Executive Compensation and the Role for Corporate Governance Regulation

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This article establishes a role for corporate governance regulation. An externality operating through executive compensation motivates regulation. Governance lowers agency costs, allowing firms to grant less incentive pay. When a firm increases governance and lowers incentive pay, other firms can also lower executive compensation. Because firms do not internalize the full benefit of governance, regulation can improve investor welfare. When regulation is enforced, large firms increase in value, small firms decrease in value, and all firms lower incentive pay. Distinct cross-sectional and cross-country predictions for the number of voluntary governance firms are provided. (*JEL* G34, G38)

The Sarbanes-Oxley Act of 2002 was enacted to protect shareholders from managerial misbehavior. Sarbanes-Oxley requires firms to maintain a sufficient standard of corporate governance. Most governance requirements of this law are measures that were available before SOX was passed. If required governance is such a good thing, why weren't firms already doing it? Why regulate corporate governance for the benefit of shareholders?

This article establishes a role for corporate governance regulation. Governance mitigates agency costs, allowing firms to grant less incentive pay. Firms do not fully internalize the benefit of governance due to the competitive labor market. When a firm improves governance, it lowers executive compensation, allowing other firms to lower executive compensation. Governance has a positive externality, too little governance is implemented in the competitive outcome, and regulation can improve investor welfare. This is not a Pareto improvement; optimal governance regulation benefits large firms but harms small firms.

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I model an economy of firms and managers. Any firm can hire any manager. Each firm hires one manager and faces an agency problem. The manager observes the firm's cash flow and can either give it to shareholders or divert it to personal uses. Governance makes it more difficult for the manager to misbehave. Firms choose the optimal combination of incentive pay and governance to induce managers to behave. Because small firms find governance too expensive, they solve the agency problem with only incentive pay. Large firms find governance cheap, so they prefer monitoring the manager closely and paying him little. Because large firms must pay managers enough not to leave the firm, small firms harm large firms by not exercising governance. There is a positive externality to governance, so regulation can improve investor welfare.

The model predicts that large firms exercise more governance than small firms do, consistent with Aggarwal et al. (2009), and that executive compensation increases in firm size, but pay-performance sensitivity decreases in firm size, consistent with Murphy (1999). The model suggests that these results are related—governance and pay-performance sensitivity are substitutes in solving agency problems. In response to governance regulation, the value of large firms increases, but the value of small firms decreases. Equity-based executive compensation falls in response to regulation, because governance and incentive pay are substitutes.

Comparing multiple industries in a single country, the number of voluntary governance firms is increasing in the severity of agency costs. Comparing across countries, the number of voluntary governance firms is hump-shaped in the severity of agency costs. The model produces distinct implications for cross-industry analysis and cross-country analysis, because different countries can have different regulatory regimes. Similarly, there are more voluntary governance firms in industries with more talented managers, but the relationship is hump-shaped across countries. There are fewer voluntary governance firms in industries with higher governance costs, but the relationship is hump-shaped across countries.

The model also suggests that the dispersion of firm productivity may have a role in explaining differences in corporate governance across time, industries, and countries. When the variance of firm productivity is high, firms exercise more governance. Because dispersion of firm productivity is countercyclical (empirically shown in Eisfeldt and Rampini 2006), the model suggests that governance should be lax during booms and tight during recessions.

Regulating corporate governance is difficult to justify. Hart (2009) argues that Sarbanes-Oxley must have been politically motivated, because governance is the outcome of contracting, and the imperfections that motivate regulation do not apply to corporate governance. Hermalin and Weisbach (1998) show that firms optimally reward good performance with lax governance, so it is difficult to argue that any particular governance scheme is the result of suboptimal contracting rather than the optimal reward to management for past success. The existing literature provides two other motivations for regulation:

time-inconsistent preferences (Kydland and Prescott 1977) and information externalities (Admati and Pfleiderer 2000). This model differs from those, because regulation limits the cost that firms with weak governance impose on other firms. In the absence of regulation, small firms implement too little governance and pay managers more than necessary (managers' participation constraints are lax at small firms), which forces large firms to pay managers more (by tightening the managers' participation constraints at large firms), because firms cannot contract on governance standards. Poor governance and excessive executive compensation are thus related—poor governance spreads through executive compensation.

This article reconciles two conflicting views from the executive compensation literature. One school of thought, the Managerial Power Perspective, claims poor governance is the cause of large levels of executive compensation granted by companies (see Bebchuk and Fried 2004). According to this view, management extracts rents from shareholders due to entrenchment. The other school claims CEOs merely receive the market value of their labor.¹ This article shows that these two views are not necessarily in conflict. Poor governance at one firm causes other firms to use poor governance and excessive executive compensation. If executive compensation is driven by a competitive market, there is a role for corporate governance regulation. The results hold under the Managerial Power Perspective if managerial rent extraction is increasing in rents extracted by other managers from other firms. Governance regulation is justified if executive compensation is increasing in executive compensation at other firms. This assumption appears reasonable for a variety of reasons, including recent articles on the relationship between executive compensation and peer group compensation, such as Faulkender and Yang (2010) and Bizjak, Lemmon, and Naveen (2008).

Governance reduces the benefit of misbehavior in the model, so results of this article should be applied only to the monitoring role of governance, such as financial disclosure and accounting standards.² Directors are not biased in favor of management, so they maximize firm value in the model. Thus, the model finds a role for governance regulation in a setting without managerial power.

Acharya and Volpin (2010) also derive a corporate governance externality operating through executive compensation. In their model, two homogeneous

¹ Gabaix and Landier (2008) find that the rise of CEO pay can be attributed to the increase in size of companies. They calibrate a superstar model of the market for executives originally conceived in Rosen (1981). Thus, Gabaix and Landier (2008) attribute the recent rise in executive pay to the market working correctly. Frydman and Jenter (2010) suggest that this view can only explain some of the dynamics of executive compensation over time. Whereas the model explains executive compensation since 1970, it fails to explain executive compensation between 1940 and 1970.

² Governance here does not refer to the GIM index from Gompers, Ishii, and Metrick (2003). The GIM index measures the strength of shareholder rights, focusing on anti-takeover provisions, but ignores independence of directors and committees, as well as auditing standards. Aggarwal et al. (2009) use a measure of the monitoring type of governance: actions taken by the firm, such as board independence and auditor quality, which mitigate agency problems.

firms do not compete directly for managerial talent but might compete later, so a firm's governance decision affects the other firm through the manager's reservation utility. Their model does not derive cross-sectional implications but instead explores market-based solutions to the externality. Also, Cheng (2009) shows that the use of relative performance evaluation leads to governance spillovers.

Section 1 presents the single-firm model and extends to a market for executives, and Section 2 examines governance regulation. Section 3 derives comparative statics, Section 4 describes empirical implications, and Section 5 contains policy implications of the model. Section 6 concludes. Proofs are in the Appendix, with additional notes in the Supplemental Materials.

1. Model

1.1 Single-firm model

A firm with size $S \in (0, \infty)$ hires a manager with talent $T \in (0, \infty)$. The firm's cash flow equals STz, where S is the size of the firm, T is the talent of the manager, and z is random. This random shock has expectation 1 and is weakly positive, though zero is a possible value (formally, $z \ge 0, z \sim F, 0 \in$ support(*F*), and Ez = 1). The firm can choose a level of governance $g \in [0, 1]$ at cost $\kappa g S$.³ Only the manager observes the cash flow y = STz. The manager reports $\hat{y} \le y$ and enjoys private benefit of $\lambda(1 - g)(y - \hat{y})$.⁴ Governance is costly action taken by the firm to decrease the private benefit of managerial misbehavior. Managerial misbehavior is lucrative but inefficient: $0 < \lambda < 1$. Both the firm and manager are risk-neutral, and the reported cash flows are contractible. The manager has an outside option of $U_0 > 0$ but has no initial wealth to invest in the project and is protected by limited liability. The firm pays $C(\hat{y})$ to the manager when he reports and delivers cash flow \hat{y} .

Given compensation $C(\cdot)$ and governance g, the manager chooses the reported cash flow \hat{y} to maximize his ex post payoff:

$$\widehat{y}(y;g) \in \underset{y' \le y}{\arg \max} \left\{ C\left(y'\right) + \lambda \left(1 - g\right)\left(y - y'\right) \right\}.$$
(1)

³ This cost function was chosen for tractability. Qualitatively similar results hold when the cost is not increasing too quickly in *S* and *T*. This allows us to match the property that governance is increasing in firm size. Similar but less elegant results hold for $(k_0 + k_1 ST) g$, where $k_0, k_1 > 0$, and for $\frac{k}{2} STg^2$. If there are fixed costs to governance (e.g., $k_0 * 1_{g>0} + k_1 Sg$), either all firms or no firms use governance, because firms will not pay a fixed cost for infinitesimal benefit. (In discrete versions of the model, qualitatively similar results are achieved with this cost function.) If governance cost is κSTg , firms have identical preferences toward governance so there is no externality.

⁴ The cash-diversion model used here is a linear case of the problem in Diamond (1984) and Lacker and Weinberg (1989), as used in DeMarzo and Fishman (2007). Solutions to this type of problem are isomorphic to solutions for effort problems with binomial effort and binomial output. g can be thought of as intensity of ex post audit, as in DeMarzo et al. (2005), because misbehavior is off-equilibrium. Off-equilibrium, the manager would not overreport if he could, because his pay-performance sensitivity is less than one (shareholders' payoff is increasing in the firm's cash flow).

The firm must pay the manager sufficiently:

$$E\left\{C\left(\widehat{y}\right) + \lambda\left(1 - g\right)\left(y - \widehat{y}\right)\right\} \ge U_0. \tag{2}$$

The firm maximizes expected profit:

$$E\left[\widehat{y}\left(y;g\right) - C\left(\widehat{y}\left(y;g\right)\right)\right] - \kappa gS,\tag{3}$$

subject to the manager's incentive compatibility constraint, the manager's participation constraint, the manager's limited liability constraint ($C(\cdot) \ge 0$), and the feasibility constraint for governance ($g \in [0, 1]$).

Lemma 1. The manager reports the cash flow truthfully in equilibrium, choosing $\hat{y}(y; g) = y$.

Lemma 1, an application of the revelation principle, shows that the manager behaves. Because $1 - \lambda(1 - g) > 0$ for any level of g, the firm is better off paying the manager his private benefit of misbehavior and inducing him to report the cash flow truthfully. The problem simplifies to the following:

$$\max_{C,g} E[y - C(y)] - \kappa g S$$

$$s.t. \ C(y) \ge C(\widehat{y}) + \lambda (1 - g) (y - \widehat{y}) \quad \forall \widehat{y} \le y$$

$$E[C(y)] \ge U_0, C(\cdot) \ge 0, \ g \in [0, 1].$$

$$(4)$$

Theorem 1. When $U_0 < \lambda ST$,⁵ the optimal contract depends on the level of talent. The firm pays a low-talent manager $(T \le \frac{\kappa}{\lambda})$ enough to solve the agency problem, setting

$$C(y) = \lambda y, g = 0$$

The firm pays a high-talent manager $(T > \frac{\kappa}{\lambda})$ no more than necessary, using governance to solve the agency problem:

$$C(y) = \frac{U_0}{ST}y, g = 1 - \frac{U_0}{\lambda ST}.$$

The firm chooses how to induce the manager to report truthfully. If the manager is less talented, the firm pays the manager enough to behave by

⁵ If $U_0 > ST$, the project produces less than the manager can produce elsewhere, so the firm will not hire the manager. If $\lambda ST \le U_0 \le ST$, the manager requires so much compensation the firm can grant him an equity share large enough to solve the agency problem. This works by the same intuition that if the principal sells the company to the agent, there ceases to be an agency problem. Because the manager has a sufficient stake (λ) in the company, he will behave.

granting him an equity share⁶ of λ . If the manager is sufficiently talented, the firm finds it optimal to monitor the manager as closely as possible and pay as little as possible. Though it seems counterintuitive that high-talent managers receive less of the firm than low-talent managers do, the result follows because equity-based pay is more expensive with a high-talent manager. Higher talented managers receive higher pay in a market setting (see Section 1.2).

Governance regulation is clearly harmful in the single-firm setting—firms could have implemented the required level of governance without regulation but chose not to. This logic extends to the case with a cross-section of firms, and the participation constraint, U(T), is an *exogenous* function of talent. However, when firms compete for managers, regulation can improve investor welfare by relaxing the participation constraint at some firms, mitigating excessive executive compensation.

1.2 General equilibrium model

There is a continuum of firms and managers, $x \in [0, 1]$ and $m \in [0, 1]$, rather than a single firm and manager. S(x) is the size of firm x, and T(m) is the talent of manager m. Size and talent are increasing and continuously differentiable. Talent is observable, freely movable, and equally useful at any firm. Each firm hires one manager. Random shocks, z, are independent across firms. Each firm chooses governance, g, prior to hiring a manager.⁷ Some firms prefer using incentive pay to solve the agency problem, whereas others prefer exercising governance, so by Theorem 1, $T(0) < \frac{\kappa}{\lambda} < T(1)$. Firms choose executive compensation and governance optimally, and each firm chooses its manager optimally.

Equilibrium An equilibrium in the market for managerial talent is a set of functions $\{m(x), C(y, x, m), g(x), w(m)\}$ that satisfies the following properties.

1. **Optimal Executive Compensation** C(y, x, m) is the optimal contract between firm x and manager m, given that firm x has hired manager m, the firm uses governance g(x), and manager m has an outside option of w(m).

⁶ Compensation to the agent is linear in the cash flow y, so the problem is solved with equity. Equity is optimal to align incentives of the manager and the firm, because the manager has the same time horizon as does the firm (this is a static problem). However, there is a dark side to equity-based pay. It leads the manager to be myopic if his horizon is shorter than the firm. Goldman and Slezak (2006) show that the manager may misrepresent the state of the firm to increase the value of his equity-based compensation.

⁷ If firms choose governance simultaneously with hiring, the differential equation for equity share explodes at x^* . Off-equilibrium, firms are willing to pay a better CEO not only for superior talent but also for lower governance costs. Less governance is necessary due to the higher equity share. This results in a singularity in the differential equation for equity share, β , at x^* . In discrete versions of the model, executive compensation is higher when management and governance are chosen simultaneously.

- 2. **Optimal Hiring** m(x) is the optimal choice of manager by firm x, given governance g(x), the compensation contract C(y, x, m), and the managers' reservation utility w(m).
- 3. **Optimal Governance** The firm chooses governance g(x) optimally, given the firm will hire manager m(x) in equilibrium, the reservation utility of that manager w(m), and optimal contract with that manager, C(y, x, m).
- 4. Endogenous Participation Constraint w (m) is the highest compensation that any other firm would be willing to pay manager m.
- 5. Each Firm Hires One Manager For any set of firms, the set of managers hired by that set of firms must have equivalent measure. Formally, for any set $A \subset [0, 1]$, the set $B(A) = \{\tilde{x} | \exists x \in A \text{ s.t. } \tilde{x} = m(x)\}$ must satisfy $\mu(A) = \mu(B(A))$.

Managers report truthfully in equilibrium (Lemma 1), so firms solve the following problem:

$$\max_{C,g,m} E_m [y - C(y, x, m)] - \kappa g S$$

$$s.t. \ C(y, x, m) \ge C(\hat{y}, x, m) + \lambda (1 - g(x))(y - \hat{y}) \quad \forall \hat{y} < y$$

$$E_m [C(y, x, m)] \ge w(m)$$

$$y = S(x) T(m) z.$$
(5)

Firms not only choose compensation and governance but also decide which manager to hire. Intuitively, managerial talent is more productive at larger firms, so large firms should be willing to pay more for managerial talent.

Lemma 2. The market for managerial talent results in an efficient allocation of managerial talent, so firm *x* hires manager *x*. Formally, m(x) = x for all *x*.

Lemma 2 shows that manager *m* is hired by firm *x*, allowing us to substitute m = x. The optimal contract is equity (Theorem 1), so define $\beta(x)$ such that $C(STz) = \beta(x) S(x) T(x) z$. Given this change of variables, the problem simplifies to

$$\max_{\substack{\beta,g}} S(x) T(x) - \beta(x) S(x) T(x) - \kappa g(x) S(x)$$
(6)
s.t. $\beta(x) \ge \lambda (1 - g(x))$
 $\beta(x) S(x) T(x) \ge w(x)$.

Define x^* so that $T(x^*) = \frac{\kappa}{\lambda}$. Large firms $(x > x^*)$ pay managers only their outside option. Small firms $(x < x^*)$ find governance too expensive, preferring

to grant managers a large equity share ($\beta \ge \lambda$) even if they must overpay managers.

Lemma 3. A manager's outside option is determined by pay at the next largest firm. Formally,

$$w(x) = \lim_{x' \to x^{-}} \left\{ \beta(x') S(x') T(x') + S(x') [T(x) - T(x')] \right\}.$$

The participation constraint becomes $\frac{d}{dx} (\beta ST) \ge S \frac{dT}{dx}$.

Executive compensation is increasing in firm size and must increase at least as fast as the product of firm size and marginal talent. Small firms $(x < x^*)$ never use governance (g = 0) but pay enough to solve the agency problem $(\beta \ge \lambda)$ and hire the manager $(\frac{d}{dx}(\beta ST) \ge S\frac{dT}{dx})$. Large firms pay just enough to hire the manager, setting $\frac{d}{dx}(\beta ST) = S\frac{dT}{dx}$ and exercising sufficient governance to induce the manager to behave, $g = \max\left\{1 - \frac{\beta}{\lambda}, 0\right\}$. Thus, compensation at large firms is

$$\beta(x)S(x)T(x) = \beta(x^*)S(x^*)T(x^*) + \int_{x^*}^x S(u)\frac{dT}{dx}(u)du.$$
 (7)

Firms do not enjoy the full benefit of corporate governance, because using governance not only allows that firm to lower executive compensation but also allows other firms to lower executive compensation. Therefore, corporate governance has a positive externality through executive compensation.

Theorem 2. Optimal governance regulation **strictly** improves investor welfare.

Theorem 2 shows that governance regulation can be beneficial; the proof shows that a small efficient change strictly improves investor welfare. However, Theorem 2 fails to describe optimal regulation. Section 1.3 applies insights from extreme value theory to provide the necessary structure to describe optimal governance regulation.

1.3 Specification

For the remainder of the article, firm size and managerial talent are assumed to have the following distribution. Firm size, S, follows a truncated power law distribution, and talent, T, follows a truncated generalized Pareto distribution.

$$S(x) = A (1 + q - x)^{-a}$$
(8)

$$T(x) = T_{Max} - \frac{B}{b} (1 + q - x)^{b}$$

for $x \in [0, 1]$, where 0 < b < a and q is a small, positive constant. Empirically, firm size appears to follow a power law distribution. If there is a very large pool of potential managers with talent drawn from a distribution with an upper bound, and the managers observed in the data are the most talented, then the distribution of talent follows by extreme value theory.⁸ Gabaix and Landier (2008) estimate $b \approx \frac{2}{3}$ and $a \approx 1$ in their calibration.

When the endogenous participation constraint binds for all $x \in (x_1, x_2)$,

$$\beta(x_2) S(x_2) T(x_2) = \beta(x_1) S(x_1) T(x_1) + \int_{x_1}^{x_2} S(u) \frac{dT}{dx}(u) du.$$
(9)

Under this specification,

$$\int_{x_1}^{x_2} S(u) \frac{dT}{dx}(u) du = \int_{x_1}^{x_2} A(1+q-u)^{-a} \left[B(1+q-u)^{b-1} \right] du$$
$$= \frac{AB}{a-b} \left[(1+q-x_2)^{b-a} - (1+q-x_1)^{b-a} \right].$$
(10)

Because b - a < 0, $(1 + q - x)^{b-a}$ is increasing in x.

The participation constraint binds at large firms (Theorem 1), so large firms $(x > x^*)$ pay

$$\beta(x) S(x) T(x) = \beta(x^*) S(x^*) T(x^*) + \frac{AB}{a-b} \left[(1+q-x)^{b-a} - (1+q-x^*)^{b-a} \right].$$
(11)

The worst CEO works at the smallest firm, so he has nowhere else to go, so w(0) = 0. Governance is too expensive for firm 0, so firm 0 grants $\beta(0) = \lambda$ to manager 0. For small firms, $x \in (0, x^*)$, either the incentive compatibility constraint or the endogenous participation constraint binds but only one binds (both require that β is sufficiently large). For simplicity, I make the following assumption.⁹

Assumption $\lambda a T_{Max} \ge B (1+q)^b (1+\lambda (\frac{a}{b}-1))$

Lemma 4. The participation constraint does not bind at small firms if this assumption holds.

When companies pay managers enough to solve the agency problem without governance, the participation constraint will not bind; managers are strictly

⁸ If you assume CEOs are the most talented subset of a very large set of potential CEOs drawn independently from an identical distribution with an upper bound, the distribution of CEOs will approach this distribution. Because Gabaix and Landier (2008) find $b \approx \frac{2}{3} > 0$, this is consistent with talent being drawn from a distribution with an upper bound. A similar argument can be given for firm size. See Gabaix and Landier (2008) for more details.

⁹ The proof of Lemma 4 shows which constraint binds at a small firm, whether or not the assumption holds. This assumption makes the solution more elegant.

better off staying at their current firms than going to smaller firms. The equilibrium is summarized by Theorem 3.

Theorem 3. Small firms pay managers enough to solve the agency problem and use no governance; for $x < x^*$, $\beta(x) = \lambda$ and g(x) = 0. Large firms pay managers just enough to hire them, using governance to solve the agency problem; for $x > x^*$, $g(x) = 1 - \frac{\beta(x)}{\lambda}$ and

$$\beta(x) S(x) T(x) = \lambda S(x^*) T(x^*) + \frac{AB}{a-b} \left[(1+q-x)^{b-a} - (1+q-x^*)^{b-a} \right].$$

Total compensation (βST) is increasing in firm size, pay-performance sensitivity (β) is decreasing in firm size, and governance (g) is increasing in firm size.

Pay-performance sensitivity across firms can be seen in Figure 1. Small companies pay sufficiently to induce the CEO to report truthfully, because governance is too expensive. Large firms pay just enough to hire the manager and use governance to induce behavior.

The profit of small firms $(x \le x^*)$ is $\Pi(x) = (1 - \lambda) S(x) T(x)$, whereas the profit of large firms $(x \ge x^*)$ is $\Pi(x) = S(x) [T(x) - \kappa] - \beta(x) S(x) T(x) \left[1 - \frac{\kappa}{\lambda T(x)}\right]$. Small firms maximize expected profit by not investing in governance, solving the agency problem through compensation. This harms large firms, because it forces them to pay managers more, though large firms prefer solving the agency problem with governance.

Theorem 3 describes the cross-sectional behavior of size, compensation, and governance. As firm size increases, compensation and governance increase,



Figure 1

Manager's equity share across firms

Firm size is increasing in the index. Though managers at larger firms receive a smaller equity share, the value of their compensation is larger than for managers at smaller firms.

whereas pay-performance sensitivity decreases.¹⁰ This result on pay is standard in the literature (Murphy 1999), but the result on governance is new. These results hold within a single managerial labor market. Section 4 provides empirical implications for executive compensation across different industries, countries, and points in time.

2. Governance Regulation

Section 1 shows that the compensation and governance decision of one firm affects other firms. This section shows how regulation can address this externality.

2.1 Optimal governance regulation

The regulator maximizes investor welfare.¹¹ The regulator can observe the size of firms and knows the distribution of talent but does not know the talent of individual managers, though the companies do.¹² The regulator can force any firm to carry out any level of governance. The regulator maximizes aggregate firm value, $\int_0^1 \Pi_r(x) dx$, subject to the incentive compatibility constraint, $\beta_r(x) \ge \lambda (1 - g_r(x))$, the participation constraint, $\frac{d}{dx} (\beta ST) \ge S \frac{dT}{dx}$, limited liability, $\beta_r(x) \ge 0$, and the feasibility of governance, $g_r(x) \in [0, 1]$, at every firm.

The regulator would like to allow small firms to pay management enough to behave while also allowing large firms to pay nothing and govern strictly. Thus, the regulator would like to set $\beta_r(x) = \lambda$ for $x < x^*$ and $\beta_r(x) = 0$ for $x > x^*$. However, each firm must pay their manager more than his outside option, so this is not feasible, which suggests that the participation constraint should bind under the optimal regulation. Theorem 4 shows this to be the case.

Theorem 4. Under optimal regulation, regulated firms pay managers only their outside option. Sufficiently large firms are regulated. The cutoff for

¹⁰ Pay-performance sensitivity here is dollar-dollar sensitivity. When the company increases one dollar in value, the manager's wealth increases by \$β. Another measure is percent-percent sensitivity (the elasticity of pay with respect to value of the company). The model shows that this is constant across firms, consistent with Edmans, Gabaix, and Landier (2009). A third measure used in the empirical literature is the dollar change in managerial pay from a percentage change in the company (dollar-percent sensitivity). The model shows that this increases in firm size, also consistent with empirical findings.

¹¹ The regulator maximizes investor welfare; executive compensation is viewed as a cost. If the regulator values executive compensation equivalently with investor welfare, the optimal regulation would ban governance, since it is costly and does not increase efficiency. However, if the regulator has a concave social welfare function and managers are richer than investors, then she would implement similar regulation but regulate fewer firms (in Theorem 4, she picks a larger x_1).

¹² If the regulator knows the talent of each manager, she could force the manager to work for the correct firm and the market for managerial talent would disappear. Alternatively, if she cannot prevent a firm from hiring another firm's manager, the results follow.

regulation, x_1 , satisfies $\psi(x_1) = 0$, where $\psi(x') = \int_{x'}^1 \left\{ 1 - \frac{\kappa}{\lambda T(x)} \right\} dx$. Finally, $x_1 < x^*$.¹³

The regulator forces some firms to exercise stricter governance than the firm would prefer (because $x_1 < x^*$). She forces medium firms, $x \in (x_1, x^*)$, to exercise governance, though it harms these firms. Because the benefit to large firms exceeds the harm to medium firms, the optimal regulation strictly improves investor welfare.

When there are enough small firms (formally, when $\psi(0) < 0$), the regulator picks a cutoff $x_1 > 0$ so that $\psi(x_1) = 0$. She leaves firms smaller than x_1 alone and forces firms larger than x_1 to govern strictly enough that the participation constraint binds, setting $g_r(x) = 1 - \frac{\beta_r(x)}{\lambda}$, where

$$\beta_r(x) S(x) T(x) = \beta_r(x_1) S(x_1) T(x_1) + \frac{AB}{a-b} \left[(1+q-x)^{b-a} - (1+q-x_1)^{b-a} \right].$$
(12)

Corollary 1. When $\psi(0) < 0$, governance required by optimal regulation is increasing in firm size; for regulated firms $(x > x_1)$, regulated governance is strictly increasing in firm size.

The manager's equilibrium share of equity under optimal regulation is shown in Figure 2. Following corporate governance regulation, equity-based executive compensation decreases, because forcing firms to govern more allows them to pay less. Figure 3 shows the impact of optimal governance regulation on firm value; it plots the ratio of firm value with optimal governance regulation to firm value without regulation (this ratio is the abnormal return of regulation). Large firms improve in value following corporate governance regulation, whereas medium firms are harmed in value, and small firms are left alone. If you were to regress the abnormal return of regulation on firm size, you would find a positive coefficient, consistent with Chhaochharia and Grinstein (2007).

2.2 Governance floor

Optimal corporate governance regulation, as described in Theorem 4, requires different governance levels from different firms. Due to practical or legal limitations, the regulator may be forced to treat all firms the same. In the United States, the Securities and Exchange Commission must treat all regulated firms the same when enforcing Sarbanes-Oxley.

In this section, the regulator chooses a governance floor, γ . Firms must implement at least this level of governance: $g_{\gamma}(x) \geq \gamma$. Firms optimize

¹³ If $\psi(0) > 0$, the optimal governance regulation sets $g_r(0) = 1$ and $\beta_r(0) = 0$ and allows β_r and g_r to follow the participation constraint.



Figure 2 Impact of optimal regulation

Manager's share of equity across firms. The solid line is equity share without regulation; the dashed line is equity share under optimal regulation. Governance regulation improves investor welfare by lowering excessive executive compensation.



Figure 3

Impact of corporate governance regulation on firm value

The dashed line is the ratio of regulation firm value to no-regulation firm value. The solid line is 1. Large firms improve in value after governance regulation, whereas small firms are harmed in value.

expected profits, taking regulation as given. A firm's problem is thus

$$\max_{\beta_{\gamma}(x),g_{\gamma}(x)} S(x) T(x) - \beta_{\gamma}(x) S(x) T(x) - \kappa g_{\gamma}(x) S(x)$$
(13)
$$s.t. \ \beta_{\gamma}(x) \ge \lambda \left(1 - g_{\gamma}(x)\right)$$
$$\beta_{\gamma}(x) S(x) T(x) \ge w_{\gamma}(x)$$
$$g_{\gamma}(x) \ge \gamma.$$

This is the same problem as in Section 1.2, with the additional constraint that $g_{\gamma}(x) \ge \gamma$.¹⁴ Define the following three types of firms.

- Wasted Governance Firm: A wasted governance firm exercises strictly positive governance, yet it has a lax incentive compatibility constraint: $\beta_{\gamma}(x) > \lambda (1 g_{\gamma}(x))$ and $g_{\gamma}(x) > 0$.
- Excessive Compensation Firm: An excessive compensation firm pays its CEO strictly more than his outside option: $\frac{d}{dx} \left[\beta_{\gamma}(x) S(x) T(x) \right] > S(x) \frac{dT}{dx}$.
- Voluntary Governance Firm: A voluntary governance firm implements more governance than required: $g_{\gamma}(x) > \gamma$.

Wasted governance firms exercise minimal governance, yet the participation constraint binds. Governance is wasted because such a firm could solve the agency problem with the same compensation and less governance. Regulation forces these firms to implement governance, γ . Though there are no wasted governance firms in the absence of regulation or under optimal regulation, a governance floor may result in the presence of wasted governance firms.

In the absence of regulation, firms smaller than firm x^* are excessive compensation firms and firms larger than firm x^* are voluntary governance firms. Lemma 5 shows how a governance floor affects the managerial labor market.

Lemma 5. Under a governance floor, γ , firm type is determined by two cutoffs: x^c and x^* . x^c is increasing in γ ; x^* does not depend on γ . Firms smaller than firm x^c are wasted governance firms. Firms larger than firm x^c but smaller than firm x^* are excessive compensation firms. Firms larger than both firm x^c and firm x^* are voluntary governance firms. Finally, $0 \le \gamma_0 < \gamma_1 < \gamma_2 < 1$.

1. When the governance floor is lax ($\gamma \le \gamma_0$), $x^c = 0$. Small firms ($x < x^*$) are excessive compensation firms, and large firms ($x > x^*$) are voluntary governance firms.

¹⁴ For tractability, firms cannot close. If firms could close, the regulator's problem might not be concave. If $T(0) \ge \kappa$, firms are still profitable after any governance floor is imposed. If $T(0) < \kappa$, the smallest firms would like to close if a sufficiently strict governance floor is implemented.



Figure 4

Impact of governance floor on managerial labor market

This graph shows the impact of a governance floor on the managerial labor market, as described in Lemma 5. Depending on the severity of the governance floor, there may be wasted governance firms (WG), excessive compensation firms (EC), or voluntary governance firms (VG).

- 2. When the governance floor is slightly strict ($\gamma_0 < \gamma < \gamma_1$), $0 < x^c < x^*$. The smallest firms ($x < x^c$) are wasted governance firms, middle firms ($x^c < x < x^*$) are excessive compensation firms, and large firms ($x > x^*$) are voluntary governance firms.
- 3. When the governance floor is strict $(\gamma_1 \le \gamma < \gamma_2)$, $x^* \le x^c < 1$. Small firms $(x < x^c)$ are wasted governance firms; large firms $(x > x^c)$ are voluntary governance firms.
- When the governance floor is very strict (γ > 2), x^c = 1. All firms are wasted governance firms.

Lemma 5 is illustrated in Figure 4, which shows x^c as a function of γ . Firm x^c is the smallest firm that granting an equity share of $\lambda (1 - \gamma)$ is enough to satisfy the participation constraint.¹⁵ Lemma 5 describes executive compensation under a governance floor. Wasted governance firms grant managers an equity share with value

$$\beta_{\gamma}(x) S(x) T(x) = \lambda (1 - \gamma) S(0) T(0) + \frac{AB}{(a - b)} \left[(1 + q - x)^{b - a} - (1 + q)^{b - a} \right]$$
(14)

and exercise minimal governance, $g_{\gamma}(x) = \gamma$. Excessive compensation firms implement minimal governance, $g_{\gamma}(x) = \gamma$, and grant managers equity share

¹⁵ x^c is the smallest firm other than firm 0, unless it is true for all firms, in which case $x^c = 0$. If $\lambda (1 - \gamma)$ is not enough to satisfy the participation constraint at any firm, $x^c = 1$. x^c is rigorously defined in the proof of Lemma 5. The assumption on page 4 guarantees that $x^c = 0$ when $\gamma = 0$. If that assumption fails, then the equilibrium will be similar to Lemma 5. However, the smallest firms ($x < x^c$) will not be wasted governance firms when $\gamma = 0$, because they implement g(x) = 0 but pay $\beta(x) > \lambda$.

 $\beta_{\gamma}(x) = \lambda (1 - \gamma)$. Voluntary governance firms pay managers only their outside option and implement governance $g_{\gamma}(x) = 1 - \frac{\beta_{\gamma}(x)}{\lambda}$. If $x^c < x^*$, then $\beta_{\gamma}(x^*) = \lambda (1 - \gamma)$, so voluntary governance firms pay managers

$$\beta_{\gamma}(x) S(x) T(x) = \lambda (1 - \gamma) S(x^{*}) T(x^{*}) + \frac{AB}{a - b} \left[(1 + q - x)^{b - a} - (1 + q - x^{*})^{b - a} \right].$$
(15)

However, if $x^c > x^*$, $\beta_{\gamma}(x^*) > \lambda(1 - \gamma)$, so voluntary governance firms pay managers

$$\beta_{\gamma}(x) S(x) T(x) = \lambda (1 - \gamma) S(0) T(0) + \frac{AB}{(a - b)} \left[(1 + q - x)^{b - a} - (1 + q)^{b - a} \right].$$
(16)

Theorem 5. There will be wasted governance firms and voluntary governance firms under any optimal strictly positive governance floor. Formally, $\gamma_{Opt} \in \{0\} \cup (\gamma_0, \gamma_2)$.

Because a floor is a blunt tool, the regulator may find it best to leave things alone, setting $\gamma_{Opt} = 0$. However, Theorem 5 shows that if it is worthwhile to implement a floor, it is optimal to implement either a slightly strict floor or a strict floor, as defined in Lemma 5.

Analysis of Theorem 5 provides implications for the number of each type of firms, producing distinct cross-country and cross-industry implications. These are explored in Section 3.2 and applied in Section 4.2.

3. Comparative Statics

The model provides testable empirical implications, as well as important policy implications. Section 3.1 derives predictions for cross-industry and cross-country comparison of governance and executive compensation from Theorem 3. Section 3.2 explores the number of voluntary governance firms when regulation is restricted to a floor, providing distinct cross-industry and cross-country results.

3.1 Cross-industries compensation and governance

Theorem 3 derives the cross-section of executive compensation and governance; larger firms pay more, have lower pay-performance sensitivity, and have stricter governance. These results hold within a single managerial labor market. Cross-industry implications are derived by applying comparative statics to the solution from Theorem 3. Keeping with definitions from Section 2.2, Theorem 3 shows that small firms are excessive compensation firms, whereas large firms are voluntary governance firms. Corollary 2 examines how these vary across industries.

Corollary 2. There are more voluntary governance firms in industries with lower governance costs (κ), higher agency costs (λ), or more talented managers (higher T_{Max} , higher *b*, or lower *B*).

Compensation at excessive compensation firms does not depend on what other firms pay, whereas compensation at voluntary governance firms does. Thus, comparative statics are different for small and large firms. Governance is too expensive for small firms; they grant managers equity share $\beta(x) = \lambda$, so executive compensation is $w(x) = \lambda S(x) T(x)$, and firm value is $\Pi(x) = (1 - \lambda) S(x) T(x)$. Small firms grant a larger equity share when agency costs are worse; an increase in λ increases pay-performance sensitivity and executive compensation but decreases firm value. Similarly, increasing S(x) T(x) increases executive compensation and firm value, so both are increasing in { $T_{Max}, -B, b, a$ }.

Comparative statics for large firms are more complicated. Executive compensation at large firms is given by

$$\beta(x) S(x) T(x) = \lambda S(x^*) T(x^*) + \frac{AB}{a-b} \left[(1+q-x)^{b-a} - (1+q-x^*)^{b-a} \right].$$
(17)

Large firms pay managers the compensation paid to manager x^* plus a premium strictly increasing in firm size. When a parameter changes, it affects executive compensation directly through the equation above and indirectly through x^* . Consider an increase in the severity of agency costs, λ . Small firms increase executive compensation, but more firms find governance worthwhile, or equivalently, x^* decreases (Corollary 2). These affect executive compensation in opposite directions (all else equal, compensation at large firms decreases when more firms exercise governance). Corollary 3 shows that the first effect dominates when λ is sufficiently large, but the second dominates for small values of λ , resulting in a U-shaped relationship.

Corollary 3. The model implies the comparative statics listed in Table 1 for large firms.

Table 1 provides testable implications for analysis of compensation and governance across industries and countries. These predictions apply to the comparison of matched firms in different industries or countries. An increase in governance costs harms firm value in two ways. Not only must firms pay more for governance, but large firms must also pay managers more (fewer firms

-	• 0					
	λ	κ	а	T_{Max}	В	b
$\overline{w(x)}$	U	+	+	U	+*	_*
$\beta(x)$	U	+	-	_*	+*	_*
g(x)	$+^*$	_	+	+*	_*	+*
$\Pi(x)$	_*	-	+	+	_*	+*

 Table 1

 Comparative statics for compensation at large firms

The impact of agency costs, λ , governance costs, κ , dispersion of firm productivity, a, and managerial talent, $\{T_{Max}, B, b\}$, on executive compensation, w, pay-performance sensitivity, β , governance, g, and firm value, II. + indicates an increasing relation, whereas +* indicates an increasing relation for sufficiently large firms. Similarly, \cup indicates a decreasing relation, and -* indicates a decreasing relation for sufficiently large firms.

find governance worth the cost; because x^* increases, executive compensation increases). The results on dispersion of firm productivity allow us to analyze how governance changes over the business cycle. See Section 4.1.

Corollary 3 also examines the relation between the distribution of managerial talent and executive compensation.¹⁶ It is unlikely that a researcher could measure managerial talent, so these results are only potentially testable.¹⁷ However, they may still be useful for natural experiments. For example, if there were an exogenous event that increased the talent of all managers in an industry, we would expect, all else equal, a decrease in pay-performance sensitivity, an increase in governance, and an increase in firm value at large firms. At small firms, increasing the talent of all managers would not affect pay-performance sensitivity but would increase firm value.

3.2 Voluntary governance firms

The optimal governance floor is found in Theorem 5. This section provides cross-industry (Corollary 4) and cross-country (Corollary 6) implications for the number of each type of firm (wasted governance, excessive compensation, and voluntary governance). Corollary 5 provides implications for the severity of the governance floor.

Corollary 4. Under a fixed governance floor, x^* is decreasing in $\{T_{Max}, -B, b, \lambda, -\kappa\}$, and x^c is decreasing in $\{T_{Max}, -B, b, \lambda, a\}$.

Lemma 5 shows that, under any governance floor, there are x^c wasted governance firms, max $\{x^* - x^c, 0\}$ excessive compensation firms, and $1 - \max\{x^c, x^*\}$ voluntary governance firms (see Figure 4). Corollary 4

¹⁶ The distribution of talent depends on three parameters: T_{Max} , B, and b. T_{Max} , the location parameter of talent, is the upper bound for talent within an industry. B is the scale parameter for talent, and b is the scope parameter. For a given manager, talent is increasing in T_{Max} ($\frac{\partial T(x)}{\partial T_{Max}} > 0$), decreasing in B ($\frac{\partial T(x)}{\partial B} < 0$), and increasing in b ($\frac{\partial T(x)}{\partial B} > 0$).

¹⁷ There may be some novel ways to measure CEO talent. For example, Milbourn (2003) proxies for CEO reputation with media mentions.

implies that the number of voluntary governance firms is increasing in $\{T_{Max}, -B, b, \lambda, -\kappa, a\}$, the number of wasted governance firms is decreasing in $\{T_{Max}, -B, b, \lambda, a\}$, and the number of excessive compensation firms is increasing in $\{\kappa, a\}$.

A uniform increase in the talent of all managers, an increase in T_{Max} , makes governance more attractive, so more firms voluntarily use governance. Also, an increase in T_{Max} increases firm value, increasing the value of a given equity share and relaxing managers' participation constraints. Comparative statics for other variables follow by similar intuition. Corollary 5 shows how the optimal floor changes when parameters change.

Corollary 5. When $\gamma_{Opt} \in (\gamma_0, \gamma_1) \cup (\gamma_1, \gamma_2)$, the optimal governance floor, γ_{Opt} , is increasing in $\{T_{Max}, -B, b, \lambda, -\kappa\}$.

Corollary 5 shows the optimal governance floor is increasing in T_{Max} , decreasing in B, increasing in b, increasing in λ , and decreasing in κ . Theorem 1 shows the benefit of governance is increasing in the talent of the manager, T(x), and increasing in the magnitude of agency costs, λ , but decreasing in governance costs, κ . Because T(x) is increasing in T_{Max} , decreasing in B, and increasing in b, Corollary 5 shows the optimal governance floor is stricter when governance is more beneficial. When the regulator can respond to a parameter change, Corollary 4 no longer applies. Corollary 6 shows how the number of each type of firm changes in response to a parameter change under optimal regulation.

Corollary 6. Under the optimal governance floor, if $\gamma_{Opt} \in (\gamma_0, \gamma_1) \cup (\gamma_1, \gamma_2)$, x^* is decreasing in $\{T_{Max}, -B, b, \lambda, -\kappa\}$, but x^c is increasing in $\{T_{Max}, -B, b, \lambda, -\kappa\}$.

The number of wasted governance firms, x^c , is increasing in $\{T_{Max}, -B, b, \lambda, -\kappa\}$. If the optimal governance floor is slightly strict, the number of excessive compensation firms, $x^* - x^c$, is decreasing in $\{T_{Max}, -B, b, \lambda, -\kappa\}$. If the optimal governance floor is strict, there are no excessive compensation firms. Comparative statics on the number of voluntary governance firms, however, are nonmonotonic. If the optimal governance floor is slightly strict, $\gamma \in (\gamma_0, \gamma_1)$, the number of voluntary governance firms is increasing in $\{T_{Max}, -B, b, \lambda, -\kappa\}$. If the optimal governance floor is strict, $\gamma \in (\gamma_1, \gamma_2)$, the number of voluntary governance firms is decreasing in $\{T_{Max}, -B, b, \lambda, -\kappa\}$. Because the optimal governance floor is increasing in $\{T_{Max}, -B, b, \lambda, -\kappa\}$, this implies a hump-shaped relation between the number of voluntary governance firms and parameters $\{T_{Max}, B, b, \lambda, \kappa\}$.

Suppose each country has a CEO labor market as described in Section 1.3 and that these markets are segmented (a CEO cannot work outside his country). Regulators are restricted to using a governance floor, and each country chooses

the optimal governance floor. Corollary 5 applies to the strength of regulation, and Corollary 6 describes the number of each type of firm.

Results are different if we consider multiple industries in a single country. Suppose each industry has a managerial labor market as described in Section 1.3. For any level of governance floor, Corollary 4 describes how the number of each type of firm varies by industry. Corollary 7 describes industry spillover effects of governance regulation.

Corollary 7. Suppose there are *N* industries in a single country (managerial labor market segmented by industry), but the regulator must enforce a uniform governance floor for all industries, γ_{Opt} . Increasing $\theta \in \{T_{Max}, -B, b, \lambda, -\kappa\}$ from one industry decreases x^* in that industry, increases the optimal governance floor, and increases x^c from other industries.

When governance becomes more attractive in an industry, x^* and x^c would decrease (Corollary 4) in that industry under fixed regulation. When governance becomes more attractive, the regulator tightens the floor, as in Corollary 5. By Lemma 5, x^c in other industries increase in response. When there is only one industry, as in Corollary 6, the regulator tightens the floor strictly enough that x^c increases, rather than decreases. With multiple industries, we cannot sign the impact on x^c within that industry.

4. Empirical Implications

This section describes the empirical implications from the model. There are several parameters that affect outcomes. The severity of agency costs, λ , affects how much incentive pay is required to induce behavior. Governance allows a firm to economize on incentive pay; governance costs are increasing in κ .

Firms are distributed according to a truncated Pareto distribution with scale parameter A and shape parameter a. Everything scales in A. An increase in a increases a given firm's size and the variance of firm size. This "firm size" may be latent—the econometrician might observe ST, not S. Thus, S could be considered the productivity of managerial talent, and a could be considered the dispersion of firm productivity.

The distribution of managerial talent follows a truncated Pareto distribution with location parameter T_{Max} , scale parameter B, and shape parameter -b. All managers have talent less than T_{Max} . The talent of a given manager is increasing in T_{Max} , decreasing in B, and increasing in b. The variance of managerial talent is increasing in B and b but is not affected by T_{Max} .

(1) Within industry, larger firms pay more, have lower pay-performance sensitivity, and have stricter governance. This is implied by Theorem 3. Pay-performance sensitivity here is dollar-dollar sensitivity. The total value of performance-based compensation increases in firm size. Thus, the model is consistent with the standard empirical findings from Murphy (1999).

Additionally, governance is increasing in firm size, consistent with Aggarwal et al. (2009). These articles show the relation holds in aggregate. This model is consistent with those empirical results.

4.1 Compensation implications

Equilibrium in the model specifies executive compensation, pay-performance sensitivity, and governance within a single managerial labor market, so comparative statics provide empirical implications for analysis of segmented managerial labor markets. Thus, these can be applied to both cross-industry analysis and cross-country analysis, because the managerial labor market is likely segmented by industry and country. These predictions are for analysis of matched firms.

(2) Governance is increasing in the dispersion of firm productivity. This is implied by Corollary 3; dispersion of firm productivity is a. When firms are close together, they force the market price for managerial talent high. The large firms are forced to grant generous executive compensation. When firms are more disperse, firms do not need to grant as much equity to their managers, so they will exercise more governance. This could be tested across industries, countries, or time.¹⁸

Eisfeldt and Rampini (2006) find that dispersion of productivity is countercyclical using census data; the variance of productivity is higher in recessions than in booms. Given this, my model suggests that governance will also be countercyclical;¹⁹ governance should be tight in recessions and lax in booms. Many (see Bogle 2005) have suggested that governance became slack during the 1990s and attributed this to investors becoming lazy because of large returns. Corollary 3 suggests that this may have been optimal.

(3) When governance costs increase, executive compensation and payperformance sensitivity increase, and governance decreases. For comparison across industries, governance costs can be thought of as difficulty of governance. As governance costs, κ , increase, fewer firms find governance worth the cost (Corollary 2), so firms must pay managers more (Corollary 3).

(4) At small firms, executive compensation and pay-performance sensitivity are increasing in agency costs. At large firms, executive compensation and pay-performance sensitivity are U-shaped in agency costs. At sufficiently large firms, governance is increasing in agency costs. Small firms find governance too expensive, so they must pay managers enough to behave. When agency

¹⁸ This assumes that there is a static equilibrium operating at any point in time. Because of the structure of the problem (common knowledge of size and talent), any optimal dynamic contract collapses to repeated static contracts, unless the firm can prevent the manager from going to another firm. A firm cannot punish a manager for poor performance if another firm can hire the manager. In order for a long-term contract to improve value, the manager must be able to commit to never working for anyone else, which is not reasonable.

¹⁹ Within my model, a recession can be thought of as a decrease in A and an increase in a such that firms are less profitable and more dispersed. Such a change in parameters will result in lower total executive compensation, lower pay-performance sensitivity, and increased governance.

costs increase, small firms pay managers more. When agency costs increase, more firms find governance to be worthwhile (Corollary 2). All else equal, large firms pay more when small firms pay more but pay less when more firms exercise governance. Corollary 3 shows that the first effect dominates for large values of λ , but the second dominates for small values of λ , resulting in the U-shaped relation. Note that this is U-shaped in the parameter space; executive compensation increases at all firms or decreases at all firms within an industry, all else equal. If pay-performance sensitivity decreases when λ increases, governance clearly increases. When pay-performance sensitivity increases, governance still increases at sufficiently large firms (Corollary 3).

(5) Industries with more talented managers exercise more governance but have lower variance of executive compensation. Governance is more cost efficient than performance-based pay when the manager is more talented (Theorem 1), so more firms exercise governance in industries with more talented managers (Corollary 2). Sufficiently large firms have lower pay-performance sensitivity and stricter governance in industries with more talented managers (Corollary 3). Thus, the model suggests that more talented managers are governed more strictly, whether the comparison is made within industry or across industries. This is distinct from Hermalin and Weisbach (1998), which suggests that firms with more talented managers are governed less strictly.

Industries with more talented managers have more valuable firms, so small firms pay managers more. If the change affects the variance of talent (decrease *B* or increase *b*), executive compensation decreases at sufficiently large firms. If all managers increase in talent (T_{Max} increases), the impact on executive compensation is unclear (U-shaped relation). This loosely suggests that the variance of executive compensation should decrease in managerial talent. Similarly, the model suggests that the variance of pay-performance sensitivity should be increasing in managerial talent.

4.2 Voluntary governance firms

In many countries, regulators must treat all firms the same; regulators set standards all firms must satisfy. Under a governance floor, the model predicts an equilibrium with three types of firms. Wasted governance firms are forced to implement governance so strict that the incentive compatibility constraint is lax. Excessive compensation firms pay managers strictly more than their outside option. Voluntary governance firms use more governance than required.

(6) Comparing multiple industries in one country, the number of voluntary governance firms in an industry is increasing in the severity of agency costs, λ . Because the regulator must apply the same governance floor to all industries, the governance floor is fixed across industries within a single country. The managerial labor market is likely segmented by industry, so Corollary 4 applies to cross-industry tests. The number of voluntary governance firms

is $(1 - \max\{x^*, x^c\})$ (Lemma 5); Corollary 4 shows that both x^c and x^* are decreasing in λ . Intuitively, as agency costs increase, more firms find governance worth the cost, so x^* decreases. Also, small firms must grant a larger equity share to induce behavior, so x^c decreases because fewer firms must grant an equity share larger than necessary to induce managerial behavior.

(7) Comparing multiple countries, the number of voluntary governance firms in a country is hump-shaped in the severity of agency costs. Different countries can implement different regulatory regimes. If each country chooses governance regulation optimally, Corollary 6 applies to cross-country tests. Corollary 6 shows that x^* is decreasing in λ , but x^c is increasing in λ . As agency costs increase, more firms find governance worthwhile, so x^* decreases. An increase in agency costs also makes governance regulation more attractive, so the regulator implements stricter regulation (Corollary 5) so that x^c increases (Lemma 5 shows that x^c is increasing in γ). Because the number of voluntary governance firms is $(1 - \max{x^*, x^c})$, the relation is hump-shaped.

(8) In a comparison of multiple industries in one country, industries with higher governance costs have fewer voluntary governance firms. In a comparison across countries, the relation is hump-shaped. Governance costs are given by κ . Corollary 4 shows that x^* is increasing in κ , but x^c is not affected by κ , which implies the cross-industry result. Corollary 6 shows that x^* is increasing in κ , but x^c is decreasing in κ .

(9) In a comparison of multiple industries in one country, industries with more talented managers have more voluntary governance firms. The relation across countries is hump-shaped. Talent is increasing in T_{Max} and b but decreasing in B. Corollary 4 shows that both x^* and x^c are decreasing in T_{Max} and b but increasing in B, which implies the cross-industry result. Corollary 6 shows x^* is decreasing in T_{Max} and b but increasing in B, yet x^c has the opposite relationship (increasing in T_{Max} and b but decreasing in B).

The cross-country results are made under the assumption that there is one industry per country. If there are multiple industries per country, the optimal floor results in the following spillover effect.

(10) The number of voluntary governance firms in a given industry is decreasing in the level of managerial talent and severity of agency costs in other industries in the same country but increasing in the level of governance costs in other industries in the same country. This follows by Corollary 7.

The number of voluntary governance firms should be measurable. However, the number of wasted governance firms and excessive compensation firms are likely more difficult to measure. Thus, the following implications are potentially testable.

(11) In a comparison of different industries in the same country, there are more wasted governance firms in industries with less talented managers, lower agency costs, and lower dispersion of firm productivity. In a comparison across countries, there are more wasted governance firms in countries with more talented managers, higher agency costs, and lower governance costs. There are x^c wasted governance firms. Because the regulator must treat all industries the same, Corollary 4 applies to cross-industry analysis. Corollary 4 shows that x^c is decreasing in $\{T_{Max}, -B, b, \lambda, a\}$. Different countries can implement different regulatory regimes, so Corollary 6 applies to cross-country analysis. Corollary 6 shows that x^c is increasing in $\{T_{Max}, -B, b, \lambda, -K\}$.

(12) In a comparison across industries in the same country, there are more excessive compensation firms in industries with higher governance costs and higher dispersion of firm productivity. In a comparison across countries, there are more excessive compensation firms in countries with less talented managers, lower agency costs, and higher governance costs. There are max $\{x^* - x^c, 0\}$ excessive compensation firms. Corollary 4, which applies to cross-industry analysis, shows that x^* is increasing in κ and x^c is decreasing in a. Corollary 6, which applies to cross-country analysis, shows that x^c is increasing in $\{T_{Max}, -B, b, \lambda, -\kappa\}$, but x^* is decreasing in $\{T_{Max}, -B, b, \lambda, -\kappa\}$.

(13) There are more wasted governance firms and fewer excessive compensation firms in a given industry when the other industries in the same country have more talented managers, higher agency costs, and lower governance costs. This is implied by Corollary 7; x^c is increasing in θ from other industries, for $\theta \in \{T_{Max}, -B, b, \lambda, -\kappa\}$. Governance regulation is more beneficial when there are more talented managers, agency costs are higher, and governance costs are lower. Thus, regulation will be tighter, and there will be more wasted governance firms in this industry (Lemma 5 shows that x^c is increasing in γ).

Finally, the model loosely suggests the following empirical implications.

(14) Executive compensation, pay-performance sensitivity, and the value of performance-based compensation decrease when governance regulation is implemented. This result follows under optimal regulation (Figure 1) and under the optimal floor. Small firms harm large firms by granting managers excessive executive compensation. Requiring firms to govern more forces small firms to govern more and pay less, allowing large firms to pay less as well. Thus, almost any regulation that requires firms to exercise more governance should result in lower executive compensation and pay-performance sensitivity.

(15) When governance regulation is enacted, large firms increase in value, whereas small firms decrease in value. This result follows under optimal regulation (Figure 3) and under the optimal floor. Executive compensation decreases after governance regulation is implemented. This change should improve the value of large firms and harm the value of small firms (large firms prefer using governance, whereas small firms prefer using compensation to induce behavior). Further, this result still holds under inefficiently strict regulation. If you regress the abnormal return of regulation on firm characteristics, there will be a positive coefficient on firm size.

5. Policy Implications

When governance regulation is enacted, the model predicts that large firms increase in value, whereas small firms decrease in value. Executive compensation, pay-performance sensitivity, and the dollar value of performance-based compensation decrease at all firms when governance regulation is implemented. This appears to describe the impact of SOX (Section 5.2).

The model suggests policy implications to maximize investor welfare (as shown in Section 2.1). Optimal regulation enforces governance standards that increase with firm size, leaving the smallest firms alone. Optimal regulation can be implemented with a subsidy of governance costs or a tax policy that limits deductibility of executive compensation.²⁰

5.1 Implementation and cost of regulation

The model shows that regulation can improve investor welfare, even when firms are behaving optimally and maximizing shareholder value. In Section 2.1, the regulator knows the size of each firm, knows the distribution of talent, and is granted the flexibility to regulate governance at each firm. It may be difficult to enforce governance requirements at all, especially at the firm level. This section discusses how regulatory costs affect the optimal regulation and proposes alternative methods to address the externality.

Whether regulation improves welfare depends on the limitations and costs associated with it. If there is a fixed cost of regulation (e.g., paying a regulator), but no variable costs, then the optimal governance regulation will unchanged (from Theorem 4), provided the cost is not too high; either regulation is worth the cost or it is not. Alternatively, if regulatory costs are only variable costs (e.g., a cost for imposing regulation on each firm regulated), the optimal regulation is similar but less strict. Specifically, optimal regulation is similar to Theorem 4, but with a larger x_1 , regulating fewer firms.

Rather than an explicit cost, the regulator may be granted limited flexibility. As shown in Section 2.2, if the regulator must implement the same governance requirements on all firms, it may be optimal to not implement regulation. When a governance floor is implemented, some firms will be forced to use wasteful governance.

Throughout the article, the cost of governance is $\kappa g S$, where κ is constant across firms and regulatory environments. However, regulating corporate governance may change κ . Governance requires inputs, which likely have an upward-sloping aggregate supply curve. If κ is an increasing function of aggregate governance, governance regulation becomes less attractive. Though optimal regulation still takes the same form, the regulator requires less of it. Governance costs increased after SOX passed, so this concern is important.

²⁰ Section 162(m) of the Internal Revenue Code will not accomplish this, because it applies only to base pay. The substitute for governance regulation requires limited deductibility of all compensation to management.

The difficulty and cost of implementing governance regulation may be sufficiently large that it is worthwhile to consider alternatives. Rather than regulation, the government can provide incentives for firms to practice more governance.

Theorem 6. Tax policy and subsidies can improve investor welfare.

- 1. A small subsidy of governance costs improves investor welfare.
- 2. Optimal governance regulation can be implemented by a subsidy of governance costs if the government can raise funds from investors efficiently.
- 3. Limiting deductibility of all payments to the CEO, made revenue neutral by a decrease in the corporate income tax, always improves investor welfare. Optimal regulation can be implemented through the tax code if the corporate income tax rate is high enough.

If the government raises funds inefficiently, then 1 holds for any finite inefficiency (of course, this requires that government revenue is not already maximized). For 2, it is important that the government can raise funds efficiently. With inefficient taxation, the optimal subsidy is smaller, resulting in an outcome similar to Theorem 4 but with fewer firms regulated. Though this fails to implement the optimal regulation, subsidizing governance may be more efficient than regulation if regulatory costs are high.

The final point of Theorem 6, **3**, shows that limiting the tax deductibility of executive compensation could replace corporate governance regulation with no cost to the government. This change must be revenue neutral (by lowering the corporate income tax rate) in order to improve investor welfare. This must apply to all executive compensation, not just base pay, so Section 162(m) does not substitute for governance regulation. Of course, if executive compensation is taxed, companies may find another way to reward their executives, unraveling the incentive effect of the tax scheme.

5.2 Sarbanes-Oxley

Sarbanes-Oxley (SOX) was passed in 2002, following the accounting scandals of 2001. The impact of this law is still the subject of debate. Chhaochharia and Grinstein (2007) show that SOX had a positive effect on firms, and Hochberg, Sapienza, and Vissing-Jorgensen (HSVJ; 2009) find that SOX had a positive effect on some firms' market value. In contrast, Zhang (2007) documents a negative stock market response to the passage of SOX.

The results on size from the model can explain these contrary findings. Governance regulation improves the value of large firms, whereas it harms the value of small firms. Chhaochharia and Grinstein (2007) show that, among firms impacted by SOX, large firms increased in value but small firms decreased in value, relative to a control group. The authors attribute this to fixed costs in governance. However, their estimates of the increase in firm value from governance are so large that it seems doubtful that large firms would forego them, even if management had full control. This article suggests that the losses to small firms were crucial to the gains at large firms. Governance regulation decreases the negative externality that small firms impose by overpaying their CEOs. This interpretation is supported by Chung (2008), who shows that firms with poor governance lowered pay-performance sensitivity in response to SOX, and Chhaochharia and Grinstein (2009), who show that firms forced to increase governance lowered executive compensation, specifically equity-based compensation, in response to SOX.²¹

The results in HSVJ (2009) can similarly be explained by size. HSVJ (2009) use a novel approach for identification of bad governance firms—lobbying behavior. HSVJ assume that if a firm lobbies against the strict implementation of SOX, that manager is extracting rents from poor governance. HSVJ show that lobbying firms increased in value relative to nonlobbying firms. My model sheds light on this finding. Because CEOs at large firms take substantial pay cuts when regulation is enforced, these CEOs would be the first to lobby against SOX. The lobbying firms tend to be much larger in HSVJ (2009) than those that do not lobby, so their findings are consistent with this intuition.

The model shows that large firms benefit from regulation, so they have a positive return when matched with other firms, consistent with Chhaochharia and Grinstein (2009) and HSVJ (2009). Large firms benefit from any regulation, so these findings fail to address whether regulation improved investor welfare. The key question is whether the benefit to large firms outweighs the harm to small firms. Zhang (2007) examines stock market reaction to news that SOX was more likely to pass or was likely to be harsher and found that the market had a negative reaction. This is consistent with Chhaochharia and Grinstein (2007), because the authors remove the smallest firms from their sample (due to their matching methodology), so their small firms are still rather large. However, Zhang (2007) suggests that SOX was expected to do more harm than good. Zhang (2007) is plagued by the absence of a control group, so the results are difficult to interpret. Alternatively, HSVJ (2009) include a back-of-the-envelope calculation suggesting that SOX improved investor welfare.

There are different types of governance, so we need to consider if a particular governance measure is similar to g in the model. In the model, governance lowers the benefit of misbehavior for the manager. HSVJ (2009) find that the effect is concentrated in firms that lobbied against enhanced financial disclosure—the measures most likely to improve transparency and make misbehavior more difficult. Chhaochharia and Grinstein (2007) identify affected firms as those that failed to meet independence requirements for directors or failed to satisfy internal control requirements. These requirements

²¹ Guthrie, Sokolowsky, and Wan (2012) attribute the results of Chhaochharia and Grinstein (2009) to outliers.

make misbehavior more difficult. Thus, these articles are likely measuring governance similar to g in the model.

In the model, there is a single market for CEO talent, and CEO talent is equally useful at all companies. However, it is unreasonable to think that the CEO of a manufacturing firm and the CEO of a financial firm could switch companies without any loss. The market for CEOs is likely segmented by industry. Thus, one can interpret this model as expressing an equilibrium in a specific industry, an interpretation supported by the fact that the positive returns in HSVJ are dampened when controlling for the one-digit industry category. Because each industry likely has a different market for CEOs, different governance standards for different industries could make sense. Corollary 5 could be used as a guide for this. However, industry-specific governance regulation would likely result in perverse outcomes, creating an incentive for firms to pretend to be in a different industry to dodge regulation.

The model has two important implications for governance regulation. Many critics have charged that SOX forces firms to exercise wasteful governance. Theorem 5 shows that the optimal floor *always* results in wasteful governance at some firms; it is a cost of restricting the regulator to treat all firms the same. However, Theorem 5 shows another important result—there will be voluntary governance firms under the optimal floor. A crucial test of whether governance regulation is too harsh is this—find a firm that voluntarily exercises stricter governance than is required by law. If you cannot find such a firm, the regulated floor is too strict. Further, the optimal floor is decreasing in κ , so if governance costs are higher than expected, the governance floor should be relaxed.

6. Conclusion

The article models an economy of firms and managers. Firms face an agency problem, which they can solve by paying the manager enough or by exercising governance. When a firm increases governance, that firm can lower executive compensation, and other firms can lower executive compensation as well because of the managerial labor market. Because firms do not enjoy the full benefit of their governance, there is a positive externality to governance, providing a role for corporate governance regulation. Small firms find governance too expensive, whereas large firms find governance worthwhile. When small firms do not use governance, executive compensation increases at large firms. Optimal governance regulation forces some firms to increase governance to limit excessive executive compensation. Optimal regulation ignores the smallest firms and implements governance standards that increase with firm size.

Most regulators are restricted to the use of a governance floor; they must apply the same floor to all firms in all industries. Thus, the model provides distinct cross-country and cross-industry implications for the number of voluntary governance firms. These implications should be testable.

Appendix: Proofs

Proof of Lemma 1. Pick a contract with governance g and compensation $C(\cdot)$ such that there exists a set of positive measure $A \subset Y$, where the manager reports $\hat{y}(y;g) < y$ for $y \in A$. Set $\tilde{C}(y) = \lambda(1-g)(y-\hat{y}) + C(\hat{y})$ for all $y \in A$. Contract \tilde{C} induces the manager to report truthfully. This improves the objective by at least $[1 - \lambda(1-g)] \int_A (y-\hat{y}(y,\lambda)) dF > 0$. (The objective may increase by more, because the manager might report y instead of \hat{y} when y' > y is the realized cash flow.) Because this change improves the objective, no such contract can be optimal. Therefore, the firm induces truthful reporting with probability 1 in any optimal contract.

Proof of Theorem 1. When $U_0 > ST$, the project ceases to be profitable. When $\lambda ST \le U_0 \le ST$, setting $C(y) = \frac{U_0}{ST}y$ satisfies the incentive compatibility constraint (IC) and the limited liability constraint (LL). The firm cannot lower the manager's expected payoff, because the participation constraint binds, and the incentive compatibility constraint is lax, so this contract is optimal for the firm.

If $U_0 < \lambda ST$, the optimal contract will be equity. Because the IC is slack at 0, the LL binds at 0, so C(0) = 0. Suppose (to the contrary) the solution to this problem involved overpaying the manager at any cash flow or, equivalently, that $\exists z \in \text{support}(F)$ such that $C(STz) = \lambda(1-g)STz + \delta$, where $\delta > 0$. The IC requires overpaying for all larger cash flows or, equivalently, that $C(STz') \geq \lambda(1-g)STz' + \delta$ for all $z' \geq z$.²² By not overpaying, setting $C(STz) = \lambda(1-g)STz$, the firm can decrease C(STz') by δ and increase the objective by $\delta \left[1 - \lim_{\xi \to z^-} F(\xi)\right]$. Thus, $C(STz) = \lambda(1-g)STz$ almost surely in any optimal contract.

The problem simplifies to

$$\max_{g} ST - \lambda (1 - g) ST - \kappa g S$$

$$s.t. \ \lambda (1 - g) ST \ge U_0,$$

$$g \in [0, 1].$$
(A1)

The objective becomes $ST(1-\lambda) + S(\lambda T - \kappa)g$, so governance is beneficial for the firm when $T > \frac{\kappa}{\lambda}$. If $T \le \frac{\kappa}{\lambda}$, governance is too expensive, so g = 0 and $C(STz) = \lambda STz$. If $T > \frac{\kappa}{\lambda}$, governance is efficient for the firm, so the manager's participation constraint binds and $\lambda (1-g) ST = U_0$. Thus, $g = 1 - \frac{U_0}{\lambda ST}$, and $C(STz) = U_0z$ when $T > \frac{\kappa}{\lambda}$.

Proof of Lemma 2. Suppose that there are two managers $(T_1 > T_0 > 0)$ and two firms $(S_1 > S_0 > 0)$. Let w_1 be the equilibrium wage paid to manager 1 and w_0 be the wage paid to manager 0. Firm 1, with governance level g_1 , prefers to hire manager 1 rather than manager 0 iff

$$S_1 T_1 - w_1 - \kappa g_1 S_1 \ge S_1 T_0 - w_0 - \kappa g_1 S_1$$

$$S_1 (T_1 - T_0) \ge w_1 - w_0.$$
(A2)

Similarly, firm 0, with governance level g_0 , prefers to hire manager 1 rather than manager 0 iff

$$S_0 T_1 - w_1 - \kappa g_0 S_0 \ge S_0 T_0 - w_0 - \kappa g_0 S_0$$
(A3)
$$S_0 (T_1 - T_0) \ge w_1 - w_0.$$

Governance levels do not impact the labor market outcome, because governance is chosen before the firm hires the manager.

²² Formally, if the firm overpays at any $z \in \text{support}(F)$, then the firm must also overpay for all $z' \in \{\tilde{z} | \tilde{z} \in \text{support}(F), \tilde{z} \geq z\}$.

Suppose to the contrary that firm 0 hired manager 1 and firm 1 hired manager 0. This is optimal for the firms iff

$$S_1 (T_1 - T_0) \le w_1 - w_0 \le S_0 (T_1 - T_0).$$
(A4)

Because $S_1 > S_0 > 0$ and $T_1 > T_0 > 0$, $S_1(T_1 - T_0) > S_0(T_1 - T_0)$. This is a contradiction. Therefore, the larger firm hires the more talented manager.

Extending to the continuous case, m(x) must be a strictly increasing function by identical logic. Because any set of firms must hire a set of managers of equivalent measure, and because $x \in [0, 1]$ and $m \in [0, 1]$, it follows that m(x) = x.

Outline of Proof of Lemma 3. The proof of Lemma 3, in the Supplemental Materials, is structured by the following logic. The outside option of manager x is to work at another firm, $x' \neq x$. Firm x' is willing to replace manager x' with manager x if the profit of firm x' increases by hiring manager x. If firm x' grants manager x equity share $\beta(x, x')$, hiring manager x is profitable only if

$$\left(1-\beta\left(x,x'\right)\right)S\left(x'\right)T\left(x\right)-\kappa g\left(x'\right)S\left(x'\right)\geq\left(1-\beta\left(x'\right)\right)S\left(x'\right)T\left(x'\right)-\kappa g\left(x'\right)S\left(x'\right).$$
 (A5)

Thus, firm x' is willing to pay up to $\beta(x') S(x') T(x') + S(x') [T(x) - T(x')]$ to hire manager x. The firm most willing to pay for manager x is firm x - dx (see the Supplemental Materials). Therefore,

$$\beta(x) S(x) T(x) \ge \beta(x - dx) S(x - dx) T(x - dx) + S(x - dx) [T(x) - T(x - dx)]$$
(A6)

or, equivalently,
$$\frac{d}{dx} (\beta ST) \ge S \frac{dT}{dx}$$
.

Outline of Proof of Theorem 2. The proof of Theorem 2, in the Supplemental Materials, is structured by the following logic. Forcing the marginal firm to exercise a little more governance benefits all large firms but only costs the marginal firm about the same as the benefit at each of the large firms. Thus, implementing a small amount of efficient governance regulation has a first-order benefit but a second-order cost, so efficient governance regulation strictly improves investor welfare.

Outline of Proof of Lemma 4. The proof of Lemma 4, in the Supplemental Materials, is structured by showing that the following claims hold. The participation constraint binds for $x < x^c$, and the incentive compatibility constraint binds for $x \in [x^c, x^*]$. Because firm size increases faster than talent, for a sufficiently large firm, granting λ of equity is sufficient in retaining the manager. Because $x^c = 0$ when $\lambda a T_{Max} \ge B(1+q)^b \left[1 + \lambda \left(\frac{a}{b} - 1\right)\right]$, the incentive compatibility constraint binds for small firms $(x < x^*)$.

Proof of Theorem 3. Lemma 4 shows that the participation constraint binds for large firms, so for $x \in [x^*, 1]$,

$$\beta(x) S(x) T(x) = \beta(x^*) S(x^*) T(x^*) + \frac{AB}{a-b} \left[(1+q-x)^{b-a} - (1+q-x^*)^{b-a} \right],$$
(A7)

whereas for small firms, the incentive compatibility constraint binds, so for $x \in [0, x^*]$, $\beta(x) = \lambda$. Governance is costly, so firms use only the amount needed to induce proper behavior, so $g(x) = 1 - \frac{\beta(x)}{\lambda}$. The result that total compensation is increasing follows directly from the participation constraint. $\beta(x)$ is shown to be strictly decreasing in the Supplemental Materials. Governance is increasing because β is decreasing.

Outline of Proof of Theorem 4. The proof of Theorem 4, in the Supplemental Materials, is structured by showing that the following claims hold. First, the regulator never lowers governance. Second, the endogenous participation constraint binds at all regulated firms. This results in

a cutoff, x_1 , which is shown to be the (unique) solution to $\psi(x_1) = 0$, where $\psi(x') = \int_{x'}^{1} \left(1 - \frac{\kappa}{\lambda T(x)}\right) dx$. This implies that $x_1 < x^*$, because $T(x) > \frac{\kappa}{\lambda}$ for all $x > x^*$, $\psi(x^*) > 0$. Finally, if $\psi(0) > 0$, the regulator sets g(0) = 1.

Proof of Corollary 1. The regulator requires firm x to implement governance $g_r(x) = 1 - \frac{\beta_r(x)}{\lambda}$, where

$$\beta_r(x) S(x) T(x) = \beta_r(x_1) S(x_1) T(x_1) + \frac{AB}{a-b} \left[(1+q-x)^{b-a} - (1+q-x_1)^{b-a} \right].$$
(A8)

Because $\frac{dg_r}{dx} = -\frac{1}{\lambda} \frac{d\beta_r}{dx}$, g_r is increasing if β_r is decreasing. β_r is strictly decreasing for $x > x_1$ by identical argument to the proof of Theorem 3, substituting x^* with x_1 .

Outline of Proof of Lemma 5. The proof of Lemma 5, in the Supplemental Materials, is structured by showing that the following claims hold. The participation constraint binds for $x < x^c$, and the incentive compatibility constraint binds for $x \in [x^c, x^*]$. The participation constraint always binds at large firms because governance is worth the cost (Theorem 1). The proof is concluded by showing that $x^c = 0$ for lax governance floors, $\gamma \in [0, \gamma_0]$, that $x^c = 1$ for very strict governance floors, $\gamma \in [\gamma_2, 1]$, and that x^c is strictly increasing in γ when $\gamma \in (\gamma_0, \gamma_2)$.

Outline of Proof of Theorem 5. The proof of Theorem 5, in the Supplemental Materials, is structured by the following logic. The regulator cares only about investor welfare, so she chooses the governance floor that maximizes aggregate firm value. Her objective function, $R(\gamma)$, is aggregate firm value. The proof shows that $\frac{dR}{d\gamma}$ is constant on $(0, \gamma_0)$, strictly decreasing on (γ_0, γ_1) , strictly decreasing on (γ_1, γ_2) , and constant on $(\gamma_2, 1)$. Further, $\frac{d-R}{d\gamma}(\gamma_0) = \frac{d+R}{d\gamma}(\gamma_0)$ and $\frac{d-R}{d\gamma}(\gamma_2) = \frac{d+R}{d\gamma}(\gamma_2) < 0$, but $\frac{d-R}{d\gamma}(\gamma_1) > \frac{d+R}{d\gamma}(\gamma_1)$. Therefore, $\frac{dR}{d\gamma}$ is decreasing, so *R* is globally concave, so the optimal floor is unique, except when $\frac{dR}{d\gamma}(0) = 0$. Thus, $\gamma_{Opt} \in \{0\} \cup (\gamma_0, \gamma_2)$ without loss of generality.

Outline of Proof of Corollary 2. Firms larger than firm x^* practice governance, so there are $1-x^*$ voluntary governance firms. x^* solves $T(x^*) = \frac{\kappa}{\lambda}$. The proof, in the Supplemental Materials, shows that $\frac{dx^*}{d\kappa} > 0$, $\frac{dx^*}{d\lambda} < 0$, $\frac{dx^*}{dT_{Max}} < 0$, $\frac{dx^*}{dB} > 0$, and $\frac{dx^*}{db} < 0$.

Outline of Proof of Corollary 3. Executive compensation at firm $x > x^*$ is given by $w(x) = \beta(x^*) S(x^*) T(x^*) + \frac{AB}{a-b} \left[(1+q-x)^{b-a} - (1+q-x^*)^{b-a} \right]$, pay-performance sensitivity satisfies $\beta(x) S(x) T(x) = w(x)$, governance $g(x) = 1 - \frac{\beta(x)}{\lambda}$, and firm value $\Pi(x) = S(x) T(x) - w(x) - \kappa g(x) S(x)$. Comparative statics are found in the Supplemental Materials using total differentiation $(\frac{dx^*}{d\theta}$ from Corollary 2).

Outline of Proof of Corollary 4. The proof is in the Supplemental Materials. When γ is fixed, x^c satisfies $\phi(x^c) = 0$ and x^* satisfies $T(x^*) = \frac{\kappa}{\lambda}$. Comparative statics are found using total differentiation.

Outline of Proof of Corollary 5. The proof of Corollary 5, in the Supplemental Materials, is structured by the following reasoning. The optimal floor can be in the following ranges: $\gamma_{Opt} = 0$, $\gamma_{Opt} \in (\gamma_0, \gamma_1)$, $\gamma_{Opt} = \gamma_1$, and $\gamma_{Opt} \in (\gamma_1, \gamma_2)$. If it is optimal not to implement a floor $(\gamma_{Opt} = 0)$, a sufficient increase in any of the parameters $\{T_{Max}, -B, b, \lambda, -\kappa\}$ will induce the regulator to implement a floor. When $\gamma_{Opt} \in (\gamma_0, \gamma_1)$ or $\gamma_{Opt} \in (\gamma_1, \gamma_2)$, the optimal floor is an interior solution, so the equilibrium is defined by three equations: the regulator's

first-order condition, $\frac{dR}{d\gamma}(\gamma_{Opt}) = 0$, the definition of x^c , $\phi(x^c) = 0$, and the definition of x^* , $T(x^*) = \frac{\kappa}{4} \cdot \frac{23}{4}$

Outline of Proof of Corollary 6. When $\gamma_{Opt} \in (\gamma_0, \gamma_1) \cup (\gamma_1, \gamma_2)$, the equilibrium is defined by three equations: the regulator's first-order condition, $\frac{dR}{d\gamma}(\gamma_{Opt}) = 0$, the definition of x^c , $\phi(x^c) = 0$, and the definition of x^* , $T(x^*) = \frac{\kappa}{\lambda}$. If $\gamma = \gamma_1, x^c = x^*$, so comparative statics are identical for x^c and x^* . The proof is in the Supplemental Materials.

Outline of Proof of Corollary 7. The proof, in the Supplemental Materials, shows a generalization of Theorem 5, with *N* industries. The first-order condition for optimality of the governance floor is $\sum_{n=1}^{N} \frac{dR_n}{d\gamma}(\gamma) = 0$, where R_n is aggregate firm value for industry *n*. The cutoffs, x_n^* and x_n^c , satisfy $\tau_n(x_n^*) = 0$ and $\phi_n(x_n^c) = 0$, where τ_n and ϕ_n are defined as in Lemma 5, with parameters from industry *n*.

Proof of Theorem 6. Suppose that the regulator pays a share δ of governance costs—when firm *x* implements governance level *g*, the government pays $\delta \kappa g(x) S(x)$, and the firm pays $\kappa (1 - \delta) g(x) S(x)$. The cost of governance for a firm becomes $\kappa (1 - \delta) g(x) S(x)$, so the firm solves the same problem as in Section 1, using $\kappa (1 - \delta)$, rather than κ , as the cost of governance. By Theorem 1, a firm uses governance iff $x > x^*(\delta)$, where $T(x^*(\delta)) = \frac{\kappa(1-\delta)}{\lambda}$. Lemma 4 and Theorem 3 hold. Therefore, a subsidy of δ is behaviorally equivalent (same *g* and β) to the outcome when the regulator chooses the optimal form of regulation from the proof of Theorem 4 and regulates all firms larger than $x^*(\delta)$. Because *T* is strictly increasing, $x^*(\delta)$ is strictly improves welfare, because it moves the outcome closer to the optimal outcome. This proves 1. Define δ_1 such that $T(x_1) = \frac{\kappa(1-\delta_1)}{\lambda}$. Thus, $x^*(\delta_1) = x_1$, so subsidizing δ_1 of governance costs is behaviorally equivalent to the optimal regulation in Theorem 4 and thus proves 2.

Alternatively, suppose that the government implements a flat corporate income tax, does not subsidize governance, and makes executive compensation only partially tax deductible. For every dollar a firm pays its executive, taxable income of the firm decreases by ρ . The firm's expected cash flow (before taxes) is $ST - \beta ST - \kappa g S$, but its tax bill is $\tau (ST - \rho\beta ST - \kappa g S)$. The firm's objective becomes

$$\Pi = (1 - \tau) ST - (1 - \rho \tau) \beta ST - \kappa g S (1 - \tau).$$
(A9)

The IC constraint binds, so $\beta = \lambda (1 - g)$, and thus

$$\Pi = [1 - \tau - (1 - \rho \tau) \lambda] ST + g [(1 - \rho \tau) \lambda T - \kappa (1 - \tau)] S.$$
(A10)

Therefore, a firm exercises governance iff $T > \frac{\kappa}{1-\tau} \frac{1-\tau}{1-\rho\tau}$. Because $\rho \in [0, 1]$, $(1-\rho\tau) \in [(1-\tau), 1]$. Define $\delta(\rho)$ so that $[1-\delta(\rho)] = \frac{1-\tau}{1-\rho\tau}$. By choosing ρ_1 such that $\delta(\rho_1) = \delta_1$, 3 follows from 1 and 2. ρ is well defined if $\tau \ge \delta_1$. Therefore, limiting tax deductibility of payments to executives is behaviorally equivalent to subsidizing governance if the corporate tax rate is high enough.

²³ Results are less intuitive when $\gamma_{Opt} = \gamma_1$. The regulator finds γ_1 optimal when it is optimal to set $x^c = x^*$ or equivalently when $\frac{d_+R}{d\gamma}(\gamma_1) \le 0 \le \frac{d_-R}{d\gamma}(\gamma_1)$ (because $\frac{d_-R}{d\gamma}(\gamma_1) > \frac{d_+R}{d\gamma}(\gamma_1)$, this is possible). Comparative statics are similar to the interior case at the corners (if $\frac{d_+R}{d\gamma}(\gamma_1) = 0$ or $\frac{d_-R}{d\gamma}(\gamma_1) = 0$). If $\frac{d_+R}{d\gamma}(\gamma_1) < 0 < \frac{d_-R}{d\gamma}(\gamma_1)$, this strict inequality still holds after a small change in parameters, the equilibrium under optimal regulation is defined by three equations: $x^c = x^*$, $\phi(x^c) = 0$, and $T(x^*) = \frac{\kappa}{\lambda}$. The only clear comparative statics in this case are $\frac{d_-R}{d\kappa} > 0$ and $\frac{d\gamma}{d\kappa} > 0$.

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