Organizations with Power-Hungry Agents

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Abstract

We analyze a model of hierarchies in organizations where neither decisions themselves nor the delegation of decisions are contractible, and where power-hungry agents derive a private benefit from making decisions. Two distinct agency problems arise and interact: Subordinates take more biased decisions (which favors adding more hierarchical layers), but uninformed superiors may fail to delegate (which favors removing layers). A designer may remove intermediate layers of the hierarchy (eliminate middle managers) or de-integrate an organization by removing top layers (eliminate top managers). We show that stronger preferences for power result in smaller, more de-integrated hierarchies. Our key insight is that hoarding of decision rights is especially severe at the top of the hierarchy.

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1 Introduction

Hayek (1945) famously argued that decisions are best made by agents who have relevant, local information.[1] Taking this information to be exogenous, and in the absence of any private benefits or agency conflicts, this immediately delivers a clear theory of the internal structure of organizations–in particular, to whom decision rights should optimally be allocated.

Following from this fundamental observation, a large literature has studied the *optimal design* of organizations both in the presence of agency costs, and without them.[2] This has deepened our understanding of how organizations–especially firms–are structured, how decision rights are allocated, how effectively information is communicated internally, and what decisions are ultimately made.

Yet a significant body of experimental evidence points to an agency problem in the design of organizations. For many individuals, decision rights carry an *intrinsic value,* beyond their instrumental benefits for achieving certain outcomes (Bartling, Fehr and Herz 2014). This literature finds a substantial under-delegation of decision-rights (Fehr, Herz and Wilkening 2013) as subjects are willing to sacrifice expected earnings to retain control. Relatedly, in an empirical study surveying 100,000 IBM employees across 50 countries, Hofstede (1980) documents a substantial variation in *preferences* over authority and delegation, summarized in a country-specific power distance index. Bloom, Sadun, and Van Reenen (2012) show that this preference index over authority is strongly correlated with actual delegation of authority in a cross-section of industries. Building on this literature, this paper moves away from the optimal-design paradigm by considering a model in which managers may be *power hungry:* they may get rents from making decisions themselves, rather than delegating them to a subordinate. A direct

[1] As he put it: "If we can agree that the economic problem of society is mainly one of rapid adaptation to changes in the particular circumstances of time and place, it would seem to follow that the ultimate decisions must be left to the people who are familiar with these circumstances, who know directly of the relevant changes and of the resources immediately available to meet them."

[2] Early important contributions include Chandler (1962) who emphasized the link between a firm's organization structure and the strategy it pursues; Marschak and Radner (1972) introduced the formal analysis of working in teams, leading to an entire literature on "team theory". The importance of agency costs in organizational design was first noted by Berle and Means (1932), and these have played an important role in much of the organizational economics literature as they have in corporate finance in thinking about the private benefits of control and the optimal structure of voting rights.

consequence is that delegation decisions are subject to moral hazard.

Our model can be used to shed light on two important questions. First, what is the optimal number of layers in a hierarchy? When do middle managers destroy value? Second, what is the optimal scope of a firm? When does integrating two sets of activities by putting them under common control of a top manager add or destroy value?

We show that while larger "power rents" results in excessive centralization for a given hierarchical organization and firm size, the presence of power-hungry managers also results in a de-layering of the organization and in smaller, more de-integrated firms. Intuitively, the anticipation of a lack of delegation makes it optimal to delayer, forcing decisions to be made by agents with better local information. Interestingly, we show that the hoarding of decisions tends to be most severe at the top of the organization. As a result, under certain regularity conditions, hierarchical layers at the top are the first to be removed when preferences for power become stronger. This is consistent with the observation that firms and hierarchies in developing economies (where decision rents are arguably larger) tend to be both smaller and more centralized (Bloom et al. 2012, and Hsieh and Klenow 2014).

Model. Formally, we consider an organization involved in a set of activities, each of which requires an action to be undertaken and each of which is assigned to a hierarchy of managers. One can think of a delegation hierarchy consisting of a CEO, followed by a division manager, a sub-division manager, a department manager, with each subsequent manager being assigned a subset of the activities of his superior. Managers are probabilistically informed about the optimal decision, and can delegate to lower-level managers when uninformed.

The organization faces two types of agency problems. The first is familiar from the delegation literature.[3] Managers are biased when taking an action and delegation therefore entails a loss of control. Concretely, managers are assigned a subset of the organization's activities and do not internalize externalities on activities not assigned to them. Lower-level managers are assigned a smaller set of activities and are therefore more biased. The second agency problem is novel, and concerns the delegation of the decision itself. Managers are power hungry in that they earn a private benefit if they, themselves,

[3] See, for example, Aghion and Tirole (1997), and Dessein (2002).

take the decision. They may therefore 'hoard' decision rights, even when uninformed.

The tools of the organization designer are limited in our model. In the spirit of the incomplete contracting literature[4], neither decisions nor the delegation of decisions are contractible. Moreover, managers do not respond to monetary incentives. The organization designer, however, can remove *layers of management* to avoid managers from hoarding decision rights. For example, she can remove the CEO or top manager so that the initial decision right is delegated by default to the next layer of management. Alternatively, she can delayer the hierarchy by removing intermediate layers of middle-management. In the limit, only the lowest-level manager remains, who is assumed to be perfectly informed about the optimal decision, but ignores any externalities with other activities. This limit corresponds to a set of de-integrated, stand-alone activities.

Results. In the absence of preferences for power, additional layers always improve outcomes and, similarly, integrating disjoint sets of activities always adds value. Intuitively, adding layers allows for a better internalization of externalities provided that the new middle or top managers are at least sometimes informed. Naturally, the presence of power-hungry managers may overturn this conclusion. An uninformed middle or top manager may then hoard decision rights, preventing better-informed lower level managers from taking informed, albeit somewhat biased, decisions. Our setup thus gives a rather direct answer to Williamson's selective intervention puzzle: why is integration not always value-increasing? By assumption, selective intervention is subject to a moral hazard problem in our model: managers may intervene and centralize decision-making even when delegation is optimal. In this sense, more power-hungry managers decrease the value of managers at all hierarchical levels.

More surprisingly, our model shows that the inefficient hoarding of power tends to be more severe at the top of the organization. While all layers of a hierarchy are valuable when preferences for power are weak, under certain regularity conditions, layers at the top are the first to be removed when preferences for power become stronger.

To see this, consider a three-layer hierarchy consisting of the President of a University (top manager), the Dean of the Business School (middle manager), and the Chair of

[4]The pioneering contributions are Grossman and Hart (1986) and Hart and Moore (1990). See Aghion and Holden (2011) and Dessein (2015) for an overview of the ensuing literature.

the Economics Division (lower level manager). Assume both President and Dean are equally power-hungry and equally likely to be informed about a particular decision pertaining to the economics division. The Dean is biased, however, as she mainly cares about the well-being of the business school. The Chair is even more biased as she mainly cares about the glory of her division. The Chair, however, is also perfectly informed about the decision at hand. Say a new professor in healthcare economics must be hired, who will also lead a university-wide center in which the Business School is a key partner.

In the absence of preferences for power, it is optimal to allocate the hiring decision to the President. Indeed, the President is unbiased and will optimally delegate hiring to the Dean if uninformed. An uninformed Dean, in turn, optimally delegates to the Chair. For intermediate preferences for power, however, it often becomes optimal to give the Business School independence over hiring. The reason is that an uninformed President is less likely to delegate than an uninformed Dean. Since hoarding of decision rights is inefficient, a biased Dean who delegates when uninformed is then often preferred over an unbiased President who makes all decisions by himself.

Why is the President more reluctant to delegate than the Dean? To see this, note first that the preferences of Dean and Chair are more aligned than the preferences of President and Chair. As a result, the Dean has a higher willingness to delegate to the Chair than the President. But what if the preference alignment between President and Dean is similar to that between Dean and Chair? Are the incentives to delegate to the next layer not identical for President and Dean? They are not. An uninformed Dean can rely on the Chair always taking an informed (albeit biased) decision. In contrast, the President knows that the Dean is often uninformed and then delegates to the Chair. Such re-delegation results in a very biased decision from the President's perspective. As a result, the President has strictly weaker incentives to delegate than the Dean and often fails to do so even though it is efficient. A smaller hierarchy, Dean-Chair rather than President-Dean-Chair, may then result in better decision-making. Note that in the latter case, a Dean-Chair hierarchy is also strictly preferred over a President-Chair hierarchy, as the President would not delegate to the Chair when uninformed.

Finally, if preferences for power are very strong, neither President nor Dean ever delegate. If they are frequently uninformed, it is then optimal to have no hierarchy at all (and let the Chair always decide). Of course, such delegation may not be credible, in which case there is inefficient centralization of decision-making.

Beyond comparative statics with respect of the magnitude of decision rents – which generally result in smaller, more de-layered organizations – we show that the value of both top and middle managers tends to be non-monotonic in the uncertainty surrounding the decision and in the bias and expertise of their subordinates. Intuitively, while say an increase in the bias of subordinates makes a superior more valuable, this also makes it more likely that the latter will inefficiently hoard decision rights. As a result, a manager is least likely to be valuable for intermediate values of bias and expertise of her subordinate. This yields the counter-intuitive result that an increase in externalities between activities may initially result in fewer layers of management and less centralization. This finding shows how preferences for power may reverse a standard result in the delegation literature (e.g. Dessein 2002; Alonso, Dessein and Matouschek 2008; Rantakari 2008)

Literature on hierarchies The paper perhaps closest to ours is Hart and Moore (2005), who analyze a model of the design of hierarchies in a setting where agents perform different tasks (coordination versus specialization). Like us, decisions are non contractible, and like us their model speaks to the optimal degree of decentralization. The key assumption they make, however, is that decisions are made hierarchically: the senior person in the hierarchy who "has an idea" about a decision makes it. Agents never actively choose whether or not to delegate. In this setting, they study when, for a given number of agents, generalists (or coordinators) should be senior to specialists. Unlike ours, their model does not speak to the optimal number of hierarchical layers in an organization.

Also closely related to our paper is Aghion and Tirole (1997) who consider a setting where there are two agents, one of whom has "formal authority" to make a decision.[5] The agents, however, are probabilistically informed about a decision and the likelihood depends on privately costly, non-contractible effort. They show that the agent who has formal authority may not have "real authority", in the sense that she will not take the ac-

[5]Baker, Gibbons and Murphy (1999) analyze a repeated-game version of Aghion and Tirole (1997) and show how the desire to build a reputation can sustain delegation to a subordinate even when it is not an equilibrium in the one-shot game.

tual decision very frequently because she optimally puts in little effort to having an idea. This is likely to occur if, for instance, the two agents have highly congruent preferences about which projects to pursue. Like us, they have an incomplete contracting model of hierarchies. Unlike us, however, they focus on *ex ante* incentives for effort rather than delegation of decision rights in a multi-layer hierarchy.

The two papers above focus on the role of hierarchies in making decisions when information is dispersed and agents have conflicting preferences. Other models in this class of decision hierarchies include Dessein (2002), Alonso et al. (2008), Rantakari (2008), Hart and Holmstrom (2010) and Dessein, Garicano and Gertner (2010).[6] Decentralization or 'removing the top layer' in a decision hierarchy may be optimal because centralization results in a distortion of information (Dessein 2002), de-motivates information acquisition (Aghion and Tirole 1997) or because the top-manager is biased (Hart and Holmstrom 2010). Unlike in our model, however, the principal or top manager is always valuable if she is, on average, a better decision-maker than the agent. Together with Hart and Moore (2005), our paper is also novel in offering a theory of multi-layered hierarchies with more than two layers.

Another strand of literature focuses instead on how hierarchies facilitate the division of labor in information processing or problem solving (Radner 1993, Bolton and Dewatripont 1994, and Garicano 2000).[7] While this approach allows the study of large, multi-layered organizations, communication costs (such as delay) rather than incentive conflicts determine the optimal organizational structure.[8]

Literature on preferences for power Social psychologists have long argued that power is a basic human need. Power is one of five *need categories* in Murray (1938)'s system of needs. In his human motivation theory, David McClelland (1961, 1975) proposes that most people are consistently motivated by one of three basic desires: the need for affiliation (or being liked by others), the need for achievement, and the need for authority or power. The intrinsic value of autonomy is also at the center of the self-determination

[6] Harris and Raviv (2002) and Alonso, Dessein and Matouschek (2015) study decision hierarchies in a team theoretical setting where there are no incentive conflicts, but where communication is limited.

[7] See Garicano and Van Zandt (2013) for a comprehensive review of this literature.

[8] Calvo and Wellisz (1978) emphasize the role of hierarchies in monitoring effort. Their focus is on explaining wage differentials across layers, rather than organizational structure.

theory of Deci and Ryan (1985). In economics, private benefits of control and preferences for power play a central role in the corporate finance literature (e.g. Aghion and Bolton, 1992, Hart and Moore, 1995, and Dyck and Zingales, 2004) and the organizational economics literature (Aghion and Tirole, 1997).[9]

Perhaps the cleanest evidence that decision rights carry an *intrinsic value,* beyond their instrumental benefits for achieving certain outcomes, is presented in an experimental paper by Bartling et al. (2014). They develop an approach which rules out alternative explanations based on regret and ambiguity aversion, and show that the intrinsic value of decision rights is both significant (on average 17 percent of the monetary payoffs associated with a decision[10]) and correlated across individuals and game parameterizations. Interestingly, higher stakes are associated with proportionally higher intrinsic values. These results confirm similar findings in Owens, Grossman and Fackler (2014), who also find that individuals are willing to sacrifice expected earnings to retain control,[11] and Fehr et al. (2013), who find a significant under-delegation of decision rights from principals to agents in settings where delegation is clearly optimal.[12] Evidence on the private benefits of autonomy can also be found in the entrepreneurship literature. Non-pecuniary motives such as the desire "to be one's own boss" are a major self-reported driver of the decision to enter self-employment (Pugsley and Hurst 2011) and entrepreneurs typically forego substantial earnings when becoming self-employed (Hamilton 2000, and Moskowitz and Vissing-Jorgensen 2002).

Outline The paper proceeds as follows. Section 2 illustrates the model for the simplest case when there are just two workers and, potentially, one boss. This section highlights our main assumptions and shows how some central results in the delegation literature may be overturned when there is moral hazard in delegation. Section 3 and 4 then con-

[9] In those literatures, control may either convey tangible benefits or be more 'psychic' in nature. Both interpretations are consistent with our model.

[10] Bartling et al. compare the certainty equivalents of delegation lotteries and non-delegation lotteries, as all decisions are risky.

[11] They find that the average participant is willing to sacrifice 8 percent to 15 percent of expected earnings in order to control their own payoff. Interestingly, Pikulina and Tergiman (2018) show how individuals are willing to accept a lower pay-off for themselves in exchange for power over the pay-off of *others*.

[12] See also Sloof and von Siemens (2018), who point to overconfidence and an "illusion of control" as a source of preferences for power.

sider three-level hierarchies where there are both middle-managers and a top manager. Section 5 generalizes the key insights to hierarchies with an arbitrary number of managerial layers. Section 6, finally, concludes by discussing some empirical implications of our model and future avenues of research.

2 Two-level hierarchies

In order to illustrate the basic assumptions which lead to moral-hazard-in-delegation, we first consider a simple example in which the organization consists of at most two levels: A boss and two workers.

2.1 A delegation hierarchy with two levels

Consider an organization engaged in two activities $s \in \{s', s''\}$. Each activity s is associated with an action choice a_s and generates a payoff

$$\pi_s \equiv \pi_s(\theta_s, a_s, a_{-s}) = 2(\theta_s a_s - \sqrt{\mu} a_{-s}) - a_s^2$$

where θ_s is an activity-specific i.i.d. shock with variance σ_θ^2, and where μ is an exogenous parameter which reflects externalities between the two activities.

By default, each activity s is assigned to a worker $m(s)$ who observes θ_s. In addition, both activities may be assigned to a boss, M, who observes θ_s with probability $p < 1$.If M is part of the organization (see subsection on 'organization design' below), then the initial decision-right over a_s is owned by $M.$ An uninformed M, however, may choose to delegate the decision right about a_s to the relevant worker who always observes θ_s.

Managerial Preferences: When choosing $a_s,$ the workers and the boss maximize the payoffs of the activities assigned to them. These preferences are taken as exogenous but can be viewed as stemming from career concerns, the ability of agents (workers, boss) to divert a fraction of the profits of activities assigned to them, or the intrinsic reward agents experience when these activities are successful. In addition, agents are power-hungry in that they derive a private benefit $r(s) > 0$ from choosing a_s. This private benefit can be viewed as the intrinsic value of making a decision (as in Bartling et al. 2014). Alternatively, one can think of a_s as a complex, multi-dimensional action with some aspects of a_s affecting organizational payoffs and other aspects affecting private (even psychological) benefits of workers. Managers are power-hungry in that they derive a private benefit from choosing a_s. We allow $r(s)$ to be either deterministic or a random variable with c.d.f. $F(\cdot)$ on support $[0, R]$ or $[0, \infty)$. As shown by Bartling et al. (2014), situational determinants may affect the intrinsic value of decision rights.[13] Similarly, non-psychological private benefits of control may depend on opportunities which arrive stochastically or are specific to individual managers.

Organization Design. The organization designer has limited instruments. Neither decisions themselves, nor the delegation of decisions are contractible. Moreover, the workers nor the boss respond to monetary incentives. The organization designer, however, can decentralize decision-making (or de-integrate the organization) by removing the boss.

2.2 Expected payoffs and moral hazard in delegation

Since the boss cares about the payoffs of both activities, she will choose the first-best action $a_s = a_s^* \equiv \theta_s - \sqrt{\mu}$ when informed and $a_s = E(\theta_s) - \sqrt{\mu}$ when uninformed. The workers are always informed, but only care about the payoffs of the activity assigned to them. When delegated authority, they therefore choose $a_s = \theta_s$.

Informed boss as decision-maker. Let us denote by U_M the expected payoffs of the boss and by $U_{m'}$ and $U_{m''}$ the expected pay-off of workers $m(s')$ and $m(s'')$. If an *informed boss* chooses both actions, this yields expected payoffs

$$\begin{aligned} U_M &= \Pi^* + r(s') + r(s'') \\ U_{m'} &= U_{m''} = \Pi^*/2, \end{aligned}$$

where Π^* are first-best profits:

$$\Pi^* = \sum\nolimits_{s \in \{s', s''\}} E(\pi_s(\theta_s, a_s^*, a_{-s}^*)),$$

[13] In fact, people prefer to delegate if it allows to shift responsibility for unpleasant outcomes (Bartling and Fischbacher, 2012), suggesting $r(s)$ may even be negative. More generally, there are many other situational determinants that likely affect how much agents (intrinsically) value making decisions.

Workers as decision-makers. By contrast, if workers $m(s')$ and $m(s'')$ are the decision-makers, then payoffs are given by

$$\begin{aligned} U_M &= \Pi^* - 2\mu \\ U_{m'} &= \Pi^*/2 - \mu + r(s') \\ U_{m''} &= \Pi^*/2 - \mu + r(s'') \end{aligned}$$

Note that shifting decision-rights from an informed boss to the workers results both in an efficiency loss, μ, as workers do not internalize externalities on each other's activities, and in a shift of the private benefits of control, $r(s')$ and $r(s'')$, from the boss to the workers.

Uninformed boss as decision-maker. Finally, if an *uninformed boss* chooses both actions, then

$$\begin{aligned} U_M &= \Pi^* - 2\sigma_\theta^2 + r(s') + r(s'') \\ U_{m'} &= U_{m''} = \Pi^*/2 - \sigma_\theta^2 \end{aligned}$$

Observe that an uninformed boss optimally delegates authority over a_s to worker $m(s)$ if and only if

$$\sigma_\theta^2 \geq \mu$$

An uninformed boss, however, only delegates if

$$\sigma_\theta^2 \geq \mu + r(s)$$

Whenever $r(s) > \sigma_\theta^2 - \mu$, there is moral hazard in delegation: the boss inefficiently hoards decision rights.

Remark 1. *Assume $\sigma_\theta^2 - \mu > 0$ so that delegation is optimal whenever the boss is uninformed. Whenever $r(s) > \sigma_\theta^2 - \mu$, there is moral hazard in delegation: an uninformed boss inefficiently holds on to decision rights.*

2.3 When is a (power-hungry) boss valuable?

With at most two layers, organization design is reduced to a single question: When is it optimal for the organization to have a boss? i.e. when is centralized decision-making optimal?

If the boss has no preferences for power ($r(s) = 0$), she always adds value. With probability p she is informed, and she chooses the first best action a_s^*. With probability $1 - p$, she is uninformed and she delegates to the worker below her whenever this is optimal, that is whenever $\sigma_\theta^2 \geq \mu$.

With preferences for power, this need not be the case. The key trade-off in this setting is as follows. On the plus side, the boss internalizes externalities between activities. On the minus side, the boss may hoard decision rights because of her preference for power, and this creates an inefficiency. Formally, an uninformed boss delegates a_s if and only if

$$r(s) \leq \overline{r} \equiv \sigma_\theta^2 - \mu.$$

On the one hand, with probability $(1-p)(1-F(\overline{r}))$, the boss takes an uninformed decision, reducing payoffs by $\sigma_\theta^2 - \mu$ relative to an organization where authority is directly allocated to the workers. On the other hand, with probability p, the presence of a boss increases efficiency by μ, as she internalizes externalities between activities when informed. Finally, with probability $(1-p)F(\overline{r})$, the presence of a boss does not affect payoffs, as she delegates efficiently. It follows that a boss is valuable if and only if

$$p\mu \geq (1-p)(1-F(\overline{r}))(\sigma_\theta^2 - \mu),$$

which can be rewritten as

$$p\sigma_\theta^2 + (1-p)F(\overline{r})\overline{r} > \overline{r}. \quad (1)$$

This immediately leads to the following proposition

Proposition 1. *Assume $\sigma_\theta^2 - \mu > 0$. Decentralization of authority (no boss) is optimal whenever $p < \overline{p}$, with $\overline{p}$ given by*

$$\overline{p}\sigma_\theta^2 + (1-\overline{p})F(\overline{r})\overline{r} = \overline{r}$$

where $\overline{r} \equiv \sigma_\theta^2 - \mu$. The thresholds $\overline{p}$ is strictly positive whenever $F(\overline{r}) < 1$, in which case *an increase in preferences for power (a downwards shift in $F(.)$ in the sense of FOSD) strictly increases $\overline{p}$.*

The above proposition yields two compelling comparative statics: First, a boss (or centralization) is only valuable if the boss is sufficiently likely to be informed and when preferences for power are not too strong. Intuitively, hoarding decision-rights is only costly when M is uninformed. If $p = 1,$ the boss is always valuable, regardless of her preferences for authority. If $p = 0,$ the boss is never valuable. Second, the value of a boss depends on her preferences for power. In particular, an upward shift in $F(.)$ in the sense of FOSD makes it more likely that a boss is valuable. The boss then has weaker preferences for power and, hence, is less likely to inefficiently hoard decision-rights when uninformed.

Perhaps surprisingly, comparative statics with respect to the other two parameters μ and σ_θ^2 are ambiguous. Inspecting (1), a decrease in $\overline{r} = \sigma_\theta^2 - \mu$ not only reduces the value of decentralization to the worker (RHS of (1)), but also reduces the probability $F(\overline{r})$ that the manager delegates to the worker. Intuitively, an increase in the incentive conflict of the workers exacerbates the moral- hazard-in-delegation faced by their boss: the boss is less willing to delegate, even though delegation remains optimal whenever the boss is uninformed. As a result, when workers become more biased (an increase in μ) it may become optimal to remove the boss and decentralize authority to workers.

Proposition 2. *A decrease in $\overline{r} \equiv \sigma_\theta^2 - \mu$, that is an increase in the worker's bias or a decrease in the worker's informational advantage, may result in removal of the boss and decentralization of authority to the workers.*

The above proposition stands in contrast with standard models in the delegation literature (see Dessein 2002, Alonso et al. 2008, Rantakari 2008), which have the unambiguous prediction that decisions are less likely to be delegated to the agent when conflicts of interest are larger.

To provide more intuition for the above result, we consider two specific distributions for $r(s)$ and show that whenever p is small, an increase in the worker's bias μ initially results in a removal of the boss and decentralization of decision-rights to those same workers:

Proposition 3. *Assume $r(s)$ is uniformly distributed on $[0, R]$ with $R < \sigma_\theta^2$ or that $r(s)$ is deterministic, that is $r(s) \equiv r < \sigma_\theta^2$. If p is sufficiently small, then decentralization (no boss) is optimal for intermediate values of worker bias μ, whereas centralization (a boss) is optimal for μ sufficiently small or sufficiently large.*

We first show this result for uniformly distributed decision rents. We subsequently consider deterministic decision rents:

Case 1 (Uniformly distributed decision rents). Assume first that $r(s)$ is uniformly on $[0, R]$ with $R < \sigma^2$. For simplicity, we normalize all parameters so that σ^2 equals 1. If $R < 1 - \mu$, an uninformed boss always delegates so that she is valuable regardless of p. In contrast, if $R > 1-\mu$, an uninformed boss delegates with probability $F(\overline{r}) = (1-\mu)/R$. From Proposition 1, decentralization to the workers (no boss) is then optimal

$$\Leftrightarrow p < \overline{p} \equiv (1-\mu)\frac{R-(1-\mu)}{R-(1-\mu)^2} \tag{2}$$

It is now easy to verify that $\overline{p}$ is hump-shaped in $\mu : \overline{p} = 0$ for $\mu < 1 - R$, $\overline{p}$ is increasing in μ for $\mu \in \left[1 - R, \sqrt{1-R}\right]$ and $\overline{p}$ is decreasing in μ for $\mu > \sqrt{1-R}$. Let $\hat{p}$ denote the maximized value of $\overline{p}$ in (2). It follows that for $p < \hat{p}$, installing a boss is optimal if the worker's incentive conflict μ is small, but an increase in μ will eventually result in the boss's removal:

Result: *There exists a $\hat{p} > 0$, such that*

- *For $p < \hat{p}$, decentralization (no boss) is optimal for intermediate values of μ. Centralization is optimal for μ sufficiently small or large.*
- *For $p > \hat{p}$, centralization (boss) is always optimal.*

Figure 1 plots $\overline{p}$ as a function of μ and this for $R = 0.8$ (green curve) and $R = 0.9$ (red curve). When boss is not likely to be informed (p is small), an initial increase in the agency conflict of the workers (an increase in μ) makes it optimal to remove the boss and decentralize authority to those workers. Intuitively, for intermediate values of μ, the moral hazard problem in the delegation of the decision then outweighs the agency problem in the decision itself.

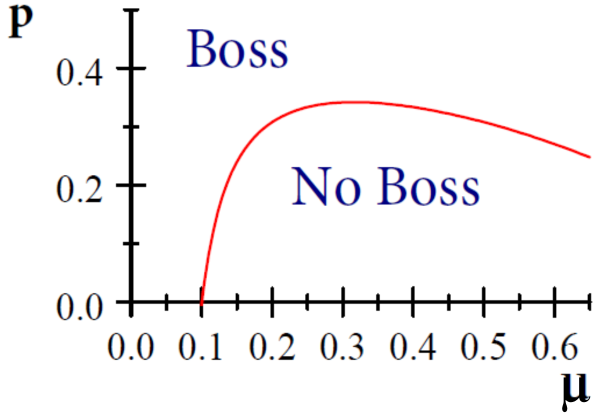

Figure 1 – Assume $r(s)$ ˜ $U[0, R]$ and $\sigma^2 = 1$. Figure 1 plots the optimal hierarchy (boss, no boss) as a function of the externality parameter μ when $R = 0.9$. A boss is valuable if $p > \overline{p}$ (red curve), while she destroys value when $p < \overline{p}$.

Case 2 (deterministic private benefits). Assume now that $r(s) = r$, so that an uninformed boss delegates if and only if $\mu < \mu_L \equiv \sigma_\theta^2 - r$. If $\mu > \mu_L$, the boss never delegates and decentralization (no boss) is optimal whenever $p\sigma_\theta^2 < \sigma_\theta^2 - \mu$, i.e. $\mu < \mu_H \equiv (1-p)\sigma_\theta^2$.
Result: *Assume $p < \hat{p} \equiv r/\sigma_\theta^2$, then decentralization (no boss) is optimal for $\mu \in (\mu_L, \mu_H)$* with $\mu_L < \mu_H$, *whereas centralization (boss) is optimal for $\mu < \mu_L$ or $\mu > \mu_H$.*

2.4 When the top manager is also the organization designer

A somewhat counter-intuitive implication of Proposition 1 is that an increase in the boss's preferences for power may result in more delegation of authority to workers, as it becomes optimal to remove the boss. In certain instances, however, such as family-run firms or owner-manager firms, the boss *is* the organization designer.

It is trivial to see that the boss then never wants to remove herself.[14] As a result, in a two-layer hierarchy, stronger preferences for power then unambiguously result in less worker authority. In multi-layer hierarchies, however, this is not necessarily the case. Indeed, the top manager may then inefficiently hold on to power, but she will optimally remove middle-layers of management when preferences for power increase.

[14]This result stands in contrast to Aghion and Tirole (1997), Dessein (2002) and Alonso, Dessein and Matouschek (2008), where a boss may (selfishly) benefit from such an ex ante commitment to delegate authority.

Example: Consider the same set-up as above, but let there be one additional layer – the CEO – who observes θ_s with independent probability $p_0 > 0$ and derives a private benefit $r_0(s)$ from choosing a_s. When uninformed, the CEO either delegates to manager M (formerly the boss), or delegates to the worker, or takes an uninformed decision. Assume both $r_0(s)$ (private benefits CEO) and $r(s)$ (private benefits manager) are i.i.d. uniformly distributed on $[0, R]$. Proposition 1 still holds. The CEO removes manager M from the hierarchy whenever $p < \overline{p}(R)$, with $\overline{p}(R)$ given by (2). Let R_1 and $R_2 > R_1$ be such that $\overline{p}(R_1) < p < \overline{p}(R_2)$. An increase in R from R_1 to R_2 then results in delayering and, often, more delegation to the worker. In contrast, an increase in R from R_0 to $R_1 > R_0$ unambiguously results in less delegation to the worker.

3 Three-level hierarchies

The previous section shows how, when bosses are power-hungry, hierarchical decision-making is only valuable when the boss is sufficiently knowledgeable. Most hierarchical organizations, however, have multiple layers of management. In this section, we study how preferences for power affect the structure of multi-layered hierarchies, and address the following questions.

- What is the value of middle layers of management?
- How does the value of middle layers of management compare to that of top layers?
- When preferences for power become more pronounced, does this tend to result in smaller organizations or flatter organizations?

To answer these questions, consider the following generalization of the model presented in Section 2:

3.1 A delegation hierarchy with three levels

An organization is engaged in a set of activities S which are partitioned into (non-overlapping) divisions $\{D_1, ..., D_n\}$. Each activity $s \in S$ is associated with an action choice a_s and generates a payoff $\pi_s(\theta_s, a)$ where $a = (a_s, a_{-s})$ is the organization's action profile and θ_s is an activity-specific shock which represents the uncertainty about the optimal action a_s to take. Section 3.2 discusses the properties of $\pi_s(\theta_s, a)$ in more detail.

Each activity s is assigned to a hierarchy of managers

$$h(s) = (h_0(s), h_1(s), h_2(s))$$

where $h_i(s) \in M \cup \{0\}$ with M the set of managers. We denote $h_i(s) = 0$ when no manager is assigned to level i and $h_i(s) = m_i(s) \in M$ otherwise. Wlog (see later) we restrict attention to symmetric organizations where $h_i(s) = 0$ if and only if $h_i(s') = 0$ for all $s' \in S$.

Lower-level managers are more specialized: the 'top manager' (or CEO) $m_0(s)$ is assigned all activities $s' \in S$ (or none, if $h_0 = 0$), the 'middle manager' $m_1(s)$ is assigned all activities $s' \in D_k$ belonging to the same division as s (or none, if $h_1 = 0$), and the 'worker' $m_2(s)$ is only assigned activity s. Figure 2illustrates 4 possible organization designs:

Abusing notation, we denote $m_j = m_j(s)$ unless confusion is possible. Manager m_j observes θ_s with independent probability

$$p_j \in [0, 1] .$$

As in our two-layer model we assume that the worker m_2 is perfectly informed, that is $p_2 = 1$. If $h_0 \neq 0$, then the initial decision-right over a_s is owned by manager m_0. An uninformed m_0, however, may choose to delegate the decision right about a_s to m_1 or m_2. When delegated authority, the middle manager m_1 either selects a_s or delegates authority over a_s to the m_2. The lower-level manager m_2 always selects a_s when delegated authority. If $h_j = 0$ for all $j < i$, then the initial decision right over a_s is allocated to manager $m_i \in \{m_1, m_2\}$. Section 3.3 discusses the above assumptions in more detail, including how decision rights over activities can be conveyed through control over activity-specific, division-specific and organization-wide assets.

Managerial Preferences: Managers maximize the payoffs of the activities assigned to them when choosing a_s. Managers, however, are also power-hungry in that they derive

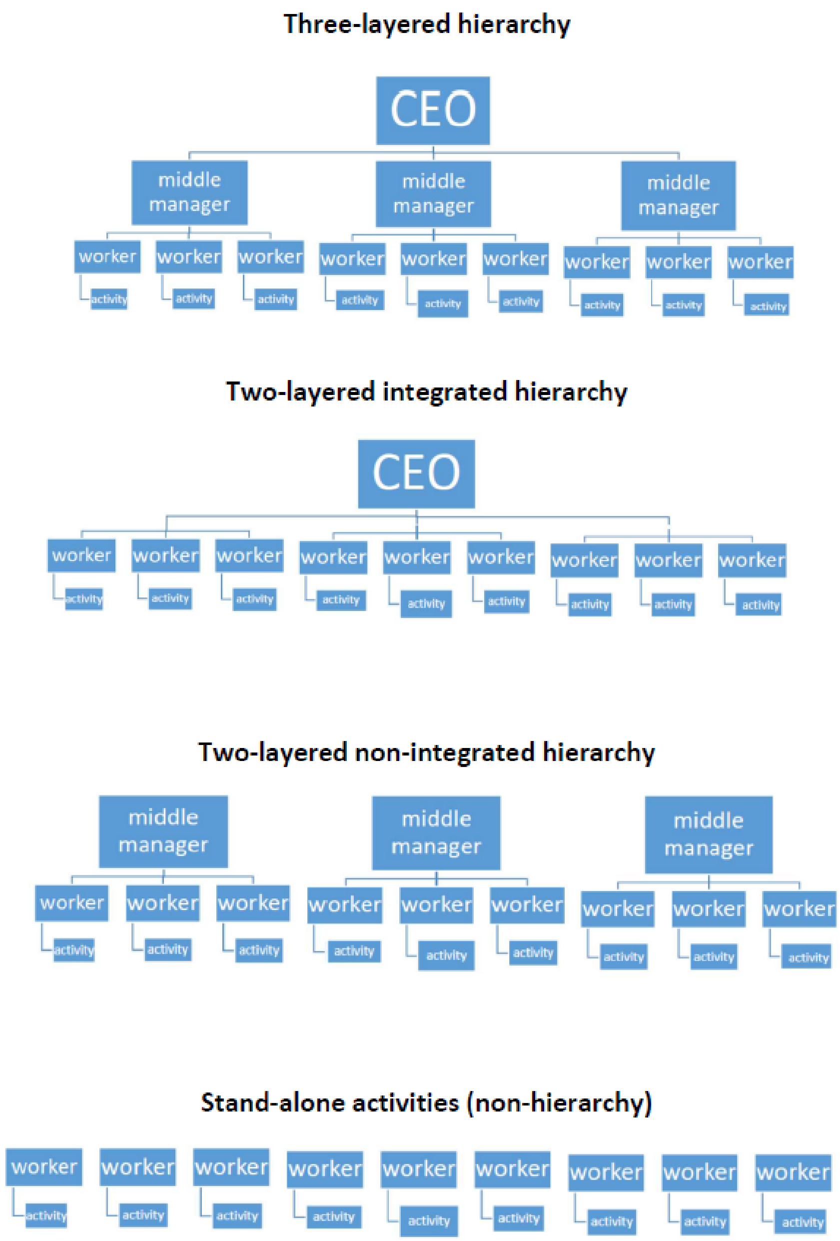

Figure 2 – Four possible organization designs.

a private benefit from choosing a_s. We denote by $r_j = r_j(s)$ the private benefits to manager m_j associated with choosing action a_s. If m_j chooses a_s, then the rent r_j is i.i.d. with c.d.f. $F(\cdot)$ on support $[0, R]$ or $[0, \infty)$. If m_j does not choose a_s, then $r_j = 0$. We refer to Section 2 for a discussion of these preferences. All decision rent draws are stochastically independent and are private information. Section 4.3 considers the special case where r_j is deterministic (and identical) for all managers. When deciding whether or not to delegate a_s to manager m_l, manager m_j takes into account the equilibrium strategies of all managers m_i with $i > j$, and behaves as if she maximizes the sum of her private benefits r_j and the expected payoffs of the activities s assigned to her.

Organization Design: Neither decisions themselves, nor the delegation of decisions are contractible. Moreover, managers do not respond to monetary incentives. The organization designer, however, can remove *layers of management*. We denote the optimal hierarchy by h^* where $h_i^* = 0$ if layer i is inactive (no manager is assigned to layer i). Without loss of generality, we assume that $h_2 \neq 0$. Hence, the smallest possible hierarchy is $h^* = \{0, 0, m_2\}$. As discussed above, agent m_2 can be interpreted as a worker who operates activity s. As we discuss in Section 3.3, given that manager m_0 is the only manager who is assigned all activities $s' \in S$, removing m_0 can viewed as a de-integration decision.

3.2 Expected payoffs

Appendix I posits a quadratic "hit-the-state" payoff specification for $\pi_s(\theta_s, a)$ which results in intuitive expressions for expected profits and which we will maintain throughout the paper. As in the model with two layers, this payoff specification is such that the optimal choice of a_s depends on θ_s and on the magnitude of externalities with other activities $s' \neq s$, but not the actions a_{-s} associated with those other activities. Without loss of generality, we therefore focus our discussion and analysis on one generic activity s and associated action a_s, taking the action profile a_{-s} as given.

Let $\Pi_{a_{-s}}(m_j)$ denote the expected *organizational payoffs* of all activities $s' \in S$ when an *informed manager* $m_j(s)$ chooses a_s and let $\Pi^*_{a_{-s}}$ denote the first-best expected payoffs (both for some given action profile a_{-s}). Since manager m_0 maximizes the payoffs of all activities, it follows that

$$\Pi_{a_{-s}}(m_0) = \Pi^*_{a_{-s}}.$$

When an informed middle manager m_1 or worker m_2 selects a_s the pay-off specification in Appendix I implies that

$$\begin{aligned}
\Pi_{a_{-s}}(m_1) &= \Pi^*_{a_{-s}} - \mu_1 \\
\Pi_{a_{-s}}(m_2) &= \Pi^*_{a_{-s}} - \mu_1 - \mu_2,
\end{aligned}$$

where the term μ_1 are the payoff losses due to externalities which are not internalized by the middle manager, and $\mu_1 + \mu_2$ reflect the externalities not internalized by the worker. When an *uninformed manager* m_j selects a_s, our quadratic payoff specification results in expected organizational payoffs

$$\Pi_{a_{-s}}(m_j) - \sigma^2,$$

where σ^2 is linear in the variance of the task-specific shock θ_s. Hence σ^2 reflects the uncertainty surrounding the optimal choice of a_s.

When deciding whether or not to delegate to the worker m_2, middle manager m_1 only cares about the expected payoffs of the activities assigned to her. Let $\Pi^1_{a_{-s}}(m_j)$ denote the *expected payoffs of all the activities assigned to manager* m_1 when an *informed manager* $m_j \in \{m_1, m_2\}$ chooses a_s. Our payoff specification implies that

$$\begin{aligned}
\Pi^1_{a_{-s}}(m_1) &\equiv \Pi^{1^*}_{a_{-s}} \\
\Pi^1_{a_{-s}}(m_2) &= \Pi^{1^*}_{a_{-s}} - \mu_2.
\end{aligned}$$

Instead, when an uninformed manager m_1 chooses a_s, those payoffs equal $\Pi^{1^*}_{a_{-s}} - \sigma^2$. To simplify the exposition, we assume that the bias in decision-making increases linearly as one moves down the hierarchy:

Assumption A1: $\mu_1 = \mu_2 = \mu$.

In this paper, we study the consequences of managers inefficiently holding on to authority. To make this analysis relevant, we make the following assumption which

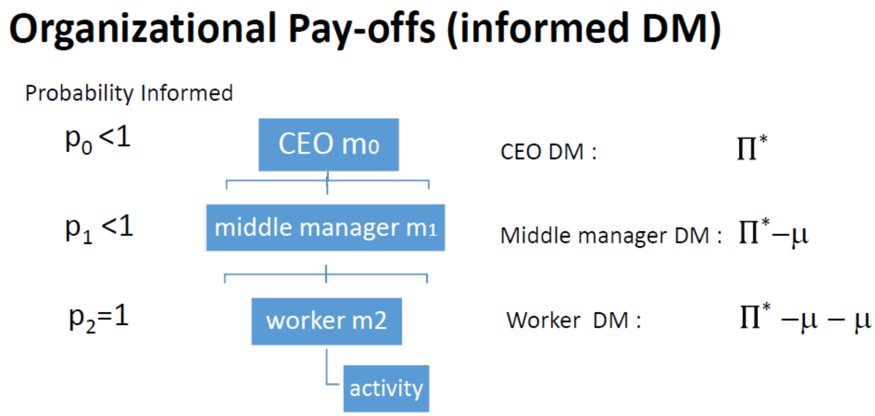

Figure 3 – Expected organizational payoffs in a three-layer hierarchy when an informed manager $m_i \in \{m_0, m_1, m_2\}$ is decision-maker (DM).

implies that delegation is efficient:

Assumption A2: $p_1\sigma^2 - \mu > 0$.

Assumption A2 guarantees that in the absence of preferences for power, an uninformed top manager m_0 is willing to delegate to the next-level manager m_1.

3.3 Discussion

Delegation hierarchies, asset ownership and de-integration: While alternative interpretations are possible, following the literature on incomplete contracts (Grossman and Hart (1986), Hart and Moore (1990)), one can think of decision rights in our model being conveyed through control or ownership of assets. Consider a number of activities $s \in S$, each of which is associated with a three-layer delegation hierarchy $h(s) = (m_0, m_1(s), m_2(s))$.Each activity s requires, at the minimum, the use of an activity-specific asset $A_s \in \Omega_2$ which is operated by worker $m_2(s)$. The organization, however, has the option to integrate its activities in a number of divisions $D = \{D_1, ..., D_N\}$ by letting activities belonging to the same division $D_i \in D$ use a common asset $A_i \in \Omega_1$. While this divisional asset does not directly affect payoffs, such integration allows the organization to convey the decision right over a_s to manager $m_1(s)$ who operates this asset. Finally, independent of whether its activities are integrated into divisions or not, the organization can employ an organization-wide asset A_0 which is required to operate all divisional assets $A_i \in \Omega_1$ (if 'active') and all activity-specific assets $A_s \in \Omega_2$. This type of organization-wide integration therefore allows the organization to assign the decision rights over the full action profile **a** to a single manager m_0. Conversely, removing manager m_0 in a delegation hierarchy is equivalent to a de-integration decision, where one hierarchy is replaced by several smaller hierarchies (if divisional assets are being used) or by a set of stand-alone assets (if no divisional assets are in use).

Formal versus real authority: In our delegation hierarchy, the initial decision-right over a_s is owned by manager m_0, the "top manager". One can think of this as m_0 having *formal authority* in the sense of Aghion and Tirole (1997). An uninformed m_0, however, may choose to delegate or "loan" the decision rights about a_s to a middle manager or worker $m_j \in \{m_1(s), m_2(s)\}$. One can view this as the delegation of "real authority" where an uninformed boss optimally refrains from overturning the actions of her subordinate.

As in Aghion and Tirole, but unlike in Dessein (2002), we implicitly assume that the activity s is sufficiently complex so that observing the choice of a_s by a middle manager or worker does not reveal the state of nature θ_s.[15] Hence, in the absence of re-delegation, the top manager has no commitment problem when "loaning" or "delegating" a decision right to a middle manager. Ex ante, a top manager optimally allows a middle manager to re-delegate a decision right to the worker. Ex post, however, the top manager may have an incentive to reclaim the decision right if she observes re-delegation. Our model therefore implicitly assumes that a top manager cannot observe whether a decision is being re-delegated or not.[16] Alternatively, if who makes the final decision is observable, then the top manager must be able to build a reputation for not reneging on delegation decisions, as in Baker, Gibbons and Murphy (1999).

4 Optimal hierarchical structure

Our model allows for four possible organization designs. The first is a *three-level hierarchy* where a top-manager sits above a middle manager, who in turn sits above a worker.

[15] Similarly, the choice of a_s by a subordinate does not reveal whether or not this subordinate was informed.

[16] Consistent with this assumption of non observability, it is often lamented that middle managers claim "ownership" for actions and accomplishments which are mainly achieved by their subordinates.

We denote this organization $h^* = (m_0, m_1, m_2)$. A second possibility is an *integrated two-level hierarchy* where, relative to the first organization, the middle manager is removed so that the top-manager sits directly above the worker i.e. $h^* = (m_0, 0, m_2)$. A third possibility is a *non-integrated two-level hierarchy* where middle managers sit above workers and the CEO is removed i.e. $h^* = (0, m_1, m_2)$. Finally, it is possible to have *stand-alone activities*, where there is only the worker in the organization i.e. $h^* = (0, 0, m_2)$.

Our study of which of those four structures is optimal proceeds as follows. In Section 4.1, we first consider a natural benchmark in which managers do not have preferences for power ($r_1 = r_2 = 0$). It is easy to show that more layers of management are always better, that is $h^* = (m_0, m_1, m_2)$.

When managers m_0 and m_1 do have preferences for power, Section 4.2 shows that $h_i \neq 0$ if and only if $p_i > p_i^*$: power-hungry managers are part of an optimal hierarchy if they have sufficient expertise. An increase in preferences for power may then result in either delayering ($h^* = (m_0, 0, m_2)$ or de-integration ($h^* = (0, m_1, m_2)$ or $h^* = (0, 0, m_2)$, depending on $\{p_0, p_1\}$.

A central insight of Section 4.2, however, is that the moral-hazard-in-delegation problem is more severe for m_0 than for m_1 : an uninformed m_0 is more likely to hoard decision rights than an uninformed m_1. Assuming deterministic decision rents, that is $r_1 = r_2 = r$, Section 4.3 uses this insight to show how preferences for power tend to result in the removal of the top manager m_0 rather than the middle manager m_1. In other words, stronger preferences for power tend to lead to small non-integrated organizations rather than large-but-flat ones, i.e. $h^* = (0, m_1, m_2)$ rather than $h^* = (m_0, 0, m_2)$.

4.1 Benchmark: No preferences for power

Consider first a natural benchmark where managers do not have preferences for power: $r_1 = r_2 = 0$.

Proposition 4. *If there are no preferences for power, the optimal organization is* $h^* = (m_0, m_1, m_2)$.

Under this organizational design the top manager m_0 holds the initial decision right over a_s. If m_0 is uninformed then she delegates to the division manager m_1. Similarly, if

m_1 has been delegated the decision right by m_0, and she is uniformed herself, then m_1 delegates to the worker m_2.

The top manager faces a relatively simple trade-off between the costs and benefits of delegation. The benefits of delegating to the division manager are that the division manager may: (a) become informed; or (b) delegate to the worker–who we have assumed is always informed. The costs of delegation are, of course, the bias that comes from delegation. Assumption A2 ensures that the informational benefits of delegation to the division manager always dominate. This leaves open the possibility, however, that it is optimal for the top manager to delegate directly to the worker. This cannot be optimal since the division manager is less biased than the worker and, given that there are no preferences for power, the division manager always delegates to the worker if the top manager would do so herself.

Finally, the organization designer finds it optimal to assign the initial decision right to the top manager, rather than to the division manager. Again, because there are no preferences for power, there is no conflict between firm owners and the top manager. The top manager always delegates if she is uninformed, but is valuable in the event that she is informed.

4.2 Value of Managerial Layers

In contrast to our benchmark, when managers are power-hungry, three-level hierarchies are not necessarily optimal anymore. In what follows, we subsequently study the value of the middle layer (or middle manager) and the value of the top layer (or CEO).

4.2.1 Value of a middle manager

When is the middle manager $m_1(s)$ part of an optimal hierarchy h^*? Note first that it does not matter whether the CEO or firm owners decide on the existence of a middle layer. Conditional on delegating authority, the CEO maximizes firm profits and her preferences are aligned with those of firm owner. It follows that $h = (m_0, m_1, m_2)$ is strictly preferred over $h = (m_0, 0, m_2)$ if and only if $(0, m_1, m_2)$ is strictly preferred over $(0, 0, m_2)$.

Note further that the value of a middle manager $m_1(s)$ in our three-level hierarchy is identical that off the boss in the two-level hierarchy analyzed in Section 2. Formally, an uninformed middle manager $m_1(s)$ will (re-)delegate a_s to the worker $m_2(s)$ if and only if

$$r_1(s) < \overline{r}_1 = \sigma^2 - \mu$$

It follows that a middle-manager is valuable if and only if

$$p_1\mu \geq (1 - p_1)(1 - F(\overline{r}_1))(\sigma^2 - \mu). \tag{3}$$

Intuitively, on the plus side (LHS of inequality), with probability p_1, the middle manager is informed and internalizes within-division externalities μ. On the minus side (RHS), with probability $1 - F(\overline{r}_1)$, an uninformed middle manager hoards decision rights because of her preference for power, and this creates an inefficiency loss equal to $\sigma^2 - \mu$. This leads to the following proposition:

Proposition 5. *A middle manager is valuable, $h_1^* = m_1 \in M$, if and only if $p_1 > \overline{p}_1$, with $\overline{p}_1$ given by*

$$\overline{p}_1\sigma_\theta^2 + (1 - \overline{p}_1)F(\overline{r}_1)\overline{r}_1 = \overline{r}_1,$$

where $\overline{r}_1 \equiv \sigma^2 - \mu$.

Since the condition (3) for the value of a middle manager in a three-level hierarchy is identical to that of a boss in a two-layer hierarchy, we refer to Section 2.3 for a detailed discussion of the comparative statics. We content ourselves to remind the reader that a middle manager is more likely to be valuable when she is more knowledgeable (higher p_1) or has weaker preferences for power (an upward shift in $F(.)$ in the sense of FOSD reduces $\overline{p}_1$). Counterintuitively, however, stronger externalities between activities (a larger μ), have an ambiguous impact on the value of a middle manager. As was also the case for a the value of a boss in a two-layer hierarchy, when preferences for power are deterministic or uniformly distributed, middle managers are least likely to be valuable for intermediate values of μ.

The analysis of the value of middle managers is of independent interest to that of the value of top managers. Indeed, in many organizations, top managers are entrenched and cannot be easily removed by firm owner (e.g. because boards are captive and/or shareholders are dispersed). Top managers, however, will not be shy to delayer the organizations by removing middle managers when those managers are often uninformed but fail to delegate efficiently because of preferences for power.

4.2.2 Value of a top manager

We now turn attention to the value of a top manager m_0 from the perspective of the board/firm owner. In order to avoid inefficient centralization of decision rights, firm owners may opt to de-integrate organizations or put in place a holding structure in which central headquarters have very limited authority. Such a structure is often adopted, for example, by business groups in Europe and Asia. Multi-nationals such as Philipps are also structured in a manner which authority is effectively decentralized to large business units for all but the most important decisions.

Consider first the incentives of the top manager to delegate. One the one hand, if the middle manager is not valuable, $h_1^* = 0$, then m_0 can only delegate to m_2 and will do so if and only if

$$r_0 \leq \tilde{r}_0 = \sigma^2 - 2\mu,$$

where r_0 are the private benefits of control of the top manager. On the other hand, if the middle manager is valuable, $h_1^* = m_1$, then it must be that m_0 prefers to delegate to m_1 rather than m_2 and she will do so if and only if

$$r_0 \leq \hat{r}_0 \equiv p_1\sigma^2 - \mu + (1 - p_1)F(\overline{r}_1)(\sigma^2 - \mu),$$

where $\overline{r}_1 = \sigma^2 - \mu$. In words, an uninformed top manager m_0 will delegate to the middle manager m_1 if her private benefits of control r_0 are smaller than the sum of (1) the informational advantage of the middle manager $p_1\sigma^2$, (2) minus the loss μ due to the fact that m_1 does not internalizes inter-divisional externalities, (3) plus a term which reflect the benefits of the middle manager delegating to the worker when uninformed. Note that even when $\sigma^2 < 2\mu$ and m_0 would never delegate herself to m_2, she still benefits from an uninformed m_1 delegating to m_2 provided $\sigma^2 > \mu$. Indeed an uninformed m_1 deciding herself yields an expected payoff of $\Pi^* - \sigma^2 - \mu$, whereas an informed m_2 deciding yields a payoff of $\Pi^* - 2\mu$.

We conclude that an uninformed top manager will delegate if and only if

$$r_0 < \overline{r}_0 = \max\{\hat{r}_0, \tilde{r}_0\}.$$

Comparing the expressions for $\overline{r}_0$ and $\overline{r}_1$ yields the following result.

Proposition 6. *Moral hazard in delegation is more severe at the top of the organization. An uninformed top manager, m_0, is less likely to delegate than an uninformed middle manager, m_1: $F(\overline{r}_0) < F(\overline{r}_1)$.*

The above proposition states that conditionally on being uninformed, manager m_0 is more likely to (inefficiently) hoard decision rights than manager m_1. Importantly, the above result holds despite the fact that both managers have the same preferences for power, as characterized by $F(.)$, and despite the fact that m_0 has the option to delegate to either m_1 or m_2, whereas m_1 can only delegate to m_2.

What is the intuition for this result? Consider first the willingness to directly delegate to the worker, m_2. Both the top manager and the middle manager have the option to do so, but the worker is twice as biased from the perspective of m_0 than from the perspective of m_1. Clearly, m_0 is more reluctant to delegate to the worker than m_1. Consider next the willingness of both m_0 and m_1 to delegate to agent in the next layer (respectively m_1 and m_2). From the perspective of the delegator (m_0 or m_1) the delegee (respectively, m_1 or m_2) is equally biased, but the delegee is more likely to become informed if she is further down the hierarchy. As a result, the value of delegation is $\overline{r}_1 = \sigma^2 - \mu$ to the middle manager, whereas the value of delegation to the top manager is at most

$$\overline{r}_0^{\max} \equiv p_1(\sigma^2 - \mu) + (1 - p_1)(\sigma^2 - 2\mu),$$

where $\overline{r}_0^{\max}$ is reached if the middle manager always delegates when uninformed. While our assumption that the worker (m_2) is perfectly informed is extreme, the result holds as long as $p_2 > p_1$.

While the top manager faces a larger temptation to hoard decision rights than the middle manager, this does not necessarily imply that she is less valuable as the middle manager is more biased when making a decision. In other words, while the middle manager is more likely to delegate efficient (she faces less of a moral hazard in delegation problem), the top manager is less biased when making the decision (she faces no agency problem as far as the decision itself is concerned). We now proceed by characterizing the value of a top manager from the perspective of firm owners. If firm owners delegate to the top manager, their payoffs equal

$$\Pi^* - \sigma^2 + p_0\sigma^2 + (1 - p_0)F(\overline{r}_0)\overline{r}_0$$

Instead, when firm owners directly delegate to the middle manager m_1 (if $h_1^* = m_1$) or the worker m_2 (if $h_1^* = 0$), their payoffs equal

$$\Pi^* - \sigma^2 + \overline{r}_0.$$

It follows that delegation to the CEO, m_0, is preferred if and only if

$$p_0\sigma^2 + (1 - p_0)F(\overline{r}_0)\overline{r}_0 \geq \overline{r}_0.$$

We thus obtain the following result.

Proposition 7. *The top manager is valuable, that is $h_0^* = m_0 \in M$, if and only if $p_0 > \overline{p}_0$, with $\overline{p}_0$ given by*

$$\overline{p}_0\sigma^2 + (1 - \overline{p}_0)F(\overline{r}_0)\overline{r}_0 = \overline{r}_0,$$

where

$$\overline{r}_0 \equiv \max\left\{\sigma^2 - 2\mu, \quad p_1\sigma^2 - \mu + (1 - p_1)F(\sigma^2 - \mu)(\sigma^2 - \mu)\right\}.$$

As was the case for the middle manager, the top manager m_0 is more likely to be valuable if p_0 is higher–that is, if she is more likely to be informed. Recall that in the benchmark setting with no preferences for power, a top manager is always valuable since she internalizes externalities whenever she is informed, and delegates authority to the middle manager whenever she is uninformed. But once managers are power-hungry this need not be the case. If she is not sufficiently likely to be informed, it can be optimal to bypass her and give the initial decision rights to the middle manager or the worker. Also similar to the case of middle managers, comparative statics other than p_0 are ambiguous.

Figure 4 plots the optimal hierarchy as a function of p_0 and p_1 for the case of uni-

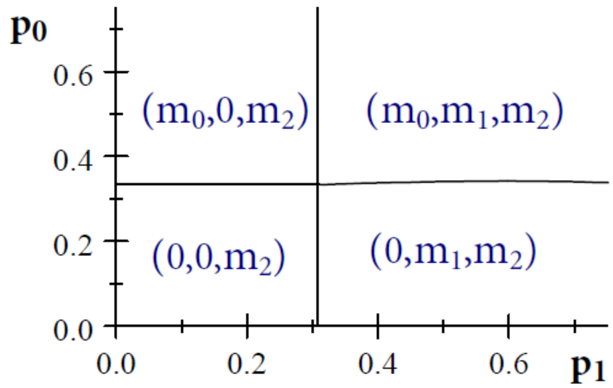

Figure 4 – Optimal hierarchy as a function of p_0 and p_1 when $\mu = 0.25$, $\sigma^2 = 1$ and $r\tilde{}U[0, R]$ with $R = 0.9$

formly distributed decision rents, $r\tilde{}U[0, R]$, when $\mu = 0.25$, $\sigma^2 = 1$ and $R = 0.9$. Appendix II provides a detailed analysis of the case of uniformly distributed decision rents.

4.3 De-integration versus de-layering

The key result of the analysis above is that "Moral hazard in Delegation" is more severe at the top of the organization: an uninformed top manager is less likely to delegate than an uninformed middle manager (Proposition 6). Since delegation by an uninformed manager is efficient (Assumption A2), this insight suggests that, as preferences for power become stronger, organizations are more likely to de-integrate (remove the top manager) than to delayer (remove the middle manager).

In what follows, we formally derive this result for the most straightforward case where the private benefits of control are deterministic and identical for all managers:

$$r_0 = r_1 = r > 0.$$

Consider the incentives of the middle manager m_1 to delegate to the worker m_2. An uninformed m_1 delegates to m_2 if and only if

$$r < \overline{r}_1 \equiv \sigma^2 - \mu.$$

Next consider the incentives of the top manager m_0 to delegate (to m_1 or m_2). We distinguish two cases:
(1) Assume first that m_1 never delegates, that is $r > \overline{r}_1$. An uninformed m_0 is then willing to delegate to m_1 if and only if

$$r < \tilde{r}_0 \equiv p_1\sigma^2 - \mu.$$

Similarly, an uninformed m_0 prefers to delegate directly to the worker m_2 (rather than make an uninformed decision) if and only if

$$r < \hat{r}_0 \equiv \sigma^2 - 2\mu.$$

Since both $\tilde{r}_0 < \overline{r}_1$ and $\hat{r}_0 < \overline{r}_1$, we conclude that if m_1 never delegates, then also m_0 never delegates.
(2) Second, assume that an uninformed m_1 always delegates, that is $r < \overline{r}_1$. An uninformed m_0 is then willing to delegate to m_1 if and only if

$$r < \overline{r}_0 \equiv p_1(\sigma^2 - \mu) + (1 - p_1)(\sigma^2 - 2\mu).$$

Note further that it is never optimal to directly delegate to the worker m_2. Indeed, m_0 prefers decisions made by an informed middle-manager over those taken by an informed worker, and an uninformed middle-manager always delegates to the worker. Formally, it is easy to verify that $\overline{r}_0 > \hat{r}_0$. The following result is now direct:

Proposition 8. *A top manager is less willing to delegate than a middle-manager: $\overline{r}_0 < \overline{r}_1$. For $r \in (\overline{r}_0, \overline{r}_1)$, an uninformed middle-manager always delegates whereas a top manager never delegate.*

We now make the following assumption:

Condition D1: *A lone manager m_0 who never delegates is dominated by a hierarchy $(0, m_1, m_2)$ where m_1 always delegates when uninformed:*

$$p_0\sigma^2 < p_1(\sigma^2 - \mu) + (1 - p_1)(\sigma^2 - 2\mu).$$

The following result holds.

Proposition 9. *Assume Condition D1 holds:*

1. *If $r < \overline{r}_0$, a three-layer hierarchy $h = (m_0, m_1, m_2)$ is optimal.*
2. *If $r \in (\overline{r}_0, \overline{r}_1)$, a two-layer hierarchy $h = (0, m_1, m_2)$ is optimal..*
3. *If $r > \overline{r}_1$, no manager ever delegates, and the initial authority is delegated to the best stand-alone manger.*

Intuitively, when $r < \overline{r}_0$ the top manager, m_0, is not "too power-hungry" and is thus willing to delegate to the middle manager, m_1. And since there is a chance that she becomes informed, the top manager, m_0, adds value to the hierarchy, regardless of p_0. When preferences for power are in an intermediate range, $r \in (\overline{r}_0, \overline{r}_1)$, a two-layer hierarchy with a middle manager and a worker is optimal since the middle manager, m_1, is willing to delegate to the worker, m_2, but the top manager will not delegate, and thus is optimally excluded from the hierarchy. Finally, when preferences for power are very large, $r > \overline{r}_1$, the middle manager, m_1, will not delegate to the worker, m_0, even if the middle manager is uninformed. In that case it is optimal to allocate the initial decision right to the whomever is the best stand-alone decision maker.

A first corollary to Proposition 9 is that even when m_0 and m_1 have equal expertise, that is $p_0 = p_1 = p$, there exists a range of decision rents r such that $h^* = (0, m_1, m_2)$ and thus $h_0^* \neq m_0$ even though m_0 is less biased than m_1. Indeed, Condition D1 then becomes

$$\mu < (1-p)(\sigma^2 - \mu)$$

which will be satisfied if μ and/or p are sufficiently small or σ^2 sufficiently large. For intermediate values of decision rents, the top manager then never delegates whereas the middle-manager and the worker cooperate effectively and yield a decision of higher expected quality than the one made by the top manager by herself. By continuity, the following corollary holds.

Corollary 1. *It is possible that $h^* = (0, m_1, m_2)$ even when $p_0 > p_1$ (and m_0 has more expertise than m_1).*

5 Multi-level hierarchies

We conclude our analysis by generalizing our insights to hierarchies with an arbitrary number of levels. To keep the analysis tractable, we assume again that decision rents are deterministic, that is $r_i = r > 0$ for all managers i.

5.1 Delegation hierarchies with multiple layers.

Our model can readily be generalized to an arbitrary number of layers, in which case each activity $s \in S$ is assigned to a hierarchy of managers

$$h(s) = (h_0(s), h_1(s), ..., h_N(s)).$$

where $h_j(s) \in M \cup \{0\}$. As before, $h_j(s) = 0$ if no manager is assigned to level i and $h_j(s) = m_j(s) \in M$ otherwise. As in our main model, each activity generates a payoff $\pi_s(\theta_s, a)$ where $a = (a_s, a_{-s})$ and θ_s is an activity-specific shock which informs the optimal choice of a_s. Each manager $m_j(s)$ observes θ_s with independent probability $p_j \in [0, 1]$ with $p_N = 1$.

When choosing a_s, a manager maximize the payoffs of the activities assigned to her. Lower-level managers (higher indices) are more specialized and, therefore, more biased. Formally, let $D_j(s) \subset S$ be the set of activities assigned to manager $m_j(s)$, then $D_j(s) \subset D_i(s)$ whenever $j > i$. We further posit that $D_0(s) = S$ whereas $D_N(s) = \{s\}$. We can think of activities being partitioned into divisions, sub-divisions and so on, with $m_j(s)$ being the manager of the level j (sub)division to which s belongs.

All managers, except for $m_N(s)$, also have the option to delegate a_s. When deciding whether or not to delegate a_s to manager $m_l(s)$ with $l > j$, manager m_j takes into account the equilibrium strategies of all other managers $m_i(s)$ with $i > j$, and behaves as if she maximizes the sum of her private benefits $r_j(s)$ and the expected payoffs of the activities $s' \in D_j(s)$ assigned to her.

5.2 Expected payoffs (N possible layers)

We now generalize the (expected) profits of the organization under different scenarios regarding who is informed and who makes the decision. Appendix I posits a quadratic "hit-the-state" payoff specification for $\pi_s(\theta_s, a)$, with $a = (a_s, a_{-s})$, which results in intuitive expressions for expected profits. Those payoffs $\pi_s(\theta_s, a)$ are such that the optimal choice for a_s only depends on θ_s and not on the action profile a_{-s}. As was the case with three hierarchical levels, we can therefore focus our analysis on one generic activity s and associated action a_s taking the action profile a_{-s} as given.

Consider first the *expected payoffs of all activities* S. Let $\Pi_{a_{-s}}(m_j)$ denote those expected *organizational payoffs* when an informed manager $m_j(s)$ chooses a_s and let $\Pi^*_{a_{-s}}$ denote the first-best expected payoffs (both for some given action profile a_{-s}). Since manager m_0 maximizes the payoffs of all activities, it follows that $\Pi_{a_{-s}}(m_0) = \Pi^*_{a_{-s}}$. When an informed manager m_j selects a_s this specification implies that

$$\Pi_{a_{-s}}(m_j) = \Pi^*_{a_{-s}} - \sum_{k=1}^{j} \mu_k,$$

where the terms $\mu_1 + ... + \mu_j$ are the payoff losses due to externalities which are not internalized by manager m_j. When an *uninformed manager* m_j selects a_s, our quadratic payoff specification results in expected organizational payoffs $\Pi_{a_{-s}}(m_j) - \sigma^2$,where σ^2 is linear in the variance of the task-specific shock θ_s.

Consider now the payoffs *of all the activities* $D_i(s) \subset S$ *assigned to manager* $m_i(s)$. Let $\Pi^i_{a_{-s}}(m_j)$ denote those *divisional payoffs* when an informed manager m_j with $j \geq i$ chooses a_s. Denoting $\Pi^i_{a_{-s}}(m_i) \equiv \Pi^{i^*}_{a_{-s}}$ our payoff specification implies that

$$\Pi^i_{a_{-s}}(m_j) = \Pi^{i^*}_{a_{-s}} - \sum_{k=i+1}^{j} \mu_k.$$

Instead, when an uninformed manager m_j chooses a_s, those payoffs equal $\Pi^i_{a_{-s}}(m_j) - \sigma^2$.

Finally, we generalize assumptions A1 and A2 from our model with three levels. First, the bias in decision-making increases linearly as we move down the organization:

Assumption A1' $\mu_i = \mu$ for $i = 1, ..., N$

Payoffs top manager/organization (informed decisions)

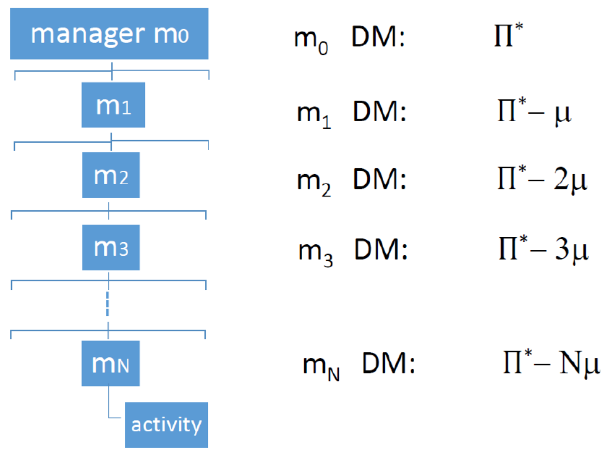

Figure 5 – Organizational payoffs as a function of whom is the decision-maker (DM). Payoffs are for informed decisions – if decisions are uninformed, deduct σ^2.

Second, when a manager is uninformed, delegation to the next layer is efficient:

Assumption A2' $p_i\sigma^2 > \mu$ for $i = 1, ..., N$

5.3 Optimal hierarchical structure (N possible layers)

We solve now for the optimal hierarchy under the restriction that all managers obtain the same deterministic private benefits of control r. Consider therefore a hierarchy

$$h(s) = (0, ..., 0, m_k, ..., m_N).$$

with $k \geq 0$, consisting of $N - (k + 1)$ consecutive levels management. Define $\tilde{r}_i$ as the threshold for r below which an uninformed manager i is willing to delegate to manager $i + 1$ provided all managers $j > i$ also delegate to manager $j + 1$ when uninformed. We now show that

$$\tilde{r}_i < \tilde{r}_{i+1}$$

so that (1) If $r < \tilde{r}_i$, all managers m_j with $j > i$ delegate when uninformed, and (2) As decision rents r increase, the manager at the top of the hierarchy, m_k, is the first to stop delegating when uninformed.

Consider first the incentives of manager $i < N-1$ to delegate to manager $i+1$. If all managers $j > i$ delegate when uninformed, then an uninformed manager i delegates if and only if $r < \tilde{r}_i$ where

$$\tilde{r}_i = p_{i+1}(\sigma^2 - \mu) + (1 - p_{i+1})(\tilde{r}_{i+1} - \mu). \tag{4}$$

Manager $N-1$, finally, delegates to manager N when uninformed if and only if

$$r < \tilde{r}_{N-1} = \sigma^2 - \mu. \tag{5}$$

Since

$$\tilde{r}_{i+1} = p_{i+2}(\sigma^2 - \mu) + (1 - p_{i+2})(\tilde{r}_{i+2} - \mu),$$

and given $p_{i+1} \leq p_{i+2}$ it follows that

$$\tilde{r}_{i+1} < \tilde{r}_{i+2} \Longrightarrow \tilde{r}_i < \tilde{r}_{i+1}.$$

Using backward induction, this implies that $\tilde{r}_0 < \tilde{r}_1 < ... < \tilde{r}_{N-1}$ since

$$\begin{aligned} \tilde{r}_{N-2} &= p_{N-1}(\sigma^2 - \mu) + (1 - p_{N-1})(\tilde{r}_{N-1} - \mu) \\ &< \tilde{r}_{N-1} = \sigma^2 - \mu \end{aligned}$$

By our definition of $\tilde{r}_i$, an uninformed manager i delegates if and only if $r < \tilde{r}_i$ provided all managers $j > i$ also delegate when informed. Given that $\tilde{r}_i < \tilde{r}_j$ for $j > i$, this is indeed the case. We conclude that manager m_i delegates to manager m_{i+1} if and only if $r < \tilde{r}_i$.[17]

The above analysis assumes that managers always delegate to the next level and that no other equilibria exist. In Appendix III, we show that skip-level delegation is never optimal with deterministic private benefits,[18] and that no other equilibria exist. We summarize as follows:

[17]Note that if $r > \tilde{r}_i$, manager i never delegates to manager $i+1$ regardless of the whether managers $j > i$ delegate when uninformed.

[18]This stands in contrast with the case where private benefits are probabilistic and skip-level delegation may be optimal.

Proposition 10. *Assume decision rents r are deterministic and identical for all agents. Given a hierarchy $h(s) = (0, .., 0, m_k, ..., m_N)$ with $k \geq 0$, there exists a unique delegation equilibrium characterized by a set of cut-off values*

$$\tilde{r}_k < \tilde{r}_{k+1} < ... < \tilde{r}_{N-1},$$

defined by (4) and (5), where for $i \geq k$, an uninformed manager m_i delegates to manager m_{i+1} if and only if $r < \tilde{r}_i$ and takes an uninformed decision if $r > \tilde{r}_i$.

Proposition 10 generalizes the insight from our previous section that moral hazard in delegation is most severe at the top of the hierarchy. This insight is especially stark with deterministic decision rents. As decision rents r increase, manager m_0 is the first to stop delegating, then manager m_1, then manager m_2 and so on.

A direct implication of Proposition 10 is that if manager $m_i \neq m_0$ is valuable than so are managers m_j with $j > i$. In other words, with deterministic decision rights, optimal hierarchies always consist of consecutive levels of management. Another implication of Proposition 10 is that top layers of management are the first to be removed as preferences for power become stronger.

The following proposition is almost a direct corollary of proposition 10:

Proposition 11. 1. *If $r < \tilde{r}_0$, then the optimal hierarchy equals $h(s) = (m_0, m_1, .., m_N)$ and all managers delegate when uninformed.*

2. *If $\tilde{r}_{k-1} < r < \tilde{r}_k$ with $k > 0$, then the optimal hierarchy is either*

   (a) *$h(s) = (m_0, m_1, .., m_N)$ in which case m_0 never delegates, or*

   (b) *$h(s) = (0, ..., 0, m_k, .., m_N)$ in which case all managers delegate when uninformed.*

In order to obtain slightly stronger result, we impose the following condition:

Condition D1': *A lone manager m_0 who never delegates is dominated by a team of managers $h(s) = (0, .., 0, m_k, .., m_N)$ who always delegate when uninformed:*

$$p_0\sigma^2 < p_k\sigma^2 - k\mu + (1 - p_k)\tilde{r}_k$$

Condition D1′ is a generalization of Condition D1 in the previous section and is always satisfied when there is '*balanced expertise*' (all managers are equally good stand-alone decision-makers).

Proposition 12. *Assume Condition D1′ holds. Then the number of hierarchical layers is decreasing in decision rents r with higher-level layers disappearing first. An increase in decision rents then always results in smaller, more disaggregated organizations.*

Proposition 12 is stated in general terms, it implies that even if manager $1, 2, ..., N-1$ all have equal expertise (e.g. all are informed with probability $p < 1$) and even though managers at the top of the hierarchy are less biased than those lower in the hierarchy, it is the managers at the top which are the first to be removed from an optimal hierarchy (as preferences for power r become stronger).

Consider, for example, the case where $h(s) = (h_1, ..., h_6)$, and all managers $i \in \{1, 2, ..., 5\}$ are equally likely to be informed except for the bottom-manager who is perfectly informed. If $p_0 = ... = p_5 = 0.6$ and the incremental pay-off loss per level is given by $\mu = \sigma^2/10$, then Condition D1′ is satisfied[19] and the optimal hierarchy as a function of decision rents r is then given by[20]

$$
\begin{array}{lll}
h^* = (m_0, m_1, m_2, m_3, m_4, m_5, m_6) & \text{if} & r < 0.762 \\
h^* = (0, m_1, m_2, m_3, m_4, m_5, m_6) & \text{if} & 0.762 < r < 0.769 \\
h^* = (0, 0, m_2, m_3, m_4, m_5, m_6) & \text{if} & 0.769 < r < 0.782 \\
h^* = (0, 0, 0, m_3, m_4, m_5, m_6) & \text{if} & 0.782 < r < 0.804 \\
h^* = (0, 0, 0, 0, m_4, m_5, m_6) & \text{if} & 0.804 < r < 0.840 \\
h^* = (0, 0, 0, 0, 0, m_5, m_6) & \text{if} & 0.840 < r < 0.9 \\
h^* = (m_0, m_1, m_2, m_3, m_4, m_5, m_6) & \text{if} & r > 0.9.
\end{array}
$$

[19] The expected value of decision made by m_0 is dominated by that of a hierarchy $h = \{m_5, m_6\}$ which delegates efficiently if and only if

$$
\begin{array}{rcl}
p_0\sigma^2 & < & p_5\sigma^2 - 5\mu + (1 - p_5)(\sigma^2 - \mu) \\
 & \Leftrightarrow & 5\mu < 0.6(1 - \mu)
\end{array}
$$

which is indeed satisfied for $\mu = 0.1$

[20] Threshold rounded to three decimals.

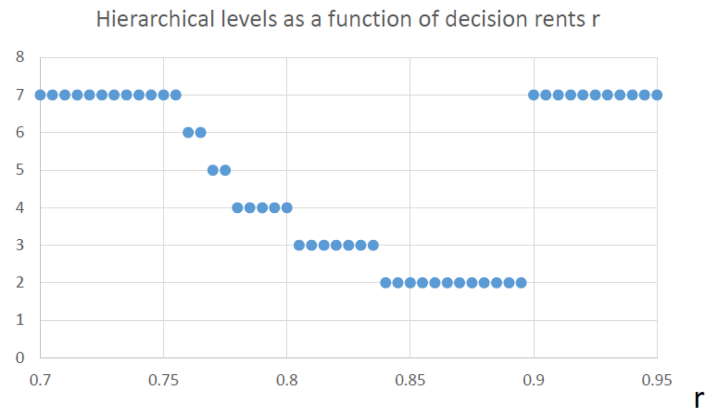

Figure 6 – Number of hierarchical levels as a function of decision rents r, when $p_0 = p_1 = \ldots = p_5 = 0.6$ and the incremental bias per level is given by $\mu = \sigma^2/10$. Top layers of management disappear first.

6 Concluding remarks

We have analyzed a model of organizational hierarchies with the novel, but realistic, ingredient that managers have preferences for making decisions themselves regardless of the decision itself. That is, they are power-hungry. Introducing this ingredient in an otherwise standard model provides a novel theory of the role and limits of middle management, as well as an intuitive response to the Williamson critique: why is integration not always value-increasing? Our model predicts optimal hierarchies to be smaller and more de-integrated in environments where preferences of power are more pronounced and top or middle managers have less information.

It is natural to think that there is heterogeneity in how power-hungry managers are across different environments. Political organizations, for-profit firms, and not for-profit firms might plausibly differ in how power-hungry their agents are. Our comparative static results shed light on some of the forces shaping the structure of these organizations. We also suggested in the introduction that developing countries may have different organizational forms, in part, due to differences in decision rents to those in developed countries.

Cultural differences, too, may be an important determinant of how much under-delegation there is in organizations. The world value survey finds a large heterogeneity

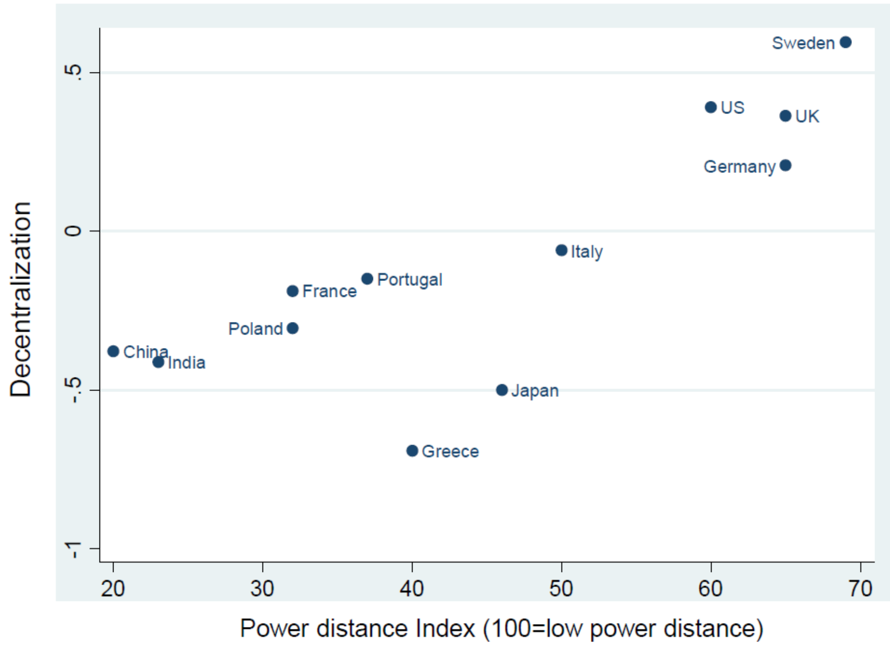

Figure 7 – Correlation between the Decentralization Index (Bloom et al. 2012) and the Power Distance Index (Hofstede 2001) is 0.8. The Decentralization Index is z-scored autonomy of plant managers in a 2006 cross-industry survey, averaged by country. The Power Distance index represents preferences over authority and delegation averaged by country, as reported by 10K IBM managers in the 1970s. The figure is reproduced from Bloom et al.

in attitudes towards authority. Similarly, in an influential management study of a large multi-national organization present in 50 countries, surveying thousands of managers, Hofstede (2001) documents large cross cultural variation in *preferences* over authority and delegation. Consistent with this premise, Bloom, Sadun and Van Reenen (2012) report startling differences in the cross-country decentralization of firms. As shown in Figure 7, those differences in actual delegation in manufacturing firms in the 2006 cross-industry survey by Bloom et al. are strongly correlated with the power-distance index by Hofstede, which measures the preferences over authority of thousands of managers in one multinational firm in the 1970s.

Our model shows that larger decision rents/stronger preferences for power affect decentralization of decision-making both directly, for a given organizational structure, and indirectly, by making smaller and more de-integrated firms optimal. An implication, therefore, is that empirical papers which study the extent of delegation must be careful when they control for organizational size and the number of managerial layers.

Given the problems that hoarding decision rights can cause, it is natural to think that organizations would seek to develop ways of discouraging such behavior. The most obvious is a direct reward for delegation.[21] But, of course, there may be more complex and subtle ones. Understanding these mechanisms may help shed light on other features of organizational design and culture. Another fascinating avenue for future research is the endogenous selection of managers into positions of power. When there is substantial (unobserved) heterogeneity among agents, one would expect the most power-hungry managers to devote most resources and effort to gain access to positions of power. Following this logic, it is likely the most power-hungry and, hence, least suitable agents who rise to the top of the hierarchy, exacerbating organizational inefficiencies.

Finally, our model speaks to a novel source of path dependence in organizations. Gibbons (2006) began a literature seeking to provide a theoretical foundation for the empirical fact that he called 'persistent performance difference among seemingly similar enterprises.' In our framework, firms can get 'stuck' with an inefficient governance structure. In our framework path dependences can stem from the fact that top managers themselves may be in control or organizational design. For instance if an organization begins with 2 layers being optimal, but then a change in the environment leads to 1 or 3 layers becoming optimal, the change will not occur because it is not in the interest of the top manager. That is, firm boundaries are path dependent. A top manager may resist both the break-up of the firm she leads as well as the take-over by another firm.

Of course, if an organizational designer realizes that the environment is subject to shocks, then they will account for this ex ante. This suggest to us that the dynamics of governance structures in settings where delegation decisions are not contractible is an interesting avenue for future work.

[21] Unless decision rents are deterministic, however, subsidizing delegation decisions provides only a partial solution and will unavoidbly result in both over- and under-delegation in equilibrium.

Appendix I: Micro-foundation of payoff structure

In this paper, we have considered an organization who is engaged in a set of activities $s \in S$. Each activity s is associated with an action choice $a_s \in A$ and generates a payoff $\pi_s(\theta_s, a)$ where $a = (a_s, a_{-s})$ is the organization's action profile and θ_s is an i.i.d. activity-specific shock with variance σ_θ^2. Each activity s is assigned to a hierarchy of managers $h(s) = (h_0(s), ..., h_N(s))$ where $h_i(s) \in M \cup \{0\}$. We denote $h_i(s) = 0$ if no manager is assigned to level i and $h_i(s) = m_i(s) \in M$ otherwise.

In this Appendix, we provide micro-foundations for the expected organizational payoffs $\Pi_{a_{-s}}(m_j)$ when $m_j = m_j(s)$ chooses a_s given some exogenously specified action profile a_{-s}. In our model section, we posited that

$$\Pi_{a-s}(m_j) = \Pi^*_{a-s} - \sum_{t \in \{1,...,j\}} \mu_t,$$

where $\Pi^*_{a-s} = \Pi_{a-s}(m_0)$ are the first-best expected payoffs given some a_{-s} and where $\mu_1, ..., \mu_N$ characterize the externalities between the activities. If an uninformed manager m_j chooses a_s, we posited that expected profits are given by $\Pi_{a-s}(m_j) - \sigma^2$, where σ^2 is linear in σ_θ^2. Note that in order to simplify the analysis and focus on the natural case where the agency conflict grows linearly as we move down the hierarchy, the model in the main text assumes that $\mu_1 = ... = \mu_N \equiv \mu$.

Three hierarchical levels To illustrate the payoff structure, consider first a three-level hierarchy with four activities, $S = \{1, 2, 3, 4\}$, one top manager, two middle managers and four workers. Activities 1 and 2 share the same middle manager $m_1(1) = m_1(2)$, and activities 3 and 4 share the same middle manager $m_1(3) = m_1(4)$. Each activity $s \in S$ is associated with a multi-dimensional action $a_s = (a_{s,0}, a_{s,1}, a_{s,2})$ who must be responsive to the activity-specific shock θ_s, but also take into account externalities μ_2 on the activity belonging to the same division (with the same middle manager) and externalities μ_1 on the activities belonging to the other division (assigned to the other middle manager).

Concretely, organizational payoffs are given by

$$\sum_{s=1,2,3,4}\left[\sum_{j=0,1,2}(\theta_s a_{s,j}-\frac{1}{2}a_{s,j}^2)-\sqrt{\mu_1}a_{s,j}-\sqrt{\mu_2}a_{s,2}\right],$$

so that first-best actions are given by

$$a_s^*\equiv(a_{s,0}^*,a_{s,1}^*,a_{s,2}^*)=(\theta_s,\theta_s-\sqrt{\mu_1},\theta_s-\sqrt{\mu_2}).$$

The payoffs of each individual activity s, however, are such that the middle manager $m_1(s)$ chooses a_s as if $\mu_1=0$ whereas the worker $m_2(s)$ chooses a_s as if $\mu_1=\mu_2=0$. In particular, let activities s and s' belong to one division (have the same middle manager $m_1(s)=m_1(s')$) and let activities $t\in S$ and $t'\in S$ belong to the other division, then we posit that

$$\pi_s\equiv\pi(\theta_s,a)=\sum_{j=0,1,2}(\theta_s a_{s,j}-\frac{1}{2}a_{s,j}^2)-\frac{1}{2}\sqrt{\mu_1}\left(a_{t,2}+a_{t',2}\right)-\sqrt{\mu_2}a_{s',1}$$

and

$$\pi_{s'}\equiv\pi(\theta_{s'},a)=\sum_{j=0,1,2}(\theta_s a_{s',j}-\frac{1}{2}a_{s',j}^2)-\frac{1}{2}\sqrt{\mu_1}\left(a_{t,2}+a_{t',2}\right)-\sqrt{\mu_2}a_{s,1}$$

so that an informed middle manager $m_1(s)$ would choose

$$(a_{s,0},a_{s,1},a_{s,2})=(\theta_s,\theta_s,\theta_s-\sqrt{\mu_2})\neq a_s^*,$$

whereas an informed worker $m_2(s)$ would choose

$$(a_{s,0},a_{s,1},a_{s,2})=(\theta_s,\theta_s,\theta_s)\neq a_s^*.$$

Since worker $m_2(s)$ maximizes π_s, she ignores both μ_1 and μ_2 when choosing a_s. Since middle manager $m_1(s)$ maximizes $\pi_s+\pi_{s'}$, she ignores μ_1 when choosing a_s and $a_{s'}$.

It is now straightforward to verify that if an informed middle manager $m_1(s)$ chooses $a_s=(a_{s,1},a_{s,2},a_{s,3})$, then this results in a payoff loss of μ_1 relative to first-best profits. Similarly, one can verify that delegating control over a_s to an informed worker $m_2(s)$ results in a payoff loss of $\mu_1+\mu_2$ relative to first-best firm profits. Finally, from the perspective of an informed middle manager $m_1(s)$, who maximizes $\pi_s + \pi_k$, delegating a_s to an informed worker $m_2(s)$ reduces divisional profits $\pi_s + \pi_k$ by μ_2.

Whenever an uninformed manager $m_j(s)$ chooses a_s rather than an informed manager $m_j(s)$, then given the quadratic payoff specification, expected (firm or divisional) payoffs are reduced by $\sigma^2 \equiv 3\sigma_\theta^2$, where σ_θ^2 is the variance of θ_s.

N hierarchical layers The simple case above is readily extended to any number of organizational layers and managers. In an $(N+1)-$level organization, each activity $s \in S$ is associated with an $(N+1)$-dimensional action $a_s = (a_{s,0}, ..., a_{s,N})$ and assigned (up) to $N+1$ managers $m_j(s)$ with $j \in \{0, 1, ..., N\}$. We denote by $D_j(s) \subset S$ the sub-set of all activities which share the same level-j manager as s and hence belong to the same level$-j$ division. By assumption, $D_0(s) = S$ as all activities share the same top manager m_0 and $D_N(s) = \{s\}$ as the lowest level manager assigned only one activity.

Organizational profits are given by[22]

$$\sum_{s \in S} \left\{ \theta_s \cdot I \cdot a_s - \tfrac{1}{2} a_s \cdot a_s - \boldsymbol{\mu} \cdot a_s \right\}, \tag{6}$$

where $I = (1, 1, .., 1)$ and $\boldsymbol{\mu} = (\sqrt{\mu_0}, \sqrt{\mu_1}, ..., \sqrt{\mu_N})$with $\mu_0 = 0$. It is easy to verify that the first-best action $a_s^* = (a_{s,0}^*, ..., a_{s,N}^*)$ is characterized by $a_{s,j}^* = \theta_s - \mu_j$. The payoffs of each individual activity s, however, are such that manager $m_j(s)$ chooses a_s as if $\mu_k = 0$ for $k \leq j$. Concretely, the payoffs associated with each individual activity are given by

$$\pi_s(\theta_s, a) = \theta_s \cdot I \cdot a_s - \tfrac{1}{2} a_s \cdot a_s - \sum_{j=1}^{N} \left(\tfrac{1}{|D_{j-1}(s)| - |D_j(s)|} \sum_{t \in D_{j-1}(s) \setminus D_j(s)} \sqrt{\mu_j} a_{t,j} \right). \tag{7}$$

In expressions (6) and (7), the term $\mu_j a_{t,j}$ is the aggregate externality imposed by activity t on all activities s that belong to the same level$-j$ division as t but not the same level$-(j+1)$ division. It follows that total payoffs are still given by (6), but manager $m_j(s)$ chooses $a_{s,k} = \theta_s$ for $k \leq j$, and $a_{s,k} = \theta_s - \sqrt{\mu_j}$ for $k > j$.

The above payoff structure results in a tractable loss of control which increases linearly as decision-making moves down the hierarchy. In particular, if a_s is delegated to

[22] To simplify notation, we drop the transponent in all vector expressions.

an informed manager $m_j(s)$ then, fixing a_{-s}, expected profits equal

$$\Pi_{a_{-s}}(m_j) = \Pi^*_{a_{-s}} - \sum_{0 \le k \le j} \mu_k,$$

where $\Pi^*_{a_{-s}}$ are first-best profits given action profile a_{-s}. If an uninformed manager $m_j(s)$ chooses a_s then because of the quadratic payoff structure, this results in a expected payoff equal to $\Pi_{a_{-s}}(m_j) - \sigma^2$, where $\sigma^2 \equiv N\sigma_\theta^2$.

Appendix II: Uniformly distributed decision rents

Consider the case where r_1 and r_2 are uniformly distributed on $[0, R]$ with $R < \sigma^2 = 1$. The top manager delegates when uninformed if and only if $r_0 \le \overline{r}_0$ where

$$\begin{array}{ll} \overline{r}_0 = 1 - 2\mu & \text{if } p_1 \le \overline{p}_1 \text{ (and } h_1^* = 0) \\ \overline{r}_0 = p_1 - \mu + (1-p_1)(1-\mu)^2/R & \text{if } p_1 \ge \overline{p}_1 > 0 \text{ (and } h_1^* = m_1 \in M) \\ \overline{r}_0 = 1 - (2-p_1)\mu & \text{if } R \le 1 - \mu \text{ (and } \overline{p}_1 = 0) \end{array}$$

We distinguish two cases:

(1) If $R < 1-(2-p_1)\mu$ both the top manager and the middle manager always delegate when uninformed, $F(\overline{r}_0) = F(\overline{r}_1) = 1$, so that

$$h^* = (m_0, m_1, m_2).$$

(2) In contrast, if $R > 1 - (2-p_1)\mu$, we have that $F(\overline{r}_0) < 1$ and

$$h_0^* \in M \Longleftrightarrow p_0 \ge \overline{p}_0 \equiv \overline{r}_0 \frac{R - \overline{r}_0}{R - \overline{r}_0^2}. \tag{8}$$

Note that when $1 - (2-p_1)\mu < R < 1 - \mu$, the middle manager always delegates when uninformed, $F(\overline{r}_1) = 1$, whereas the top manager hoards decision rights with positive probability, $F(\overline{r}_0) < 1$.

Comparative statics other than p_0 are ambiguous. Figure 8 and Figure 9 illustrate the non-monotonic comparative statics with respect to μ when p_1 is such that $h_1^* = m_1 \in M$.

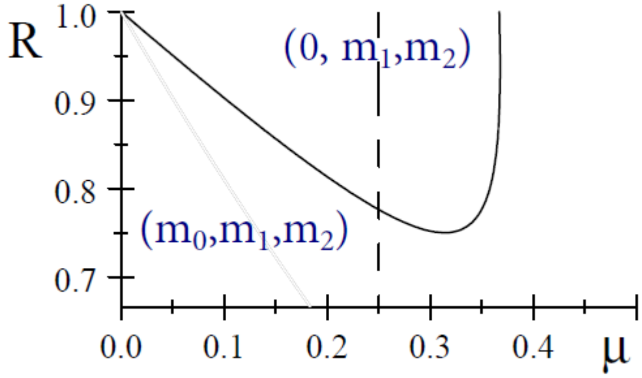

Figure 8 – Optimal hierachies as function of R and μ when $p_1 = 1/2$ and $p_0 = 1/4$. To the right of the dotted line, m_0 is a better stand-alone decision-maker than m_1 yet $(0, m_1, m_2)$ is often the optimal hierarchy.

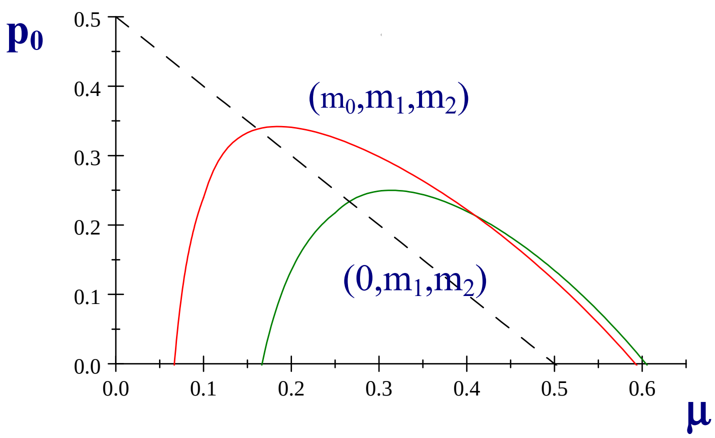

Figure 9 – Assume r_i ˜ $U[0, R]$ and $\sigma^2 = 1$, then $h_0^* = m_0 \in M \Leftrightarrow p_0 > \overline{p}_0$ as given by Propostion 7. Figure 9 plots $\overline{p}_0$ as a function of μ when $p_1 = 1/2$, and this for $R = 0.9$ (red curve), and $R = 0.75$ (green curve). $h^* = (m_0, m_1, m_2)$ above the curve $\overline{p}_0$, whereas $h^* = (0, m_1, m_2)$ below the curve. m_0 is a better stand-alone decision-maker than m_1 above the dashed black line, but there is still an area for which $h_0^* \neq m_0$.

The top-manager is least likely to be valuable for intermediate values of μ. Note that, unlike in standard delegation models (see, for example, Alonso et al. 2008) for p_1 small, an initial increase in externalities between activities, a characterized by an increase in μ, results in a shift towards decentralization.

Beyond the impact of μ and σ^2, also an increase in p_1- the presence of a more informed middle manager – has an ambiguous impact on whether the top manager is valuable. A more informed m_1 increases both the the value $\overline{r}_0$ of delegating the initial decision right to m_1 and the probability $F(\overline{r}_0)$ with which an uninformed top manager m_0 will be delegating herself to m_1. This is also illustrated in Figure 9.

Appendix III: Omitted proofs

Proposition 10 *Assume decision rents r are deterministic and identical for all agents. Given a hierarchy $h(s) = (0, ..., 0, m_k, ..., m_N)$ with $k \geq 0$, there exists a unique delegation equilibrium characterized by a set of cut-off values $\overline{r}_k < \overline{r}_{k+1} < ... < \overline{r}_{N-1}$ where an uninformed manager $m_i(s)$ delegates to manager $m_{i+1}(s)$ if and only if $r < \overline{r}_i$.*

Proof: Consider equilibria where manager m_i chooses $a(s)$ or delegates to manager m_{i+1}. We will later verify that a manager m_i never has an incentive to delegate to manager m_{i+k} with $k \geq 2$.

Note first that fixing r, every manager m_i has a unique value of delegation $\overline{r}_i(r)$ where she delegates if and only if $r < \overline{r}_i(r)$. There are no multiple equilibria. To see this, note that for manager m_i the value of delegation only depends on the delegation thresholds $\overline{r}_j(r)$ of the managers $j > i$. Moreover, manager m_{N-1} has a unique value of delegation $\overline{r}_{N-1}(r) = \overline{r}_{N-1}$ as her delegation decision is independent of the delegation decisions of any other manager. But this implies that, fixing r, there manager m_{N-2} also has unique delegation threshold $\overline{r}_{N-2}(r)$. By backward induction, the same is true for manager m_{N-3} and so on. We conclude that for each r, there exists a unique vector $(\overline{r}_k(r), \overline{r}_{k+1}(r), ..., \overline{r}_{N-1})$ such that manager $m_i(s)$ delegates to manager $m_{i+1}(s)$ if and only if $r < \overline{r}_i(r)$.[23]

[23]The same argument applies if manager m_i can delegate to any manager $j > i$.

Let us now define $\tilde{r}_i$ as manager m_i's delegation cut-off for r provided that all managers $j > i$ delegate when uninformed. Since such delegation is efficient (Assumption A1-G), it must be that $\overline{r}_i(r) \leq \tilde{r}_i$ and

$$\overline{r}_i(r) = \tilde{r}_i \Leftrightarrow r \leq \tilde{r}_j \text{ for all } j > i.$$

It follows that if

$$\tilde{r}_0 < \tilde{r}_1 < ... < \tilde{r}_{N-1}, \tag{9}$$

then $\overline{r}_i(r) = \tilde{r}_i$ if $r < \tilde{r}_i$ and $\overline{r}_i(r) \leq \tilde{r}_i$ if $r > \tilde{r}_i$. Hence, if (9) holds, every manager $m_i(s)$ delegates when uninformed if and only if

$$r < \overline{r}_i = \tilde{r}_i.$$

In order to prove Proposition 10, we thus only need to show that (9) holds.

At the bottom of the hierarchy, an uninformed m_{N-1} delegates to m_N if and only if

$$r < \tilde{r}_{N-1} = \sigma^2 - \mu.$$

One level up, provided m_{N-1} delegates when uninformed, an uninformed m_{N-2} delegates to m_{N-1} if and only if $r < \tilde{r}_{N-2}$ where

$$\begin{aligned} \tilde{r}_{N-2} &= p_{N-1}(\sigma^2 - \mu) + (1 - p_{N-1})(\sigma^2 - 2\mu) \\ &= p_{N-1}(\sigma^2 - \mu) + (1 - p_{N-1})(\tilde{r}_{N-2} - \mu). \end{aligned}$$

More generally, provided all managers $j \geq i$ delegate when uninformed, an uninformed m_{i-1} delegates to m_i if and only if $r < \tilde{r}_{i-i}$ where

$$\tilde{r}_{i-1} = p_i(\sigma^2 - \mu) + (1 - p_i)(\tilde{r}_i - \mu).$$

Since

$$\tilde{r}_i = p_{i+1}(\sigma^2 - \mu) + (1 - p_{i+1})(\tilde{r}_{i+1} - \mu),$$

and since $p_i \leq p_{i+1}$, it follows that $\overline{r}_i < \overline{r}_{i+1} \Longrightarrow \tilde{r}_{i-1} < \overline{r}_i$. As one can easily verify that

$\tilde{r}_{N-2} < \tilde{r}_{N-1}$, we obtain (9):

$$\tilde{r}_0 < \tilde{r}_1 < ... < \tilde{r}_{N-1}.$$

To conclude we verify that given (9), manager m_i strictly prefers to delegate to manager m_{i+1} rather than to any manager m_{i+k} with $k \geq 2$ whenever $r \leq \tilde{r}_i$. Consider the trade-off between delegating to manager m_{i+1} versus manager m_{i+2} (the argument is easily extended to any manager m_{i+k}). If informed, manager m_{i+1} will choose a better action than manager m_{i+2} (i.e. an action yielding a higher pay-off to m_i). If uninformed, manager m_{i+1} will delegate to manager m_{i+2} given that $r \leq \tilde{r}_i < \tilde{r}_{i+1}$. It follows that manager m_i never gains, and sometimes loses by directly delegating to manager m_{i+2}. Skip-level delegation is never optimal. QED

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