trust. In fact, prices after reform are at least 170 francs higher in treatments with reform (treatments OMR and PM) than in treatment OM, which exceeds the 45 franc price increase from reform predicted oby ur model by a large margin. Hence, in the experiment, reform lowers the penalty operators face for period 1 opportunism by more than our than our model predicts, which is consistent with the larger deficit in reputable operator behavior we observe.

Result 4 Consistent with our model, reform resets customers trust and causes them to reward firms that reform by setting higher period 2 goods' prices.

Consistent with prediction (ii) prices of period 2 goods for unrevealed firms are significantly higher in OMR-I compared with OM-I and there is little difference between period 2 prices for goods from unrevealed firms in treatments OMR-II and OM-II.[27] Thus, updated period 2 customer beliefs about unrevealed operators appear to reflect differences in period 1 behavior predicted by our model, and the updates are in the direction predicted by Bayes rule.

Result 5 Consistent with belief updating in our model, customers reward unrevealed firms more when some managers are expected to act opportunistically in Period 1 (OMR-I) than when all managers are expected to act reputably (OM-I).

8 Discussion

This paper considers the question of how governance structure—the identity of the agents setting operating policy—affects the sustainability of firm reputation with outsider stakeholders and their trust in firms' production standards. We characterize perfect Sequential Nash equilibria in a setting where stakeholders have imperfect information about the commitment of firms to reputable behavior. In this framework, we show that governance structure matters; both firms controlled by informed insider owners and firms controlled by uninformed outsider "common/universal owners" may opt for opportunistic policies promising short-term gains that potentially destroy stakeholder trust and firm reputation. However, the conditions for maintaining trust and reputation under the two governance structures are fundamentally different. Factors that favor trust/reputation sustainability under informed insider control reduce sustainability under uninformed outsider control and vice versa.

We also consider corporate reform and restructuring after detected opportunism and consider how reform affects the sustainability of trust/reputation. We show that, under both governance structures, the option to reform, by lowering the cost of losing trust/reputation, makes it more difficult for firms to commit to maintaining trust/reputation. However, uninformed outsider control, by separating the agents making the operating decisions that affect trust/reputation from the value engendered by reform, mitigates the adverse effects of corporate reform on trust/reputation sustainability.

Through a laboratory experiment, we investigate the robustness of our findings to behavioral deviations from rational expectations. In the experiment, stakeholder responses to firm behavior are produced by laboratory subjects' choices rather than by Bayesian updating. Although subject behavior is generally inconsistent with forward-looking rational expectations, the qualitative conclusions of our model are nevertheless supported by the experiment. In the online appendix, we show that behaviors appear to follow an experience weighted attraction model, which is commonly observed in experiments. Thus, our experiment provides evidence for the external validity of our theoretical predictions when actors learn from experience instead of following forward looking rational expectations with Bayesian updating.

[27] We use the second half of the data for consistency with the analysis above. Every significant relationship in Table 7 remains significant and in the same direction when using all the data. However, using all the data, prices for revealed professional managers falls significantly below unrevealed professional managers under parameter set 2 and overall, as predicted.

Table 7: *Customer responses to revelation.* In this table we present period 2 prices for goods in the second half of the experiment. ***, ** and * denote t-test significance at the 99%, 95% and 90% levels of confidence respectively. DoF indicates Degrees of Freedom = the number of combined observations - 2.

			Revelation Status		Revealed vs Unrevealed			
Treatment	Parameter Set		Unrevealed	Revealed	Diff.	t-stat	p-value	DoF
OM	I		309.75	97.86	-211.89***	2.75	0.01	130
	II		411.60	106.71	-304.89***	4.26	0.00	118
OMR	I		524.68	268.17	-256.51***	4.06	0.00	130
	II		450.45	286.06	-164.39**	2.29	0.02	130
PM	I		349.28	273.26	-76.02	1.01	0.31	112
	II		326.25	281.00	-45.25	0.71	0.48	130
		Diff.	214.93***	170.31***				
	I	t-stat	3.71	-2.54				
OM		p-value	0.00	0.01				
vs		DoF	180	80				
OMR		Diff.	38.85	179.35***				
	II	t-stat	0.69	-2.92				
		p-value	0.49	0.00				
		DoF	185	63				
		Diff.	39.53	175.40**				
	I	t-stat	0.75	-2.12				
OM		p-value	0.46	0.04				
vs		DoF	189	53				
PM		Diff.	-85.35*	174.29**				
	II	t-stat	-1.70	2.37				
		p-value	0.09	0.02				
		DoF	184	64				
		Diff.	-175.40***	5.09				
	I	t-stat	-3.11	0.07				
OMR		p-value	0.00	0.95				
vs		DoF	163	79				
PM		Diff.	-124.20**	-5.06				
	II	t-stat	-2.48	-0.07				
		p-value	0.01	0.95				
		DoF	193	67				

References

Alexander, Cindy R, “On the nature of the reputational penalty for corporate crime: Evidence,” *Journal of Law and Economics*, 1999, *42* (S1), 489–526.

Amel-Zadeh, Amir, Fiona Kasperk, and Martin Schmalz, “Mavericks, Universal, and Common Owners-The Largest Shareholders of US Public Firms,” Technical Report, CESifo 2022.

Bar-Isaac, H. and S. Tadelis, “Seller reputation,” *Foundations and Trends in Microeconomics*, 2008, *4* (4), 273–351.

Barber, Brad M and Masako N Darrough, “Product reliability and firm value: The experience of American and Japanese automakers, 1973–1992,” *Journal of Political Economy*, 1996, *104* (5), 1084–1099.

Becker, Gordon M, Morris H DeGroot, and Jacob Marschak, “Measuring utility by a single-response sequential method,” *Behavioral Science*, 1964, *9* (3), 226–232.

Bénabou, Roland and Jean Tirole, “Incentives and prosocial behavior,” *American Economic Review*, 2006, *96* (5), 1652–1678.

Berg, Joyce, John Dickhaut, and Kevin McCabe, “Trust, reciprocity, and social history,” *Games and economic behavior*, 1995, *10* (1), 122–142.

— , — , and — , “Risk preference instability across institutions: A dilemma,” *Proceedings of the National Academy of Sciences of the United States of America*, 2005, *102* (11), 4209–4214.

Brandts, Jordi and Neus Figueras, “An exploration of reputation formation in experimental games,” *Journal of Economic Behavior & Organization*, 2003, *50* (1), 89–115.

Camerer, Colin and Keith Weigelt, “Experimental tests of a sequential equilibrium reputation model,” *Econometrica*, 1988, *56* (1), 1–36.

Camerer, Colin F, Teck-Hua Ho, and Juin-Kuan Chong, “Sophisticated experience-weighted attraction learning and strategic teaching in repeated games,” *Journal of Economic Theory*, 2002, *104* (1), 137–188.

Chakravarthy, Jivas, Ed deHaan, and Shivaram Rajgopal, “Reputation repair after a serious restatement,” *Accounting Review*, 2014, *89* (4), 1329–1363.

Cole, Harold L and Narayana Kocherlakota, “Dynamic games with hidden actions and hidden states,” *Journal of Economic Theory*, 2001, *98* (1), 114–126.

Coles, Jeffrey L, Michael L Lemmon, and J Felix Meschke, "Structural models and endogeneity in corporate finance: The link between managerial ownership and corporate performance," *Journal of Financial Economics*, 2012, *103* (1), 149–168.

Cremer, Jacques, "Cooperation in ongoing organizations," *Quarterly Journal of Economics*, 1986, *101* (1), 33–49.

Cripps, Martin, George Mailath, and Larry Samuelson, "Imperfect monitoring and impermanent reputations," *Econometrica*, 2004, *72* (2), 407–432.

Davis, Douglas D and Charles A Holt, "Experimental economics: Methods, problems, and promise," *Estudios Economicos*, 1993, pp. 179–212.

Diamond, Douglas W, "Reputation acquisition in debt markets," *Journal of Political Economy*, 1989, *97* (4), 828–862.

Economist, "Schumpeter: Getting a handle on a scandal," *The Economist*, 2018, *March 28.*

Economist Intelligence Unit, "Reputation: Risk of risks," *Economist Intelligence Unit Global Risk Briefing*, 2005, (4), 1–23.

Erev, Ido and Alvin E Roth, "Predicting how people play games: Reinforcement learning in experimental games with unique, mixed strategy equilibria," *American Economic Review*, 1998, *88* (4), 848–881.

Farber, David B., "Restoring trust after fraud: Does corporate governance matter?," *Accounting Review*, 2005, *80* (2), 539–561.

Fischbacher, Urs, "z-Tree: Zurich toolbox for ready-made economic experiments," *Experimental Economics*, 2007, *10* (2), 171–178.

Forsythe, Robert, Russell Lundholm, and Thomas Rietz, "Cheap talk, fraud, and adverse selection in financial markets: Some experimental evidence," *Review of Financial Studies*, 1999, *12* (3), 481–518.

Fox, John, "The learning of strategies in a simple, two-person zero-sum game without saddlepoint," *Behavioral Science*, 1972, *17* (3), 300–308.

Frydman, Cary and Gideon Nave, "Extrapolative beliefs in perceptual and economic decisions: Evidence of a common mechanism," *Management Science*, 2017, *63* (7), 2340–2352.

Fuster, Andreas, Ricardo Perez-Truglia, Mirko Wiederholt, and Basit Zafar, "Expectations with Endogenous Information Acquisition: An Experimental Investigation," *The Review of Economics and Statistics*, forthcoming 2020, pp. 1–54.

Gaines-Ross, Leslie, *Corporate Reputation: 12 Steps to Safeguarding and Recovering Reputation*, Hoboken, NJ: John Wiley & Sons, Inc., 2008.

Holmstrom, Bengt R. and Jean Tirole, "Chapter 2 The theory of the firm," in "Handbook of Industrial Organization," Vol. 1 of *Handbook of Industrial Organization*, Elsevier, 1989, pp. 61–133.

Huyck, John B Van, Raymond C Battalio, and Richard O Beil, "Tacit coordination games, strategic uncertainty, and coordination failure," *American Economic Review*, 1990, *80* (1), 234–248.

Jarrell, Gregg and Sam Peltzman, "The impact of product recalls on the wealth of sellers," *Journal of Political Economy*, 1985, *93* (3), 512–536.

John, Kose and David C Nachman, "Risky debt, investment incentives, and reputation in a sequential equilibrium," *Journal of Finance*, 1985, *40* (3), 863–878.

Johnson, Simon, Peter Boone, Alasdair Breach, and Eric Friedman, "Corporate governance in the Asian financial crisis," *Journal of Financial Economics*, 2000, *58* (1-2), 141–186.

Kagel, John H and Dan Levin, "Independent private value auctions: Bidder behaviour in first-, second-and third-price auctions with varying numbers of bidders," *Economic Journal*, 1993, *103*, 868–879.

Karpoff, Jonathan, "Does reputation work to discipline corporate misconduct?," in Michael Barnett and Timothy Pollock, eds., *The Oxford Handbook of Corporate Reputation*, Oxford University Press, 2011, chapter 18, pp. 361–382.

Karpoff, Jonathan M and John R Lott Jr, "The reputational penalty firms bear from committing criminal fraud," *Journal of Law and Economics*, 1993, *36* (2), 757–802.

__ **, D Scott Lee, and Gerald S Martin**, "The cost to firms of cooking the books," *Journal of Financial and Quantitative Analysis*, 2008, *43* (3), 581–611.

Kreps, David M and Robert Wilson, "Reputation and imperfect information," *Journal of Economic Theory*, 1982, *27* (2), 253–279.

__ **and** __ , "Sequential equilibria," *Econometrica*, 1982, *50* (4), 863–894.

Levin, Jonathan and Steven Tadelis, "Profit sharing and the role of professional partnerships," *The Quarterly Journal of Economics*, 2005, *120* (1), 131–171.

Liberman, B, "Experimental studies of conflict in some two-person and three-person games," *Mathematical methods in small group processes*, 1962.

Liker, Jeffrey, *The Toyota-Way: 14 Management Principles from the World's Greatest Manufacturer*, McGraw-Hill Companies, Inc., 2004.

Liu, Qingmin, "Information acquisition and reputation dynamics," *Review of Economic Studies*, 2011, *78* (4), 1400–1425.

Lucas, Robert E, "Adaptive behavior and economic theory," *Journal of Business*, 1986, *59* (4, Part 2), 401–426.

Mailath, George J and Larry Samuelson, "Who wants a good reputation?," *Review of Economic Studies*, 2001, *68* (2), 415–441.

Maksimovic, Vojislav and Sheridan Titman, "Financial Policy and Reputation for Product Quality," *Review of Financial Studies*, 1991, *4* (1), 175–200.

McMillan, Charles, "From applause to notoriety: Organizational reputation and corporate governance," in Ronald J. Burke, Graeme Martin, and Cary L. Cooper, eds., *Corporate Reputation: Managing Opportunities and Threats*, Gower: Burlington, Vt. 2011, pp. 161–180.

Messick, David M, "Interdependent decision strategies in zero-sum games: A computer-controlled study," *Behavioral Science*, 1967, *12* (1), 33–48.

Milgrom, Paul and John Roberts, "Predation, reputation, and entry deterrence," *Journal of Economic Theory*, 1982, *27* (2), 280–312.

Morrison, Alan D. and William J. Wilhelm, "Partnership firms, reputation and human capital," *American Economic Review*, 2004, *94*, 1682–1692.

Murphy, Deborah L, Ronald E Shrieves, and Samuel L Tibbs, "Understanding the penalties associated with corporate misconduct: An empirical examination of earnings and risk," *Journal of Financial and Quantitative Analysis*, 2009, *44* (1), 55–83.

Myerson, Roger B, "Optimal coordination mechanisms in generalized principal–agent problems," *Journal of Mathematical Economics*, 1982, *10* (1), 67–81.

Neral, John and Jack Ochs, "The sequential equilibrium theory of reputation building: A further test," *Econometrica: Journal of the Econometric Society*, 1992, pp. 1151–1169.

New York Times, "Kobe Steel Blames Plant Managers for Quality Control Scandal," *New York Times*, Nov. 10, 2017.

Noe, Thomas H, Michael J Rebello, and Thomas A Rietz, "Product market efficiency: The bright side of myopic, uninformed, and passive external finance," *Management Science*, 2012, *58* (11), 2019–2036.

Noe, Thomas H., Michael J. Rebello, and Thomas A. Rietz, "Firm reputation and agency: Information environments, corporate governance and its optics," 2024.

Peltzman, Sam, "The effects of FTC advertising regulation," *Journal of Law and Economics*, 1981, *24* (3), 403–448.

Plott, Charles R, "Industrial organization theory and experimental economics," *Journal of Economic Literature*, 1982, *XX*, 1485–1527.

Shachat, Jason and Todd Swarthout, "How do people play against Nash opponents in games which have a mixed strategy equilibrium?," 2008.

Shleifer, Andrei and Daniel Wolfenzon, "Investor protection and equity markets," *Journal of Financial Economics*, 2002, *66* (1), 3–27.

_ **and Robert W Vishny**, "A survey of corporate governance," *The Journal of Finance*, 1997, *52* (2), 737–783.

Smith, Vernon L and James M Walker, "Monetary rewards and decision cost in experimental economics," *Economic Inquiry*, 1993, *31* (2), 245–261.

Tirole, Jean, "A Theory of Collective Reputations (with Applications to the persistence of Corruption and to Firm Quality)," *Review of Economic Studies*, 1996, *63*, 1–22.

Zizzo, Daniel John, "Experimenter demand effects in economic experiments," *Experimental Economics*, 2010, *13* (1), 75–98.

For online publication only

Appendix

Governance, Stakeholder Welfare, Crises and Recovery: An Experiment

A Examples of organizational reputation crises in firms

Table A.1: *Examples of organizational reputation crises and recovery attempts.*

Year	Company	Event	Response
2015-2018	Theranos	Falsified medical testing ability.	Theranos denied allegations. Partners stopped using Theranos. SEC charged Thernos with Fraud, removed CEO, and barred her from serving as an officer or director of public companies. Thernos closed 9/5/2018.
2017	Kobe Steel	Falsified quality data.	Changed quality control processes and reporting procedures. Established an Independent Investigation Committee, a Quality Governance Restructuring Deliberation Committee and a Quality Management Department.
2016	Wells Fargo	Fake accounts.	Fined by regulators. Terminated employees, ended sales goals, restructured sales practices, replaced CEO and other management. New CEO resigned in April 2019.
2015	Volkswagen	Faked emission test results.	Replaced CEO. Suspended some employees. Recalled cars. Refocused on electric and hybrid vehicles. Compensated owners. Regulators signed off on software updates.
2013	Lululemon	"Too sheer" yoga pants.	Created new factory oversight system and new organizational structure. Replaced CEO.
2012	Barclays	Manipulated LIBOR rates.	Created new "Brand and Reputation Committee." Replaced CEO. Adopted "zero tolerance" policy.
2012	JP Morgan	"London Whale."	Overhauled risk metrics. Replaced personnel. Dismantled trading arm that caused the problem.
2009-2016	Takata Air Bags	Manipulated test data on air-bag inflators.	NHTSA ordered revision of production and quality control procedures. NHTSA fined Takata for inadequate response. Takata filed for bankruptcy on 6/26/17.
2009-2010	Toyota	Acceleration problems.	Recalled and redesigned systems. Developed the "Toyota Way." Restructured oversight under "Customer First Committee."
2007	Mattel	Lead paint on toys.	Recalled toys. Created new testing procedures. Changed suppliers. Put Mattel personnel in supplier's factories.
2007	RC2	Lead paint on toys.	Recalled toys (initially at owners' shipping expense). Takara Tomy purchased RC2 in April, 2011.
2006-2008	Siemens	Corruption	Set up anticorruption task force. Created rules and compliance processes, training programs, disciplinary actions, terminated employees.

B Proofs of results

Proof of Lemma 1. Under professional management, in period 2, the payoff to a normal operator who selects operating policy $o_2 \in \{m,s\}$ at some $\hbar_2^o$ is

$$v_2^{\text{po}}(o_2|\hbar_2^o) = \begin{cases} B_2(p_2)\,\mathbb{1}[q_1 = h] & o_2 = s, \\ B_2(p_2)\,\mathbb{1}[q_1 = h] + c & o_2 = m. \end{cases}, \quad \text{for all } \hbar_2^o \in \mathcal{H}_2^o. \tag{B.1}$$

The indicator function for $q_1 = h$ it is included because the normal operator in period 2 is the original period 1 operator only when period 1 quality is h. As we have described previously, replacement managers do not receive operator contracts. Under owner management, in period 2, the payoff to a normal operator who selects operating policy $o_2 \in \{m,s\}$ at some $\hbar_2^o$ is

$$v_2^{\text{oo}}(o_2, p_2|\hbar_2^o) = \begin{cases} p_2 - e - R\,\mathbb{1}[q_1 = l] & o_2 = s, \\ p_2 - e + c - R\,\mathbb{1}[q_1 = l] & o_2 = m. \end{cases}, \quad \text{for all } \hbar_2^o \in \mathcal{H}_2^o. \tag{B.2}$$

The result follows directly from inspecting the operator payoffs described by equations (B.1) and (B.2). □

Proof of Lemma 2. Part (a). The claim about $\mu_1^*(\hbar_1^c)$ follows because, in period 1, the price is set before customers observe the action of the operator; so the probability customers assign to the operator being committed is their prior belief, ρ_1.

Now consider P_1^*. The committed operator always chooses policy s and the normal operator sets policy m by hypothesis. Under the policy s, $q_1 = h$. Thus, the expected value of the period 1 good equals $\mu_1^*(\hbar_1^c) + \delta\,(1 - \mu_1^*(\hbar_1^c))$. Since $\mu_1^*(\hbar_1^c) = \rho_1$ the expected quality of the period 1 good equals $\rho_1 + \delta\,(1-\rho_1)$, which equals F_1 defined in this lemma. The rational expectations condition for a sequential equilibrium (Definition 1.a) thus implies that $P_1^*(\hbar_1^c) = F_1$.

Now consider Part (b). When $o_1^*(\hbar_1^o) = m$, customers' period 2 history $\hbar_2^c = (\hbar_1^c, h)$ is reached both when the (i) operator is committed and when the (ii) operator is normal and the m policy results in $q_1 = h$. The probability of (i) is $\mu_1^*(\hbar_1^c)$, which equals ρ_1. The probability that the operator is normal, chooses policy m, and $\tilde{n}_1 = 1$, is $\delta\,(1-\rho_1)$. Thus, Bayes rule implies that

$$\mu_2^*(\hbar_1^c, h) = \frac{\rho_1}{\rho_1 + \delta\,(1-\rho_1)}.$$

Now consider P_2^*. Lemma 1 shows that a normal operator will set $o_2 = m$. Using the same arguments as used in part (a), we see that the rational expectations condition (Definition 1.a) implies that

$$P_2^*(\hbar_1^c, h) = 1 \times \frac{\rho_1}{\rho_1 + \delta\,(1-\rho_1)} + \delta \times \left(1 - \frac{\rho_1}{\rho_1 + \delta\,(1-\rho_1)}\right). \tag{B.3}$$

Next, note that equation (3) implies that

$$\rho_1 = \frac{F_1 - \delta}{1 - \delta}. \tag{B.4}$$

Replacing the ρ_1 terms on the right-hand side of equation (B.3) , with the right-hand side of equation (B.4) and simplifying verifies the expression for $P_2^*(\hbar_1^c, h)$ presented in this lemma. □

Proof of Lemma 3. Part (a) follows because, in period 1, the price is set before customers observe the actions of the operator; so the probability that customers assign to the operator being committed at $\hbar_1^c$ is the customers' prior, ρ_1.

Now consider P_1^*. The committed operator always chooses operating policy s. By hypothesis the normal operator sets $o_1^*(\hbar_1^o) = s$. The s policy always yields an h quality good in period 1. So, $q_1 = h$. Hence, the good's value equals 1 and the rational expectations condition (Definition 1.a) implies that the customers' price at $\hbar_1^c$ equals 1.

Part (b) follows because, when $o_1^*(\hbar_1^o) = s$, the customer history $\hbar_2^c = (\hbar_1^c, h)$ is reached with probability 1. Thus Bayes rule implies that $\mu_1^*(\hbar_1^c) = \mu_2^*(\hbar_2^c)$.

Now consider P_2^*. Lemma 1 shows that, at all date 2 histories of the normal operator, the normal operator plays m. Using the same argument as used in Lemma 3.a, we see that, when the operator plays s, expected good quality equals 1, and when the operator plays m, expected good quality equals δ. Thus, the rational expectations condition (Definition 1.a) implies that the price of the period 2 good, $P_2^*(\hbar_1^c, h)$, equals $1 \times \rho_1 + \delta\,(1-\rho_1)$. □

Proof of Lemma 4. Part (a) follows because $\hbar_2^c = (\hbar_1^c, l)$ implies that $q_1 = l$, so reform is initiated and is successful with prior probability r. When reform is successful, the (normal) operator must use policy s by assumption. When reform fails, Lemma 1 shows that the operator chooses policy m. The Lemma's specification of P_2^* follows from the same argument used to establish Part (a) of Lemma 2 after replacing $t = 1$ with $t = 2$ and replacing ρ_1 with r. □

Lemma B-1. *Let g represent any fixed governance policy in $\mathcal{G}$ and let $\hbar_1^o(\mathscr{R})$ represent the operator's period 1 history on the equilibrium path in a reputation equilibrium, i.e., $\hbar_1^{o*} = \hbar_1^o(\mathscr{R}) := (g, P_1^*(g))$. Then, in any subgame starting from g, (a) a reputation equilibrium exists under governance policy g if and only if*

$$\hat{v}_1^{po}(s, g|\mathscr{R}) - \hat{v}_1^{po}(m, g|\mathscr{R}) = (1-\delta)\left(\big(B_2(F_1) - B_2(F_r)\big) - c\,\frac{\delta}{1-\delta}\right) \geq 0.$$

(b) In the reputation equilibrium, beliefs and prices are given by Lemma 3, and Lemma 4 and operator strategies are $o_1^*(\hbar_1^o) = s$, for all $\hbar_1^o \in \mathcal{H}_1^o$, and $o_2^*(\hbar_1^o) = m$, for all $\hbar_2^o \in \mathcal{H}_2^o$.

Proof of Lemma B-1. For fixed governance policy, g, histories in $\mathcal{H}_1^o$ vary only with respect to period-1 prices, $p_1 \in \mathbb{R}_+$. The payoff to a normal operator, in period 1, who selects operating policy $o_1 \in \{m,s\}$ at some history $\hbar_1^o$ is

$$v_1^{\text{po}}(o_1,g|\hbar_1^o) = B_1(p_1) + \begin{cases} v_2^{\text{po}}\Big(o_2(\hbar_2^o(s\text{-}h)), B(P_2(\hbar_1^c,h))|\hbar_2^o(s\text{-}h)\Big) & o_1 = s. \\ c + \delta\, v_2^{\text{po}}(o_2(\hbar_2^o(m\text{-}h)), B_2(P_2(\hbar_1^c,h))|\hbar_2^o(m\text{-}h)) + (1-\delta)\, B_2(P_2(\hbar_1^c,l)) & o_1 = m, \end{cases}$$

for all $\hbar_1^o \in \mathcal{H}_1^o$, where

$$\hbar_2^o(m\text{-}h) = (\hbar_1^o, m, h, P_2(\hbar_1^c,h)) \text{ and } \hbar_2^o(s\text{-}h) = (\hbar_1^o, s, h, P_2(\hbar_1^c,h)). \tag{B.5}$$

Inspection of equation (B.5) shows that the difference between the payoff from the s and m policies is not affected by p_1. Hence, any policy that is a best reply for the operator at $\hbar_1^o(\mathscr{R})$, is a best reply for all $\hbar_1^o \in \mathcal{H}_1^o$. So define the function $\hat{v}_1^{\text{po}}(\cdot|\mathscr{R}) : \{m,s\} \times \mathcal{G} \to \mathbb{R}$ by substituting the results of Lemmas 1, 3 and 4 into equations (B.5) and (B.1). The resulting function is

$$\hat{v}_1^{\text{po}}(o_1,g|\mathscr{R}) = \begin{cases} B_1(1) + \big(B_2(F_1) + c\big) & o_1 = s, \\ B_1(1) + \delta\,\big(B_2(F_1) + c\big) + (1-\delta)\, B_2(F_r) & o_1 = m. \end{cases} \tag{B.6}$$

A comparison of these two payoffs establishes the lemma. □

Definition B-1. We will define the following condition,

$$B_2(F_2) - B_2(F_r) \leq c\,\frac{\delta}{1-\delta}, \tag{B.7}$$

as the *no-reputation condition* and represent the set of governance policies that satisfy the condition with $\mathcal{G}_{\neg\mathscr{R}}$.

Lemma B-2. *Let g represent any fixed governance policy in $\mathcal{G}$ let $\hbar_1^o(\neg\mathscr{R})$ represent the operator's period 1 history on the equilibrium path in a no-reputation equilibrium. Then, in any subgame starting from g, (a) a no-reputation equilibrium exists under governance policy g if and only if*

$$\hat{v}_1^{po}(s,g|\neg\mathscr{R}) - \hat{v}_1^{po}(m,g|\neg\mathscr{R}) = (1-\delta)\left(\big(B_2(F_1) - B_2(F_r)\big) - c\,\frac{\delta}{1-\delta}\right) \leq 0,$$

and (b) in the no-reputation equilibrium, beliefs and prices are given by Lemma 2, and Lemma 4 and operator strategies are $o_1^*(\hbar_1^o) = m$, for all $\hbar_1^o \in \mathcal{H}_1^o$, and $o_2^*(\hbar_1^o) = m$, for all $\hbar_2^o \in \mathcal{H}_2^o$.

Proof of Lemma B-2. Using the same arguments as in the Proof of Lemma B-1, except using Lemma 2 instead of Lemma 3, we can define a $\hat{v}_1^{\text{po}}(\cdot|\neg\mathscr{R})$ function by substituting the beliefs and prices determined by Lemmas 1, 2 and 4 into equations (B.5) and (B.1). The resulting function is

$$\hat{v}_1^{\text{po}}(o_1, g|\neg\mathscr{R}) = \begin{cases} B_1(F_1) + \big(B_2(F_2) + c\big) & o_1 = s, \\ B_1(F_1) + \delta\,\big(B_2(F_2) + c\big) + (1-\delta)\,B_2(F_r) & o_1 = m. \end{cases} \tag{B.8}$$

A comparison of these two payoffs establishes the lemma. □

Proof of Lemma 5. The fact that $F_1 < F_2$ (equation (5)) and the assumed monotonicity of operator contracts imply that it is always the case that $B(F_2) \geq B(F_1)$. Inspection of the reputation and no reputation conditions shows that, if the reputation condition is strictly satisfied, or $B(F_2) > B(F_1)$ and the reputation condition is satisfied, then the no-reputation condition cannot be satisfied. Conversely, if the reputation condition is satisfied with equality and $B(F_2) = B(F_1)$ then it is possible for both the reputation and reputation and no reputation conditions to be satisfied. The lemma now follows from Lemmas B-1 and B-2. □

Lemma B-3. *If g^* is an optimal governance policy, (a) either (i) $g^* \in \mathcal{G}_{\mathscr{R}}$ and g^* is an efficient reputation ensuring governance policy or (ii) $g^* \in \mathcal{G}_{\neg\mathscr{R}}$ and g^* is a no-expected compensation policy. (b) If $g^* \in \mathcal{G}_{\mathscr{R}}$, in the subgame rooted at g^*, a unique reputation equilibrium exists, no no-reputation equilibria exist. (c) If $g^* \in \mathcal{G}_{\neg\mathscr{R}}$, in the subgame rooted at g^*, a unique no-reputation equilibrium exists, no reputation equilibria exist.*

Proof of Lemma B-3. The proof follows directly from the discussion of the efficient reputation-assuring policy and the no expected compensation policies preceding Proposition 1. □

Proof of Proposition 1. Part (a) of Lemma B-3 shows that, although $\mathcal{G}_{\mathscr{R}} \cap \mathcal{G}_{\neg\mathscr{R}}$ might be non-empty, members of $\mathcal{G}_{\mathscr{R}} \cap \mathcal{G}_{\neg\mathscr{R}}$ are never optimal governance policies. Given Lemma B-3, we can partition the set of candidate equilibria: we call members of the set defined by (i), $\mathscr{R}$-candidate equilibria, and the set defined by (ii) $\neg\mathscr{R}$-candidate equilibria.

Consider the owner's payoff function

$$v^{\mathrm{PM}}(g,P,o) = P_1(h_1^c) - B_1(P_1(h_1^c)) - e + \rho_1\left(P_2(h_1^c,h) - B(P_2(h_1^c,h)) - e\right) + \tag{B.9}$$
$$(1-\rho_1)\Bigg(\mathbb{1}[o_1(h_1^o)=s]\left(P_2(h_1^c,h) - B(P_2(h_1^c,h)) - e\right) +$$
$$\delta\,\mathbb{1}[o_1(h_1^o)=m]\left(P_2(h_1^c,h) - B(P_2(h_1^c,h)) - e\right) +$$
$$(1-\delta)\mathbb{1}[o_1(h_1^o)=m]\left(P_2(h_1^c,l) - B(P_2(h_1^c,l)) - e - R\right)\Bigg).$$

Because all $\mathscr{R}$-candidate equilibria are payoff equivalent as are all $\neg\mathscr{R}$-candidate equilibria, substituting equilibrium-path operator strategies and good prices, defined in Lemmas B-1 and B-2, into the owner's payoff function v^{PM} results in a well-defined function, denoted by $\hat{v}^{\mathrm{PM}}$, which maps the payoffs from $\mathscr{R}$ and $\neg\mathscr{R}$-candidate equilibria into owner payoffs. After an algebraic simplification that uses the relationship between F_1 and ρ_1 defined in equation (B.4), the resulting expressions are

$$\begin{aligned}\hat{v}^{\mathrm{PM}}(\mathscr{R}) &= 1 - e + (F_1 - e - b^*), \\ \hat{v}^{\mathrm{PM}}(\neg\mathscr{R}) &= (F_1 - e) + (1-F_1)\,(F_r - e - R) + F_1\,(F_2 - e).\end{aligned} \tag{B.10}$$

Comparing $\hat{v}^{\mathrm{PM}}(\mathscr{R})$ and $\hat{v}^{\mathrm{PM}}(\neg\mathscr{R})$ yields

$$\begin{aligned} & 1 - e + F_1 - e - b^* \geq F_1 - e + (1-F_1)(F_r - R - e) + F_1(F_2 - e) \\ \iff\ & \pi_1 - b^* \geq (1-F_1)\pi_r + F_1\left(1 + \delta - \frac{\delta}{F_1} - e\right) \iff b_1^* \leq (1-F_1)(\pi_1 - \pi_r + \delta), \end{aligned} \tag{B.11}$$

where $\pi_1 = 1 - e$ denotes the period 1 profit if the good's price is 1, and $\pi_r = F_r - e - R$ denotes the period 2 profit if the firm is reformed. This yields the conditions for the existence and uniqueness of reputation equilibria. □

Lemma B-4. *Under owner management (a) a reputation equilibrium exists if and only if*

$$(F_1 - F_r + R)\,(1-\delta) - c\,(1 - (1-\delta)\,r) \geq 0,$$

and (b) in the reputation equilibrium, beliefs and prices are given by Lemma 3, and Lemma 4 and operator strategies are $o_1^*(h_1^o) = s$, for all $h_1^o \in \mathcal{H}_1^o$, and $o_2^*(h_1^o) = m$, for all $h_2^o \in \mathcal{H}_2^o$.

Proof of Lemma B-4. In period 2, the payoff to a normal operator who selects operating policy $o_2 \in \{m,s\}$ at some h_2^o is described in expression (B.2). Similarly, in period 1, the payoff from selecting operating policy $o_1 \in \{m,s\}$ at history $\hbar_1^o$ is

$$v_1^{oo}(o_1,g)|\hbar_1^o) = \begin{cases} p_1 - e + v_2^{oo}\big(o_2(\hbar_2^o(s\text{-}h)), P_2(\hbar_1^c,h)\big|\hbar_2^o(s\text{-}h)\big) & o_1 = s, \\ p_1 - e + c + \delta\, \underbrace{v_2^{oo}\big(o_2(\hbar_2^o(m\text{-}h)), P_2(\hbar_1^c,h)\big|\hbar_2^o(m\text{-}h)\big)}_{\text{Term 1}} + \\ (1-\delta)\Big(\underbrace{(1-r)\,v_2^{oo}\big(o_2(\hbar_2^o(m\text{-}l)), P_2(\hbar_1^c,l)\big|\hbar_2^o(m\text{-}l)\big) + r\,(P_2(\hbar_1^c,l) - e - R)}_{\text{Term 2}}\Big) & o_1 = m, \end{cases} \tag{B.12}$$

for all $\hbar_1^o \in \mathcal{H}_1^o$, where $\hbar_2^o(s\text{-}h) = (\hbar_1^o, s, h, P_2(\hbar_1^c,h))$, $\hbar_2^o(m\text{-}h) = (\hbar_1^o, m, h, P_2(\hbar_1^c,h))$, and, $\hbar_2^o(m\text{-}l) = (\hbar_1^o, m, l, P_2(\hbar_1^c,l))$

Substituting the necessary conditions for reputation equilibria imposed by Lemmas 1–4 into these payoff functions yields

$$\hat{v}_1^{oo}(o_1|\mathscr{R}) := \begin{cases} 1 - e + (F_1 - e + c) & o_1 = s, \\ 1 - e + c + \delta\,(F_1 - e + c) + (1-\delta)\,(F_r - e + c - R - rc) & o_1 = m. \end{cases} \tag{B.13}$$

Comparing the payoffs contingent on $o_1 = s$ and $o_1 = m$ yields the desired condition:

$$\begin{aligned} 1 - e + (F_1 - e + c) \geq 1 - e + c + \delta\,(F_1 - e + c) + (1-\delta)\,(F_r - e + c - R - rc)\Big) \\ \iff (F_1 - F_r + R)\,(1-\delta) - c\,(1 - (1-\delta)\,r) \geq 0. \end{aligned} \tag{B.14}$$

Note also that:

$$\begin{aligned} 1 - e + (F_1 - e + c) \geq 1 - e + c + \delta\,(F_1 - e + c) + (1-\delta)\,(F_r - e + c - R - rc)\Big) \\ \iff F_1 - e \geq \delta(F_1 - e) + \delta c + (1-\delta)(\pi_r + g) \iff F_1 \geq 1 - \pi_1 + b^* + \pi_r + g, \end{aligned} \tag{B.15}$$

where $\pi_1 = 1 - e$ denotes the period 1 profit if the good's price is 1, $\pi_r = F_r - e - R$ denotes the period 2 profit if the firm is reformed, and $g = (1-r)\,c$ represents the owner-operator's expected post-reform gain from opportunism. □

Lemma B-5. *Under owner management (a) a no reputation equilibrium exists if and only if*

$$(F_2 - F_r + R)\,(1-\delta) - c\,(1 - (1-\delta)\,r) \leq 0,$$

and (b) in the no reputation equilibrium, beliefs and prices are given by Lemma 2, and Lemma 4 and operator strategies are $o_1^*(\hbar_1^o) = m$, for all $\hbar_1^o \in \mathcal{H}_1^o$, and $o_2^*(\hbar_1^o) = m$, for all $\hbar_2^o \in \mathcal{H}_2^o$.

Proof of Lemma B-5. Substituting the necessary conditions for reputation equilibria imposed by Lemmas 1–4 into the owner-operator's payoff functions in equations (B.2) and (B.12) yields

$$\hat{v}_1^{\text{oo}}(o_1|\neg\mathscr{R}) := \begin{cases} 1-e+(F_2-e+c) & o_1 = s \\ 1-e+c+\delta\,(F_2-e+c)+(1-\delta)\,(F_r-e+c-R-rc) & o_1 = m. \end{cases} \tag{B.16}$$

A comparison of the two payoffs establishes the lemma. □

Proof of Proposition 2. Note that the condition for existence of a reputation equilibrium presented in Lemma B-4 is equivalent to condition (B.15), which is the condition presented in the proposition. Note that $F_2 > F_1$. Thus, inspection of the conditions in Lemmas B-4 and B-5 shows that, if the condition for a reputation equilibrium provided in Lemma B-4, is satisfied, the condition for a no-reputation equilibrium provided by Lemma B-5 cannot be satisfied. Hence, if the existence condition for a reputation equilibrium provided in Lemma B-4 is satisfied, a reputation equilibrium exists, and a no-reputation equilibrium does not exist. This establishes the proposition. □

Proof of Proposition 3. We prove the contrapositive of the proposition, i.e., that if a reputation equilibrium exists under owner management but not under professional management, then the hypothesis of Proposition 3, equation (15) is false.

To see this note that, if the conditions for a reputation equilibrium are satisfied under owner-management but not delegated management, then Propositions 1 and 2 imply that

$$\begin{aligned} F_1 &> 1-\frac{b^*}{\delta+(\pi_1-\pi_r)}, \\ F_1 &\geq 1+b^*-(\pi_1-\pi_r)+g. \end{aligned} \tag{B.17}$$

Expression (B.17) implies that

$$F_1 \geq \max\left[1-\frac{b^*}{\delta+(\pi_1-\pi_r)}, 1+b^*-(\pi_1-\pi_r)+g\right]. \tag{B.18}$$

Clearly,

$$\max\left[1-\frac{b^*}{\delta+(\pi_1-\pi_r)}, 1+b^*-(\pi_1-\pi_r)+g\right] \geq \inf_{b\geq 0}\max\left[1-\frac{b}{\delta+(\pi_1-\pi_r)}, 1+b-(\pi_1-\pi_r)+g\right]. \tag{B.19}$$

Let

$$b^o = \frac{\delta + (\pi_1 - \pi_r)}{1 + \delta + (\pi_1 - \pi_r)} ((\pi_1 - \pi_r) - g).$$

Algebra shows that

$$1 - \frac{b^o}{\delta + (\pi_1 - \pi_r)} = 1 + b^o - (\pi_1 - \pi_r) + g.$$

Again, simple algebra shows that $(\pi_1 - \pi_r) - g > 0$ and thus $b^o \geq 0$. Because,

$$\begin{aligned} 1 - \frac{b}{\delta + (\pi_1 - \pi_r)} \quad & \text{is strictly decreasing in } b, \\ 1 + b - (\pi_1 - \pi_r) + g \quad & \text{is strictly increasing in } b, \end{aligned}$$

$$1 - \frac{b}{\delta + (\pi_1 - \pi_r)} > (<) 1 + b - (\pi_1 - \pi_r) + g \iff b < (>) b^o.$$

Thus,

$$\begin{aligned} & \inf_{b \geq 0} \max \left[1 - \frac{b}{\delta + (\pi_1 - \pi_r)}, 1 + b - (\pi_1 - \pi_r) + g \right] \\ & \qquad = \max \left[1 - \frac{b^o}{\delta + (\pi_1 - \pi_r)}, 1 + b^o - (\pi_1 - \pi_r) + g \right] = \frac{1 + \delta + g}{1 + \delta + (\pi_1 - \pi_r)}. \end{aligned} \tag{B.20}$$

Expressions (B.18), (B.19), and (B.20) imply that

$$F_1 \geq \max \left[1 - \frac{b^*}{\delta + (\pi_1 - \pi_r)}, 1 + b^* - (\pi_1 - \pi_r) + g \right] \geq \frac{1 + \delta + g}{1 + \delta + (\pi_1 - \pi_r)}.$$

Which implies that the hypothesis of the proposition, inequality (15), is false. □

Proof of Corollary 1. Offering reputation-assuring compensation is optimal if and only if

$$\begin{aligned} 1 - e + F_1 - e - b^* & \geq F_1 - e + F_1(F_2 - e) \\ \iff \pi_1 - b^* & \geq F_1 \left(1 + \delta - \frac{\delta}{F_1} - e \right) \\ \iff b_1^* & \leq (1 - F_1)(\pi_1 + \delta). \end{aligned} \tag{B.21}$$

The result follows directly. □

Proof of Corollary 2. Defecting to act opportunistically is suboptimal if and only if

$$\begin{aligned} 1-e+F_1-I &\geq 1-I+\delta(F_1-I) \\ \iff F_1-e &\geq \delta(F_1-e)+\delta c \\ \iff F_1 &\geq 1-\pi_1+b^*. \end{aligned} \tag{B.22}$$

The result follows directly. □

Lemma B-6. *When the firm is controlled by an owner-operator, in a mixed equilibrium:*

1. $p_1^* = \frac{F_1-\delta}{p_2^*-\delta}$.
2. *If the owner-operator remains unrevealed,* $p_2^* = 1-\pi_1+b^*+\pi_r+g$.
3. *If the owner-operator is normal, the owner picks policy* m *with probability* $\eta = \frac{1-p_1^*}{(1-\rho_1)(1-\delta)}$.

Proof of Lemma B-6. To be willing to randomize, the owner-operator must be indifferent between policies s and m. Her expected payoff from setting $o_1 = s$:

$$p_1^*-e+p_2^*-I, \tag{B.23}$$

Her expected payoff from setting $o_1 = m$ equals:

$$p_1^*-I+\delta(p_2^*-I)+(1-\delta)\Big(r(F_r-e)+(1-r)(F_r-I)-R\Big). \tag{B.24}$$

The price in each period equals the total probability of a high quality good. Since beliefs and, thus, prices conform to Bayes' rule. The period 2 posterior probability of the owner-operator being the committed type conditioned on remaining unrevealed is $\frac{\rho_1}{F_1^*}$. Thus, the period 2 price conditioned on the owner-operator remaining unrevealed in period 1 equals:

$$\begin{aligned} p_2^* = \frac{\rho_1}{p_1^*}+\left(1-\frac{\rho_1}{p_1^*}\right)\delta = \delta+\frac{\rho_1(1-\delta)}{p_1^*} &= \delta+\frac{F_1-\delta}{p_1^*} \\ \iff p_1^* &= \frac{F_1-\delta}{p_2^*-\delta}. \end{aligned} \tag{B.25}$$

Equating the two expected payoffs, (B.23) and (B.24), we obtain

$$\begin{aligned} p_1^*-e+p_2^*-I = p_1^*-I+\delta(p_2^*-I)+(1-\delta)\Big(r(F_r-e)+(1-r)(F_r-I)-R\Big) \\ \iff p_2^*-e = \delta(p_2^*-I)+(1-\delta)(\pi_r+g) \\ \iff (1-\delta)(p_2^*-e) = \delta c+(1-\delta)(\pi_r+g) \\ \iff p_2^* = 1-\pi_1+b^*+\pi_r+g. \end{aligned} \tag{B.26}$$

□

C Subject instructions

This appendix contains instructions for the owner-manager treatment with the opportunity to reform under Parameter Set I. Differences across treatments are minimal and instructions for other treatments are available on request.

INSTRUCTIONS

General

You are about to participate in an experiment on decision making. If you follow these instructions carefully and make good decisions, you might earn a considerable amount of money, which will be paid to you in cash at the end of the experiment.

At the beginning of the experiment, all players are assigned a type: Blue or Green. You will remain Blue or Green throughout the experiment. Next, one Blue and one Green Player are randomly assigned to a 2-player group. These players will interact with each other for two periods. Then, players are randomly re-assigned to new groups for two more periods. This process repeats until the end of the experiment.

The currency used in these games is francs. Each period, you receive franc payoffs that are yours to keep. At the end of the experiment, you will exchange francs for dollars. Your individual exchange rate will be displayed on your computer terminal after the experiment starts. Do not reveal this number to anyone. At the end of the experiment, your francs will be converted to dollars at this rate, and you will be paid in dollars. Note that the more francs you earn, the more dollars you earn regardless of the exchange rate.

Stages of the Game

Each period is divided into two stages.

Briefly, in Stage I, the Blue Player makes decisions about producing an item and sells it to the experimenter. In Stage II, the Green Player will have an opportunity to buy the item from the experimenter. There are two types of items: Round, worth 1,000 francs to the Green Player and Square, worth 0 francs to the Green Player.

Because it will make it easier to understand, we describe the Stages in reverse order.

Stage II Instructions

Green Player Decision

In Stage II, the Green Player sets a "Limit Price" for an item and *may* buy the item. If he or she does buy the item, it will be at a "Discounted Price" that is less than or equal to the Limit Price.

If the Green Player buys the item, he or she will receive a "Redemption Value" of 1,000 francs for a Round item and 0 francs for a Square item.

The item type is determined in Stage I but the type will not be known by the Green Player until after he or she establishes the Limit Price in Stage II.

Procedures

The Limit Price and the Discounted Price for the item will be determined as follows.

1. Limit Price: The Green Player will be asked to indicate the *highest* price he or she is willing to pay for the item. This determines the ***Limit Price***. The Limit Price must be between 0 and 1,000 (inclusive). The Green Player is asked to enter the price and press "OK" to continue.

2. Discounted Price: The computer program will determine a ***Discounted Price*** by drawing a random number between 0 and 1,000 (inclusive) to be the Discounted Price.

If the random draw is ***less than or equal to*** the Limit Price, the Green Player will buy the item at the Discounted Price from the experimenter and receive the Redemption Value.

If the random draw is ***greater than*** the Limit Price indicated by the Green Player, then the Green Player will not buy the item.

Thus, the Limit Price defines the highest price that the Green Player will pay for the item. If he or she buys the item it will be at a Discounted Price less than or equal to the Limit Price.

Payoff Determination

The Green Player starts each period with working capital of 1,000 francs. This allows the Green Player to pay up to 1,000 francs for an Item. Three quarters (75%) of the working capital will be deducted at the end of the period. The Green Player's payoffs are determined as follows:

If the Discounted Price is greater than the Limit Price:

Period Payoff = 1,000 – 750 = 250.

If the Discounted Price is less than the Limit Price:

Period Payoff = 1,000 + Redemption Value – Discounted Price – 750.

Notice that buying the item increases your payoff whenever the Redemption Value is higher than the Discounted Price AND you buy the item (that is, the Limit Price is higher than the Discounted

Price).

Notes on this Procedure

If you are a Green Player, it is in your best interest to be accurate; that is, the best thing you can do is state truthfully the highest price you would be willing to pay for the item as the Limit Price. If the price stated is too high or too low, then you pass up opportunities that you would prefer.

Suppose you are a Green Player and you are certain that the Item will be Round. Then, you should set a Limit Price of 1,000. If you set it less, say 800, then whenever the random draw is between 800 and 1,000, you will not purchase the item even though the item is worth more to you than the discounted price. For example, if the Discounted Price is 900, you are better off buying the item (Payoff = 1000+1000-900-750 = 350) than not buying the item (Payoff = 1000-750 = 250). The only way to insure that you will always buy the item when the Discounted Price is less than the value is to set the Limit Price at 1,000.

Similarly, if you are certain that the Item will be Square, then you should set a Limit Price of 0. If you set it more, say 200, then whenever the random draw is between 0 and 200, you end up buying the item even though it is worthless to you. For example, if the Discounted Price is 100, you are worse off buying the item (Payoff = 1000+0-100-750 = 150) than not buying the item (Payoff = 1000-750 = 250). The only way to insure that you will never buy the item when the Discounted Price is more than the value is to set the Limit Price at 0.

Similar arguments imply that, if, on average, you expect the item value to be X francs (e.g., 500), then you should set a Limit Price equal to X (e.g., 500). If so, you always buy the item when the Discounted Price is less than what you think it is worth on average and never buy it if the Discounted Price is more than what you think it is worth.

We will discuss Stage I next. Before doing that, are there any questions about the Green Player's actions in Stage II and the Green Player's payoffs?

<u>Stage I Instructions</u>

In Stage I, the Blue Player selects a "production method." Methods available and the earnings received by the Blue Player vary as described below.

Determining Available Production Methods

In the first period of a group interaction, the computer randomly determines the production methods available to the Blue Player.

In the first period, 1/8 (12.5%) of the Blue Players MUST produce according to the following method in BOTH periods:

- **Method 1: Sure**, which always produces a Round Item

In the first period, the other 7/8 (87.5%) of the Blue Players can CHOOSE between producing according to:

- **Method 1: Sure**, which always produces a Round Item.
- **Method 2: Mixed**, which produces a Round Item 1/20 (5%) of the time and a Square Item 19/20 (95%) of the time.

In the second period, these Blue Payers will be restricted to a single production method as follows:

- If these Blue Players produce a Round Item in the first period of a group interaction, they MUST produce according to **Method 2 Mixed** in the second period of the group interaction.
- If these Blue Players produce a Square Item in the first period of a group interaction, the computer will randomly re-draw production methods for the second period of the group interaction. In this case, 1/10 (10%) of the Blue Players MUST produce according to **Method 1: Sure** and 9/10 (90%) MUST produce according to **Method 2: Mixed** in the second period of the group interaction.

Payoff Determination

The Blue Player's payoffs are determined by a "Sale Price" set by the experimenter and a method payment in each period.

In the first period of a group interaction, the Sale Price equals the Limit Price set by the Green Player. Thus, the payoff is the Limit Price minus a method payment that depends on the method chosen. Specifically:

Period 1 Payoff		
Method:	Method 1: Sure	Method 2: Mixed
Availability:	Always	7/8 (87.5%) of the time
+ Sale Price - Method Payment	Limit Price -111	Limit Price -51
Total Payoff	Limit Price - 111	Limit Price - 51

For example, suppose the Limit Price was 500 in Period 1. Your payoff would be:

- 500-111=389 if **Method 1: Sure** was available and chosen.
- 500-51=449 if **Method 2: Mixed** was available and chosen.

In the second period of the group interaction, the Blue Player is always restricted to one production method. The Sale Price is set by the experimenter depending on the Item Type produced in Period 1 and the redraw outcome. In addition, if the Period 1 Item was Square, the experimenter will charge a cost to redraw production methods.

The Blue Player's payoffs are summarized in the following table:

Period 2 Payoff				
Period 1 Item:	Round (No Redraw)		Square (Redraw)	
Method:	Method 1: Sure	Method 2: Mixed	Method 1: Sure	Method 2: Mixed
Availability:	If only Method 1 was available in Period 1	If both Methods were available in Period 1	1/10 (10%) of the time	9/10 (90%) of the time
+ Sale Price - Method Payment - Redraw Cost	192 -111 0	192 -51 0	145 -111 -10	145 -51 -10
Total Payoff	81	141	24	84

In Period 2 after a Round Item in Period 1, your payoff would be:

- 81 if **Method 1: Sure** becomes the only available method in Period 2 because it was the only available method in Period 1.
- 141 if **Method 2: Mixed** becomes the only available method in Period 2 because both methods were available in Period 1 and a Round item was produced.

In Period 2 after a Square Item in Period 1 and a redraw in Period 2, your payoff would be:

- 24 if **Method 1: Sure** becomes the only available method as a result of the redraw.
- 84 if **Method 2: Mixed** becomes the only available method as a result of the redraw.

We will discuss how player types and groups are determined next. Before doing that, are there any questions about the Blue Player's actions in Stage I and the Blue Player's payoffs?

Group, Player Type and Technology Determination

At the beginning of the experiment, you are assigned a player type: "Blue" or "Green." You remain this type of player for the entire experiment. Every 2 periods, one Blue and one Green Player are matched randomly to play the game for two periods. Everyone is re-assigned to new groups every 2 periods. Thus, in periods 1 and 2, you will be with one group. In period 3, you will be randomly re-assigned to new groups for periods 3 and 4, etc.

The computer draws new Production Methods at the beginning of each group interaction (that is, every 2 periods) as follows:

1. 1/8 (12.5%) of the Blue Players will ONLY be able to produce using "**Method 1: Sure**."
2. 7/8 (87.5%) of the Blue Players on average will be able to produce using EITHER "**Method 1: Sure**" OR "**Method 2: Mixed**."

If no redraw occurs in Period 2 of a group interaction, "**Method 1: Sure**" remains the only available production method if it was the only available method in Period 1. "**Method 2: Mixed**" becomes the only available production method if both methods were available in Period 1.

If a redraw occurs in Period 2 of a group interaction because a Square item was produced in Period 1, "**Method 1: Sure**" becomes the only available production method 1/10 (10%) of the time and "**Method 2: Mixed**" becomes the only available production method 9/10 (90%) of the time.

Neither the Methods available nor the Method actually chosen are revealed to the Green Player. The Item type is revealed after Period 1 and whether methods were redrawn is revealed between periods. So, in Period 2, there are the following possibilities:

1. The Blue Player produced a Round Item in Period 1. Thus, the Green Player does not know whether "**Method 1: Sure**" or "**Method 2: Mixed**" was used in Period 1 nor which is the only available method in Period 2. (Recall, **Method 1: Sure** is always available and, sometimes, **Method 2: Mixed** produces a Round Item in Period 1.)

2. The Blue Player produced a Square Item in Period 1 and a redraw occurred. Thus, the Green Player knows that "**Method 2: Mixed**" was available and used in Period 1, but does not know the method available in Period 2. (Recall that, after a redraw, 1 in 10 times, only **Method 1: Sure** is available and 9 in 10 times only **Method 2: Mixed** is available.)

<u>End of Period Results</u>

The computer program reports results to you at the end of each period. Beginning in the next period a history of results appears in two windows. The left window shows the publicly available information given to all players in your group. Note that this will NOT give the Methods available to or used by the Blue Player. The right window gives your private information and shows your payoff. You can scroll through these windows and record results as you wish. In particular, you may want to fill in your earnings on your receipt each period.

<u>End of Experiment Rules</u>

The computer will total your earnings in francs at the end of the experiment. It multiplies this amount by the exchange rate to determine the amount of dollars you receive. Fill this number in on your receipt. You will be paid this amount of dollars in cash.

Are there any questions?

Summary Sheet

Methods are drawn randomly each time groups are reassigned as follows:

1. Initially, 1/8 of the Blue Players will have ONLY "**Method 1: Sure**" available.
2. The other 7/8 of the Blue Players will have both "**Method 1: Sure**" and "**Method 2: Mixed**" available.

Within a group:

1. If the Period 1 item is Round and "**Method 1: Sure**" was the only method available, it remains the only available method in Period 2.
2. If the Period 1 item was Round and both methods were available, "**Method 2: Mixed**" becomes the only available method in Period 2.
3. If the item produced in Period 1 was Square then, methods are redrawn in Period 2.

3.1. “**Method 1: Sure**” will be the only method 1/10 times.

3.2. “**Method 2 Mixed**” will be the only method the other 9/10 times.

Neither the methods available nor the method actually used in any given period will be revealed to the Green Player. Only the Item type will be revealed.

The game proceeds as follows:

1. Players are randomly assigned to groups every two periods. The Blue Player is assigned newly drawn Methods.

2. Stage I

   2.1. The Blue Player chooses a method.

   2.2. The Blue Player receives a payment as follows:

      - In the first period of a group interaction, the Blue Player receives: the Limit Price of the item minus 111 if **Method 1: Sure** is used OR the Limit Price minus 51 if **Method 2: Mixed** is used.
      - In the second period of a group interaction, the Blue Player receives:
        - 81 if a Round item was produced in Period 1 and Method 1: Sure is used in Period 2.
        - 141 if a Round item was produced in Period 1 and Method 2: Mixed is used in Period 2.
        - 24 if a Square item was produced in Period 1 and Method 1: Sure is used in Period 2.
        - 84 if a Square item was produced in Period 1 and Method 2: Mixed is used in Period 2.

3. Stage II

   3.1. The Green Player receives working capital of 1,000 each period.

   3.2. The Green Player will be told whether Methods have been newly drawn, re-drawn or be restricted to a single method from the prior period.

   3.3. Prices are determined:

      - The Green Player decides the most he or she is willing to pay for the item and sets the Limit Price.

- The computer draws a random Discounted Price between 0 and 1,000.
- If the Discounted Price is less than or equal to the Limit Price, the Green Player will buy the item at the Discounted Price and receive the Redemption Value (1000 for Round and 0 for Square).

3.4. In all cases, the Green Player returns 75% of the working capital (750).

You are free to make as much money as you can according to these rules.

D Second period payoffs in the experimental game.

Table D.2: *Operator payoffs in the second period.*

Firm Type	Period 1 Good Quality	Reform Outcome	Period 2 Technology	Parameter Set I	Parameter Set II
Panel A: OM Treatments					
Secure	High	N.A.	Reliable	169 - 111 = 58	288- 111 = 177
Insecure	High	N.A.	Vulnerable	169 - 51 = 118	288 - 51 = 237
Insecure	Low	N.A.	Vulnerable	0	0
Panel B: OMR Treatments					
Secure	High	N.A.	Reliable	192 - 111 = 81	288- 111 = 177
Insecure	High	N.A.	Vulnerable	192 - 51 = 141	288 - 51 = 237
Insecure	Low	Success	Reliable	145 - 111 - 10 = 24	145 - 111 - 10 = 24
Insecure	Low	Failure	Vulnerable	145 - 51 - 10 = 84	145 - 51 - 10 = 84
Panel C: PM Treatments					
Secure	High	N.A.	Reliable	30	30
Insecure	High	N.A.	Vulnerable	30 + 60 = 90	30 + 60 = 90
Insecure	Low	Success	Reliable	0	0
Insecure	Low	Failure	Vulnerable	0	0

E Learning and experience weighted attraction in the experiment

Prior research on reputation in laboratory settings documents that (1) subject behavior deviates systematically from predictions of a rational choice equilibrium benchmark and (2) as subjects gain experience, their strategies better approximate equilibrium predictions (e.g., Brandts and Figueras, 2003; Noe et al., 2012). The main purpose of our experiment is to see whether our theory survives such systematic behavioral deviations. We document this in the main body of the paper. Here, we ask whether the experience moves behavior toward equilibrium predictions as documented in prior research.

E.1 Operator choices as a Markov process

We study how operator choices evolve using two methods. First, we model them as a Markov process (cf. Axelrod, 1987; Erev and Roth, 1998) and ask whether state transitions evolve toward equilibrium predictions. There are three possible operator condition–choice pairs: $(\text{secure}, \text{reliable})$, $(\text{insecure}, \text{reliable})$, $(\text{insecure}, \text{vulnerable})$. We use these three pairs as the states of the Markov model. We term the first pair the "secure" state. The second the "reputation" state, and the third, the "opportunistic" state.[1] We estimate the transition matrix using the method of moments, and use the estimated transition matrix to compute steady-state probabilities (Norris, 1998). The estimates are presented in Panel A of Table E.3. Panel B of Table E.3 provides estimates conditioned on the previous round's outcome. Overall, the evidence in Table E.3 indicates a tendency for reputable behavior to increase with operator experience.

E.2 Experience weighted attraction

We also estimate regression models of subject behavior. Again, we are asking whether behavior moves toward equilibrium behavior with experience. We model subject choices as a function of the treatment, subject demographics, and experience. We use dummy variables to represent treatments and parameter set/treatment interactions and gender (which is the only demographic variable that appears significantly correlated with behavior). We account for subject experience using experience weighted attraction (EWA) models along the lines of Erev and Roth (1998) and Camerer et al. (2002) that account for the profitability of past choices.

[1] Of course, the operator has no control over transitions to the strategy in the secure state. These transitions are controlled entirely by the parameter set and random draws. However, the transitions will figure into the overall stable probabilities and, therefore, must be considered.

Table E.3: *Evolution of reputation formation.* Panel A presents the initial frequency, overall frequency, and estimated steady state probability of the reputation state, the state where the firm is insecure yet the reliable technology is adopted by the operator. Panel B presents the frequency of adoption of the reliable technology by operators whose firms are insecure conditioned on the outcome in the previous round. The last column of Panel B shows the χ^2 statistic for independence between the prior strategies and reputable behavior in the next period.

Panel A: Frequencies and steady state (SS) probabilities of reputation building

	Paremter Set 1			Paremter Set 2		
Treatment	Round 1	Overall	SS	Round 1	Overall	SS
OM	61.9%	72.6%	74.0%	61.1%	68.2%	68.7%
obs.	21	241	#N/A	18	198	#N/A
OMR	50.0%	50.2%	50.2%	50.0%	56.8%	57.2%
obs.	20	225	#N/A	18	199	#N/A
PM	46.7%	69.7%	72.8%	47.1%	59.6%	61.3%
obs.	15	201	#N/A	17	208	#N/A

Panel B: Frequency of reputation building conditioned on previous round's outcome

		Outcome in previous round				
	State:	Secure	Reputation	Opportunistic		
	Good's Quality:	High	High	Low	High	
	Treatment					Chi2 (p-value)
Parameter Set 1	OM	80.0%	78.5%	61.1%	0.0%	12.10 (0.007)
	OMR	30.8%	61.5%	46.4%	0.0%	13.12 (0.004)
	PM	59.1%	83.9%	51.0%	33.3%	22.38 (0.000)
Parameter Set 2	OM	58.7%	75.3%	66.7%	0.0%	6.36 (0.095)
	OMR	48.7%	62.2%	58.6%	0.0%	4.70 (0.195)
	PM	52.3%	85.2%	31.5%	20.0%	46.31 (0.000)

E.2.1 Experience weighted attraction for operators

To model operator behavior, along the lines of Erev and Roth (1998) and Camerer et al. (2002), we define the attraction to the reputation, opportunism and secure strategies as follows:

$$\begin{aligned} A_{s,t}^{Reputation} &= A_{s,t-1}^{Reputation} + \Phi_{s,t-1}^{Reputation}\left[\pi_{s,t-1}^{Reputation} - \delta E(\pi_{s,t-1}^{Defection}) - \min\left(\pi_{s,t-1}^{i} - \delta E(\pi_{s,t-1}^{j})\right)\right], \\ A_{s,t}^{Opportunism} &= A_{s,t-1}^{Defection} + \Phi_{s,t-1}^{Defection}\left[\pi_{s,t-1}^{Defection} - \delta E(\pi_{s,t-1}^{Reputation}) - \min\left(\pi_{s,t-1}^{i} - \delta E(\pi_{s,t-1}^{j})\right)\right], \text{ and} \\ A_{s,t}^{Secure} &= A_{s,t-1}^{Secure} + \Phi_{s,t-1}^{Secure}\left[\pi_{s,t-1}^{Secure} - \delta E(\pi_{s,t-1}^{Secure}) - \min\left(\pi_{s,t-1}^{i} - \delta E(\pi_{s,t-1}^{j})\right)\right], \end{aligned} \tag{E.27}$$

where t indexes rounds (each consisting of two periods), $A_{s,t}^{i}$ is the attraction that strategy i holds for subject s in round t (with $A_{s,1}^{i} = 0$); $\Phi_{s,t-1}^{i}$ is an indicator function equal to 1 if subject s plays strategy i in round $t-1$; $\pi_{s,t-1}^{i}$ is the (two-period overall) profit received by subject s who played strategy i in round $t-1$; $E(\pi_{s,t-1}^{\neg i})$ is the profit subject s would have expected to receive by playing the best alternative strategy to i in period $t-1$; and δ is a weighting function for the strategies not played. Subtracting the minimum possible profit difference both normalizes the attractions and insures that attractions are never negative. If $\delta = 0$, the subject weights only payoffs actually received in updating attractions. If $\delta = 1$, the subject weights strategies played equally with the forgone earnings of unplayed strategies.

To see the intuition behind these attraction measures, consider a simple example. Suppose an owner-manager of an insecure firm plays the reputation strategy in treatment OM-I. The payoff to the strategy is: $p_0 - 111 + 118$. The expected payoff from the opportunism strategy is: $p_0 - 60 + 0.05 \times 118$. In this case, the lowest possible payoff to any strategy is -53. So, if $\delta = 0$, the increment to attraction is: $p_0 - 111 + 118 + 53 = p_0 + 60$. If $\delta = 1$, the subject considers the expected payoff to the defection strategy and the lowest difference in expected payoffs between strategies is -58. So, the increment to attraction becomes $p_0 - 111 + 118 - (p_0 - 51 + 0.05 \times 118) + 58 = 110.1$.

Given the attractions at the beginning of a round, the propensity to play a strategy is given by:

$$q_{s,t}^{i} = \frac{A_{s,t}^{i}}{\sum_j A_{s,t}^{j}}. \tag{E.28}$$

Note that, as defined, higher (lower) payoffs from playing the reputation strategy in the past add to (subtract from) the propensity to play it again. Similarly, lower (higher) payoffs to playing the opportunism strategy in the past adds to (subtract from) the propensity to play the reputation strategy currently. Thus, a greater propensity for reputable behavior is driven by either high past payoffs to the reputation strategy or low past payoffs to opportunism.

Each model assumes that the propensity to make a choice (i.e., the choice's "attraction") depends on the weighted average of the prior profitabilities of playing each choice relative to the prior profitabilities of playing other choices. We calculate two sets of attraction measures: In one set, the propensities depend only on the profitabilities of prior choices, referred to as "Gross Profit EWA." In the second set, the propensities are computed by comparing the outcome of each choice relative to the most profitable feasible alternative choice, defined as "Net Profit EWA."[2] Our estimates employ robust standard errors clustered by subject to control for repeated observations.[3] We present the estimates in Table E.4.

In Table E.4 we present logit models of operator behavior. The estimates in the table suggest that (i) consistent with our model's prediction, adding reform reduces reputable behavior under Parameter Set I and there is no significant difference between the OM and PM treatments in fostering reputation. Men are somewhat more prone to behave reputably under Parameter Set I.[4] (ii) operators are more prone to choose the reliable technology when this choice has led to higher payoffs in previous rounds. (iii) professional managers are more responsive to past profitability than owner-managers.

E.2.2 Explaining customer conjectures in period 1

For customers, we change the attraction measures slightly because of the continuous strategy space. We measure attraction as either (1) average period 1 net profits received by customers in prior interactions as a result of buying goods or (2) average prior period 1 values observed by customers in prior rounds. Specifically, we define the "attraction" of a good as either:

$$A_{s,t}^{good} = \sum_{n=1}^{t-1} \frac{\Phi_{s,n}^{i} \left(V_{s,n}^{good} - DP_{s,n}^{good} \right)}{t-1} \tag{E.29}$$

or

$$A_{s,t}^{good} = \sum_{n=1}^{t-1} \frac{V_{s,n}^{good}}{t-1} \tag{E.30}$$

[2]We note that, because propensities are probabilities, alternative specifications of these models would be to use the log-odds ratio of the reliable technology choice propensity as the independent variable. While the results mirror those displayed in Table E.4, we lose 28% of the observations because the propensities are either 0 or 1.

[3]Fixed effects models cannot be used because each subject participates in only one treatment.

[4]In unreported regressions aggregating across treatments, men remain somewhat more prone to form reputations than women. Men (women) account for 50.36% (49.64%) of operator decisions for insecure firms. Interactions of gender, treatment and parameter set show no significant coefficients.

Table E.4: *Logit regression analysis of reputable behavior by operators of insecure firms.* The dependent variable equals 1 if an operator chooses the reliable technology. Gender is a dummy variable equal to 1 if the subject is male. Owner-Mgr., Owner-Mgr. w/ Reform and Professional Mgr. are dummy variables for the governance structure treatments. Experience weighted attraction (EWA) regressions include separate propensities to play the reputation strategy in each treatment as defined in equations (E.27) and (E.28) with $\delta = 0$ or $\delta = 1$. Robust standard errors clustered by subject appear in parentheses below each estimate.

			Gross Profit EWA		Net Profit EWA	
	Parameter Set		Parameter Set		Parameter Set	
	I	II	I	II	I	II
Constant	0.66^{***}	0.69^{***}	-0.57	-0.03	-0.39	-0.06
	(0.24)	(0.25)	(0.41)	(0.37)	(0.39)	(0.45)
Gender	0.53^{*}	0.17	0.45^{**}	0.08	0.56^{**}	-0.02
(1=Male)	(0.28)	(0.28)	(0.20)	(0.20)	(0.24)	(0.23)
Owner-Mgr.	-0.84^{***}	-0.48^{*}	-0.24	-0.47	-0.30	-0.30
w/ Reform	(0.30)	(0.29)	(0.46)	(0.41)	(0.46)	(0.50)
Professional Mgr.	-0.15	-0.40	-0.77	-1.21^{***}	-1.39	-1.61^{***}
	(0.40)	(0.36)	(0.70)	(0.47)	(0.91)	(0.55)
Exp. Wtd. Propensity			2.09^{***}	1.39^{***}	1.26^{***}	1.21^{**}
x Owner-Mgr.			(0.66)	(0.54)	(0.47)	(0.53)
Exp. Wtd. Propensity			1.52^{***}	1.76^{***}	1.11^{*}	1.17^{**}
x Owner-Mgr. w/ Reform			(0.51)	(0.54)	(0.63)	(0.54)
Exp. Wtd. Propensity			2.94^{***}	3.09^{***}	3.06^{***}	3.74^{***}
x Professional Mgr.			(0.76)	(0.54)	(0.92)	(0.60)
Obs.	667	605	667	605	667	605
Psuedo R2	4.43%	0.87%	11.84%	9.45%	8.50%	9.98%

***, ** and * denote significance at the 99%, 95% and 90% levels of confidence, respectively.

where $A_{s,t}^{good}$ is subject s's attraction to the good in round t, $V_{s,n}^{good}$ equals the good's value in round n, $\Phi_{s,n}^{i}$ is an indicator function equal to 1 if subject s purchased the good in round n, and $DP_{s,n}^{good}$ is the good's discounted price for subject s in round n. We refer to the first measure as "Average Prior Net Profit Attraction." It averages prior net profits, weighting un-purchased goods by 0 and purchased goods by their value relative to their purchase prices (analogous to $\delta = 0$ in equation E.28). Thus, it considers not just the value of goods purchased, but also the cost of purchasing them. This measure does not capture the effect of goods not purchased. The second, "Average Prior Value Attraction," is the prior average good value. It is the analog of equation (E.27) with $\delta = 1$ because goods not purchased have the same weight as purchased goods.[5]

Table E.5 presents estimates of the effect of treatments, parameter sets and experience on period 1 prices.[6] The estimates uniformly indicate that experience matters. Average Prior Net Profit has a uniformly large and positive effect on prices in all treatments under Parameter Set I. The effect remains positive but is only weakly significant (at best) in Parameter Set II. Average Prior Values always has a large and statistically significant positive effect on prices in both parameter sets. Our earlier evidence indicates that operators' strategies evolve toward adoption of the reputation strategy, especially after experiencing higher profits. This tendency, when combined with the evolution of customer strategies toward setting higher good prices suggests that the feedback between customer and operators' strategies tends to reduce both the systematic deficiency in reputable behavior as well as the substantial undervaluation of goods observed in the experiment.

E.2.3 Explaining customer conjectures in period 2

Table E.6 presents estimates of experience weighted attraction (EWA) models for period 2 prices. Consistent with our model's predictions, revelation results in a significant price drop of around 320 francs under both parameter sets. The direct effects of reform are broadly in line with the model's predictions. Prices are higher for revealed firms in the professional management and owner manager with reform treatments. For unrevealed firms, as the model predicts, period 2 prices are higher only when we add reform to owner management under Parameter Set I. The estimates incorporating EWA models uniformly indicate that experience matters. As is the case with period 1 goods' prices, customers generally tend to raise (lower) their bid prices for goods

[5] We note that this also happens to be the method of moments estimator for a Beta-Binomial Distribution for the probability of a high quality good based on prior observations.

[6] Because, in theory, prices directly convey probabilities of high quality items, we could construct a logistic version of the regressions using OLS on the implied logistic variable defined as $\ln\left(\frac{P/1000}{1-P/1000}\right)$. However, if we do this, we lose 36% of the observations because subjects either set prices at 0 or 1000.

Table E.5: *Censored normal regressions explaining period 1 prices.* Gender is a dummy variable equal to 1 if the subject is male. Round number is the number of rounds at that point in the experimental session. Owner-Mgr., Owner-Mgr. w/ Reform and Professional Mgr. are dummy variables for the governance structure treatments. Attraction regressions include average values and average prior net profits in previous rounds. Robust standard errors clustered by subject appear in parentheses below each estimate. ***, ** and * denote significance at the 99%, 95% and 90% levels of confidence, respectively.

			Average Prior Net Profit Attraction		Average Prior Value Attraction	
	Parameter Set		Parameter Set		Parameter Set	
	I	II	I	II	I	II
Constant	704.15***	759.76***	540.03***	704.04***	119.00	416.77**
	(112.30)	(100.35)	(93.44)	(132.96)	(164.59)	(163.00)
Gender	-48.07	-135.84	-74.04	-129.39	-56.42	-82.46
(1=Male)	(83.45)	(83.84)	(72.09)	(90.13)	(73.37)	(76.20)
Round Number	8.02**	4.94*	7.41**	4.34	8.96**	2.98
	(3.42)	(2.87)	(3.78)	(2.91)	(3.59)	(3.07)
Owner-Mgr.	-215.63**	-98.53	-115.73	-148.14	54.08	-335.57
w/ Reform	(105.40)	(111.94)	(106.33)	(166.53)	(188.91)	(262.44)
Professional Mgr.	-104.89	-143.75	-28.87	-134.22	168.22	-188.76
	(112.12)	(97.45)	(127.02)	(132.67)	(201.16)	(199.58)
Attraction			1.07***	0.18	0.80***	0.42**
x Owner-Mgr.			(0.36)	(0.23)	(0.21)	(0.18)
Attraction x Owner-			0.44***	0.64*	0.48***	0.88***
Mgr. w/ Reform			(0.14)	(0.37)	(0.16)	(0.30)
Attraction			0.41*	0.49	0.41***	0.58***
x Professional Mgr.			(0.21)	(0.33)	(0.16)	(0.21)
Obs.	756	792	693	726	693	726
Left Censored	76	96	71	88	71	88
Right Censored	191	196	174	178	174	178
Psuedo R2	0.41%	0.29%	1.46%	0.70%	1.35%	1.40%

after observing higher (lower) quality goods in the past.

Overall, the analysis shows that (1) the intuition underlying our model survives significant behavioral deviations from optimizing behavior and (2) over time, behaviors moves toward those predicted, increasing the tendency toward the equilibria predicted by our model.

Table E.6: *Censored normal regressions explaining period 1 prices.* Gender is a dummy variable equal to 1 if the subject is male. Round number is the number of rounds at that point in the experimental session. Owner-Mgr., Owner-Mgr. w/ Reform and Professional Mgr. are dummy variables for the governance structure treatments. Attraction regressions include average values and average prior net profits in previous rounds. Robust standard errors clustered by subject appear in parentheses below each estimate. "***," "**," "*" denote significance at the 99%, 95% and 90% levels of confidence respectively.

			Average Prior Net Profit Attraction				Average Prior Value			
			Revealed Firms		Unrevealed Firms		Revealed Firms		Unrevealed Firms	
	Parameter Set		Parameter Set		Parameter Set		Parameter Set		Parameter Set	
	I	II	I	II	I	II	I	II	I	II
Constant	250.31**	426.53***	-127.52	-205.38	-65.97	384.94**	-115.73	-186.83	-166.68	202.93
	(118.65)	(117.85)	(205.00)	(220.85)	(234.78)	(164.58)	(184.05)	(224.01)	(201.56)	(128.10)
Gender	12.87	71.04	-107.06	38.92	114.26	84.80	-75.21	-8.32	119.41	93.74
(1 = Male)	(90.97)	(92.93)	(130.68)	(167.45)	(141.46)	(110.35)	(122.43)	(178.77)	(119.91)	(96.90)
Period	-8.31*	-5.71	0.81	4.22	7.83	-0.59	3.82	3.32	4.89	-2.66
	(4.38)	(3.68)	(9.34)	(6.65)	(6.94)	(5.60)	(8.98)	(6.46)	(6.91)	(5.24)
Owner-Mgr.	348.09***	60.76	350.07*	333.60**	398.63*	-30.89	212.47	372.68**	315.48*	-172.67
w/ Reform	(115.24)	(109.51)	(190.01)	(151.18)	(219.92)	(153.14)	(178.15)	(173.97)	(190.06)	(158.43)
Professional Mgr.	216.39*	-11.47	399.74	314.97**	148.95	-111.77	331.64	254.66*	210.43	-16.60
	(128.11)	(86.71)	(266.20)	(152.90)	(235.90)	(125.23)	(212.54)	(153.35)	(183.71)	(139.42)
Revealed	-314.29***	-327.30***								
	(72.22)	(84.76)								
Attraction			-3.24**	220.41	-0.34	-0.11	-0.46	-0.08	1.17**	0.71**
x Owner-Mgr.			(1.50)	#N/A	(0.52)	(0.37)	(0.61)	(0.50)	(0.47)	(0.33)
Attraction x Owner-			0.18	-0.35	0.22	0.47	0.34*	0.11	0.74***	1.07***
Mgr. w/ Reform			(0.64)	(0.44)	(0.32)	(0.44)	(0.18)	(0.21)	(0.21)	(0.31)
Attraction			-0.78	1.07*	-0.32	0.25	0.86**	0.46	0.56*	0.30
x Professional Mgr.			(0.64)	(0.63)	(0.57)	(0.28)	(0.37)	(0.37)	(0.33)	(0.20)
Obs.	736	212	135	154	338	482	135	154	338	182
Left Censored	252	96	53	56	96	111	53	56	96	111
Right Censored	96	119	8	12	60	77	8	12	60	77
Psuedo R2	0.96%	0.63%	1.34%	1.69%	0.62%	0.24%	1.81%	1.25%	1.58%	1.52%

References

Axelrod, Robert, "The evolution of strategies in the iterated prisoner's dilemma," in Christina Bicchieri, Richard Jeffrey, and Brian Skyrms, eds., *The Dynamics of Norms*, Cambridge University Press, 1987, chapter 1, pp. 1–16.

Brandts, Jordi and Neus Figueras, "An exploration of reputation formation in experimental games," *Journal of Economic Behavior & Organization*, 2003, *50* (1), 89–115.

Camerer, Colin F, Teck-Hua Ho, and Juin-Kuan Chong, "Sophisticated experience-weighted attraction learning and strategic teaching in repeated games," *Journal of Economic Theory*, 2002, *104* (1), 137–188.

Erev, Ido and Alvin E Roth, "Predicting how people play games: Reinforcement learning in experimental games with unique, mixed strategy equilibria," *American Economic Review*, 1998, *88* (4), 848–881.

Noe, Thomas H, Michael J Rebello, and Thomas A Rietz, "Product market efficiency: The bright side of myopic, uninformed, and passive external finance," *Management Science*, 2012, *58* (11), 2019–2036.

Norris, James R, *Markov Chains*, Cambridge University Press, 1998.