# Two Heads May Not Be Better Than One: Corporate Board Structure, Managerial Self-Dealing, and Common Agency

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(Comments are very welcome )

**Abstract**

This paper compares the effects on corporate performance and managerial self-dealing in a situation in which the CEO reports to a single Board that is responsible for both monitoring management and establishing performance targets to an alternative in which the CEO reports to two Boards, each responsible for a different task. The equilibrium set of the common agency game induced by the dual board structure is fully characterized. Compared to a single board, a dual board demands less aggressive performance targets from the CEO, but exerts more monitoring. A consequence of the first feature is that the CEO always exerts less effort toward production with a dual board. The effect of a dual board on CEO self-dealing is ambiguous: there are equilibria in which, in spite of the higher monitoring, self-dealing is higher in a dual system. The model indicates that the strategic interdependence generated by the assignment of different tasks to different boards may yield results that are far from the desired ones.

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"It would be a mistake for supervisory powers to be separated off in the Boardroom" (The Financial Times, January 14, 2003)

"Another problem is that audit committees are evolving into mini-boards" (The Economist, March 20, 2004)

# 1 Introduction

Recent corporate scandals have drawn a great deal of attention to the potential lack of oversight over managers exercised by corporate boards. Indeed, scandals at Enron, Tyco, WorldCom, and others have motivated both legislative (the Sarbanes – Oxley Act of 2002 in the U.S.) and regulatory (e.g., new corporate governance guidelines of the NYSE) changes in corporate practice requirements, with special focus on the monitoring role to be exercised by Boards of Directors.

Despite the fact that monitoring the CEO is an important part of a Board of Directors' duties, it is widely acknowledged that, in addition to monitoring, directors also play a fundamental role in advising, developing strategy and establishing goals for the companies they serve (Lorsch and MacIver, 1989). An important question then is whether these roles are conflictive, and, if so, how to design the board structure so as to maximize its effectiveness in both of these tasks.

This paper aims to provide a partial answer to this broad question by comparing the effects on corporate performance and managerial self-dealing in a situation in which the CEO reports to a single board that is responsible for both monitoring management and establishing performance targets to an alternative in which the CEO reports to two different boards, one that is responsible for monitoring the management and the other that is in charge of defining performance targets.[1]

[1] The establishment and review of performance are some of the duties credited to Board of Directors. As Kootnz (1967) points out, "a major function of the board of directors is to determine enterprise objectives". More specifically, "most objectives can and should be refined in numerical terms. One can expect to have growth objectives in sales, expressed in specific amounts or percentages, and profit objects measured in total amount, percent of sales, or return on investment". Also, Brown (1976, p.26) illustrates this point as follows: "The board's concern with a review of *performance* is a major task. This is now perhaps the most adequately fulfilled of the Board's functions". Moreover, "... the board of directors is the proper body for the establishment of Broad policies and procedures and

Both types of arrangements are seen in practice. In fact, boards tend to be structured as either unitary or two-tiered. Unitary boards can be found in countries as the United States, England and Italy, while for countries such as Germany, Holland and Austria the two-tiered system is adopted. In the first system, all directors stand legally responsible for both managing the company's business and monitoring the CEO. In my model, this would correspond to a situation in which management reports to one principal. In a two-tier board, the managing and monitoring tasks are legally split among a board of managers and a supervisory board. A natural interpretation of this scheme is that the CEO is supposed to report to two different principals.

The relative merits of these institutions have been the focus of much discussion among practitioners, scholars and legislators (see, for instance, Roe (1993) and Romano (1993)). The clear separation of tasks and its potential positive effect on the amount of monitoring of the CEO is generally believed to be one of the most desirable features of a two-tiered system. Indeed, as there seems to be general consensus that boards tend to be too cozy with management, such a belief has induced a movement in the U.S. towards a system that resembles, *de facto,* a two-tiered one.

More concretely, in response to the string of corporate malfeasance scandals, the Sarbanes – Oxley Act of 2002 and the new Corporate Governance Rules of the NYSE specify that companies in the U.S. should have a committee exclusively responsible for the appointment, compensation and scrutiny of outside auditors.[2]Such a requirement is in its essence an assignment of monitoring and management activities to different entities in the boardroom. Some have been expressing concern regarding the implications of such changes in the effectiveness of corporate boards,[3] but it is obvious that those changes have as a premise the belief that such task separation will induce more monitoring of the CEO. .

It is undeniable that, *fixing* the level of all other instruments available to align the CEO's interests to the shareholders', the more monitoring performed by the Board, the better. Therefore, implicit in any argument that

for reviewing senior personnel and performance".

[2]See, for instance, the new NYSE Corporate Governance guidelines at http://www.nyse.com/pdfs/finalcorpgovrules.pdf

[3]Manisfestations of concern abound in the popular press. See, for instance, the special report on Corporate Boards in the March 20th issue of The Economist. Scholars and practitioners have also manifested concern. See, for instance, Carter and Lorsch (2003).

favors one institution over the other in terms of the amount of monitoring it induces is the assumption that all other "incentive" instruments are held the same. However, it is not clear this is necessarily true. In fact, it may be the case that in response to more monitoring exerted by one principal (say, the supervisory board in a two-tier board), the other principal decides to reduce the level of other instruments if they are substitutes in the provision of incentives.

Therefore, a thorough comparative analysis of the benefits and costs of making the CEO to report to one or two principals must take into account (i) the existence of a myriad of instruments to align his incentives with the shareholders' and, perhaps more importantly, (ii) that an institutional framework that assigns different roles to different principals will induce *strategic interaction* among them. Both of these points seem to have been ignored on most of the theoretical and practical discussions about the optimal way to structure Corporate Boards.

In this paper, I address explicitly some of these issues in a simple model in which a CEO can exert effort towards production and the pursuit of inefficient self-dealing operations (e.g., cash and asset diversion). In the model, effort towards production is unobservable. While the same is in principle true for self-dealing operations, upon monitoring/auditing the CEO, the board may find hard evidence of it with some probability. In those states, the amount of the operation can be fully recouped.

Monitoring, however, is a costly activity as it requires time, effort, and some expertise. Additionally and perhaps more related to the question the paper tries to answer, it is generally acknowledged that directors fear to be perceived as having a confrontational attitude towards the CEO.[4] It seems reasonable, therefore, to assume that part of such cost is personal and hard to contract upon. Moreover, such assumption incorporates the notion that the Board is often "captured" by the CEO. In fact, such notion seems to be driving this movement towards the requirement of a more watchful board. From a modelling perspective, this cost introduces a misalignment between the shareholder's and the board's interests.

A measure of total revenues (which is affected by both types of efforts) is available so the board can also demand from the CEO the attainment of cer-

[4] One of the Directors interviewed by Mace (1971) puts it as follows: "You don't say everything you think at a board meeting. There is a certain amount of professional courtesy if you are going to be a good director".

tain performance targets. As a consequence, incentives can be "input" based (auditing/monitoring) or "output" based (Lazear (1995)). I analyze how the use of both of these instruments changes when one moves from a situation in which the CEO reports to one Principal responsible for both monitoring and the establishment of goals to a situation in which two distinct Principals are each responsible for one (and only one) task. The assumption adopted throughout is that the Boards maximize revenues net of the payments made to the CEO and the personal and non-contractible cost of monitoring.

As is often observed (see Mace (1971), for example), the Board of Directors' job is significantly complicated by the fact it has to rely on information provided by the CEO to perform its duties. As an example, if the CEO is – and it seems reasonable to think this is the case – better informed than the Board about the current market conditions, it becomes harder for the Board to establish performance targets that are compatible with the environment the firm is operating on (e.g., the management may use the claim to be in an adversary environment to devote less time to perform productive activities). Eliciting proper information from the management turns out, therefore, to be also an important issue for corporate boards. I try to capture this idea by assuming the CEO has private information regarding the quality of project the firm has access to.

The interaction of information asymmetry with the non-observability of effort and the possibility of the pursuit of self-dealing by management makes the problem of designing an optimal contract non-trivial for the principal(s). In particular, a contract that induces efficient (first best) levels of effort and self-dealing will not be optimal for them.

A unitary board that decides both on monitoring and performance measures internalizes all benefits and costs of these choices. This is not necessarily optimal if they are to act on behalf of shareholders because of the non-contractible monitoring costs. On the other hand, in a two-tier board, each principal's contract specifies the level of the variables under their control, and each contract must be a best response to the other. Neither board fully internalizes the effects of their choices on their peers' payoff (Martimort and Stole, 2003).

As it turns out, such externalities in fact induce, for *all* possible equilibria of the game played among the Principals, more monitoring of the CEO by the supervisory board when compared to the unitary board case. However, it is also the case a two-tier structure induces the demand of less aggressive performance targets from him. In fact, these two features of a dual system (more monitoring and less aggressive performance) are intrinsically related.

The reason is that, in the model, performance targets and monitoring levels are *complements* in the CEO's preferences: more monitoring, by decreasing the marginal benefit of the pursuit of self-dealing, reduces the latter; this, on its turn, decreases the marginal cost of productive effort, and, as a consequence increases the CEO willingness to deliver more aggressive targets. Such complementarity, along with the separation of tasks in the boardroom, makes the Supervisory Board, when deciding on how much to monitor, to perceive, as an additional benefit, the increased performance target the CEO is willing to deliver. This is what generates more monitoring. Moreover, since targets and monitoring are *substitute* incentive instruments to preclude self-dealing, the Management Board reduces the former. This reduction, on its turn, reinforces the perception of an additional benefit of monitoring by the Supervisory Board, and the equilibrium features just described ensue.

The combination of more monitoring and less performance targets have ambiguous consequences for self-dealing as (i) for a fixed level of performance target, the more monitored the manager is, the less self-dealing he will pursue, and (ii) for a fixed level of monitoring, the less aggressive the demand for performance, the higher the incentive for the CEO to exert effort towards self-dealing rather than toward production. As a result, there exist equilibria in which, at least for some of the project's qualities, the level of self-dealing *increases* in a two-tier board case when compared to the unitary one despite of the increase in monitoring. There are also equilibria in which the amount of self-dealing decreases for at least some of the project's qualities.

Moreover, even though the effect of an institutional change on self-dealing is ambiguous, the effect on productive effort is unambiguous: in *all* possible equilibria, effort will decrease with a dual structure. Therefore, an inevitable cost of splitting the tasks in the Boardroom is the reduction of the amount of effort towards production. Even worse news is that such a decrease in effort towards production may be accompanied by more self-dealing. It seems therefore that the costs generated by the lack of coordination of policies derived by the separation of tasks in the boardroom may offset the potential benefits of having a more watchful board.

Regarding profits, I don't have a full characterization of how expected profits compare under both board structures. I do know, however, that profits under a unitary system are higher than in a two-tiered one when the project quality is high enough. Moreover, in all numerical exercises I ran, the expected profits under a Unitary Board System were higher. The above – along with the worst performance regarding the levels of productive effort – seems to indicate that the expected profits under a unitary system are always higher. However, as of yet, this is just a conjecture to be verified.

The sources of the seemingly superiority of a unitary system over the dual board relate to the lack of coordination over policies brought by the separation of tasks in the boardroom that more than offset the gains brought by a higher amount of monitoring of the CEO. One may argue that this is just an artifact of the assumed simultaneity of the boards' moves. To show this is not the case, I change the timing of the model slightly to accommodate the possibility of the supervisory board deciding on monitoring after the management board decides over the performance targets. It is shown that, in such a setting, there is a unique equilibrium in the game among boards. The amount of self-dealing is higher, and the profits are lower than under a unitary system. I also argue that, in the model, the setting in which the boards move sequentially yields the same outcome as when the boards decide independently on their variables but communicate the information extracted from the CEO among themselves.

The paper is organized as follows. The next section makes a brief review of the related literature. Section 3 describes the set-up of the model and the timing of events. In section 4, I solve the model for a useful benchmark – the case in which the quality of the project is known to the board – that helps to understand the difficulties faced by he Boards in inducing both high effort and no self-dealing from the CEO when monitoring is costly to them and the quality of the project is CEO's private information. Section 5 solves the model for the single Principal case (Unitary Board). Section 6 characterizes the set of equilibria for the Two-Principal case (Two-Tier Board). On the way towards characterizing the equilibria, I discuss briefly the complications arising from the strategic link among the Principals' and compute their best responses for a fixed set of contracts offered by the other party. Section 7 compares both institutional frameworks in terms of their induced amount of self-dealing and productive effort. Section 8 discusses a particular Corporate Governance Mechanism that seems to be complementary to a Two-Tier system and is widely used in at least one country adopting the Dual System, namely Germany. Section 9 solves the model for the case in which the boards move sequentially rather than simultaneously. The concluding remarks are drawn in section 10. All proofs are relegated to the appendix.

# 2 Related Literature

The theoretical literature on corporate boards is relatively small. Most, if not all, of the papers focus on the reason why weak boards may arise. Hermalin and Weisbach (1998), for instance, develop a model in which the main board's tasks are to hire and (possibly) fire management. The board's independence is endogenously determined in a bargain game between the CEO – who has strict preferences for a less independent board – and the incumbent board members. The CEO's bargain power stems from his perceived ability *vis a vis* a potential substitute. A powerful CEO can impose a less independent board which performs less monitoring. Warther (1998) develops a model in which the CEO, upon not being fired after an explicit opposition of the board, is capable of ejecting some of its members. The focus is on how this power affects the board's behavior. It is shown that such power induces a low frequency of open dissent in the board room.

In Almazan and Suarez (2003), a weak board – one in which an incumbent CEO can veto his replacement – is complementary to low incentive pay in the provision of incentives to the CEO and, therefore, may arise as the (overall) cost minimizing structure of incentives of a company. Adams and Ferreira (2004) focus on the board's dual role as advisors and monitors of management. In their setting, information that is relevant for the board's advisory role may not be disclosed by a CEO who is monitored closely, as such information is potentially informative about his ability. As a consequence, the board may pre-commit to a reduced amount of monitoring to induce information sharing. Also, related to the present paper, they consider the possibility of assigning the right to fire the manager (the monitoring task) to an entity who does not have an advisory role. Finally, Hermalin (2004) considers the potential implications of a trend toward more diligent boards on variables as the CEO's tenure and compensation, and the external hires as CEOs.

The present paper, in turn, is concerned with the interaction of the existence of more than one instrument to provide incentives to top management (the rest of the literature focus on the monitoring one) with two different institutional frameworks; one in which the adoption of these instruments is decided by a single entity, and the other in which each instrument is under control of a different entity. The focus is how the use of these instruments varies with the institutional arrangement and the resulting implications for the behavior of the top management regarding corporate malfeasance and productive effort.

# 3 Model

The model I consider has two kinds of risk-neutral parties. The first one is a CEO who works for a company endowed with a project of quality $\theta$. He can exert productive effort and, by virtue of his control over the company's activities, can extract resources (self-deal) from the firm. The company's revenues are assumed to be contractible and are given by $y = \theta + e_1 - e_2$, where $e_1$ is the CEO's unobservable effort towards production, and $e_2$ is the amount of resources he can allocate for self-dealing operations. There are many ways – ranging from the purchase of a corporate jet to selling output below market prices to companies they (or some acquaintances) own, from investing in unprofitable projects with empire building purposes to outright cash and asset diversion – in which a manager can use his discretion to derive private benefit at the expense of shareholders. These possibilities are captured by $e_2$ in the model. The project's quality, $\theta$, is assumed to be CEO's private information.

The other parties in the model are the principals to which the CEO reports. I analyze two different institutional frameworks. The first one has the CEO reporting to only one principal (unitary board). In the other, he reports to two different principals (two-tier board). Both principals care about profits but dislike monitoring the management. More specifically, both principals maximize revenues net of the payments made they make to the CEO and the personal cost of monitoring. This objective function is motivated by the extensive evidence that Board members tend to be captured by the CEO, or that directors fear to be perceived as having a confrontational attitude toward management (Mace (1971), Lorsch and MacIver (1989)). Their difference stems solely from the tasks they are assigned.

A fundamental distinction between the two types of effort the CEO can exert, $e_1$ and $e_2$, is that, upon monitoring/auditing the CEO, the Board can recoup part of the resources associated with the self-dealing operation. More specifically, I assume that there exists a continuum of auditor types

$p \in [0,1]$. Upon hiring an auditor of type $p$, the board finds hard evidence of self-dealing operation with that probability. Moreover, if hard evidence is found, the resources can be fully recouped.[5] The tougher the auditor (as measured by a higher $p$) hired by the Board, the higher the (personal) cost incurred by the boards.[6] For simplicity, I assume the cost is given by $\frac{p^2}{2}$. Throughout the paper, I will refer to the choice of the auditor type as the monitoring level proposed by the Board.

Regarding the project, the Principals views its quality as being distributed over the interval $[\underline{\theta}, \overline{\theta}] \subseteq (0,1]$ according to the c.d.f. $F(\theta)$ , with corresponding density $f(\theta)$.Throughout the analysis, it will be assumed that the distribution satisfies

(A1) $f(\theta)$ is strictly log concave and differentiable, and

(A2) $f(\underline{\theta}) \geq 1$

The first part of (A1) implies that $\frac{1-F(\theta)}{f(\theta)}$ is strictly decreasing in $\theta$ (Bagnoli and Bergstrom, 1989), which guarantees the satisfaction of a monotonicity condition in the one-principal case. Differentiability is used to characterize the equilibrium set of the common agency game induced by the two-tier system. (A2) suffices to assure that, for the unitary board case, all non-negativity constraints are satisfied. More stringent assumptions on the distribution than (A2) (as well as on the value of the worst possible project, $\underline{\theta}$) may possibly be needed to guarantee that an equilibrium exists in the game among Boards induced by a two-tier structure and to compare the levels of self-dealing for both institutional frameworks. Such assumptions will be made explicitly whenever needed.

The CEO's preferences over payments, efforts and monitoring levels are represented by

[5] One can think that, with such hard evidence, shareholders could go to court and try and overturn the business decision associated with $e_2$. In fact, as described by Goode (1992, p. 139) "the remedy most commonly sought against someone who is considered to have breached his fiduciary obligations to his company is an account and payment of the profits derived from his allegedly improper conduct. Sometimes a claim is laid to particular assets in his hands, or even to the entirety of a business developed from the infringing activity on the basis of a constructive trust".

[6] I assume that the monetary cost of hiring an auditor (e.g., payments to be made) are the same irrespective of $p$. I set this cost to being zero.

$$V(w, p, e_1, e_2) = w + (1-p)e_2 - \frac{e_2^2}{2} - \frac{e_1^2}{2},$$

where $w$ is the total pay made to him by the Principals. There are two implicit assumptions in the specification of the manager's preferences that deserve being mentioned.[7]

The first of them is that there are no exogenous outside punishments (e.g., going to jail) for being caught pursuing self-dealing operations. The realism of such assumption is clearly contingent on the nature of corporate malfeasance. As argued above, there is a whole range of types of private benefits a manager can generate upon being in control. While for some of those it is unlikely that, even if caught, the CEO will incur in such penalties, for others (outright theft, for example) the same is not true. However, in my favor, such outside punishments tend to be lump-sum. As I am concerned with the *level* of corporate malfeasance, as long as expected outside punishment[8] is not big enough, such an assumption is inessential.

The second assumption, coming from the term $-\frac{e_2^2}{2}$ in the CEO's preferences, is that effort towards corporate malfeasance is inefficient. If self-dealing was neutral from an efficiency point of view, the possibility of its pursuit by the CEO would pose no substantial problems for the board(s). Indeed, one could allow the CEO to perform as much self-dealing as he wanted and reduce his pay by the exact same amount.

## 3.1 Timing of Events and The Contract Space

The timing of the events is depicted in Figure 1. Initially, at period zero, the firm is set, a manager is hired and the Corporate Board Structure is defined. In period 1, the CEO gets privately acquainted with the quality, $\theta$, of the project.

[7]The functional form specifications (e.g., quadratic and separable cost functions) are made mainly for convenience as they allow me to solve analytically the model with 2 principals. It does not seem that any of the insights of the model rely heavily on such functional forms (the only important feature of the functional forms is that the two types of efforts are (weakly) substitutes for the CEO).

[8]Such expected punishment would depend both on the probability of hard evidence being found and some exogenous probability that depends on features as the legal framework of the country the firm is established on, and, as pointed out above, the nature of corporate malfeasance.

In period 2, if the Board Structure is the Unitary one, a unique set of contracts $\{w(y,p), y, p\}_{y \in R_+, p \in [0,1]}$,specifying payments, monitoring levels and performance targets, is offered to the CEO. In case the Board Structure is Two-Tier, two set of contracts are offered: $\{t^m(y), y, \}_{y \in R_+}$by the Management Board and $\{t^s(p), p\}_{p \in [0,1]}$ where, respectively, $t^m(y)$ and $t^s(p)$ are the payments made to the CEO upon the latter compromising delivering $y$ and accepting being monitored with intensity $p$. In such case, $w(y,p) \equiv t^m(y) + t^s(p)$.

The CEO picks the contracts that fit him better in period 3 (in the Two-Principal Case, he *must* contract with both Principals, i.e., the model is one of intrinsic common agency (Bernheim and Whinston (1986)) and then chooses how much to pursue of effort towards production and self-dealing taking into account his performance target compromise, $y$. All variables (with the exception of the effort levels and the project's quality) become public and payments are made in the end of the period.

In period 4, the auditor hired by the Board monitors and finds hard evidence of corporate malfeasance with probability $p$. The amount self-dealt is fully recouped in such states.

# 4 A Useful Benchmark

In order to understand better the forces at play in the model, and, in particular, the difficulties faced by the boards in inducing both high effort and no self-dealing from the CEO, it is worth analyzing the model for the case in which the quality of the project is common knowledge.

In this case, irrespective of its structure, the Board can contract with the CEO in a way that attains (by inducing a socially optimal allocation and leaving no rents for the CEO) the highest possible level of profits despite the fact that its is costly for it to monitor the CEO. In fact, it turns out not to be necessary to monitor the CEO when $\theta$ is known. Hence, in the paper's setting, it is the combination of unobservable efforts, *and* the private information from the CEO's part (along with the Board's private cost of monitoring) that makes the problem of designing an optimal contract non-trivial for the principal(s).

To solve the model, it is convenient to move to the CEO's problem of choosing the amount of self-dealing to pursue in period 3 once he has committed to deliver $y$ in revenue and knows he will be monitored with intensity $p$. Noting that $e_1 = y + e_2 - \theta$ and that, given the committed $y$, the payment $w(y,p)$ cannot affect his optimal choice of $e_2$,

$$\max_{e_2 \geq 0} (1-p)e_2 - \frac{e_2^2}{2} - \frac{(y+e_2-\theta)^2}{2}$$

Denoting by $v(p,y;\theta)$ the value of this program and by

$$e_2(p,y;\theta) = \{ \begin{array}{c} \frac{(1-p+\theta-y)}{2} \text{ if } y \leq 1-p+\theta \\ 0 \text{ otherwise} \end{array}$$

its solution, the boards can behave in period 1 as if the CEO had utility function $U(w,p,y;\theta) = w + v(p,y;\theta)$.

I start by analyzing the Unitary Board case and leave the Dual Board's analysis for the appendix. Normalizing the CEO's outside option to zero, the problem the Board faces is to maximize $y + pe_2(p,y;\theta) - w - \frac{p^2}{2}$ subject to $w + v(p,y;\theta) \geq 0$. It is optimal to set wages so that this latter constraint holds with equality. Hence, the problem becomes

$$\max_{y,p \geq 0} y + pe_2(p,y;\theta) + v(p,y;\theta) - \frac{p^2}{2}$$

The solution entails $y = 1+\theta$ and $p = 0$. Such combination, while sparing the board from the cost of monitoring the CEO, induces no self-dealing and a first best level of productive effort. More interestingly, one can verify that the same combination of $y$ and $p$ also constitutes an equilibrium in a two-tier board system.

**Proposition 1** *If the quality of the project, $\theta$, is known by the boards, the chosen contract by a unitary board attains (by inducing a socially optimal allocation and leaving no rents for the CEO[9]) the highest possible level of profits for the company. Moreover, for the two-tier board case, there is always an equilibrium that mimics the unitary board's outcome*

In a setting with private information, on the other hand, the fact the Board is forced to rely on information provided by the CEO to establish performance targets brings two direct effects. Firstly, as it will be shown in the

[9] That is, $e_1(\theta) = 1$, $e_2(\theta) = 0$ and $p(\theta) = 0$, for all $\theta$. Additionally, $w(y,p,\theta) = y - (\frac{1}{2} + \theta)$ guarantees that no rents are left to the CEO.

next section, it makes it optimal to distort the level of performance target down in a unitary board system. It is clear then that for the same amount of monitoring exerted in the full information benchmark, namely $p = 0,$ a reduction in the performance target will induce positive self-dealing from the CEO's part. Consequently, a setting with asymmetric information will introduce a motive for monitoring. Putting somewhat differently, as performance targets and monitoring are substitute instruments to prevent self-dealing, the reduction of the latter induces the need for the former. On its turn, the need for monitoring along with monitoring being costly to the Board introduces a wedge between the shareholders' and the Boards' interests. This tension will generate, from the shareholders' perspective, a sub-optimal amount of monitoring of the CEO and the resulting perception that the board should be more watchful.

Second, as will be seen in section 6.1, a corporate board structure that splits the Board's duties will, in a setting with asymmetric information, always introduce a non-trivial strategic interaction between the Supervisory and Management Boards. This strategic interaction will make the combination of $y$ and $p$ for a dual board to differ from the one set by a unitary board in all possible equilibrium.

# 5 Asymmetric Information: The Unitary Board Case

Under private information, when the Board is initially structured with only one principal, matters are relatively simple. By the Revelation Principle, one can restrict attention to direct mechanisms in which the CEO reports a project quality $\widehat{\theta}$ to the Principal and is demanded to attain $y(\widehat{\theta})$, monitored with intensity $p(\widehat{\theta})$, and receives a payment of $w(\widehat{\theta})$.

As argued above, the board can behave in period 1 as if the CEO had utility function $U(w, p, y; \theta) = w + v(p, y; \theta)$. So the board's problem can be written as

$$\max_{\{y(\theta),p(\theta)\}} E(y(\theta) + p(\theta)e_2(p(\theta), y(\theta); \theta) - w(\theta) - \frac{p(\theta)^2}{2}) \tag{1}$$

$$
\begin{aligned}
& \quad s.t. \\
U(w(\theta), p(\theta), y(\theta); \theta) &\geq U(w(\widehat{\theta}), p(\widehat{\theta}), y(\widehat{\theta}); \theta) \text{ for all } \theta, \widehat{\theta} \\
U(w(\theta), p(\theta), y(\theta); \theta) &\geq 0 \text{ for all } \theta, \textit{and } p(\theta) \in [0,1]
\end{aligned}
$$

The first set of constraints in (1) are the Incentive Compatibility (IC) ones: it must be in the manager's best interest to report truthfully to the Board. The second set are the Participation Constraints (IR): the contracts must be so that the CEO's equilibrium payoff is at least equal to his outside option.

It is standard to replace the (IC) constraints by a "first order condition" for truthtelling and a monotonicity condition. Formally, letting $U(\theta)$ be the equilibrium utility of the CEO when the project quality is $\theta$,

**Lemma 1** *The set of contracts* $\{w(\theta), p(\theta), y(\theta)\}_{\theta \in \{\underline{\theta}, \overline{\theta}\}}$ *is incentive compatible if, and only if,*

*(i)* $U(\theta) = U(\underline{\theta}) + \int_{\underline{\theta}}^{\theta} (y(\tau) + e_2(p(\tau), y(\tau); \tau) - \tau) d\tau$

*(ii)* $y(\theta) - p(\theta)$ *is non-decreasing in* $\theta$

Using Lemma 1, we can readily see that $w(\theta) = U(\underline{\theta}) + \int_{\underline{\theta}}^{\theta} (y(\tau) + e_2(p(\tau), y(\tau); \tau) - \tau) d\tau - v(p(\theta), y(\theta); \theta)$. Substituting this in the objective function and integrating by parts, the Board's program becomes

$$
\max_{\{y(\theta), p(\theta)\}, U(\underline{\theta})} E(y + pe_2(p, y; \theta) + v(p, y; \theta) - (U(\underline{\theta}) + \frac{(1 - F(\theta))}{f(\theta)}(y + e_2(p, y; \theta) - \theta) - \frac{p^2}{2})
$$

$$
s.t.\ U(\underline{\theta}) \geq 0,\ y(\theta) - p(\theta) \text{ non-decreasing in } \theta \text{ and } p(\theta) \in [0,1].
$$

Clearly, it is optimal to set $U(\underline{\theta})$ equal to zero. Moreover, ignoring the other constraints and maximizing the objective pointwise, we have, using (A1)

**Proposition 2** *Under a Unitary Board, the optimal contract specifies*

*(i)* $y(\theta) = 1 + \theta - \frac{(1-F(\theta))}{f(\theta)}$

*(ii)* $p(\theta) = \frac{(1-F(\theta))}{3f(\theta)}$

*The induced amount of self-dealing is* $e_2(p(\theta), y(\theta); \theta) = \frac{(1-F(\theta))}{3f(\theta)} > 0$ *for all* $\theta \in [\underline{\theta}, \overline{\theta})$

The contract offered by the Principal induces positive self-dealing from the CEO whenever the project quality is not the highest one. The intuition for this is that, because the CEO is better informed than the Board, the eliciting of this information requires the provision – through a higher wage – of some rents to the CEO. To reduce the size of such rents, the Board demands less aggressive performance targets. This reduces the marginal cost (and therefore increases the incentives for) the CEO exerting self-dealing. The Board could then reduce the marginal benefits of self-dealing by increasing its monitoring by hiring a tougher auditor. However, the latter is assumed to be costly.

From the point of view of the shareholders, a unitary board exerts a sub-optimal amount of oversight over the CEO. If the shareholders were in charge of hiring the auditor themselves, they would rather, taking as fixed the performance targets set by the Board, increase the monitoring to some level in the range $[\frac{1-F(\theta)}{f(\theta)}, 1]$ to preclude self-dealing altogether.[10]

The latter point has triggered some discussion on the potential benefits of moving to a dual system, and, more importantly, a whole set of new rules intended to increase the oversight over the management in the U.S.[11] Most of these changes have as a practical consequence the separation of management and supervisory tasks to different bodies in a Corporate Board, much as in a two-tier board scheme. The next section analyses, using the above model, some of the possible consequences of these changes.

[10] There are many reasons why the shareholders may not be able to monitor (or, more realistically, impose contractually to the board auditing standards that would correspond to more monitoring of the top management) the CEO themselves. In my view, the most compelling ones are their lack of expertise and atomicity.

[11] The same is true in England. See, for instance, the Higgs Report at http://www.dti.gov.uk/dd/non_exec_review/pdfs/higgsreport.pdf

# 6 Asymmetric Information: The Two-Tier Board Case

In this section, the case in which the CEO reports to two Principals is considered. I first describe the complications arising from the introduction of a second principal when the instruments each of them control affect the agent's payoff in a non-separable way. I then analyze the behavior of each of the Principals when they take as fixed the set of contracts offered by the other one. The set of all possible equilibria is characterized and their implications on the company's performance and the amount of self-dealing are derived. Both boards are assumed to maximize revenues net of the payments they make to the CEO and their personal cost of monitoring.

## 6.1 Common Agency Leading to Strategic Interaction Among Principals

Solving the model for the two-tier board case involves some additional complications. The main issue is that the Principals must offer contracts that are mutual best responses. The strategic link among boards comes from the preferences of the CEO. As argued above, in period 1, the CEO's (induced) preferences over monitoring and performance can be expressed by

$$U(t^m + t^s, p, y; \theta) = t^m + t^s + v(p, y; \theta),$$

where $v(p, y; \theta) = \max_{e_2}(1-p)e_2 - \frac{e_2^2}{2} - \frac{(y+e_2-\theta)^2}{2}$. When the solution to this problem involves positive self-dealing, the CEO's induced utility function will depend in a non-separable way on both and $y$ and $p$. As a consequence, the contract he is willing to take from the supervisory board will depend on the contract offered by the management board and vice-versa.[12] A slight complication in my setting is that whether or not the amount of self-dealing will be positive *depends,* in turn, on the set of contracts offered by the principals. It turns out, however, that the boards will not attain an outcome in which no self-dealing is pursued in equilibrium for CEO's with access to projects in the range $[\underline{\theta}, \overline{\theta})$.

[12] If the CEO's payoff depended on both instruments in a separable way, there would be no strategic link and, in fact, no difference between having him reporting to either one or two Principals. This is so because, under separability, the optimal contract he picks from one Principal is not affected by the one he has with the other.

**Proposition 3** *There can be no equilibrium in the Two-Principal case in which a CEO with access to a project of quality $\theta \in [\underline{\theta}, \overline{\theta})$ does not pursue self-dealing.*

The above result follows because any pair of contracts that induce no self-dealing from the CEO generates an incentive for at least one board to free-ride on the other. As an illustration, the best response from the supervisory board to a set of contracts offered by the management board that does not induce self-dealing is not to monitor at all. But if the supervisory board is not monitoring, it can never be optimal for the management board to demand targets that induces no corporate malfeasance.

In addition to the intrinsic difficulties related to finding a profile of mutual best responses, the main practical complication arising from the boards' strategic dependence is that, as opposed to the single principal case, it is potentially with loss of generality to restrict attention to Direct Revelation Mechanisms. However, as shown by Martimort and Stole (2002, 2003), an extension of the Taxation Principle (see, Salanie, 1997) applies and the whole equilibrium set can be computed using a fairly simple methodology. The next two sections, by considering each of the Board's best responses to a fixed set of contracts offered by the other, describe such methodology for the present model and discusses the additional complications that must be handled.

## 6.2 The Management Board's Problem

The approach I adopt follows Martimort and Stole (2003). The main idea is to consider individually each of the Principal's problem for a fixed set of contracts offered by the other. In such case, under some assumptions that have to be checked in equilibrium, the methodology used in the single board case applies fully and the problem reads exactly as a single principal's one.

If $\{t^s(p), p\}_{p \in [0,1]}$ is the menu of possible contracts offered by the Supervisory Board, the CEO will choose among them the one that maximizes his utility. As a consequence, it is as if the Management Board had to deal with a CEO with preferences given by

$$\Psi(t^m, y, \theta) = t^m + \psi(y, \theta), \tag{2}$$

where $\psi(y, \theta) = \max_p t^s(p) + v(p, y; \theta)$. By Proposition 2, for any set of contracts that may arise in equilibrium, the solution to this program, $p(y; \theta)$, depends non-trivially on $y$. This dependence will drive all the differences between the unitary board case and the two-tier one, as those are related to the externalities involved in having two different parties deciding on such instruments.

The problem of the Management Board is, for a fixed set of contracts offered by the other principal, equivalent to one of a single Principal deciding on performance target and facing an agent with the preferences in (2). The Revelation Principle applies in such a case so that attention can be restricted to Direct Mechanisms of the form $\{y(\widehat{\theta}), t^m(\widehat{\theta})\}_{\widehat{\theta}}$. Defining $\Psi(\theta) = \max_{\widehat{\theta}} \Psi(t^m(\widehat{\theta}), y(\widehat{\theta}), \theta)$, applying the Envelope Theorem twice, one has, along the lines of Lemma 1,

**Lemma 2** *Fix a certain $\{t^s(p), p\}_{p\in[0,1]}$, and assume that for such set of contracts $\psi_{y\theta}(y,\theta) > 0$, then $\{y(\widehat{\theta}), t^m(\widehat{\theta})\}_{\widehat{\theta}}$ is Incentive Compatible if, and only if,*

*(i)* $\Psi(\theta) = \Psi(\underline{\theta}) + \int_{\underline{\theta}}^{\theta} (y(\tau) + e_2(p(y(\tau),\tau), y(\tau);\tau) - \tau) d\tau$

*(ii)* $\frac{dy(\theta)}{d\theta} \geq 0$

Implicit in the statement of the Lemma is the fact that the single crossing condition ($\psi_{y\theta}(y,\theta) > 0$) needed to replace the incentive compatibility constraints in the Management Board's problem by conditions (i) and (ii) is now endogenous: it depends explicitly on the set of contracts offered by the other board. The conclusion of the Lemma will be valid only if it turns out that, for the *equilibrium* set of contracts, $\psi_{y\theta}(y,\theta) > 0$.

Ignoring this issue for now, as the Management Board maximizes $E(y + pe_2(y, p(y;\theta);\theta)) - t^m - \frac{p(y;\theta)^2}{2})$, proceeding in the same fashion as in the previous section (i.e., integrating condition (i) in Lemma 2 by parts, ignoring condition (ii) and noting that it is always optimal to set $\Psi(\underline{\theta}) = 0$ as it minimizes the payment to the CEO and guarantees the satisfaction of the IR's), its problem becomes:

$$\max_y E(y+p(y;\theta)e_2(y,p(y;\theta);\theta))+\psi(y,\theta)-\frac{(1-F(\theta))}{f(\theta)}(y+e_2(p(y,\theta),y);\theta)-\theta)-\frac{p(y;\theta)^2}{2}$$

The first order condition for optimality is then given by

$$1 - \frac{p(y,\theta)}{2} - (y + e_2(p(y,\theta),y);\theta) - \theta) - \frac{(1-F(\theta))}{2f(\theta)} + \tag{3}$$
$$\frac{dp(y;\theta)}{dy}[\frac{(1-F(\theta))}{2f(\theta)} + e_2(p(y,\theta),y);\theta) - \frac{3p(y,\theta)}{2}] = 0$$

The separation of tasks introduces, when compared to the single Principal case, the term $\frac{dp(y;\theta)}{dy}[\frac{(1-F(\theta))}{2f(\theta)} + e_2(p(y,\theta),y);\theta) - \frac{3p(y,\theta)}{2}]$ in the first order condition for the optimal performance target to be demanded from the manager. This is because a marginal increase in $y$ will increase the marginal cost of self-dealing for the CEO, and as a consequence, he will be willing to accept more monitoring from the Supervisory Board. The latter reduces the amount of self-dealing he does and, consequently, his overall rents by $\frac{dp(y;\theta)}{dy}[\frac{(1-F(\theta))}{2f(\theta)} + e_2(p(y,\theta),y);\theta)] > 0$. On the other hand, such increase in monitoring induces a higher overall cost for the Board. The term $\frac{dp(y;\theta)}{dy}\frac{3p(y,\theta)}{2}$ captures this effect.

Whether the Management Board will be more or less aggressive in the demand for performance when compared to the unitary board case will depend on the size of these two effects. This in turn will depend on the equilibrium response of the supervisory board to a more aggressive policy from the management board, $\frac{dp(y;\theta)}{dy}$, as well as on the equilibrium levels of monitoring and self-dealing, $e_2(p(\theta), y(\theta); \theta)$ and $p(\theta)$.[13]

## 6.3 The Supervisory Board's Problem

One can solve the Supervisory's Board problem – for a fixed set of contracts $\{t^m(y), y\}_{y\in\Re_+}$ – in the same way it was done with the Management Board. As before, it is convenient to define by $\phi(p;\theta) = \max_y t^m(y) + v(p,y,\theta)$ the preferences of the CEO induced by $\{t^m(y), y\}_{y\in\Re_+}$, and by $y(p;\theta)$ the solution to this program. One can then treat the manager as if he had utility function

$$\Phi(t^s, p; \theta) = t^s(p) + \phi(p;\theta)$$

Attention by the Supervisory Board can be restricted to direct mechanisms of the form $\{t^s(\widehat{\theta}), p(\widehat{\theta})\}_{\widehat{\theta}}$. Along the lines of Lemma 2, one has, defin-

[13] Note also that, as in the case of the single crossing condition, the pseudo-concavity of the Management's Board objective function is endogenous and has to be checked in equilibrium.

ing $\Phi(\theta) = \max_{\widehat{\theta}} \Phi(t^s(\widehat{\theta}), p(\widehat{\theta}), \theta)$, the following characterization of Incentive Compatibility under a single crossing condition,

**Lemma 3** *Fix a certain $\{t^m(y), y\}_{y \in \mathbb{R}_+}$, and assume that for such set of contracts $\phi_{\theta p}(p, \theta) > 0$, then $\{p(\widehat{\theta}), t^s(\widehat{\theta})\}_{\widehat{\theta}}$ is Incentive Compatible if, and only if,*

*(i)* $\Psi(\theta) = \Psi(\underline{\theta}) + \int_{\underline{\theta}}^{\theta} (y(p(\tau); \tau) + e_2(p, y(p(\tau); \tau); \tau) - \tau) d\tau$

*(ii)* $\frac{dp(\theta)}{d\theta} \geq 0$

Using the above result and following all the steps from the previous section, the supervisory board's problem becomes

$$\max_p E(y(p;\theta) + pe_2(y(p;\theta), p;\theta)) + \phi(p;\theta) - \frac{(1 - F(\theta))}{f(\theta)}(y(p;\theta) + e_2(y(p;\theta), p;\theta) - \theta) - \frac{p^2}{2}$$

The first order condition for optimality is then given by

$$\frac{dy(p;\theta)}{dp}[1 - \frac{p}{2} - \frac{(1 - F(\theta))}{2f(\theta)}] - \frac{3}{2}p + \frac{(1 - F(\theta))}{2f(\theta)} = 0 \qquad (4)$$

As in the case of the Management Board, this first order condition for the optimal level of monitoring differs from the one in the Unitary case by the term $\frac{dy(p;\theta)}{dp}[1 - \frac{p}{2} - \frac{(1-F(\theta))}{2f(\theta)}]$, which again captures the externalities among the Boards. However, it can be shown that, as opposed to the management board's case, a comparison between monitoring levels can be done even for some off-equilibrium interaction among the Principals.

**Proposition 4** *In response to any set of contracts $\{t^m(y), y\}_{y \in \Re_+}$ offered by the Management Board that may arise in equilibrium, the monitoring exerted by the Supervisory Board will be strictly larger than the one in the Unitary Board*

Therefore, in all possible equilibria of the game induced by the dual board structure, the CEO will be watched more closely than in a situation in which he has to report to a single board. It seems, therefore, that the separation of tasks in the boardroom accomplishes the goal of inducing a higher monitoring of the CEO when directors dislike to watch the top management. In principle, this is a good thing. However, in order to analyze the overall effect of the presence of two principals on the main variables of the model, one still has to characterize what will be the equilibrium levels of monitoring *and* performance.

## 6.4 Equilibrium

Equations (1) and (2) describe the optimality condition for each the Principals for a given set of contracts proposed by the other. To derive the equilibrium, it is needed (i) to derive the forms of both $\frac{dy(p;\theta)}{dp}$ and $\frac{dp(y;\theta)}{dy}$,when those are evaluated at the equilibrium levels of monitoring and performance and (ii) by verifying whether the single crossing conditions required by Lemmas 2 and 3 hold for the candidate equilibria, check the validity of the approach just used . In this section, I focus on the first of these points and leave to the appendix the analysis of the second.

The expressions $\frac{dy(p;\theta)}{dp}$ and $\frac{dp(y;\theta)}{dy}$measure (respectively) how the optimal choice of performance (monitoring) by the CEO responds to an increase in the monitoring (performance) level exerted (requested) by the Supervisory (Management) Board.

Since $y(p;\theta)$ is the solution of $\max_y t^m(y) + v(p, y, \theta)$, one has[14], by the Implicit Function Theorem, $\frac{dy(p;\theta)}{dp} = -\frac{1}{2(t^{m''}(y)-\frac{1}{2})}$. In equilibrium, from the first order condition of the above program, it must be the case that for all $\theta$

$$t^{m'}(y(\theta)) - [y(\theta) + e_2(p(\theta), y(\theta); \theta) - \theta] = 0,$$

totally differentiating this expression with respect to $\theta$, one has

$$(t^{m''}(y) - \frac{1}{2})\dot{y}(\theta) + \frac{1}{2}(\dot{p}(\theta) + 1) = 0.$$

Therefore, $\frac{dy(p(\theta);\theta)}{dp} = \frac{\dot{y}(\theta)}{\dot{p}(\theta)+1}$ in equilibrium. By the very same steps, it can be shown that $\frac{dp(y(\theta);\theta)}{dy} = \frac{\dot{p}(\theta)}{\dot{y}(\theta)-1}$. Collecting such expressions, substituting in

[14]Throughout the analysis, I will be assuming that the solution to this progarm is interior (which is a necessary condition for a differentiable equilibrium). The appendix shows that this will be true in equilibrium.

the optimality conditions for the Principals, imposing the equilibrium ones, one has

**Proposition 5** *Any equilibrium in the Two-Principal game solves the system of differential equations defined by*

$$\frac{\dot{y}(\theta)}{\dot{p}(\theta)+1}[1-\frac{p}{2}-\frac{(1-F(\theta))}{2f(\theta)}]-\frac{3}{2}p+\frac{(1-F(\theta))}{2f(\theta)}=0$$

$$1-\frac{p}{2}-(y+e_2(p,y);\theta)-\theta)-\frac{(1-F(\theta))}{2f(\theta)}+\frac{\dot{p}(\theta)}{\dot{y}(\theta)-1}[\frac{(1-F(\theta))}{2f(\theta)}+e_2(p,y);\theta)-\frac{3p}{2}]=0$$

*for some boundary conditions defined by* $e_2(\overline{\theta})=0$ *and some* $p(\overline{\theta})$ *bounded below by* $\frac{1}{2}$*and above by* $1$*. Conversely, there are distributions* $F(.)$ *and values for* $\underline{\theta}$ *so that any solution of the system with such boundary conditions is an equilibrium.*

The boundary conditions along with the qualifiers regarding the distribution $F(.)$ and the value of $\underline{\theta}$ are needed to guarantee that the procedure adopted to derive the equilibrium is valid.

The above system of differential equations characterizes the set of all possible equilibria of the game played among Boards. From Proposition 4, it is known that the solution to such system will induce a level of monitoring which is higher than in a unitary board system. It remains to figure out what will be the effect of a dual system on the level of performance targets. Once both the equilibrium monitoring levels and performance targets are known, the comparison between the induce amount of both effort levels for the two institutional frameworks can be done.

# 7 Monitoring Isn't Everything, or: The (Potentially) Perverse Effects of Splitting the Board's Duties

## 7.1 The Effects on Productive Effort

The equilibria in Proposition 5 differ by the amount of monitoring exercised over the CEO with the best project, $p(\overline{\theta})$. It is worth noting that, in the unitary board case, such a CEO is not monitored at all. In fact, given the performance target demanded from the CEO who reports to have access to the highest quality project, $1+\overline{\theta}$, monitoring is indeed not needed. The reason is clear: for such a high performance target, the CEO's marginal cost of pursuing self-dealing $e_2$ is $1+2e_2$ , while the marginal benefit is $1-p$. The latter is (weakly) smaller than the former for all $p$, and $e_2$. Therefore, positive self-dealing will not be pursued irrespective of the monitoring exerted by the board. Since monitoring is costly, the board optimally chooses to give full discretion to the CEO. It is clear from the argument above that, at least for the highest quality project, a Unitary Board can coordinate the use of both instruments in a way that induces the best possible outcome.

In a two-tier system, on the other hand, the supervisory board will be watching the CEO with the highest quality project with probability $p(\overline{\theta})>0$. It is illuminating to understand why this is so and interpret it as an implication of free-riding from the management board's part.

When facing a CEO of type $\overline{\theta}$, the supervisory board considers, as a benefit, that an increment in monitoring will induce the CEO to take a contract with the management board that demands more aggressive performance targets. This is captured by the expression $\frac{dy(p(\overline{\theta});\overline{\theta})}{dp}[1-\frac{p(\overline{\theta})}{2}\ ]>0$. The sign of this expressions follows from two reasons. The first and more obvious is that monitoring and performance targets are complements in the CEO's preferences: the higher the monitoring, the smaller the amount self-dealt which implies that the marginal cost of exerting productive effort is smaller and, as a consequence, the CEO is willing to deliver more $y$, i.e., $\frac{dy}{dp}\geq 0$. Second, and more interestingly, this expression is *strictly* positive due to the fact that the management board will demand, in any equilibrium, exactly $y(\overline{\theta})=1-p(\overline{\theta})+\overline{\theta}$ so that a CEO with a project of quality $\theta$ close to $\overline{\theta}$ will be pursuing positive self-dealing. Putting somewhat differently, the perceived benefit that induces positive monitoring from the type $\overline{\theta}$ CEO is only existent because the management board free-rides on such monitoring and demands less aggressive results in the first place.[15]

[15] As argued in section 4, the fact that there is a non-trivial strategic interaction between boards (so that, in particular, $\frac{dy}{dp}\geq 0$ holds strictly) is exactly due to the fact that, by Proposition 3, strictly positive self-dealing is pursued for $\theta\in[\underline{\theta},\overline{\theta})$. Note that if $y(\overline{\theta})>1-p(\overline{\theta})+\overline{\theta}$ there would be no self-dealing for a CEO with projects close enough

If the boards could move to a situation in which higher performance targets, say $y(\overline{\theta}) = 1 + \overline{\theta}$, are demanded from (and, accordingly, less oversight is exerted of) the type $\overline{\theta}$ CEO, some of the effects discussed below would not prevail. It turns out that they cannot attain such outcome because this would require, for types nearby $\overline{\theta}$, a combination of policies inducing no self-dealing. Such combination cannot be achieved in equilibrium due to the free-riding incentives that both principals have.

Clearly, the free-riding problem just discussed does not impede the boards to preclude self-dealing from a CEO with project $\overline{\theta}$. However, as performance targets is the only force able to induce effort towards production for a CEO with project $\overline{\theta}$, such CEO will be exerting less effort in a two-tier board than in a unitary board. It turns out that the level of performance targets in a two-tier system is, in any equilibrium, always smaller than for a unitary board. As consequence, the effort towards productive activities will always be smaller for a two-tier board. More explicitly, letting, $y^{1P}$ and $y^{2P}$, and $e_1^{1P}$ and $e_1^{2P}$ be, respectively, the levels of performance targets and effort towards production in the unitary board and two-tier board cases

**Proposition 6** *Irrespective of the equilibrium considered in the dual board case, $y^{1P}(\theta) \geq y^{2P}(\theta)$ for all $\theta$. The latter implies that $e_1^{2P}(\theta) < e_1^{1P}(\theta)$ for all $\theta$.*

Therefore, the model suggests that an unavoidable outcome of splitting the tasks in the Boardroom is the reduction of the amount of effort towards production.

## 7.2 The Effects on Self-Dealing

One may argue that the resulting reduction in the level of productive effort exerted by the CEO in a dual system is an unfortunate but necessary cost to be incurred in order to reduce the amount of inefficient corporate malfeasance. In fact, it could be claimed that the cost introduced by the lack of coordination of policies discussed above and the resulting free-riding from the management board's part has as a beneficial counterpart an increase in the amount of monitoring exerted by the directors. The flaw with such a

to $\overline{\theta}$.

belief is that it ignores (i) that the induced reduction in productive effort comes, at least partly, from a less aggressive policy from the management board and, (ii) the smaller the demanded performance target, the smaller the marginal cost of pursuing self-dealing, and, consequently, the higher the CEO's incentive to self-deal.

Therefore, on the one hand, one has that for a fixed level of monitoring, the less aggressive the demand for performance, the higher the incentives for the CEO to pursue self-dealing. On the other hand, by Proposition 4, the Supervisory Board monitors more the CEO and for a fixed level of performance target, the more monitored the manager is, the less self-dealing he has incentives to pursue.

On intuitive grounds, it seems that the overall effect on self-dealing should be ambiguous and dependent on the attained equilibrium. This turns out to be indeed the case. Denoting by $e_1^{2P}(\theta)$, and $e_2^{2P}(\theta)$ the level of effort toward self-dealing activities in the single and dual board systems respectively

**Proposition 7** *In any equilibrium in which $p(\overline{\theta}) > \frac{3}{5}$, there exists $\theta^* \in [\underline{\theta}, \overline{\theta})$ such that $e_2^{2P}(\theta) > e_2^{1P}(\theta)$ for $\theta \in (\theta^*, \overline{\theta}]$. For equilibria in which $p(\overline{\theta}) \leq \frac{3}{5}$, the amount self-dealt in a two-tier system is smaller than in a unitary one for at least a subset of projects*

The interesting fact about the above result is that equilibria associated with *higher* monitoring (as they generate lower levels of performance targets in equilibrium) are bounded to induce more corporate malfeasance for at least some project qualities. This indicates that a thorough analysis of the benefits of having the CEO being monitored more closely must necessarily take into account the induced (equilibrium) responses in the use of other instruments available to align his interests to the shareholders'. This point is specially relevant for an institutional framework that assigns the control over different incentive instruments to different and independent bodies as in a dual board system, or as has been the case regarding transforming the audit committees into "mini-boards" as suggested by the quotation in the beginning of the paper

As an illustration of Proposition 7, Figure 2 plots the levels of corporate malfeasance for the case in which $\theta$ is uniformly distributed over $[0.5, 1]$ and the monitoring of the CEO with project quality 1 is $p(1) = \frac{2}{3}$. Note that, for such case, the amount self-dealt in a two-tier structure is higher than in a unitary system for *all* projects.

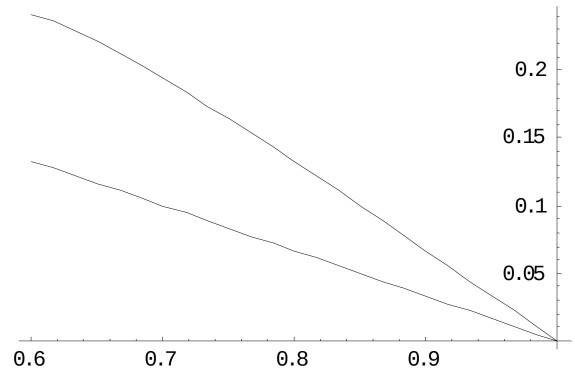


Figure 2: Self-Dealing Levels

The discussion so far has focused on the induced amounts of productive effort and self-dealing under both institutional frameworks. Regarding profits, it is easy to see that when the project quality is $\overline{\theta}$, the profit induced by a One-Principal Structure is higher than the one in a Two-Principal as both structures induce no self-dealing and the former induces the first best amount of productive effort.[16] A continuity argument guarantees that the same is true for all $\theta$ close to $\overline{\theta}$. Unfortunately, as of yet, I could not characterize the relationship of profit levels for the other possible $\theta's$, so that a full blown ranking of expected profits cannot be made.

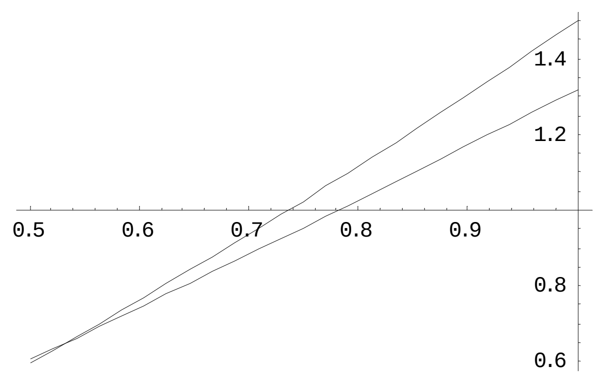


Figure 3: Profit Levels

[16]Recall there are no informational costs of inducing the efficient amount of productive effort from the highest possible type.

I conjecture, however, that a unitary board always fares better than the two-tiered one regarding expected profits. In fact, for all the numerical simulations I ran (assuming a uniform distribution for the project quality), the expected profits were higher under a Unitary Board. Figure 3 plots profits against project quality for the case in which $\theta$ is uniformly distributed over $[0.5, 1]$ and $p(1) = \frac{3}{5}$.

# 8 Two-Tier Boards and Other Governance Mechanisms

The results above seem to indicate that, under the assumption that the only source of misalignment of interests between the board members and the shareholders is the cost of monitoring the CEO, a unitary board system fares better than a two-tier one. Moreover, they seem to be indicative that the legislative and regulatory changes under action in the U.S. may have some unintended outcomes. This point has an intrinsic value in its own: the design of an Optimal Corporate Board Structure must take into account the existence of a myriad of instruments to induce good behavior from the management and, even more importantly, that an institutional framework that assigns different roles to different Boards will induce *strategic interaction* among them. The explicit consideration of such (induced) interaction is important for an adequate analysis of the effects of any policy separating the board's tasks on its effectiveness.

But all this leads to a very natural question: if it is indeed the case that a unitary board system dominates a two-tiered one, why would one ever observe the latter? In the huge majority of countries, the choice of the Board system is not available to the firms: it is a legal imposition. However, France is an example of a country in which the choice of the system is the companies'. Presumably, then, the choice of one system over the other reflects solely perceptions regarding their relative performance as Governance Mechanisms. In favor of the model, it turns out that the huge majority of french companies adopt the Unitary System (Hopt, 1992).

Despite being somehow compatible with the predicted superiority of a unitary system implied by the paper, it is hard to take the above information as (even anecdotal) evidence corroborating it. Therefore, addressing explicitly the above question seems to be important. I think that an answer to it (and, in particular, an explanation for the rationale behind the changes in the U.S.) has to be found in either of two possibilities.

The first one is that there may be an additional source of misalignment between some board members and shareholders *on top* of their disliking of monitoring the CEO (e.g., some directors representing the interests of a large shareholder which, at times, may not coincide with those of the minority shareholders, or the directors themselves colluding with the CEO on the extraction of the company's resources) so that the introduction of an additional independent entity in the board solely in charge of monitoring may improve matters by providing a "check" on the other board. I am trying to address this point in my ongoing research. It should be noted, however, that even if this is the case for some companies and even if the imposition of an additional party solely in charge of monitoring improves matters for those companies, as long as this additional layers of moral hazard are not significant for some firms, the result of such imposition will not be unambiguously positive throughout the Economy. A somewhat related point was made by Holmstrom and Kaplan (2003). They conjecture that the Sarbanes-Oxley Act should have positive effects on firms with very poor governance practices and negative for companies with fairly good governance practices.

The second is that countries adopting a two-tier system may have Governance Mechanisms that are *complementary* to a two-tiered board. I will try and argue below, using some evidence from Roe (1992) and Romano (1992), that this is the case for Germany, at least.

In Germany, the ownership structure of public corporations differs sharply from that in the U.S. Large Financial Intermediaries hold concentrated block of stocks in German firms. Moreover, the banks enter the boardroom by combining votes from the stocks in Bank Controlled Investment Companies, and stock that the bank's brokerage customers leave in its custody. As a consequence, it is often the case that a handful of institutional shareholders votes 20% of a large company's stock (Roe, 1992, p. 1938). Hence, as half of the seats in the supervisory board are occupied by directors elected by shareholders,[17] this control over the voting stock implies that a small group of

[17] The other half is elected by workers.

shareholders exercise significant influence over some of the board's members.

The potential governance benefits brought by the presence of a large shareholder have already been largely explored in the literature (see, for instance, Shleifer and Vishny, 1986). In terms of the present model, one could argue that the presence of a large shareholder would result in the members of the supervisory board not incurring the (personal) cost of monitoring the CEO.[18] The reasons why, in the German case, this seems to be so are, among others, (i) the notion of them owing their position to the institution they represent, rather than to some member of the Board or to the CEO himself, and (ii) that the existence of large shareholders can act as an effective check on the performance of the Board members (Roe, 1992), so that, if any, the perceived personal (and pecuniary, as their position in the board is owed to those institutions) cost from the point of view of a member of the Supervisory Board is of *not* monitoring the CEO.

In terms of the interaction of this mechanism with Corporate Board Structure, one could argue that a two-tier system facilitates the monitoring of the Board members by an external identity by making it clear what are the directors in the board that have to be targeted. It seems, however, that none of the above points are intrinsically related to such separation of tasks in the Boardroom itself, but with the fact that an *additional* mechanism is available to exercise tight control over those Board members in charge of monitoring the CEO.

As opposed to Germany, in the U.S., as well as in other countries, it has been long argued that the CEO is the one influencing Board members. Indeed, it seems that the CEO tends to dominate both executive *and* non-executive – who are supposed to be independent – directors (Lorsch and MacIver, 1989).[19] Hence the possibility that both the members of management and supervisory Board in a Two-Tier system (or executive and non-executive directors in a Unitary one) share the dislike for monitoring along with the separation of tasks (either explicitly through the establishment of a Two-Tier system, or through changes in Legislation as in the U.S.) may lead to unintended results that are far from desired, as predicted by the model.

[18]In such extreme case, it is easy to see that the Supervisory Board would set $p(\theta) = 1$, and the Management Board would set $y(\theta) = 1 + \theta - \frac{(1-F(\theta))}{f(\theta)}$. This clearly dominates a system in which a director which dislikes monitoring is in charge of it.

[19]As an anecdote, when comparing the similarities between the Enron and Parmalat's scandals, the 1/17/04 issue of the Economist stated "The lack of independence of non-executive directors is another issue in common"

# 9 Sequential Moves, Coordination and Communication[20]

The results derived in section 7 suggest that the losses generated by the lack of coordination of policies once the board is split in two offset the potential gains induced by a higher monitoring of the CEO. One may argue that this is solely a consequence of the assumption made about the simultaneity of moves of the two boards.

To show that this is not the case, I change the timing of the model slightly to allow for the possibility that the Supervisory Board decides on how much to monitor after observing the performance targets set by the management board. Arguably, in such a setting, the amount of coordination among the Boards is higher as the Supervisory Board can "fine tune" its decisions to those made by the Management Board, and the latter, by moving first, can influence the amount of monitoring to be exerted through its choice of the performance target.

More explicitly, I add a period between period 3 and the time at which the CEO decides upon $e_1$ and $e_2$, and assume that the choice of $p$ by the Supervisory Board is made in such period, after the demanded $y$ by the Management Board is set (and accepted by the CEO). A relevant issue is whether the Supervisory Board can infer the project quality from the performance target specified by the Management Board. I will be assuming throughout this is the case and show that it will happen in equilibrium.

At the new period, as the decision regarding $y$ is sunk, the Supervisory Board chooses the amount of monitoring to solve the following program[21]

$$\max_{p\in[0,1]} pe_2(p,y;\theta) - \frac{p^2}{2}$$

The solution to this problem is given by

$$p(y;\theta) = \{ \begin{array}{c} \frac{(1+\theta-y)}{4} \text{ if } y \leq 1+\theta \\ 0 \text{ otherwise} \end{array}$$

[20] This section was independently suggested to me by Jonathan Levin and William Fuchs. I am grateful to both.

[21] Note that, as it is assumed (and verified in equilibrium) that the Supervisory Board correctly infers the project's quality $\theta$, it can optimally imposes the monitoring level $p$ without making any payment to the CEO.

In period 2, the Management Board anticipates that, upon correctly inferring $\theta$, this will be the amount of monitoring exerted by the Supervisory Board and will then (proceeding as in section 2, just replacing $p$ by $p(y;\theta)$) choose $y$ so to

$$\max_{y\geq 0} y + p(y;\theta)e_2(p(y;\theta), y;\theta) + v(p(y;\theta), y;\theta) - (\frac{(1-F(\theta)}{f(\theta)})(y + e_2(p(y;\theta), y;\theta) - \theta)$$
$$-\frac{p(y;\theta)^2}{2}$$

The solution to this program yields

**Proposition 8** *If , in a Two-Tier Board System, the Supervisory Board chooses on monitoring after the Management Board sets its target the resulting unique equilibrium has*

*(i)* $y(\theta) = 1 + \theta - \frac{20}{19}[\frac{1-F(\theta)]}{f(\theta)}]$

*(ii)* $p(\theta) = \frac{5}{19}[\frac{1-F(\theta)]}{f(\theta)}]$

*The induced amount of self-dealing is given by* $e_2(\theta) = \frac{15}{38}[\frac{1-F(\theta)]}{f(\theta)}]$. *Moreover, profits under a unitary board are (pointwise) higher than in a dual board.*

Note first that, under (A1), performance targets are strictly increasing in the project's quality so that the Supervisory Board, upon observing $y$, can indeed infer the type of the project as assumed in the derivation of the equilibrium.

Moreover, one sees that, when compared to the Unitary System, a Dual Board System in which the monitoring decisions are taken by the Supervisory Board after the establishment of performance targets will reduce the level of *both* instruments. As a first consequence, the amount self-dealt by the CEO will be higher than in a Unitary System. Secondly, when compared with a unitary system, profits under a dual system are, for all $\theta$, lower.

Interestingly, the analysis of the model for the case in which the boards move sequentially also sheds light on another potential issue that could be raised regarding the way the two-tier system was modeled in the paper. A somewhat implicit assumption made in section 6 is that both boards have to provide incentives to infer correctly the quality of the project available to the CEO so to design the instruments under their control in an optimal way (given the equilibrium policy of the other tier). A natural question is what would happen in case the boards decide independently on the instruments under their control but can communicate the information extracted from the CEO. As it turns out, when the management board communicates to the supervisory board the inferred quality of the project the induced outcome is exactly the same as the one in which the boards move sequentially.

To see this is indeed the case, note that in order to infer the project's quality the management board has to screen the different CEO's "types". This has to be done through the offer of a menu of performance targets contingent on the CEO's announcement of $\theta$. Therefore, when the information – or, more precisely, the CEO's announcement – is communicated to the Supervisory Board, the performance target committed to be delivered is sunk, which implies that its maximization problem is, on the equilibrium path (i.e., when the CEO reports truthfully), the same as the one above. The Management Board anticipates this and, as a consequence, maximizes the same objective function as above. This discussion proves

**Proposition 9** *The model when the Management Board communicates the CEO's announcement to the Supervisory Board yields the same outcome as in the setting in which the boards move sequentially. Therefore, a Dual System induces less profits and more self-dealing than a Unitary System*

The above two results corroborate the apparent superiority of a unitary board over a two-tier board in our set-up, by checking its robustness with respect to the way the boards communicate profit-relevant information disclosed by the CEO, and to the possible way the boards move in a dual system.

# 10 Concluding Remarks

This paper aimed to provide a first step towards answering the question of how one should optimally design corporate boards. I analyzed the effects on performance and managerial self-dealing when one moves from a setting in which the CEO reports to a single board who is responsible for both monitoring management and establishing performance targets to one in which the CEO reports to two different boards, one who is responsible for monitoring the management and the other who is in charge of defining performance targets.

The main results are as follows. When compared to the unitary board's case, a two-tier board system will result in (i) more monitoring over the CEO in all possible equilibria of the game induced by the dual structure, (ii) due to the strategic link between the board's and the fact that monitoring and performance targets are substitutes in the provision of incentives for to avoid the pursuit of self-dealing, less aggressive performance targets demanded from the CEO. This latter result along with the fact that performance targets are the only instruments available to induce productive effort, will imply that (iii) in all possible equilibria, productive effort will be smaller in a Dual system. Finally, (i) and (ii) imply that (iv) the impact of a dual system on managerial self-dealing is ambiguous: there are equilibria in which the amount self-dealt is *higher* under a Dual System.

It seems that the main lessons for Board Structure Design is that a thorough comparative analysis of the benefits and costs of making the CEO to report to one or two Principals must take into account the existence of a myriad of instruments to align his incentives with the shareholders, and, perhaps more importantly, an institutional framework that assigns different roles to different Principals will induce *strategic interaction* among them. Some unintended (and undesirable) outcomes may ensue.

In terms of future research, there are plenty of paths to follow. The most obvious ones are, first, in the spirit of considering (as in Holmstrom and Milgrom (1994)) how the existence of a myriad of incentives instruments interact with each other, the explicit inclusion of additional corporate governance mechanisms in a formal model of corporate boards (e.g., the presence of large shareholders serving as a check on the board). Secondly, it would be interesting to analyze the effect of introducing an identity in the boardroom solely in charge of monitoring when an additional source of misalignment of interests between some Board members and shareholders exists *in addition* to their disliking of monitoring the CEO.

# 11 Appendix: Proofs

**Proof of Proposition 1:** The first order (necessary and sufficient) conditions for the program in the text are

$$e_2(p, y; \theta) - \frac{p}{2} - e_2(p, y; \theta) - p = 0$$

$$1 - \frac{p}{2} - (y + e_2(p, y; \theta) - \theta) = 0$$

where the above conditions use the fact that, by the Envelope Theorem, $\frac{dv(p,y;\theta)}{dp} = -e_2(p, y; \theta)$, and $\frac{dv(p,y;\theta)}{dy} = -(y + e_2(p, y; \theta) - \theta)$. It is clear that both equations imply the $y$ and $p$ in the text for the Unitary Board Case. Moreover, such $y$ and $p$ induce productive effort of 1, and no self-dealing. Those two features along with no monitoring imply that social surplus is maximized. As, for all $\theta$, the CEO is left with no rents, the outcome stated in the proposition holds.

For the two-tier system, consider first the Supervisory's Board Problem

for a given $\{y, t^m(y)\}_y$ offered by the Management Board. Let $y^*(p; \theta)$ be the solution to

$$\max_y t^m(y) + v(p, y; \theta)$$

The Supervisory's Board problem is to maximize, upon choosing $p$ and $t^s(p)$,

$$y^*(p; \theta) + pe_2(p, y^*(p; \theta); \theta) - t^s(p) - \frac{p^2}{2}$$

subject to

$$t^s(p) + t^m(y^*(p; \theta)) + v(p, y^*(p; \theta); \theta) \geq 0$$

By the very same token, for a fixed set of contracts offered by the Supervisory Board, the Management Board solves

$$\max_{y, t^m(y)} y + p^*(y; \theta) e_2(p^*(y; \theta), y; \theta) - \frac{p^*(y; \theta)^2}{2} - t^m(y)$$

subject to

$$t^s(p^*(y; \theta)) + t^m(y) + v(p^*(y; \theta), y; \theta) \geq 0$$

where $p^*(y; \theta)$ is the solution to $\max_p t^s(p) + v(p, y; \theta)$.

Clearly, both constraints bind at an optimum. It is easy to see that $y^*(p; \theta) = 1 + \theta$ for all $p$,and $p^*(y; \theta) = 0$ for all $y$ is an equilibrium: if the supervisory does not monitor the CEO irrespective of its type and the level of $y$, the solution to the management board entails $y = 1 + \theta$ and the converse. ■

**Proof of Lemma 1:** Necessity: As argued in the text, the CEO can be treated as having preferences given by $w + v(p, y; \theta)$. Define

$$U(\theta) = \max_{\widehat{\theta}} U(\widehat{\theta}|\theta) \equiv w(\widehat{\theta}) + v(p(\widehat{\theta}), y(\widehat{\theta})); \theta),$$

where, as in the text, $v(p(\widehat{\theta}), y(\widehat{\theta})); \theta) = \max_{e_2}(1-p)e_2 - \frac{e_2^2}{2} - \frac{(y+e_2-\theta)^2}{2}$. It is easy to see that the objective function of this latter program is both continuous in $e_2$, and has a continuous partial derivative with respect to $\theta$. Moreover, one can, without loss of optimality, compactify its choice set. It can also be easily seen that the solution to this program is unique. Therefore, by Corollary 4 in Milgrom and Segal (2002), $v(p(\widehat{\theta}), y(\widehat{\theta})); \theta)$ is everywhere differentiable with respect to $\theta$, its derivative being $(y + e_2 - \theta)$. As a consequence, by Theorem 2 in Milgrom and Segal, $U(\theta)$ is absolutely continuous and, hence, has an integral representation as in the text (which uses the fact that $\frac{dv(p(\theta), y(\theta)); \theta)}{d\theta} = (y(\theta) + e_2(y(\theta), p(\theta); \theta) - \theta) = \frac{y-p-\theta}{2}$). The monotonicity condition follows from the fact that an additional necessary condition for truthtelling is that $-\frac{d^2U(\widehat{\theta}|\theta)}{d\theta^2}|_{\widehat{\theta}=\theta} = \frac{d^2v(p(\widehat{\theta}), y(\widehat{\theta})); \theta)}{d\theta d\widehat{\theta}}|_{\widehat{\theta}=\theta} \geq 0$.

Sufficiency: Take $\widehat{\theta} > \theta$, one has

$$\begin{aligned} U(\widehat{\theta}) - U(\theta) &= \int_{\theta}^{\widehat{\theta}} (\frac{y(\tau) - p(\tau) - \tau}{2}) d\tau \geq \int_{\theta}^{\widehat{\theta}} (\frac{y(\theta) - p(\theta) - \tau}{2}) d\tau = \\ & \int_{\theta}^{\widehat{\theta}} \frac{d(w(\theta) + v(p(\theta), y(\theta)); \tau))}{d\tau} d\tau \\ &= U(w(\theta), p(\theta), y(\theta); \widehat{\theta}) - U(w(\theta), p(\theta), y(\theta); \theta) = \\ & U(w(\theta), p(\theta), y(\theta); \widehat{\theta}) - U(\theta) \end{aligned}$$

(where the first equality follows from (i) in the Lemma and the first inequality follows from (ii)) so that if a CEO has access to a project $\widehat{\theta}$ has no incentives to report $\theta$ (the first equality follows from the integral representation of $U(\theta)$ in (i) and the first inequality from the monotonicity condition (ii)). The argument for $\theta > \widehat{\theta}$ is analogous and the result follows.■

**Proof of Proposition 2** For ease of notation I will be denoting $\frac{1-F(\theta)}{f(\theta)}$ by $H(\theta)$ throughout this and the other proofs. The first order conditions with respect to $y$ and $p$ for pointwise maximization of the program in the text yield:

$$1-\frac{p}{2}-(y+e_2-\theta)-\frac{H(\theta)}{2}=0$$

$$e_2-\frac{p}{2}-e_2+\frac{H(\theta)}{2}-p=0$$

(where the second equality uses the fact that, by the Envelope Theorem, $\frac{dv(p,y;\theta)}{dp}=-e_2$ and the first uses the fact that, again, by the Envelope theorem, $\frac{dv(p,y;\theta)}{dy}=-(y+e_2-\theta)$). It is easy to see that the solution to this system yields (i) and (ii) in the Proposition. The amount of self dealing follows because $e_2(y,p;\theta)=\frac{1-p+\theta-y}{2}$.■

**Proof of Proposition 3:** Assume, towards a contradiction, that there exists an equilibrium so that, for some $\theta' \in [\underline{\theta},\overline{\theta})$, $e_2(p(\theta'),y(\theta');\theta')=0$. Fix the equilibrium $\{t^s(p,p\}_p$ and consider the Management Board's problem. As argued in the text, it as if the Management Board was facing a CEO with preferences given by $\psi(y,\theta)=\max_p t^s+v(p,y;\theta)$. Proceeding as in the text, its problem becomes to maximize the following objective pointwise:

$$\max_y y+p(y;\theta)e_2(y,p(y;\theta);\theta)+\psi(y,\theta)-H(\theta)(y+e_2(y,p(y;\theta);\theta)-\theta)-\frac{p(y;\theta)^2}{2}$$

By assumption, for type $\theta'$, given his equilibrium choice of $p$, the Management Board will optimally choose $y$ in the range of the domain so that so that $e_2(p(\theta'),y(\theta');\theta')=0$, i.e., $y\geq 1+\theta'-p$. Therefore, at $\theta'$, as the CEO will not self-deal, no explicit strategic interaction will ensue and the Management's objective will read

$$y-\frac{1}{2}(y-\theta')^2-H(\theta')(y-\theta)-\frac{p^2}{2}$$

Hence, in response to the equilibrium menu offered by the Supervisory Board, it must be the case that $y(\theta')=1+\theta'-H(\theta')$, which calls for $p(\theta')\geq H(\theta')>0$. However, proceeding in exactly the same fashion for the Supervisory Board, we see that, as monitoring is costly, the best response for any $y$ that do not induce self-dealing is $p(\theta')=0$.■

**Proof of Lemma 2:** Follows by the very same steps used in the proof of Lemma 1, and is omitted. ■

**Proof of Lemma 3:** Follows by the very same steps used in the proof of Lemma 1, and is omitted. ■

**Proof of Proposition 4:** It suffices to show that $\frac{dy(p;\theta)}{dp}[1-\frac{p}{2}-\frac{H(\theta)}{2}] > 0$. As the Step 5 in the proof of Proposition 2 shows, under (A1) and (A2) in any possible equilibrium $H(\theta) \leq 1$ so that $[1-\frac{p}{2}-\frac{H(\theta)}{2}] > 0$ as $p < 1$. Moreover, as $\frac{d^2v(p,y;\theta)}{dpdy} > 0$, necessarily $\frac{dy(p;\theta)}{dp} > 0$ (by Topkis (1998) and by the assumption that $y(p;\theta)$ is interior). ■

**Proof of Proposition 5:** I proceed in several steps.

STEP 1 : Deriving the form of the system of differential equations and the value of $\frac{dp(y(\theta);\theta)}{dy}$ in equilibrium.

**Proof:** The form of the system of differential equations follows from the steps derived in the text. For the sake of completeness, I show here that $\frac{dp(y(\theta);\theta)}{dy} = \frac{\dot{p}(\theta)}{\dot{y}(\theta)-1}$. To this end, note that $p(y;\theta) = \arg\max_p t^s(p) + v(p,y;\theta)$. By the Implicit Function Theorem, using interiority, we have that

$$\frac{dp(y;\theta)}{dy} = -\frac{1}{2t^{s''}(p)+1}$$

Additionally, in equilibrium, from the first order condition of the above program, it must be the case that for all $\theta$

$$t^{s'}(p(\theta)) - [e_2(p(\theta),y(\theta);\theta)] = 0, \tag{5}$$

Totally differentiating the expression above one finds

$$t^{s''}(p(\theta))\dot{p}(\theta) + \frac{\dot{p}(\theta)}{2} + \frac{\dot{y}(\theta)}{2} - \frac{1}{2} = 0, \text{ which implies}$$

$$\frac{dp(y(\theta);\theta)}{dy} = \frac{\dot{p}(\theta)}{\dot{y}(\theta)-1}$$

STEP 2: In any differentiable equilibrium in which $e_2(y(\overline{\theta}), p(\overline{\theta}); \overline{\theta}) = 0$, $\dot{p}(\theta) \geq 0$ for all $\theta$.

**Proof:** First, note that in any differentiable equilibria a CEO with type $\theta$ has to choose from the Supervisory Board (given the equilibrium contract he picked from the Management Board) a contract that satisfies (FCOS). A second order necessary condition for that being optimal is $t^{s''}(p(\theta)) + \frac{1}{2} < 0$. As derived in Step 1, $t^{s''}(p(\theta)) + \frac{1}{2} = \frac{1-\dot{y}(\theta)}{\dot{p}(\theta)}$ so that necessarily the sign of $\dot{p}(\theta)$ has to be the same as the one of $\dot{y}(\theta) - 1$. Therefore, if it was the case that $\dot{p}(\theta) < 0$ for some $\theta \in [\underline{\theta}, \overline{\theta}]$ one would have $\dot{y}(\theta) - 1 < 0$. The fact that $e_2(y(\theta), p(\theta); \theta) > 0$ for all $\theta \in [\underline{\theta}, \overline{\theta})$ assures that this cannot happen at $\overline{\theta}$ (as otherwise, $\dot{e}_2(\overline{\theta}) > 0$ along with $e_2(\overline{\theta}) = 0$ would imply that for some $\theta$ close to $\overline{\theta}$ the amount of self-dealing would be negative). If this happens for some $\theta < \overline{\theta}$, by continuity, there must exist a $\theta' \in (\theta, \overline{\theta})$ so that $\dot{e}_2(\theta') = 0$ which, on its turn, implies that $\dot{y}(\theta') - 1 = -\dot{p}(\theta')$, contradicting the fact that the sign of $\dot{p}(\theta)$ has to be the same as the one of $\dot{y}(\theta) - 1$.

STEP 3: Given steps 1 and 2, the monotonicity constraints of both Boards hold in equilibrium if, and only, if $\dot{y}(\theta) - 1 \geq \dot{p}(\theta)$.

**Proof:** Note that $\dot{p}(\theta) \geq 0$ along with the integral representation of the CEO's utility is equivalent to the contract offered by the Supervisory Board if, and only if, $\phi_{\theta p}(p, \theta) > 0$. Applying twice the Envelope Theorem, one has that $\phi_\theta = (y(p;\theta) + e_2(y(p;\theta), p; \theta) - \theta)$. Hence, $\phi_{\theta p} = \frac{1}{2}(\frac{dy(p;\theta)}{dp} - 1)$.Therefore, one needs to have $\frac{dy(p;\theta)}{dp} - 1 \geq 0$ when this expression is evaluated at the equilibrium $p$ and $y$. As $\frac{dy(p;\theta)}{dp}$ when evaluated at the equilibrium is $\frac{\dot{y}(\theta)}{\dot{p}(\theta)+1}$, this can hold if, and only if, $\dot{y}(\theta) - 1 \geq \dot{p}(\theta)$.

By the very same token, $\dot{y}(\theta) > 0$ (which is implied by $\dot{y}(\theta) - 1$ having the same sign as $\dot{p}(\theta)$) along with the integral representation of the CEO's utility being Incentive Compatible calls $\psi_{y\theta}(y, \theta) > 0$. Proceeding as above, this happen if only if for $1 - \frac{dp(y(\theta);\theta)}{dy} \geq 0$. In equilibrium, $\frac{dp(y(\theta);\theta)}{dy} = \frac{\dot{p}(\theta)}{\dot{y}(\theta)-1}$ and the result follows.

STEP 4: If there is a continuously differentiable solution to the system of differential equations so that $e_2(y(\overline{\theta}), p(\overline{\theta}); \overline{\theta}) = 0$, $\dot{p}(\theta) \geq 0$ for all $\theta$,and $\frac{\dot{y}(\theta)}{\dot{p}(\underline{\theta})+1} \geq 1$, $\dot{y}(\theta) - 1 \geq \dot{p}(\theta)$ for all $\theta$

**Proof:** It is easy to see that, whenever $e_2(y(\overline{\theta}), p(\overline{\theta}); \overline{\theta}) = 0$, $\frac{\dot{p}(\overline{\theta})}{\dot{y}(\overline{\theta})-1} = \frac{1}{3}$ so that the claim is true at $\overline{\theta}$. By assumption, the same is true at $\underline{\theta}$. To complete the proof, then, it suffices to show that $\frac{\dot{y}(.)}{\dot{p}(.)+1} - 1$ cannot cross zero (strictly) more than once. Suppose that was the case. There would exist $\theta' < \theta''$ so that $\frac{\dot{y}(\theta')}{\dot{p}(\theta')+1} = 1 = \frac{\dot{y}(\theta'')}{\dot{p}(\theta'')+1}$. From the first equation of the system, $p(\theta') = p(\theta'') = \frac{1}{2}$. Since $\dot{p}(\theta) \geq 0$, $p(\theta) = \frac{1}{2}$ for all $\theta \in [\theta', \theta'']$, implying that $\dot{p}(\theta) = 0$ for all such $\theta$. Plugging the latter in the second equation, one has

$$y(\theta) = 1 + \theta - H(\theta), \text{ for all } \theta \in [\theta', \theta'']$$

Thus, $\dot{y}(\theta) = 1 - H'(\theta) > 1$ , for all $\theta \in [\theta', \theta'']$ which contradicts $\frac{\dot{y}(\theta')}{\dot{p}(\theta')+1} = \frac{\dot{y}(\theta'')}{\dot{p}(\theta'')+1} = 1$.

An immediate consequence of Step 4 is that whenever $e_2(y(\overline{\theta}), p(\overline{\theta}); \overline{\theta}) = 0$, and $p(\underline{\theta}) \geq \frac{1}{2}$,[22] the monotonicity constraints required by Lemmas 2 and 3 hold whenever $\dot{p}(\theta) \geq 0$ for all $\theta$. Moreover, the local concavity of the agent's problems when dealing with the CEO is guaranteed in such case. It turns out that by imposing some additional conditions on the distribution and on the value of $\underline{\theta}$, a solution to the system of differential equations with the properties required by Step 4 always exist. This, on its turn, assures existence of equilibrium for the common agency game. I impose these conditions "implicitly" in the next step.

STEP 5: Assume that $e_2(y(\overline{\theta}), p(\overline{\theta}); \overline{\theta}) = 0$, and $p(\overline{\theta})$ is bounded below by $\frac{1}{2}$. Take any $\widetilde{F}(.)$ so that the corresponding density satisfies (A1) and (A2), and consider an interval of the form $[a, \overline{\theta}]$. For any solution of the system of differential equations for "projects" $[a, \overline{\theta}] \subset (0, 1]$ with distribution $\widetilde{F}(.)$,

[22] Which guarantees that $\frac{\dot{y}(\theta)}{\dot{p}(\underline{\theta})+1} \geq 1$.

there is a $\underline{\theta} \geq a$, and $F(.)$ (whose density also satisfies (A1), and (A2)) so that, for the projects $[\underline{\theta}, \overline{\theta}]$ with distribution $F(.)$, the conditions in Step 4 hold.

**Proof:** If $e_2(y(\overline{\theta}), p(\overline{\theta}); \overline{\theta}) = 0$, $\frac{\dot{p}(\overline{\theta})}{\dot{y}(\overline{\theta})-1} = \frac{1}{3}$. Moreover, if $p(\overline{\theta})$ is bounded below by $\frac{1}{2}$, $0 < \dot{p}(\overline{\theta}) < \dot{y}(\overline{\theta}) - 1$ (see the next step). If , under $\widetilde{F}(.)$ and $[a, \overline{\theta}]$, $\frac{\dot{p}(.)}{\dot{y}(.)-1}$ never crosses zero strictly, the result follows trivially by letting $F(.) = \widetilde{F}(.)$, and $a = \underline{\theta}$. Otherwise, let $\theta' \in (a, \overline{\theta})$ be the smallest project so that $\dot{p}(\theta') = 0$, and $\dot{p}(\theta) \geq 0$ for all $\theta > \theta'$. It is easy to see that at such $\theta'$, $\dot{y}(\theta') - 1 > 0$ so that, by the first equation in the system, $p(\theta') > \frac{1}{2}$. Therefore letting $\underline{\theta} = \theta'$, and $f(\theta) = \frac{\widetilde{f}(\theta)}{1-\widetilde{F}(\theta')}$ for $\theta \geq \underline{\theta}$, and zero otherwise, the result follows (it is easily seen that $f(\theta)$ is log concave and that (A2) is also satisfied).

STEP 6: The Boundary Conditions are as in the text.

**Proof:** Fix any equilibrium in which $e_2(y(\overline{\theta}), p(\overline{\theta}); \overline{\theta}) = 0$.That $p(\overline{\theta})$ is bounded away from 1 follows because, otherwise, for $\theta$ close enough to $\overline{\theta}$, by continuity of $p(.)$, it would be the case that self-dealing would be pursued by a CEO with project of quality $\theta$, which cannot be true by Proposition 2. As for $p(\overline{\theta})$ being larger than $\frac{1}{2}$, this follows because at $\overline{\theta}$, using the second equation of the system and $e_2(y(\overline{\theta}), p(\overline{\theta}); \overline{\theta}) = 0$, it must be the case that

$$\frac{\dot{p}(\overline{\theta})}{\dot{y}(\overline{\theta}) - 1} = \frac{1}{3}$$

Substituting this in the first equation, one has

$$\dot{p}(\overline{\theta}) = \frac{2p(\overline{\theta}) - 1}{3(1 - p(\overline{\theta}))}$$

Therefore, $\dot{p}(\overline{\theta}) > 0$ whenever $p(\overline{\theta}) > \frac{1}{2}$. Additionally, so to guarantee that $p(\underline{\theta}) \geq \frac{1}{2}$, as $\dot{p}(\theta) \geq 0$,we must have that $p(\overline{\theta})$ is bounded below by $\frac{1}{2}$.$\blacksquare$

**Proof of Proposition 6:** Noting that $e_1 = y + e_2 - \theta = \frac{(y+1-p-\theta)}{2}$ and that, by Proposition 3, $p^{2P}(\theta) > p^{1P}(\theta)$ for all $\theta$, the second part is trivially true whenever $y^{1P}(\theta) \geq y^{2P}(\theta)$ for all $\theta$. Towards a proof for the latter, note that whenever $\theta'$ is so that $y^{2P}(\theta') = y^{1P}(\theta') = 1 + \theta' - \frac{(1-F(\theta'))}{f(\theta')}$ one must have, by the second equation of the system,

$$\frac{\dot{p}(\theta')}{\dot{y}(\theta') - 1}[\frac{H(\theta')}{2} + e_2(p, y); \theta') - \frac{3p}{2}] = 0$$

For this to hold, we must have either $\dot{p}(\theta') = 0$, or $[\frac{H(\theta')}{2} + e_2(p, y); \theta') - \frac{3p}{2}] = 0$. To rule out the second possibility, note that whenever

$$\frac{H(\theta')}{2} + e_2(p, y); \theta') - \frac{3p}{2} = 0, \text{ and } y^{2P}(\theta') = y^{1P}(\theta'), \text{ one has } p(\theta') = \frac{H(\theta')}{2}$$

. Using this in the first equation, this implies

$$\frac{\dot{y}(\theta')}{\dot{p}(\theta') + 1} = \frac{3p(\theta') - H(\theta')}{2 - p(\theta') - H(\theta')} < 1$$

which contradicts the fact that, necessarily, in equilibrium, $\dot{y}(\theta) - 1 \geq \dot{p}(\theta)$ for all $\theta$.

Therefore, it must be the case that $\dot{p}(\theta') = 0$ . As necessarily $\dot{y}(\theta') - 1 \geq 0$, one must have $p(\theta') \geq \frac{1}{2}$. Using this fact it can be readily concluded, by continuity, that for all $\epsilon > 0$ sufficiently small[23]

$$\frac{H(\theta' - \epsilon)}{2} + e_2(p(\theta' - \epsilon), y(\theta' - \epsilon)); \theta' - \epsilon) - \frac{3p(\theta' - \epsilon)}{2} < 0$$

.

Using this in the second equation of the system, along with $\frac{\dot{p}(\theta)}{\dot{y}(\theta) - 1} \geq 0$ for all $\theta$ in equilibrium, one has that, whenever $y^{2P}(\theta') = y^{1P}(\theta')$,

$$y^{2P}(\theta' - \epsilon) \leq 1 + \theta' - \epsilon - H(\theta' - \epsilon) = y^{1P}(\theta' - \epsilon)$$

This, along with the fact that $y^{2P}(\overline{\theta}) < y^{1P}(\overline{\theta})$, implies that necessarily $y^{2P}(\theta) \leq y^{1P}(\theta)$ for all $\theta$, as otherwise there would exist $\theta'$ and $\epsilon'$ so that $y^{2P}(\theta') = y^{1P}(\theta')$ and $y^{2P}(\theta' - \epsilon) > y^{1P}(\theta' - \epsilon)$ for all $\epsilon < \epsilon'$. ■

[23] As $\frac{H(\theta')}{2} + e_2(p(\theta'), y(\theta')); \theta') - \frac{3p(\theta')}{2} < 0$

**Proof of Proposition 7:** Note that, at $\overline{\theta}$,

$$\frac{\dot{p}(\overline{\theta})}{\dot{y}(\overline{\theta})-1}=\frac{1}{3}, \text{ which implies that}$$

$$\dot{y}(\overline{\theta})=3\dot{p}(\overline{\theta})+1$$

Moreover, as $\dot{e}_2^{2P}(\overline{\theta})=\frac{(-\dot{p}(\overline{\theta})+1-\dot{y}(\overline{\theta}))}{2}$, using $\dot{y}(\overline{\theta})=3\dot{p}(\overline{\theta})+1$, one has that $\dot{e}_2^{2P}(\overline{\theta})=-2\dot{p}(\overline{\theta})$. From the second equation in the system, it can be seen that $\dot{p}(\overline{\theta})=\frac{2p(\overline{\theta})-1}{3(1-p(\overline{\theta}))}$. Noting that $\dot{e}_2^{1P}(\overline{\theta})=-\frac{1}{3}$, we have that whenever $p(\overline{\theta})>\frac{3}{5}$, $\dot{e}_2^{2P}(\overline{\theta})<\dot{e}_2^{1P}(\overline{\theta})$. Therefore, as $e_2^{2P}(\overline{\theta})=e_2^{1P}(\overline{\theta})$, for $\theta$ close enough to $\overline{\theta}$, $e_2^{2P}(\theta)>e_2^{1P}(\theta)$. Therefore, there trivially exists $\theta^*$ as stated in the Proposition. For the second part, it suffices to note that whenever $p(\overline{\theta})<\frac{3}{5}$, $\dot{e}_2^{2P}(\overline{\theta})>\dot{e}_2^{1P}(\overline{\theta})$ , so that $e_2^{2P}(\theta)<e_2^{1P}(\theta)$ for $\theta$ close enough to $\overline{\theta}$.■

**Proof of Proposition 8:** Follows trivially from the first order conditions for the Program in the text and the expressions for $p(y;\theta)$ and $e_2(p,y;\theta)$. For the second part of the Proposition, it is easy to see, using $e_1=y+e_2-\theta$ that profits can be written as

$$\theta+e_1-\frac{1}{2}e_1^2-\frac{1}{2}e_2^2-H(\theta)(e_1)$$

Note that this expression is strictly decreasing in $e_1$ in the range $(1-H(\theta),\infty)$ and strictly decreasing in $e_2$. As $1-H(\theta)<1-\frac{2H(\theta)}{3}=e_1^{1P}<1-\frac{25H(\theta)}{38}=e_1^{2P}$ and the amount self-dealt is higher under a two-tier system, the result follows.■

**Proof of Proposition 9:** In the text. ■

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