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Resumen ejecutivo

Este trabajo estudia la literatura de toma de decisiones en ambientes con información asimétrica y sin transferencias monetarias. Quien debe tomar la decisión, llamado el principal, carece de información relevante acerca de los efectos de la decisión a tomar. Otro jugador, mejor informado pero cuyos intereses divergen de aquellos del principal, llamado el agente, puede enviar mensajes al principal para así influir en la decisión.

Dependiendo del tipo de compromiso que el principal puede hacer, la transmisión de información del agente al principal y el resultado del juego puede variar. Cuatro tipos de juegos se estudian en este trabajo.

En el juego de comunicación, el principal es incapaz de comprometerse a una decisión antes de recibir el mensaje del agente, por lo que siempre tomará la decisión que más se ajusta a sus intereses. El principal mantiene el control sobre la decisión, pero la transmisión de información es difusa. En el juego de delegación completa, el principal puede delegar al agente el derecho a decidir. El agente tomará entonces la mejor decisión para él. En este caso, la decisión es eficiente y la información es utilizada en su totalidad, pero conllevará con seguridad una pérdida para el principal. En el tercer tipo, el principal delega la decisión, pero tiene el derecho de vetarla y de volver a la situación de *status quo*. Esta situación permite al principal mantener un grado de control, pero la posibilidad de veto introduce ruido en la transmisión de información. En el cuarto tipo, el principal puede comprometerse a una regla de decisión, desde el espacio de mensajes del agente al espacio de decisiones. Esto es equivalente a delegar la decisión al agente, habiendo restringido *ex-ante* las decisiones disponibles.

Estos cuatro casos son analizados en un modelo simple. Si el principal es capaz de comprometerse, como en el cuarto caso, esto siempre es óptimo. Si no, su preferencia entre los tres casos restantes depende del *status quo* y del nivel de discrepancia con el agente. El derecho a veto es útil sólo si el *status quo* es cercano a la preferencia del agente. El principal prefiere mecanismos donde hay más compromiso.

Adicionalmente, el equilibrio del caso en que el principal mantiene el derecho a veto pero puede limitar *ex-ante* la decisión del agente es caracterizado. El principal restringe más en equilibrio la decisión del agente que cuando no tiene derecho a veto. Este mecanismo es mejor para el principal que comunicación pura y es preferido a delegación completa si el *status quo* es cercano a la decisión promedio preferida por el agente.

Abstract

In this dissertation, I review the literature in decision making with asymmetric information and no monetary transfers. An uninformed decision maker, or principal, is uncertain about the effects of the decision she will make. A better informed, but biased, player, the agent, can send messages to the principal in order to influence her decision.

Depending on the type of commitment the principal is able to make, the transmission of information from the agent to the principal and the outcome of the game will vary. I study four different types of game.

In the first type, called communication game, the principal is not able to make any sort of commitment, and will always take the decision that is better for her given the message received. In this setting, the principal retains control, but the information transmission is the noisiest and the outcome the least efficient. In the second type, or full delegation, the principal can delegate the decision rights to the agent, who will then take his preferred decision. In this game, the decision taken is efficient and all the available information is used, but it will cost the principal for certain. In the third type, the principal delegates, but the decision taken by the agent can be overruled and a status quo policy chosen. This setting allows the principal to retain some control, but noise will be introduced by the possibility of a veto. In the fourth type, the principal can fully commit to a rule from report by the agents to decisions. This is equivalent to let the agent make the decision but to restrict the set of available decision ex-ante, by setting an upper bound.

These four cases are analyzed under a tractable and simple model. If the principal is able to commit to the fourth type, it will always be optimal to do so. If not, the preferences over the other three types depends on the status quo policy and on the size of the conflict of interest. Keeping veto right is useful only if the status quo is aligned with the agent's preferences. The principal will prefer mechanisms with higher levels of commitment, and will delegate more to a less biased agent.

Additionally, the case where the principal keeps veto rights but can restrict the set of proposals. The set of decisions that the agent is allowed to propose is more limited than if the principal had no veto right. This type of mechanism always yields higher expected payoff than pure communication and is preferred to full delegation if the status quo policy is sufficiently aligned with the agent's interests.

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I Introduction

Asymmetries of information are widespread within most organizations. For instance, a manager of a particular branch of a company will surely be more knowledgeable in the matters concerning this branch than the CEO of the company could be. Likewise, a monopolist will know more about its costs or sales than the regulating authorities, and an interested party will possess information that could help legislators. Information sharing, however is often limited by conflicts of interest. A branch manager could have short-term objectives that conflict with the general welfare of the firm, a monopolist will typically want to cut down production and increase margins and the interested party, or lobbyist, will want to hide information in order to benefit from the legislative design.

This asymmetry of information has been addressed by several authors. Two opposing, though non conflicting paradigms have dominated the literature in the last decades. On the one hand, the Mechanis Design paradigm assumes that the uninformed party, called the principal, has full commitment power in order to contract the decision making on the information the informed party, or agent, will provide. This way, even if the outcome will be suboptimal from the principal's perspective when compared to a full information setting, there will often be full transmission of information, or a fully separating Perfect Bayesian Equilibrium. A fundamental tool for the Principal in this case is that she can contract monetary transfers as well as a decision rule. This allows the principal to compensate the agent for the information provided. Take the case of a regulated monopolist with private information about its production cost as an example. The regulator has to set the price (or quantity, which is equivalent when the demand function is known) at which the monopolist will be allowed to sell. The regulator would like to set the price equal to the firm's marginal cost, but the firm would like a higher price. If the firm truthfully reveals its marginal cost and the principal has made no commitment to a price setting mechanism, the price set will be the marginal cost and the firm will have no utility. Therefore, if the regulator was taking the firm's revelation as truthful, the firm would lie in order to be able to sell at a higher price. However, as the regulator knows this, there can be no such equilibrium.

There are, however, mappings from costs to prices and transfers that can restore efficiency. For instance, if the regulator has committed set the price equal to marginal cost and transfers such that the firm always obtains the same utility as if it were setting the price with no regulation, then the outcome is efficient. However, the transfers can be too high and make this unoptimal for the principal. An intermediate solution is to find the optimal mechanism (a mechanism is here defined as a mapping from costs to prices and transfers) such that the firm always finds it optimal to reveal its true type.

In this case the price set will be greater than marginal cost but lower than when the firm would set it on its own, and the firm is left with positive surplus

On the other hand, the Cheap Talk (or communication) literature studies the situation where the principal, in this paradigm called the receiver, has no commitment power and will always, after receiving a report from the agent (or sender), take the decision that maximizes her own utility given her posterior beliefs. In the case of the monopolist and the regulator described above, this would imply that after any report from the firm, the regulator will set a price equal to the expected marginal cost (equal to the marginal cost if the receiver is sure of the cost after the report), and will give no monetary transfer to the firm. As argued above, this will make full information sharing impossible, and monetary transfers unimplementable, whenever there is a conflict between the sender and the receiver. There is, however, a way in which information transmission is possible. As Crawford and Sobel (1982) showed, the sender and the receiver can agree on a partition of the cost space (in this case the partition is a set of intervals) such that it is optimal for the sender to reveal in which of the intervals the true cost is, knowing that the receiver will make her decision optimally once her beliefs have been updated. How fine this partition can be will depend on how apart the sender's and the receiver's preferences are, which intuitively means that the more agreement there is on the preferred outcome, the more information transmission is possible. In the regulated monopolist example, one of these equilibria would be a threshold below which the firm is considered efficient and above which the firm is considered inefficient. The regulator will set a different price for a different type of firm (now a "type" is understood as the interval in which the cost is), that will be set by maximizing the social surplus conditional on the information received, and the firm will find it in its own interest to truthfully reveal its type.

A third, much less studied, paradigm is that of delegation. Delegation models assume an intermediate level of commitment power. The principal is in this case unable to commit to a full mapping from types to outcomes, but can credibly commit to delegate decision power to the agent while imposing some restrictions. This way, the agent will take the decision by himself, but within the boundaries imposed by the principal. Delegation models are attractive mainly for two reasons. First, delegation is often observed in practice. Indeed, within an organization, often the principal delegates some of the decisions to better informed agents. The second reason, which may also explain the first, is that delegation is often much simpler to implement and better for the principal than setting up a complicated mechanism or than simply communicating with the agent.

Obviously, any outcome of the delegation and of the communication game is feasi-

ble under the Mechanism Design paradigm where the principal has full commitment. Therefore, whenever the principal has enough commitment power to use this paradigm, it will be preferred. However, the ranking from the principal's perspective between delegation and communication will depend on the specification of each model and on the type of delegation to which the principal can credibly commit. Indeed, if the principal can commit at no cost to any type and structure of delegation set, then any outcome of the communication game can be obtained by delegation and thus delegation is trivially preferred. Nevertheless, the fact that delegation models' main assumption is the limit on commitment power, implies that different assumptions, that will lead to different delegation structures, must be analyzed.

In this dissertation, several models of delegation will be reviewed and compared to one another and to the available benchmarks. These models include optimal delegation, full delegation and veto-power delegation. Additionally, optimal interval delegation with veto power is presented. This setting assumes that the principal can choose how to delegate, but cannot credibly commit to give up her veto rights. This type of delegation has not been studied in the literature and is given here as a natural extension to the other delegation models analyzed.

For any delegation structure that is available for the principal, the choice between delegation and communication is mainly based on the tradeoff between information and control. When delegation is used, the agent will truthfully reveal his type for a non-zero measure set of types, something that is not always true for communication games. However, by choosing delegation, the principal gives away authority on the decision making, which can be more costly than the gain on information and decision-making efficiency.

When the principal will choose delegation is a non-trivial issue. We see, both in theory and in practice, delegation and communication used in different situations. Understanding when and why communication is preferred to delegation, and viceversa, is the main goal of this dissertation. For this, the literature on both types of models, and the literature that compares them will be reviewed and completed, by using the most tractable model, that has been used as the leading example in the literature.

This dissertation is organized as follows. In the next section, the basic model will be introduced and the basic result for communication games will be stated. This will show that even if the decision maker has no commitment power whatsoever, transmission of information can take place. In section III, however, we will see that even if communication is possible, it will not always be optimal. This is done so by introducing and studying the different models of delegation, and by comparing the results to

the outcome of the communication game. In section IV, the solution to the optimal delegation problem with veto power is characterized, taking the results in section III as a basis. Finally, section V concludes, establishing when and why each mechanism is preferred.

II The Basic Model

In this section, the basic model will be introduced, along with the benchmark communication solution. It is worth mentioning that many of the articles reviewed in this dissertation use more general models than the one presented here, though all of them use it extensively in their leading examples. This review will use the basic model in order to obtain comparable results and for tractability's sake.

The game consists of two players. The uninformed player will be undistinctively called the principal or the receiver (terms more common in the delegation and communication literature, respectively) and will be named by feminine pronouns. The informed player will be called the agent or the sender and denoted by masculine pronouns.

The principal has to make a decision over a variable $y \in \mathfrak{R}$. The utility that the players obtain from this decision is influenced in an additive way by $\theta \in [0, 1]$, which is known only to the agent. The way that θ acts over the players' utility is explained in the political science literature as the actions and the outcomes being distinct; the actual outcome that will be realized after a political decision has been taken is known to the agent but not to the principal. Thus, the outcome $x \in \mathfrak{R}$ is given by

$$x = y - \theta.$$

Preferences are assumed to be quadratic loss functions. The principal's preferred outcome is set without loss of generality equal to zero, and the agent's preferred outcome, called the "bias" is given by $b > 0$. The utility functions can therefore be written as:

$$U^P(y, \theta) = -(y - \theta)^2$$

and

$$U^A(y, \theta, b) = -(y - \theta - b)^2.$$

The private information parameter θ is obtained from a random variable with cumulative distribution function F and density function f . In most of this dissertation, this

random variable will be assumed to be uniformly distributed.

The communication game was first solved by Crawford and Sobel (1982). The timing of the communication game is as follows:

1. Nature draws θ from the given distribution.
2. The agent learns the parameter θ .
3. He sends a message to the principal.
4. The principal updates her beliefs and makes a decision.
5. Payoffs are realized.

What is relevant about the signal is that it is costless for the agent, which means that he will bear no external cost whatsoever for any signal he sends (he may however, affect the outcome and thus bear an endogenous cost). This is in sharp contrast with signaling models previous to the mentioned article, where communication between the receiver and the sender was done through costly signaling (see, for instance, Spence's [1973] education model). In this model, the agent can send any signal he desires, from a completely uninformative one ("I will not reveal the value of θ ") to a fully informative one ("the value of θ is equal to $1/2$ "). At the same time, the beliefs, defined as a mapping from the message space to the set of distribution over θ 's support, that the principal will form after receiving the signal will give the relevance of the signal: there is always an equilibrium under which the principal ignores any signal received. In equilibrium, the sender can correctly predict what the beliefs of the receiver will be after having gotten the signal.

A strategy for the agent is a mapping function m from $[0, 1]$ to the message space. A strategy for the principal consists on a mapping \bar{y} from the message space to the real numbers. An equilibrium (more specifically, a Bayesian Nash equilibrium) is given by a message space, a strategy for each player and a belief system such that: the principal's strategy is optimal given the belief system; the agent's strategy is optimal given the principal's strategy; and the belief system is consistent with the agent's strategy.

As argued in the introduction, it is easy to see that no fully revealing equilibrium can exist for any value of the bias. Indeed, if there was a belief system such that the principal is fully informed after having received the signal, the receiver will take a

decision such that the outcome is equal to her preferred point, and the agent will have an incentive to misreport θ in order to shift the outcome towards his own preferred point.

Crawford and Sobel show that any equilibrium of the game is a *partition equilibrium*, in which θ 's support is divided into intervals such that the message of the agent consists on truthfully revealing in which interval the parameter is situated and the principal takes the optimal action given that he knows the message to be truthful. Formally an *N-partition equilibrium* is given by:

1. A set of boundaries $\{a_i\}_{i=0}^N$ with $a_0 = 0$, $a_N = 1$ and $a_i < a_j$ whenever $i < j$.
2. A strategy by the agent consisting on sending a message $m(\theta) = n$ if $\theta \in [a_{n-1}, a_n)$.
3. A belief system given by a cumulative distribution function $\tilde{F}(\cdot|n)$ such that $\tilde{F}(\theta|n) = F(\theta|\theta \in [a_{n-1}, a_n))$
4. A strategy by the principal satisfying $\bar{y}(m) = \arg \max_y E[U^P(y, \theta)|\theta \in [a_{n-1}, a_n)]$

If the private information parameter is uniformly distributed, the optimal action by the principal will be to take a decision in the center of the interval in which the parameter is situated. The condition that the agent's strategy must be optimal allows to characterize the boundaries (when θ is equal to a boundary a_i , the agent must be indifferent between sending the signal i and the signal $i + 1$, due to continuity of the agent's utility function):

$$a_i = a_1 i + 2i(i - 1)b$$

with

$$a_1 = (1 - 2N(N - 1)b) / N.$$

This last result also gives the feasible number of intervals that the support can be divided in. Indeed, one must have $a_1 \leq 1$, which is automatically satisfied for $N = 1$ and for $N > 1$ such that

$$N \leq -\frac{1}{2} + \frac{1}{2} \left(1 + \frac{2}{b}\right)^{\frac{1}{2}}.$$

Crawford and Sobel prove that, for any given value of the bias, it is Pareto improving to have more intervals in a partition. It is assumed that the players coordinate in the

most informative equilibrium, that is the one with the greatest possible number of partitions. The greatest number of partitions for a given bias, that is, the largest integer that satisfies the condition above, is denoted $N(b)$. Given that $N(b)$ is non-increasing, a natural corollary of this is that the closer the preferences of the agent are to those of the principal, the more information will be revealed. This, along with the fact that transmission of information may actually take place when talk is cheap, are their main results.

The ex-ante expected utility for the principal will be a useful benchmark in the next section. It can be shown that it is equal to the negative expected residual variance, this is the variance that the receiver expects to have on the parameter after having received the equilibrium signal. The value in this case is (*CT* meaning ‘‘Cheap Talk’’):

$$EU^P(CT) = -\frac{1}{12N^2} - \frac{b^2(N^2 - 1)}{3}.$$

III Delegation Models

We understand by delegation, a mechanism in which the decision is made by the agent, within the constraints set by the principal in advance. If the agent’s preferred action is within the ones allowed, which I will call the Delegation Set, then that action is implemented. The delegation problem can be stated as:

$$\max_{y(\cdot) \in \mathfrak{R}, D \in \mathcal{D}} \int_0^1 U^P(y(\theta), \theta) dF(\theta)$$

subject to

$$y(\theta) \in \arg \max_{y \in D} U^A(y, \theta, b),$$

where \mathcal{D} is a set of subsets of the real numbers, which varies according to the type of delegation studied.

When a principal delegates a decision to an agent, she is actually agreeing to a contract (explicitly or implicitly). Thus, the type of delegation that the principal will set will depend on her commitment power. Several models of delegation, that vary mainly on the kind of commitment that the principal is able to make, will be reviewed in this section, though the main focus will be on the three types most used in the literature: optimal delegation, full delegation and full delegation with veto right (also called closed rule delegation), and on the more tractable case of the private information being uniformly distributed in the interval $[0, 1]$.

III.1 Optimal delegation

In the Optimal Delegation problem, the principal can choose any set of decisions as the delegation set. This problem was first studied by Holmstrom (1984). Later, Melumad and Shibano (1991) formalized the notion already present in Holmstrom's work that delegation is actually the optimal mechanism when transfers are not available. To see this, let us state the decision making problem not as a delegation problem, but as a Mechanism Design one, where the principal commits to a mapping from states of the world to decisions, and transfers are not allowed. Now, the principal maximizes her utility subject to the agent's incentive compatibility constraint (participation constraints are ignored), so the problem becomes:

$$\max_{y(\theta)} \int_0^1 U^P(y(\theta), \theta) dF(\theta)$$

subject to

$$U^A(y(\theta), \theta, b) \geq U^A(y(\hat{\theta}), \theta, b) \quad \forall \theta, \hat{\theta} \in [0, 1].$$

The incentive compatibility constraint, if expressed as a first order condition on the agent's report, can be written (in any point where the optimal function is differentiable):

$$y'(\theta)U_y^A(y(\theta), \theta, b) = 0$$

which means that at any such points, the optimal mechanism is either locally constant or it takes the value preferred by the agent. The points at which the optimal mechanism assigns a value equal to the agents' preferred value form the *delegation set*, as they represent the values for which the principal will allow the agent to make his preferred choice. In what is a particular case of propositions 1 to 3 in Melumad and Shibano (1991), I will show that for any utility function of the principal and any distribution of the private information parameter, the optimal mechanism is to delegate the decision, setting the delegation set equal to the union of a numerable quantity of intervals (some of which may consist of a single point), out of which the agent will choose his preferred action. Also, properties of the mechanism for the types whose preferred points are contained in no delegation set are obtained.

If one writes

$$-(y(\theta) - \theta - b)^2 \geq -(y(\hat{\theta}) - \theta - b)^2$$

and

$$-(y(\hat{\theta}) - \hat{\theta} - b)^2 \geq -(y(\theta) - \hat{\theta} - b)^2,$$

adding both constraints yields

$$(y(\theta) - y(\hat{\theta}))(\theta - \hat{\theta}) \geq 0$$

which means that the optimal decision rule is non-decreasing¹, which at its turn implies it is continuously differentiable (and therefore continuous) almost everywhere.

Now, let us analyse what type of discontinuity there will be in those numerable (if any) points where $y(\theta)$ is discontinuous. Take $\bar{\theta} \in (0, 1)$ such that $y^+(\bar{\theta}) \equiv \lim_{\theta \rightarrow \bar{\theta}^+} y(\theta) \neq \lim_{\theta \rightarrow \bar{\theta}^-} y(\theta) \equiv y^-(\bar{\theta})$. From incentive compatibility, the type- $\bar{\theta}$ agent must be indifferent between $y^+(\bar{\theta})$ and $y^-(\bar{\theta})$. Furthermore, as $y^+(\bar{\theta}) \neq y^-(\bar{\theta})$ but $U^A(y^+(\bar{\theta}), \bar{\theta}, b) = U^A(y^-(\bar{\theta}), \bar{\theta}, b)$, we must have

$$\frac{y^+(\bar{\theta}) + y^-(\bar{\theta})}{2} = \bar{\theta} + b.$$

If we take any interval $[\theta_1, \theta_2]$ that is fully contained in a delegation set, $y(\theta)$ is trivially continuous in the open interval (θ_1, θ_2) . Plus, in the edges, say θ_2 , it is easy to see from the expression above that, as $y^-(\theta_2) = \theta_2 + b$, then $y^+(\theta_2) = \theta_2 + b$ as well, which means that it will be continuous in θ_2 too.

It is also easy to see that $y(\bar{\theta}) \in \{y^-(\bar{\theta}), y^+(\bar{\theta})\}$, because if $y(\bar{\theta})$ took a value in the open interval $(y^-(\bar{\theta}), y^+(\bar{\theta}))$, there would be for some $\varepsilon > 0$ an interval $(y(\bar{\theta}) - \varepsilon, y(\bar{\theta}) + \varepsilon)$ in which incentive compatibility would be violated.

Now we can see that any incentive compatible mechanism, for any objective function for the principal and for any prior distribution on θ will consist on constant pieces and on agent-preferred intervals. Every agent-preferred interval will be followed by a constant piece, attached to it continuously. Any discontinuity that there may be is a jump discontinuity, surrounded by constant portions, that will be associated to pooling intervals from the agents. These properties are valid for any utility function and for any probability distribution of the private information parameter. An example of an incentive compatible mechanism is shown in figure 1.

Now the principal must choose the optimal incentive compatible mechanism. Choosing a delegation set uses the agent's information in an efficient way. Also, as the principal is risk averse and as a delegation set keeps the amount of the loss constant for the principal, it is desirable to delegate. However, a constant interval will mean that for some values of θ the outcome will be closer to her preferred one, so if these values are relatively likely, she will prefer a constant piece. In the figure, the principal delegates for $\theta \in [\theta_1, \theta_2] \cup \{\theta_4\} \cup [\theta_6, 1]$. The intervals $[\theta_2, \theta_3]$ and $[\theta_4, \theta_5]$ are closer to the principal's ideal than they would be under delegation for those values. If those gains

¹For a proof with generic utility functions, see Melumad and Shibano (1991).

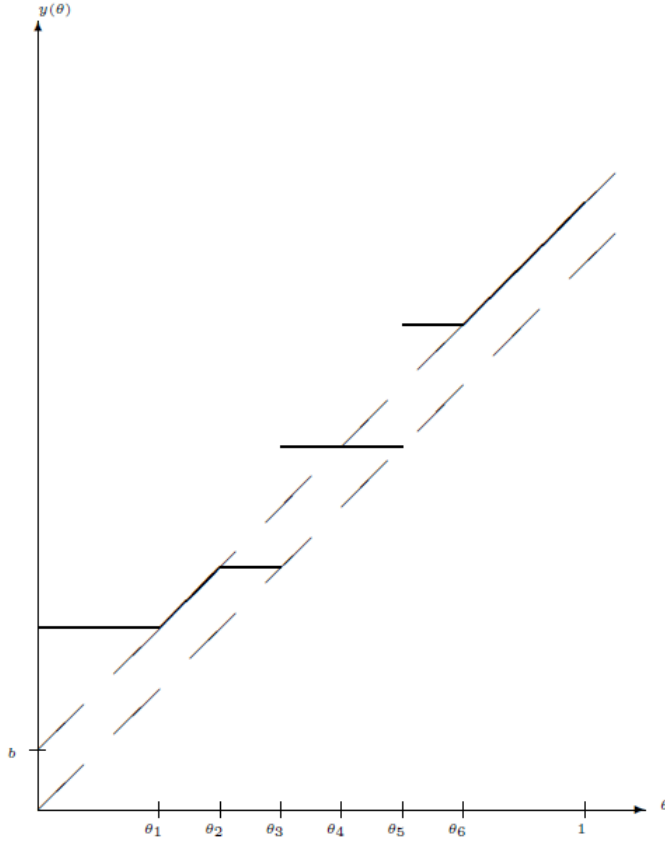


Figure 1: An incentive-compatible outcome.

compensate the losses of the intervals $[\theta_3, \theta_4]$ and $[\theta_5, \theta_6]$, which may be possible due to the probability distribution of θ , then the principal will prefer to have these constant pieces and the discontinuities that result thereof.

However, in this case the probability distribution is uniform, the principal will have no gain in introducing these discontinuities, so the resulting optimal mechanism will be continuous in the entire support. Indeed, if there was a discontinuity, the principal would be better off by replacing the two constant portions by the side of the discontinuity by a delegation set². As the mechanism is continuous, it will consist of a single delegation set or, equivalently, of a lower and an upper threshold on the decisions allowed to be taken by the agent. It is intuitive, and actually easily proven, that a lower threshold will be of no interest to the principal. Indeed, a lower bound

²For a formal proof, see Melumad and Shibano (1991) and for the general conditions that grant continuity see Alonso and Matouschek (2008)

$x^L = \theta^L + b$ will make that for any type $\theta < \theta^L$ the mechanism will yield an outcome equal to the lower bound, when actually the outcome preferred by the agent, $\theta + b$, leaves the principal better off.

The optimal mechanism then takes the strikingly simple form:

$$y(\theta) = \begin{cases} \theta + b & \text{if } \theta \leq \theta^H \\ \theta^H + b & \text{if } \theta > \theta^H \end{cases}$$

The upper threshold is obtained by a straightforward maximization problem. The first order condition is:

$$\int_{\theta^H}^1 U_y^P(\theta^H + b, \theta) f(\theta) d\theta \leq 0,$$

with equality if $\theta^H > 0$.

This first order condition tells us that the upper threshold is such that the principal's expected utility, given that $\theta > \theta^H$, is maximized. This means that the principal chooses a delegation set and a constant portion; when the value falls in the delegation set, the principal obtains a utility equal to $-b^2$ for sure, and thus the loss is due exclusively to a depart from her preferred outcome, and in no way to the variability of the outcome. If the value falls in the constant portion, on the other hand, the expected outcome is optimal for the principal given the posterior beliefs, and the loss comes exclusively from the variation in the outcome. The optimal mechanism for quadratic loss function and uniform distribution is illustrated in figure 2. The optimal threshold is given by $\theta^H = 1 - 2b$, for any $b < 1/2$ (there is no delegation otherwise), and it follows that $\theta^*(\theta^H) - \theta^H = 1 - \theta^*(\theta^H) = b$, with $\theta^*(\theta^H) = E[\theta | \theta > \theta^H]$. The expression for the principal's ex-ante expected utility is (*OD* stands for "Optimal Delegation"):

$$EU^P(OD) = -b^2 \left(1 - \frac{4b}{3} \right).$$

In the monopolist example, this is equivalent to price-cap regulation (see Alonso and Matouschek [2008]). Note that just as in this case, setting a lower bound in the price would not, in any case, benefit the regulator. In the basic model, the regulating agency will classify the monopolists in two kinds: the efficient and inefficient ones. But, instead of setting a fixed price for each type of monopolist, the agency will allow efficient firms to set their preferred price, and will set a price for the inefficient firms equal to their expected marginal cost.

As the outcome of the communication game is incentive compatible and thus a feasible mechanism, it is straightforward that optimal delegation will be better to the

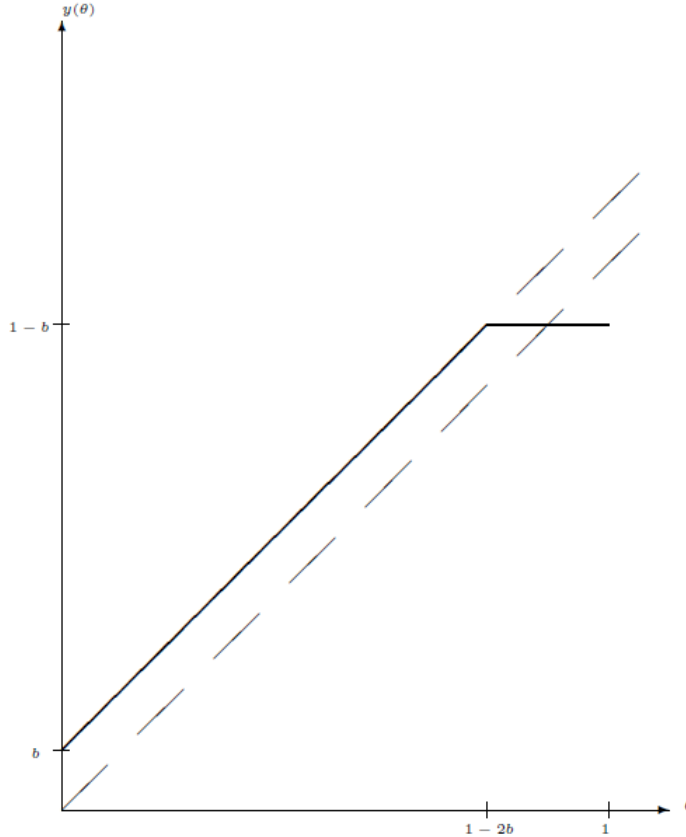


Figure 2: The optimal mechanism.

principal than the cheap talk equilibrium. From the expressions for the expected utility this is easily seen. In fact, one may restrict attention to values of the bias such that $N(b) \geq 2$, which is equivalent to $b \leq \frac{1}{4}$. For these values, the communication equilibrium utility is bounded above by $EU^P(CT) = -\frac{b}{3} + \frac{b^2}{3}$, the value of the utility when one allows for $N(b)$ non-integers. This value is lower than $EU(OD)^P$ for the relevant values of the bias.

Delegation is valuable with respect to an uninformed decision whenever

$$\int_0^1 U_y^P(b, \theta) f(\theta) d\theta > 0.$$

This means that delegation is valuable whenever the principal benefits from allowing an agent who is marginally higher than the lowest type take his preferred decision or, equivalently, whenever an uninformed principal's optimal choice would be higher than the value of the bias, which would imply that she can benefit from the advice of an informed agent whenever the type is small enough. Thus, for any bias $b < \bar{b}$ delegation

is valuable, where \bar{b} is implicitly defined by

$$E[U_y^P(\bar{b}, \theta)] = 0,$$

or, in the uniform case, for any bias $b < \frac{1}{2}$.

III.2 Full delegation

Optimal delegation assumes that the principal cannot commit to contingent transfers, but can fully commit not to overrule the agent once he has given his advice. Thus, the principal must be able to commit to giving away decision rights while still keeping some discretion. This might not be possible. It may be the case, for example, that the outcome is verifiable only informally and therefore cannot be contracted upon, or it may be the case that a principal can only commit to delegate by granting full decision rights to the agent. Then, there exists the same trade-off as before: the principal must weigh constant but certain loss against an optimal in expectation but variable outcome. The difference with optimal delegation is that this time the trade-off is not about choosing for what types each loss will occur, but about having a constant loss for every type, or taking uninformed (or imperfectly informed) decision for any value of the parameter. This is the problem studied by Dessein (2002).

When comparing full delegation to communication (again, comparing with optimal delegation is trivial), we see that for large values of the bias, delegation will be of no value. Indeed, as shown by the optimal delegation model, when the bias is large ($b \geq 1/2$), the principal is better off taking a completely uninformed decision without consulting the agent. The utility of delegation, with quadratic loss function, is

$$EU^P(FD) = -b^2,$$

as the loss will be equal for every state of the world. For any $b > \frac{1}{4}$, communication will not take place (i.e. the only cheap talk equilibrium consists of a single interval) and the expected utility of the principal of keeping control is

$$EU_0^P = -\frac{1}{12}.$$

Therefore, for any $b \in (\frac{1}{4}, \frac{1}{\sqrt{12}}]$, delegation is preferred over communication and for any bias larger than this, control is preferred.

Furthermore, from the expression for $EU^P(CT)$, Dessein shows that, given b , for any $N \geq N(b)$, $EU^P(CT) < -b^2$, and thus delegation is also preferred. Dessein also

analyzes generic distributions and shows that delegation is preferred to communication when the variance of the private information is large compared to the bias and when the principal is more risk-averse.

One striking result is that in Crawford and Sobel's leading example, whenever delegation is possible, communication will not take place at all in equilibrium. Indeed, for any value of the bias for which communication could exist (i.e. $N(b) > 1$), delegation is strictly preferred. This is, of course, a consequence of the assumptions of the model. In particular, the constant bias assumption and the uniform distribution play a significant role. Unfortunately, the characterization of the communication equilibrium becomes untractable when relaxing these assumptions and no general results relaxing these assumptions have been found.

One assumption that Dessein implicitly made and that can be easily relaxed, however, is that there is no uncertainty that realizes after communication.

Indeed, consider this simple modification to the model: there is a random variable ε , with mean $\bar{\varepsilon}$ and variance σ_ε^2 , whose value is known to the principal when making the decision were the decision rights maintained, but is not known to the agent when making the decision if the rights have been delegated. The payoffs are

$$U^P(y, \theta) = -(y - \theta - \varepsilon)^2$$

and

$$U^A(y, \theta, b) = -(y - \theta - b - \varepsilon)^2.$$

In this setting, the communication equilibrium is exactly as in Crawford and Sobel, so there is no loss of generality in omitting this situation. Indeed, the report will also consist on an interval, and the principal's chosen action will be as in the original CS equilibrium, but correcting for the realized value of ε . That is, if the report is $\theta \in [a_i, a_{i+1})$, the decision will be $y^* = \frac{a_i + a_{i+1}}{2} + \varepsilon$. The payoffs remain unchanged as well.

With delegation, however, the decision chosen by the agent will be $y(\theta) = b + \bar{\varepsilon}$, yielding an expected payoff

$$EU^P = -b^2 - \sigma_\varepsilon^2$$

to the principal, and an expected payoff

$$EU^A = -\sigma_\varepsilon^2$$

to the agent. If delegation was being studied independently, the effect of ε could be sometimes omitted, but when comparing delegation to communication, its effect is noticeable.

Obviously, if the variance is large, communication will be preferred to delegation. But note that even if σ_ε^2 is very small, delegation will, at least for some values of the bias, no longer dominate communication. Indeed, no matter how small the variance is, if the bias is small enough, communication will be preferred to delegation.

III.3 Closed-rule delegation

A third model of delegation, that involves a different type of commitment, is full delegation with veto right, also known as the closed rule delegation (Gilligan and Krehbiel 1987, Baron 2000, Krishna and Morgan 2001). This is a rule that has been studied mainly by political scientists, as it exists in actual legislative procedures. Actually, as Gilligan and Krehbiel point out, it is the renouncement of this veto power that has drawn most of the attention.

Under this procedure, there is a status quo measure $y_0 \geq 0$ that can be implemented by the principal instead of the agent's proposition. Thus, if an agent has proposed an action y^A , which has modified the principal's beliefs in a given way, it will be implemented if and only if

$$E_\theta[U^P(y^A, \theta)|y^A] \geq E_\theta[U^P(y_0, \theta)|y^A].$$

The trade off between this rule and the full delegation is that having a veto right allows the principal to take a better decision (compared to full delegation) when the state of the world is close to the status quo, but at the same time, the report is noisier around these values and thus entails a loss for both the principal and the agent. Indeed, when values of θ are extreme, the principal will incur a loss due to her accepting the agent's proposal and thus approving a decision that departs from her ideal one. On the other hand, when the values of θ are moderate, the agent will have incentives to provide noisy information in order to make the principal reject the status quo due to the uncertainty it will entail.

Gilligan and Krehbiel (1987) characterize an equilibrium of the closed rule delegation game and compare it to the game of pure communication (open rule)³. As in this model the principal takes an action after the agent has made a recommendation, there may be multiple equilibria. Indeed, there will always be an equilibrium for which the agent will randomize over actions that will not be picked (or “babble”), the principal will not modify her beliefs, and then will choose the status quo. The most “intuitive” equilibrium for this game, the one found by Gilligan and Krehbiel, is understood as follows. Suppose, first, that the agent will always report his preferred policy. Then, if the principal believes this, she will veto any proposition in the interval $[y_0, y_0 + 2b]$. Now, if the agent knows that any proposal in that interval will be vetoed, then for any value of $\theta \in (y_0, y_0 + b]$ (this is, the values for which his ideal policy lies in $(y_0 + b, y_0 + 2b]$), the agent will have an incentive to propose a policy $y_0 + 2b + \varepsilon$. This will not be an equilibrium either, of course, but it gives an intuition that there will be a pooling region to the right of the “veto area” (if that area lies within the support of θ). Note, however, that the outcome function $y(\theta)$, that maps the private information parameter to the outcome space, must be incentive compatible in the sense defined at the beginning of this section. This is the rationale of the Gilligan-Krehbiel equilibrium described in the following lemma.

Lemma 1 (Gilligan-Krehbiel Equilibrium). *For a game given by parameters b and y_0 such that $y_0 - b \geq 0$ and $y_0 + 3b \leq 1$, an equilibrium of the game of closed rule delegation is given by a proposal $y^*(\theta)$, a belief system $\hat{f}(y)$ and a veto strategy $V^*(y) \in \{\text{veto}, \text{approve}\}$ such that*

$$y^*(\theta) = \begin{cases} \theta + b & \text{if } \theta < y_0 - b \\ y \in [y_0, y_0 + 4b) & \text{if } \theta \in [y_0 - b, y_0 + b) \\ y_0 + 4b & \text{if } \theta \in [y_0 + b, y_0 + 3b] \\ \theta + b & \text{if } \theta > y_0 + 3b, \end{cases}$$

$$\hat{f}(y) = \begin{cases} y - b & \text{if } y \in [b, y_0) \\ U[y_0 - b, y_0 + b] & \text{if } y \in [y_0, y_0 + 4b) \\ U[y_0 + b, y_0 + 3b] & \text{if } y = y_0 + 4b \\ y - b & \text{if } y \in (y_0 + 4b, 1] \\ 0 & \text{if } y < b \\ 1 & \text{if } y > 1 + b, \end{cases}$$

³Much of the analysis done by Gilligan and Krehbiel focuses on the incentives of the agent to acquire expertise, i.e. to pay a cost for finding out the value of θ . This issue will not be treated in this dissertation

$$V^*(y) = \text{veto iff } y \in (y_0, y_0 + 4b).$$

The proof that this is indeed an equilibrium is straightforward. First, it is easy to see that the on-the-equilibrium-path beliefs are bayesian updates given the agent's equilibrium strategy. Second, it is also straightforward that both the agent's and the principal's strategies are optimal given the other's strategy and given the beliefs. Finally, off-the-equilibrium-path beliefs are set in a natural way.

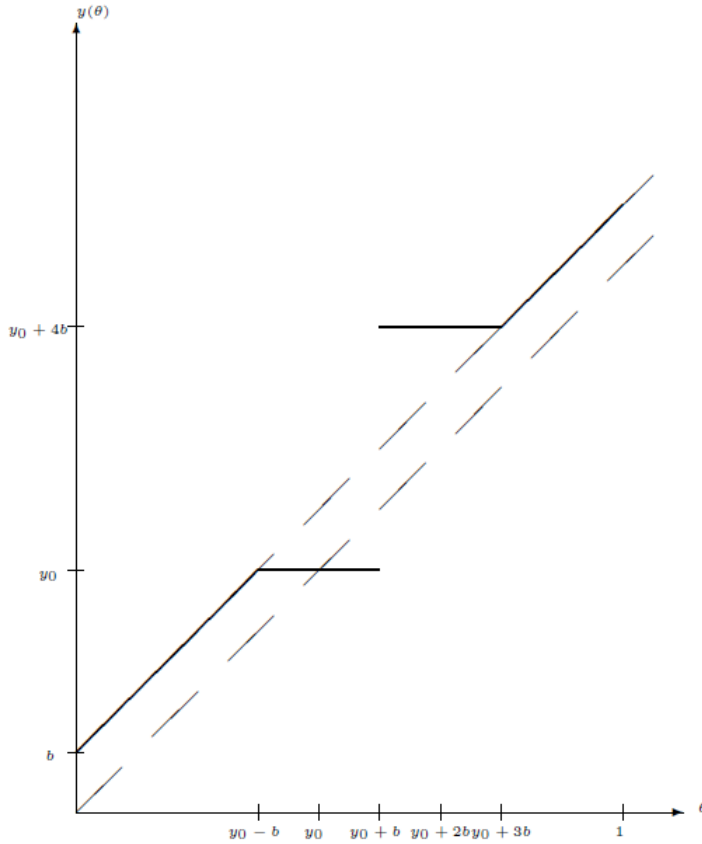


Figure 3: Outcome of the *GK* equilibrium.

Gilligan and Krehbiel proposed this equilibrium without restrictions on the parameters, and drew general conclusions from it. This was noted first by Baron (2000). Indeed, when $y_0 - b < 0$, the off-the-equilibrium path beliefs given above make that it is profitable for the agent to deviate when the observed type is close to zero, as the agents' favourite policy will be accepted by the principal. In order to avoid this, non-plausible off-the-equilibrium-path beliefs would have to be defined, which would

make the resulting game less robust to basic refinements⁴. Likewise, when $y_0 + 3b < 1$, the principal has an incentive to veto the proposal $y_0 + 4b$.

Krishna and Morgan (2001) proposed an alternative equilibrium, that Pareto dominates the one proposed by Gilligan and Krehbiel, which is proposed in the following lemma and whose outcome is represented in figure 4.⁵

Lemma 2 (Krishna-Morgan Equilibrium). *For a game given by parameters b and y_0 such that $y_0 \geq 0$ and $y_0 + 2b \leq 1$, an equilibrium of the game of closed rule delegation is given by a proposal $y^*(\theta)$, a belief system $f(y)$ and a veto strategy $V^*(y) \in \{\text{veto}, \text{approve}\}$ such that*

$$y^*(\theta) = \begin{cases} \theta + b & \text{if } \theta < y_0 - b \\ y \in [y_0, y_0 + 2b) & \text{if } \theta \in [y_0 - b, y_0) \\ y_0 + 2b & \text{if } \theta \in [y_0, y_0 + 2b) \\ y_0 + 4b & \text{if } \theta \in [y_0 + 2b, y_0 + 3b) \\ \theta + b & \text{if } \theta > y_0 + 3b, \end{cases}$$

$$\hat{f}(y) = \begin{cases} \max\{y - b, 0\} & \text{if } y < y_0 \\ U[\max\{y_0 - b, 0\}, y_0] & \text{if } y \in [y_0, y_0 + 2b) \\ U[y_0, y_0 + 2b] & \text{if } y \in [y_0 + 2b, y_0 + 4b) \\ U[y_0 + 2b, \min\{y_0 + 3b, 1\}] & \text{if } y = y_0 + 4b \\ \min\{y - b, 1\} & \text{if } y \geq y_0 + 4b \end{cases}$$

$$V^*(y) = \text{veto iff } y \in (y_0, y_0 + 2b) \cup (y_0 + 2b, y_0 + 4b).$$

⁴In particular, a property that is desired from the principal's belief system is monotonicity, meaning that the posterior beliefs are such that a higher report can not entail "lower" posterior beliefs, i.e. if $y' > y''$, then the posteriors are such that $\hat{F}(\theta|y') \leq \hat{F}(\theta|y'')$. As the agent's preferred choice is strictly increasing in the state of the world, monotonicity is equivalent to demanding from out of equilibrium beliefs that the principal interprets a deviation as the agent proposing something better for him. Also, throughout this dissertation, uniform out of equilibrium beliefs are considered as a desirable property.

⁵The Krishna-Morgan equilibrium, as originally presented by the authors, consisted of different off-the-equilibrium-path beliefs. They are re-defined here to comply with the monotonicity requirement established in the previous footnote

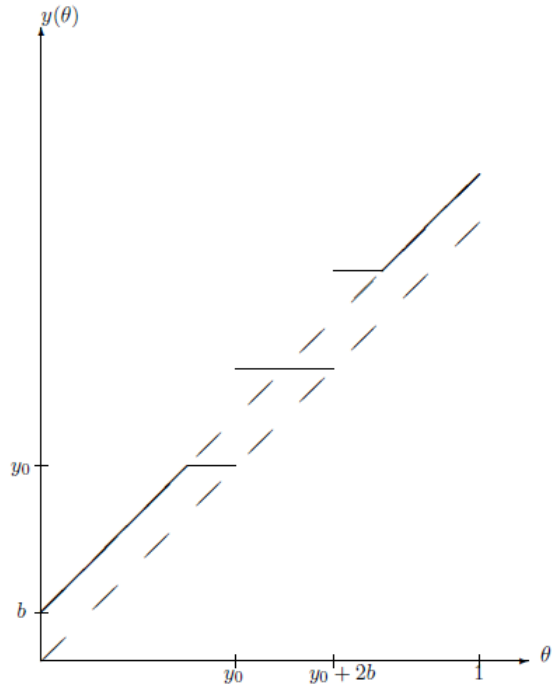


Figure 4: Outcome of the *KM* equilibrium.

Besides Pareto-dominance, the Krishna-Morgan equilibrium (henceforth referred to as *KM* equilibrium) also has the advantage of being valid for a larger range of parameters than the Gilligan-Krehbiel equilibrium (henceforth, *GK* equilibrium), even if this was not noted by the authors when proposing it. The reason for this, is that in the *GK* equilibrium, if any of the two constant portions is “made shorter” (by making $y_0 - b < 0$ or $y_0 + 3b > 1$), by no matter how little, then the equilibrium is no longer valid for uniform out of equilibrium beliefs. If $y_0 - b < 0$, then for values of θ lower than $y_0 + b$, the agent finds it no longer profitable to give “just any” recommendation, knowing that it will be vetoed, because the principal might accept it. Likewise, if $y_0 + 3b > 1$, the principal will veto proposals of $y = 4b$, coming from θ values higher than $y_0 + b$. This is not so for the *KM* equilibrium, where the first and the third constant portions can be of any size up to b . These are the two reasons why the *KM* equilibrium will be used for the analysis instead of the *GK* equilibrium.

The argument in the above paragraph gives the intuition for the equilibrium when $y_0 + b > 1$ ⁶. Indeed, the equilibrium consists of the veto working as an upper bound on the agent’s proposals. The characterization is the following.

⁶The case where $b > \frac{1}{2}$ will be ignored, as no communication is possible and no proposal will ever be accepted

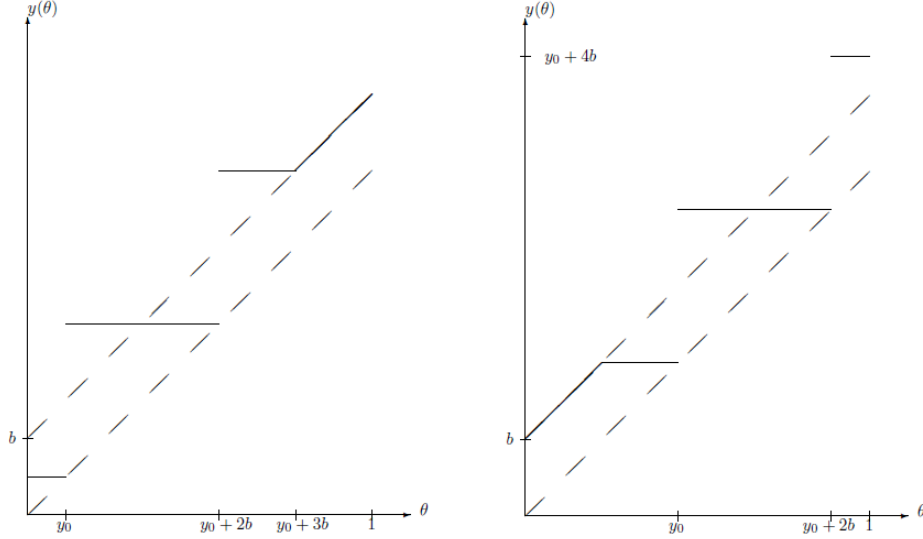


Figure 5: Extension of the *KM* equilibrium for $y_0 - b < 0$ (left) and for $y_0 + 3b > 1$ (right).

Lemma 3 (Upper bound equilibrium). *For a game given by parameters b and y_0 such that $y_0 + b \geq 0$ and therefore $y_0 - b \geq 0$, an equilibrium of the game of closed rule delegation is given by a proposal $y^*(\theta)$, a belief system $\hat{f}(y)$ and a veto strategy $V^*(y) \in \{\text{veto}, \text{approve}\}$ such that*

$$y^*(\theta) = \begin{cases} \theta + b & \text{if } \theta < y_0 - b \\ y \in [y_0, 1 + b) & \text{if } \theta \in [y_0 - b, y_0), \end{cases}$$

$$\hat{f}(y) = \begin{cases} \max\{y - b, 0\} & \text{if } y < y_0 \\ U[\max\{y_0 - b, 0\}, \min\{y - b, 1\}] & \text{if } y > y_0, \end{cases}$$

$$V^*(y) = \text{veto iff } y > y_0.$$

The only remaining case to be characterized is that when $y_0 + b < 1$ and $y_0 + 2b > 1$. This is a case intermediate between the upper bound and *KM* equilibria. For an intuition, take parameters such that the valid equilibrium is the upper bound one, and consider b growing, while keeping $y_0 - b > 0$. Once b goes above the level of $1 - y_0$,

there are no uniform out of equilibrium beliefs that could justify the principal vetoing every proposal above y_0 , of which the agent could not take advantage. The agent, then, has a pooling strategy for high values of θ , accepts the veto for intermediate values and sees his favorite policy accepted for lower values. This is valid for any value of the bias down to $(1 - y_0)/2$. In this limit case, the equilibrium turns into the *KM* one⁷. The characterization of this intermediate equilibrium is given in the following lemma.

Lemma 4 (Intermediate equilibrium). *For a game given by parameters b and y_0 such that $y_0 + b < 1$ and $y_0 + 2b > 1$, an equilibrium of the game of closed rule delegation is given by a proposal $y^*(\theta)$, a belief system $\hat{f}(y)$ and a veto strategy $V^*(y) \in \{\text{veto}, \text{approve}\}$ such that*

$$y^*(\theta) = \begin{cases} \theta + b & \text{if } \theta < y_0 - b \\ y \in [y_0, 2 - y_0 - 2b] & \text{if } \theta \in [y_0 - b, 1 - 2b) \\ 2 - y_0 - 2b & \text{if } \theta > 1 - 2b, \end{cases}$$

$$\hat{f}(y) = \begin{cases} \max\{y - b, 0\} & \text{if } y < y_0 \\ U[\max\{y_0 - b, 0\}, 1 - b] & \text{if } y \in [y_0, 2 - y_0 - 2b) \\ U[1 - b, 1] & \text{if } y = 2 - y_0 - 2b \\ 1 & \text{if } y > 2 - y_0 - 2b \end{cases}$$

$$V^*(y) = \text{veto iff } y \in [y_0, 2 - y_0 - 2b),$$

where the value $2 - y_0 - 2b$ is obtained as the value x such that $(x + y_0)/2 = 1 - b$.

A graphic representation of this type of equilibrium is given in figure 6. The agent pools for $\theta \in [1 - 2b, 1]$ and accepts the veto for $\theta \in [y_0 - b, 1 - 2b]$.

Now that the full characterization is done, comparisons can be made with the other equilibria presented in this dissertation. For this, two different situations will be considered. In the first case, the principal can, when choosing closed rule delegations,

⁷This intermediate equilibrium could be extended for values of the bias down to $(1 - y_0)/3$, where it becomes equivalent to the *GK* equilibrium. This is not considered due to the choice made for the *KM* equilibrium

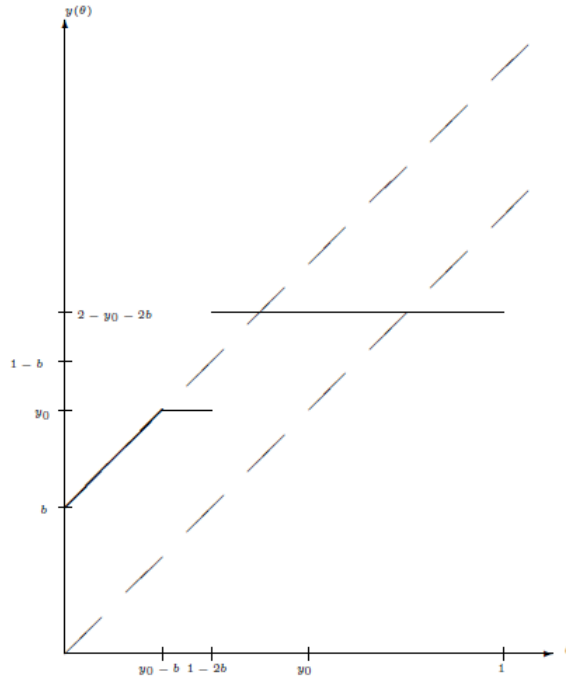


Figure 6: Graphic representation of an intermediate equilibrium.

set the value of the status-quo, making its choice endogenous. In the second one, the status-quo policy is given exogenously, and thus the principal must take it as a given when selecting the most beneficial mode of decision-making.

First, note that if the status quo is set to $y_0 = 1 - b$, then the full commitment outcome is replicated, and thus the closed rule delegation with endogenous choice of status quo is preferred to any type of delegation, including in particular the cases of cheap talk and full delegation, studied earlier. Indeed, veto power can be seen as a way of implementing the optimal delegation result. This result is generalized by Mylovanov (2008) in a more general setting. He called it the *veto-power principle*, and is stated as follows:

Lemma 5. *Veto-power principle* *There exists an optimal outcome that can be implemented through veto-based delegation.*

The setting in which Mylovanov proved this result consists of utility functions such that the preferred choices of the two players are non-decreasing in θ and can intersect at most once, and a generic distribution over a compact set of states of the world. For the simplified setting used in this dissertation, the prove is by construction, noting, as

above, that the optimal outcome is implemented by a given default policy.

The case with exogenous status quo is more complex, as it involves comparing a utility function that depends on two variables (the status quo and the bias) and that presents several discontinuities. To make the different cases that will be treated easier to follow, the areas of validity of the different type of equilibria are presented in figure 7.

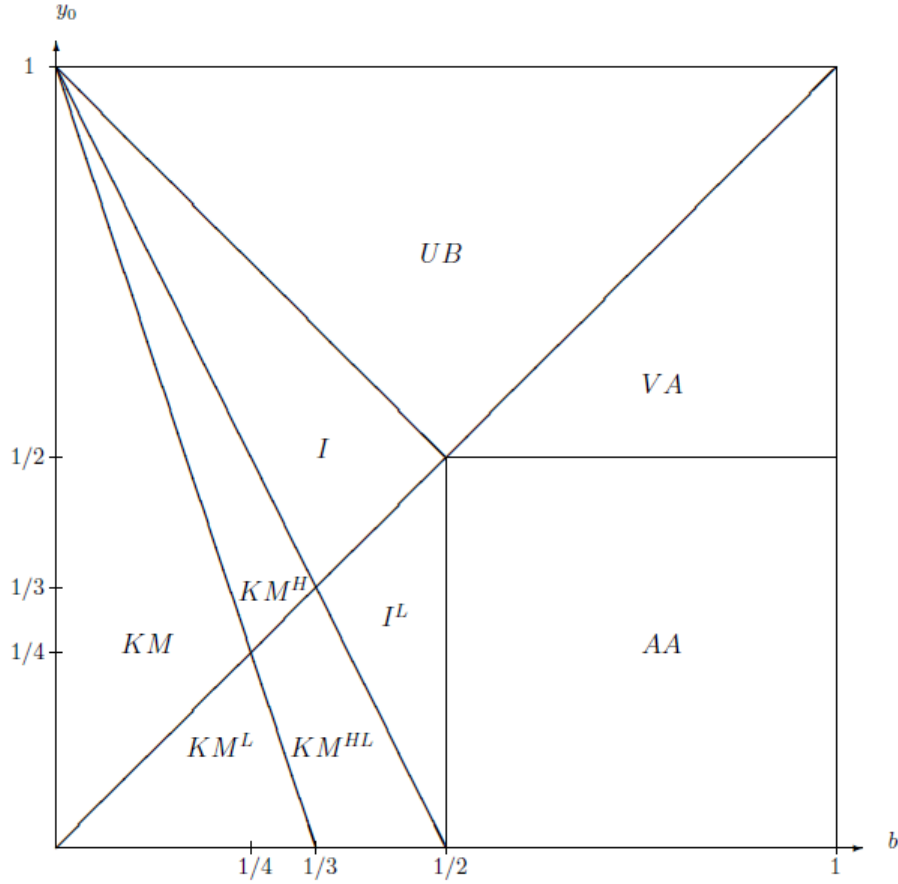


Figure 7: Different regions in the (b, y_0) space where different types of equilibria apply.

The space $[0, 1]^2$ is divided in nine regions. The region such that $y_0 + 2b \leq 1$ is where the KM equilibrium is valid. This region is itself divided into four. The region labeled KM corresponds to $y_0 + 3b > 1$ and $y_0 - b > 0$, which is the original region of validity according to KM . The region where $y_0 + 3b > 1$ but $y_0 + 2b < 1$ (labeled KM^H , where H stands for “high”), whose graphic representation is shown right on figure 5, has pooling for high values of the state of the world. Conversely, the region

where $y_0 - b < 0$ (KM^L in figure 7, left in figure 5) has pooling for low values of θ . If both conditions are simultaneously satisfied (region KM^{HL} in figure 7), the outcome function consists of three pooling intervals that completely cover the support.

When $y_0 + 2b > 1$ and $y_0 + b < 1$ the equilibrium is of the Intermediate type. If $y_0 - b > 0$ (region I) the outcome function is strictly increasing for low values of θ (figure 6). If $y_0 - b < 0$ (region I^L), the equilibrium consists of two pooling intervals and no full separation. If $y_0 - b > 0$ and $y_0 + b > 1$, the valid equilibrium is of the Upper-bound type (region UB in figure 7).

If $y_0 - b < 0$ and $b > 1/2$, no transmission of information is possible, and the equilibrium can take two forms. If $y_0 < 1/2$, the agent will propose $y^* = 1 - y_0$ and the principal will accept it (region AA for “accepts all”), and if $y_0 > 1/2$ the status quo will be implemented for every θ (VA for “veto all”).

Tedious but straightforward calculations yield the principal’s expected utility for each region:

$$\begin{aligned}
EU^P(KM) &= -b^2 - \frac{4}{3}b^3 \\
EU^P(KM^H) &= -b^2 - 3b^2(1 - y_0 - 2b) + 2b(1 - y_0 - 2b)^2 - \frac{1}{3}(1 - y_0 - 2b)^3 \\
EU^P(KM^L) &= -b^2 - 2b^3 - \frac{1}{3}y_0^3 + y_0b^2 \\
EU^P(KM^{HL}) &= -\frac{16}{3}b^3 + y_0^2(4b - 1) + y_0(4b - 1)^2 + \frac{1}{3}(4b - 1)^3 \\
EU^P(I) = EU^P(UB) &= -b^2 + \frac{4}{3}b^3 - b(1 - y_0 - b)^2 - \frac{1}{3}(1 - y_0 - b)^3 \\
EU^P(I^L) = EU^P(AA) = EU^P(VA) &= -\frac{1}{3} + y_0(1 - y_0)
\end{aligned}$$

The analysis and comparison with cheap talk and full delegation will be done separately for each type of equilibrium.

KM

This case, where $y_0 - b > 0$ and $y_0 + 3b < 1$ was analyzed by Krishna and Morgan (2001). They prove that their equilibrium is better than cheap talk whenever it is valid. Also,

it is strictly worse than full delegation, as proven by Dessein.

KM^H

Note that in this region, $1 - y_0 - 2b \in [0, b]$ and therefore the expected utility takes values between $-b^2 - \frac{4}{3}b^3$ and $-b^2$. This implies that full delegation is preferred to closed-rule delegation in this region.

Also, note that for all b such that there exists a pair $(b, y'_0) \in KM$ (i.e. for all $b \in [0, 1/4]$), the expected utility of a pair $(b, y''_0) \in KM^H$ is higher than that of (b, y'_0) . This means that for $b \in [0, 1/4]$, KM^H is also preferred to cheap talk. For $b > 1/4$, the cheap talk equilibrium consists of no communication and an expected utility of $-1/12$ for the principal. The curve $EU^P(KM^H) = -\frac{1}{12}$ crosses the KM^H region, and therefore the equilibrium in this case can be better or worse than an uninformed decision.

KM^L

The expected utility in this case is non increasing in y_0 , and as $y_0 \leq b$, the payoff for the principal for any value of the bias is contained in the interval $[-b^2 - 2b^3, -b^2 - \frac{4}{3}b^3]$. Therefore, full delegation is preferred to closed rule delegation in the KM^L region.

For comparing with cheap talk, recall that, given a bias b , the most informative cheap talk equilibrium consists of a single interval if $b > \frac{1}{4}$, two intervals if $\frac{1}{12} < b \leq \frac{1}{4}$ and of three or more intervals if $b \leq \frac{1}{12}$.

If $b > \frac{1}{4}$, the expected utility from cheap talk is equal to $-\frac{1}{12}$. Also, the highest value that y_0 can take is $1 - 3b$, and thus the highest payoff the principal can get for a bias $b \in [1/4, 1/3]$ is given by $-\frac{1}{3} + 3b - 9b^2 + 4b^3$, and this is always lower than $-\frac{1}{12}$.

If $b \in (\frac{1}{12}, \frac{1}{4}]$, then the cheap talk equilibrium consists of two intervals and the principal's payoff is given by $-\frac{1}{48} - b^2$. The curve $EU^P(KM^L) = -\frac{1}{48} - b^2$ crosses the region $\{(b, y_0) \in KM^L : b \in (\frac{1}{12}, \frac{1}{4}]\}$, and therefore cheap talk can be better or worse than this equilibrium for these values of b .

If $b \leq \frac{1}{12}$, then $N(b) \geq 3$. Consider b such that the most informative cheap talk equilibrium consists of $N \geq 3$ intervals. Then the difference in the principal's utility between the cheap talk equilibrium and the closed rule delegation equilibrium is given by

$$\begin{aligned} & -\frac{1}{12N^2} - \frac{b^2(N^2 - 1)}{3} + b^2 + 2b^3 + \frac{1}{3}y_0^3 - y_0b^2 \\ & \leq -\frac{1}{12N^2} - \frac{b^2(N^2 - 1)}{3} + b^2 + 2b^3 \\ & = -\frac{1}{12N^2} - \frac{b^2(N^2 - 4)}{3} + 2b^3, \end{aligned}$$

where the inequality is due to $EU^P(KM^L)$ being decreasing in y_0 .

For N intervals to be an equilibrium, we need to have $b \leq \frac{1}{2N(N-1)}$, and thus the above expression is bounded above by

$$\begin{aligned} & \frac{1}{4N} \left[-\frac{1}{3} + \frac{1}{N(N-1)^3} \right] - \frac{b^2(N^2 - 1)}{3} \\ & \leq \frac{1}{4N} \left[-\frac{1}{3} + \frac{1}{24} \right] - \frac{b^2(N^2 - 1)}{3} \\ & = -\frac{7}{96N^2} - \frac{b^2(N^2 - 1)}{3} \leq 0 \end{aligned}$$

therefore if $b \leq \frac{1}{12}$, closed rule delegation is preferred to cheap talk.

This proves that closed rule is preferred to cheap talk in the KM^L region if and only if

$$EU^P(KM^L) \geq -\frac{1}{48} - b^2.$$

KM^{HL}

It is straightforward to prove numerically that in this entire region, full delegation is preferred to closed rule delegation and closed rule delegation is preferred to an uninformed decision.

I and UB

Note that, even if these two cases are different, they give the same expected utility to the principal. This is because in the Intermediate equilibrium's polling interval $[1 - 2b, 1]$, the agent's proposal $2 - y_0 - 2b$ is such that the principal is indifferent between accepting the proposal and vetoing it. Therefore, it gives the same utility as if she was vetoing any proposal higher than the status quo.

Note also that the expected utility reaches the maximum value for a given bias of $-b^2 + \frac{4}{3}b^3$ when $y_0 = 1 - b$. As said before, this is the optimum when the status quo can be chosen, and it implements the outcome of full commitment optimal delegation.

These equilibria are always preferred to full delegation, and can be preferred or not to cheap talk equilibria.

The Intermediate equilibrium is a novel contribution of this dissertation, up to my knowledge. Dessein (2002), when comparing full delegation with closed-rule delegation consider an upper-bound type equilibrium in the region where I consider an intermediate equilibrium. However, he does not propose out of equilibrium beliefs that sustain this equilibrium.

If one was to implement an upper bound equilibrium in the *I* region, the principal correctly infers that $\theta \in [y_0 - b, 1]$ when receiving a proposition y_0 . Then, when receiving a proposition $y^* > y_0$, beliefs must be such that she will veto this proposition. However, from uniform out of equilibrium beliefs, any belief when receiving this offer must entail a preferred point higher than the status quo, and thus it would be in the principal's interest to accept some of these offers. Therefore, no "reasonable" out of equilibrium beliefs exist that support an upper bound equilibrium in the *I* region. Furthermore, the *I* type equilibrium is Pareto improving with respect to the upper bound one, as the agent is strictly better off while the principal's expected utility is unchanged.

I^L, AA and VA

These equilibria all yield to principal a payoff equal to always choosing the status quo. In the case of the *I^L* equilibrium, there is information transmission, but this does not favor the principal: if the state of the world is higher than $1 - 2b$, the agent makes an

offer that leaves the principal with the same payoff as in the status quo (conditional on $\theta > 1 - 2b$).

They are never better than cheap talk and are better than full delegation whenever

$$-\frac{1}{3} + y_0(1 - y_0) \geq -\frac{1}{12}.$$

Figures 8 and 9 show how the closed rule delegation payoffs compare to full delegation and cheap talk

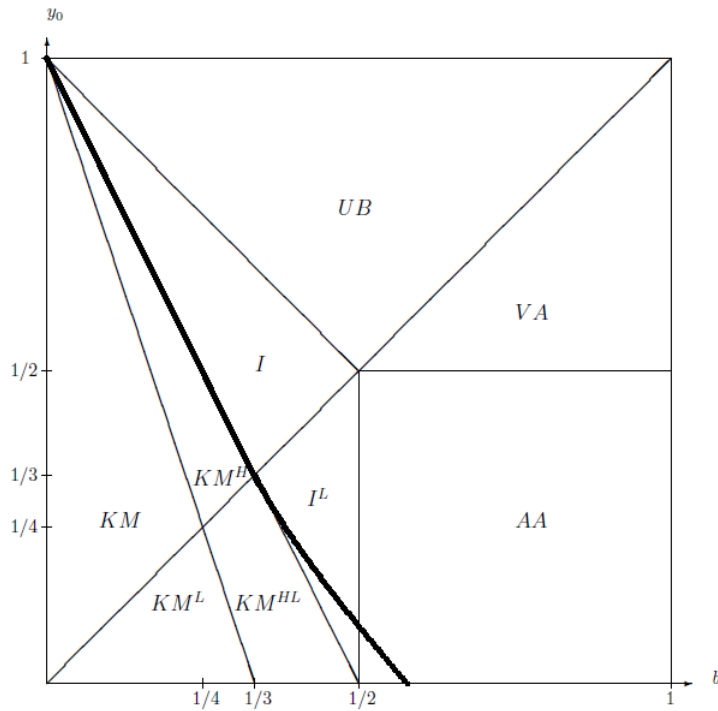


Figure 8: Representation of principal's preferences between full delegation and closed rule delegation.

These results show the optimal solution to the tradeoff between control and information. For any value of the status quo, when the bias is very closed to zero, full delegation is preferred, as it will make full use of the information available. For very large values of the bias, however, control becomes more important, and if the bias is large enough, then full control is preferred. The preferences for intermediate values of the bias depends on the value of the status quo decision.

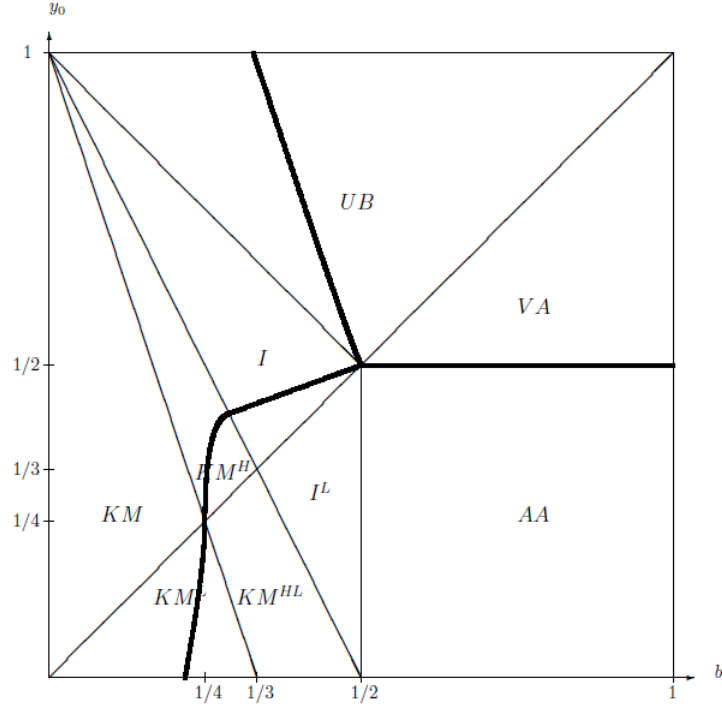


Figure 9: Representation of the principal's preferences between communication and closed rule delegation.

As the bias grows, the cases where the status quo is relatively high and the case where it is relatively low behave differently. If the bias is lower than $1 - \frac{\sqrt{3}}{3}$, then veto-power delegation is never preferred, and for large biases, the preferred choice is to take an uninformed decision. For these values of the status quo, the preference over the three options (full delegation, cheap talk and veto power) changes as follows, as the bias grows:

$$FD \succ VP \succ CT \rightarrow FD \succ CT \succ VP \rightarrow CT \succ FD \succ VP \rightarrow CT \succ VP \succ FD.$$

For values of the status quo higher than $1 - \frac{\sqrt{3}}{3}$, the preference over delegation mechanisms for intermediate values of the bias is changed:

$$FD \succ VP \succ CT \rightarrow VP \succ FD \succ CT \rightarrow VP \succ CT \succ FD \rightarrow CT \succ VP \succ FD.$$

This is expected, since when the status quo is high and the bias is intermediate, this allows communication for low states of the world and control for high states of the world, characteristics that are shared with the optimal delegation outcome found in the full commitment setting.

IV Limited discretion and veto power

A case that has not been studied from a strategic point of view is that of limited discretion with veto power. This type of delegation was proposed by Epstein and O'Halloran (1994). In their setting, the principal could set a status quo policy, y_0 , and what they called an amount of discretion, d . This means that the informed agent could only propose an outcome contained in the interval $[y_0 - d, y_0 + d]$ and, besides, the principal could veto the proposal in favor of the status quo. What makes this analysis incomplete, is that the principal is informed of the state of the world at the moment of deciding whether to veto the proposal or not. This makes that the proposal has no strategic value, thus the veto power does not induce any noise in the information transmission (indeed, there is no information transmission) and therefore keeping veto power is always beneficial for the principal.

In the setting studied in this dissertation, the main issue is how the principal's commitment power and the rules that she commits to affect the informational efficiency of decision making, which makes the Epstein-O'Halloran result irrelevant. Furthermore, it is unclear why the principal, knowing that she will be informed of the state of the world at the moment of making a decision, would delegate to an equally informed but biased agent.

In the setting studied here, the principal sets a delegation set $[m, M]$. Without any calculations, there are four observations that can be made.

First, if there was no veto power, we have already shown that this delegation set would be equivalent to setting an upper threshold equal to $\max\{1 - b, \frac{1}{2}\}$, which yields the optimal incentive compatible outcome. Therefore, holding a veto power in this setting is never ex-ante optimal for the principal. The question here, thus, is not about whether the principal will choose to keep a veto power, but whether the commitment not to overrule a proposal is credible or not.

Second, if the principal could freely set the status quo, the optimal delegation outcome can be trivially obtained, without even having to use Mylovannov's veto-power principle. It is sufficient to set the status quo to any point not contained in the optimal delegation set.

Third, it is also clear that giving the principal the power to limit the agent's discretion will increase her ex-ante payoff with respect to unconstrained delegation with

veto power, because adding only inactive constraints is always feasible.

Finally, for any value of the bias such that cheap-talk yields no communication (i.e. for any $b > \frac{1}{4}$), this set-up will always dominate cheap-talk, given that the uninformed decision outcome, $y^* = \frac{1}{2}$, can be trivially obtained by setting the delegation set equal to the singleton $\{\frac{1}{2}\}$.

This section has as objective to characterize the optimal delegation set the principal will set. This set, however, depends on the equilibrium that the principal anticipates that will be played, and we have already seen that the veto power equilibria need not be unique. I will characterize the optimal boundaries when the principal anticipates that the continuation game will be a modification of the veto-power delegation equilibrium described in the previous section.

Before fully characterizing the equilibrium, note that imposing a lower bound will always be harmful for the principal. Indeed, this can have two effects. On one hand, it will move the proposed outcomes away from the principal's preferred choice. On the other hand, it will make communication noisier. Both these effects lower the principal's expected payoff, thus I will focus on finding the optimal upper bound of the delegation set, which will be denoted M .

In all of the cases described below, the additional restriction of the expected utility being higher than the one that could be obtained if taking an uninformed decision has to be considered. This will be analyzed once all the cases have been characterized, given the common characteristics that this restriction will have.

IV.1 High bias case: $b > \min\{1 - y_0, \frac{1}{2}\}$

This case coincides with the *UB* case of the previous subsection when $b \leq \frac{1}{2}$. It is straightforward that setting $M_0^* = 1 - b$ will yield the same outcome as the optimal delegation set described in subsection III.1.

When $b > \frac{1}{2}$, the optimal outcome can be obtained by setting $M^* = \frac{1}{2}$. The agent will never propose anything lower than $\frac{1}{2}$ as it is a dominated strategy.

IV.2 High-intermediate bias case: $b < \frac{1}{2}$, $y_0 + b < 1$ and $y_0 + 2b > 1$

This case coincides with the I and I^L cases of the previous subsection. In this case, a boundary $M > 2 - y_0 - 2b$ will have no effect on the equilibrium.

If the principal imposes a boundary $M \in [y_0, 2 - y_0 - 2b]$, then the equilibrium takes the following form:

$$y(\theta) = \begin{cases} \theta + b & \text{if } \theta \in [0, y_0 - b] \\ y_0 & \text{if } \theta \in [\max\{0, y_0 - b\}, \frac{M + y_0 - 2b}{2}] \\ M & \text{if } \theta > \frac{M + y_0 - 2b}{2}, \end{cases}$$

where the position of the jump discontinuity, $\frac{M + y_0 - 2b}{2}$ is such that the incentive compatibility is maintained. A priori, the constraint $M \geq 2b - y_0$ would have to be imposed. We will see later, when comparing to the uninformed decision outcome, that this constraint is always satisfied if the optimum is of this type.

Calculating the principal's marginal utility of M out of this expression, one finds that:

- It is positive in $M = y_0$.
- It is negative in $M = 2 - y_0 - 2b$.
- The expected utility is maximized at

$$M_1^* = \frac{4 - y_0 - 2\sqrt{(1 - y_0)^2 + 3b^2}}{3}$$

It is easy to see that this local maximum is the global maximum for this case. Indeed, if the principal sets a boundary $M < y_0$, then the equilibrium outcome is

$$y(\theta) = M$$

if $M < b$, and

$$y(\theta) = \begin{cases} \theta + b & \text{if } \theta \in [0, M - b] \\ M & \text{if } \theta > M - b, \end{cases}$$

if $M \geq b$ (which can happen only if $y_0 \geq b$).

As $b < \frac{1}{2}$, then the first case is never optimal (it is always beneficial to rise M), and the second case has a local maximum $M_0^* = 1 - b$ only if $y_0 \geq 1 - b$, which falls out of the case analyzed here.

I will show in the analysis of the next case, that M_1^* is valid in a parameter region larger than the one studied in this case. The complete analysis of the validity and optimality of M_1^* will be done in the next cases.

IV.3 Low-intermediate bias case: $y_0 + 2b < 1$ and $y_0 + 3b > 1$

This case coincides with the KM^H and KM^{HL} of the previous subsection. For parameters b and y_0 in this area, the upper bound can be contained in any of the intervals $[0, y_0]$, $[y_0, y_0 + 2b]$ or $[y_0 + 2b, y_0 + 4b]$. Any boundary higher than $y_0 + 4b$ will have no effect on the equilibrium.

If the boundary is assumed to be lower than the status quo, it turns out that the only local optimum candidate is $M_0^* = 1 - b$, but this contradicts the fact that $y_0 + b < 1$, which tells us that the optimal boundary will not be in this interval for parameters in this area.

If the boundary is assumed to be in the interval $[y_0, y_0 + 2b]$, then the equilibrium takes the exact same form as in the previous case and the local maximum is also M_1^* . This value is indeed in the relevant interval for parameters such that $y_0 + b < 1$ and $y_0 + (2 + \sqrt{2}b) \geq 1$, which fully contains the parameters in this case.

If the boundary is assumed to be in the interval $[y_0 + 2b, y_0 + 4b]$, then the equilibrium outcome is

$$y(\theta) = \begin{cases} \theta + b & \text{if } \theta \in [0, y_0 - b] \\ y_0 & \text{if } \theta \in [\max\{0, y_0 - b\}, y_0] \\ y_0 + 2b & \text{if } \theta \in [y_0, \frac{M+y_0}{2}] \\ M & \text{if } \theta > \frac{M+y_0}{2}. \end{cases}$$

Straightforward calculations show that the marginal utility is negative if $y_0 + (2 +$

$\sqrt{2}b) \geq 1$, which excludes this type of optimum in this case.

If the boundary is assumed to be lower than y_0 , the same argument than in the previous case excludes a potential optimum. Therefore, in this case the optimal boundary is M_1^* as well.

IV.4 Low bias case: $y_0 + 3b < 1$

This case covers the KM and KM^L areas of the previous subsection. The argument to show that there is no optimal boundary lower than the status quo holds in this case as well, so the boundary can be contained in any of the intervals $[y_0, y_0 + 2b]$, $[y_0 + 2b, y_0 + 4b]$ or $[y_0 + 4b, 1 + b]$.

By the same arguments of the previous two cases, if the boundary is assumed to be in the first of these three intervals, the optimal boundary is equal to M_1^* and this is valid for any parameters such that $y_0 + (2 + \sqrt{2})b \geq 1$.

If the boundary is assumed to be in the interval $[y_0 + 2b, y_0 + 4b]$, then the maximization yields the local optimum

$$M_2^* = \frac{4 - y_0 - 2b - 2\sqrt{(1 - y_0)^2 - 4b(1 - y_0) + tb^2}}{3}.$$

This value is contained in the mentioned interval for any parameters such that $y_0 + (2 + \sqrt{2})b \leq 1$ and $y_0 + (4 + \sqrt{2})b \geq 1$, which gives the region for which it is a local optimum.

If the boundary is assumed to be higher than $y_0 + 4b$, then the local optimum is equal to $M_0^* = 1 - b$ and it is valid whenever $y_0 + 5b \leq 1$. We see, then, that there is a region, where $y_0 + 5b \leq 1$ and $y_0 + (4 + \sqrt{2})b \geq 1$, in which there are two local optima that need to be compared. For this, it is useful to define $\delta = \frac{1 - y_0}{b}$. This auxiliary parameter can take values between zero and $\frac{1}{b}$. Then, the area where M_2^* is a valid local optimum is $\delta \in [2 + \sqrt{2}, 4 + \sqrt{2}]$ and the area where M_0^* is a valid local optimum is $\delta \in [0, 1] \cup [5, +\infty)$. The intersection of these sets is given by $\delta \in [5, 4 + \sqrt{2}]$. With these transformation, replacing y_0 by $1 - \delta b$, M_2^* can be expressed

$$M_2^* = 1 - \frac{b}{3} \left(2 - \delta + 2\sqrt{7 - 4\delta + \delta^2} \right).$$

Doing this variable change, the expression for $EU^P(M_0^*) - EU^P(M_2^*) = 0$ is an equation that depends only on δ , and that has a single real solution $\delta^* \in [5, 4 + \sqrt{2}]$ whose approximate value is $\delta^* \approx 5.2028$. As both utility functions are concave at that point, M_0^* is preferred right of that point, and M_2^* is preferred left of that point.

A good way to summarize this set of results is as a function of b and δ . The optimal upper bound is given by

$$M^* = 1 - bx(\delta)$$

for $\delta \in [0, \frac{1}{b}]$, where

$$x(\delta) = \begin{cases} 1 & \text{if } \delta \leq 1 \\ \frac{-\delta + 2\sqrt{\delta^2 + 3}}{3} & \text{if } \delta \in (1, 2 + \sqrt{2}] \\ \frac{-(\delta - 2) + 2\sqrt{(\delta - 2)^2 + 3}}{3} & \text{if } \delta \in (2 + \sqrt{2}, \delta^*] \\ 1 & \text{if } \delta > \delta^*, \end{cases}$$

whenever this yields an expected utility higher than $-\frac{1}{12}$, the utility of an uninformed decision.

Note that $x(\delta) \geq 1$, with strict inequality for $\delta \in (2 + \sqrt{2}, \delta^*)$, which indicates that with veto power the principal restricts the decision set more than what she would optimally do if there was full commitment.

To fully characterize the equilibrium, one needs to find the parameters for which the expected utility is higher than $-\frac{1}{12}$. For this, the principal's expected utility is needed:

$$EU^P(\delta \leq 1) = -b^2 + \frac{4}{3}b^3$$

$$EU^P(M_1^*) =$$

$$\begin{cases} -\frac{1}{3}y_0^3 + \frac{1}{3}\left(\frac{y_0 - M_1^* + 2b}{2}\right)^3 - \frac{1}{3}\left(\frac{M_1^* - y_0 - 2b}{2}\right)^3 + \frac{1}{3}(M_1^* - 1)^3 & \text{if } y_0 - b < 0 \\ -b^2(y_0 - b) + \frac{1}{3}\left(\frac{y_0 - M_1^* + 2b}{2}\right)^3 - \frac{1}{3}\left(\frac{M_1^* - y_0 - 2b}{2}\right)^3 + \frac{1}{3}(M_1^* - 1)^3 & \text{if } y_0 - b \geq 0 \end{cases}$$

$$EU^P(M_2^*) =$$

$$\begin{cases} -\frac{1}{3}y_0^3 - \frac{8}{3}b^3 + \frac{1}{3}\left(\frac{y_0 - M_2^* + 4b}{2}\right)^3 - \frac{1}{3}\left(\frac{M_2^* - y_0}{2}\right)^3 + \frac{1}{3}(M_2^* - 1)^3 & \text{if } y_0 - b < 0 \\ -b^2(y_0 - b) - \frac{8}{3}b^3 + \frac{1}{3}\left(\frac{y_0 - M_2^* + 4b}{2}\right)^3 - \frac{1}{3}\left(\frac{M_2^* - y_0}{2}\right)^3 + \frac{1}{3}(M_2^* - 1)^3 & \text{if } y_0 - b \geq 0 \end{cases}$$

$$EU^P(\delta > \delta^*) = \begin{cases} -b^2 - \frac{1}{3}(y_0 - b)^2(2b - y_0) & \text{if } y_0 - b < 0 \\ -b^2 & \text{if } y_0 - b \geq 0. \end{cases}$$

In what is left of this subsection, the parameter regions will be defined according to where the optimal upper bound is located. Thus, the space $[0, 1] \times [0, \frac{1}{2}]$ of status quo outcomes and biases is divided into four, according to the value of $\delta = \frac{1-y_0}{b}$. For each of the four cases, the conditions for an upper bound to be better than an uninformed decision will be found.

Low bias case: $\delta > \delta^*$

In this case, the bias reaches a maximal value of $\frac{1}{\delta^*} \approx 0.192$. The principal's expected utility is non-decreasing in y_0 and decreasing in b , so the worst expected utility the principal can obtain is equal to $-\frac{1}{\delta^{*2}} - \frac{2}{3\delta^{*3}} \approx -0.042 > -\frac{1}{12}$, so the limited-discretion delegation with veto power always includes some transmission of information in this case.

Intermediate-low bias case: $\delta \in [\delta^*, 2 + \sqrt{2})$

In this case, the optimal upper bound is M_2^* whenever it yields an expected utility higher than $-\frac{1}{12}$. Due to the untractable form that the utility functions takes, numerical methods are preferred. The following solution is obtained:

- When $y_0 - b \geq 0$, the upper bound M_2^* always yields a higher expected utility than an uninformed decision.
- When $y_0 - b < 0$, there is a region in the plane (b, y_0) in which it is optimal to take an uninformed decision.
- This region is located south-east of a curve that intersects $y_0 = 0$ at the point $(0.2883, 0)$ and that intersects $\delta = 2 + \sqrt{2}$ at the point $(0.2899, 0.0101)$.

It can be seen that the region where an uninformed decision is taken is rather small. This will not be so, as it will be seen, in the next case.

Intermediate-high bias case: $\delta \in [2 + \sqrt{2}, 1)$

In this region, the optimal upper bound will be equal to M_1^* whenever this yields a higher utility than an uninformed decision and whenever $M_1^* + y_0 - 2b \geq 0$. Note that if $\frac{1}{2} - b \leq b - y_0$, then an upper bound $M = \frac{1}{2}$ will induce a constant outcome, equal to $\bar{y} = \frac{1}{2}$.

As in the previous case, the expressions are rather untractable, so numerical methods are preferred. The following results are obtained:

- If $y_0 - b \geq 0$, limited discretion always dominates an uninformed decision.
- If $y_0 - b \geq 0$, it is trivially satisfied that $M_1^* + y_0 - 2b > 0$, as $M_1^* \geq y_0$.
- Whenever the constraint $EU^P \geq -\frac{1}{12}$ is satisfied, the constraint $M_1^* + y_0 - 2b \geq 0$ is also satisfied.
- If $y_0 - b < 0$, there is a region of the (b, y_0) plane in which an uninformed decision is preferred.
- This region is located south-east of a curve, implicitly defined by $EU^P = -\frac{1}{12}$, that intersects $y_0 + (2 + \sqrt{2})b = 1$ approximately at a point $(0.2847, 0.0278)$, and that goes through the point $(\frac{1}{2}, \frac{1}{2})$.

As it can be seen, the area where an uninformed decision is preferred is far from trivial in this case.

High bias case: $\delta \geq 1$

It is trivial to see that in this case, as it gives the same outcome as the optimal delegation solution, veto-power delegation with limited discretion is always better than an uninformed decision and thus the optimal upper bound is always $M_0^* = 1 - b$.

Now, I have fully characterized the optimal amount of discretion that is given to the agent when the principal cannot renounce her veto power. It is easy to see that $x(\delta) \geq 1$. This is because in the low-intermediate and high-intermediate bias cases, the upper bound has not only an effect on the information pooling at the top of the support, but also has an effect on information transmission in lower states of the world, through the position of the discontinuity in the outcome function. This raises the marginal utility of the upper bound with respect to the continuous outcome case (or, more generally, with respect to the case where the upper bound does not generate a discontinuity), which lowers the optimal threshold when compared to the optimal delegation solution. Figure 10 shows graphically the areas where each optimal upper bound is valid, including the areas where an uninformed decision is optimal. Note the small region south-east of M_2^* , where an uninformed decision is optimal.

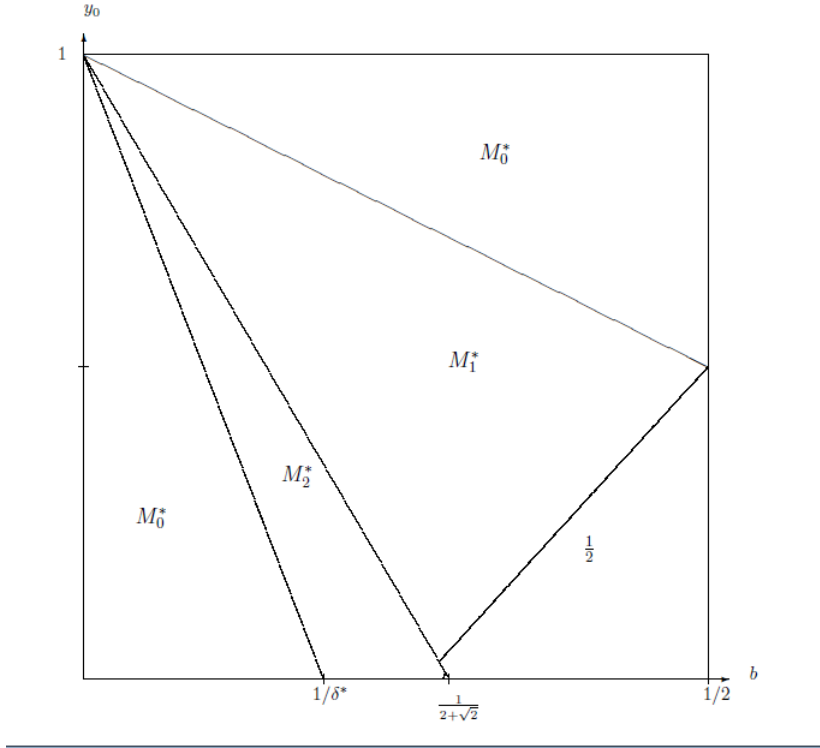


Figure 10: Optimal discretion with veto power.

We have left to see if this type of contract adds anything to pure communication. There are two facts that are already evident. First, for any bias larger than $1/4$, that is, for any bias where there would be no communication, veto-power delegation with limited discretion does as well as ex-ante for the principal. Second, for any parameter profile (b, y_0) such that veto-power delegation dominates cheap talk, veto-power delegation with limited discretion dominates cheap talk as well. These two facts make that limited discretion delegation dominates cheap talk in most of the (y_0, b)

plane. The only case that is left to prove is the one in which the bias is lower than 0.25 and cheap talk dominates veto-power delegation. One can see in figure 9 where this area is located. One portion of this area is in the M_1^* region, while the other portion is located in the M_2^* region, and in the entire region, $b > \frac{1}{12}$, which implies $N(b) = 2$. Numerical methods show that in both these regions veto-power with limited discretion strictly dominates cheap talk. This gives the following lemma:

Lemma 6 (Veto-power delegation with limited discretion versus cheap talk). *For any value of the parameters (b, y_0) , veto-power delegation with limited discretion dominates cheap talk.*

To complete the analysis, we need to characterize the cases where veto-power delegation with limited discretion dominates full delegation. Note that this particular comparison has normative value only in the very particular case where a principal can only give up veto rights by fully delegating decision rights. Thus, if the principal intervenes in any way in the decision making process, for instance by limiting the agent's discretion, then she cannot give up veto rights. If she could, we would find ourselves in the optimal delegation case and the principal would always prefer, ex-ante, to give up the right to ex-post veto the agent's proposal. With this in mind, the principal can either give up any influence in the decision-making process, or control it by both limiting the feasible decision set and by vetoing the decision ex-post. The comparison is summarized in the following lemma.

Lemma 7 (Veto-power delegation with limited discretion versus full delegation). *The principal will prefer to fully delegate to the agent if and only if one of the following conditions is satisfied:*

- $\delta \geq \delta^*$ and $y_0 - b < 0$.
- y_0 and b are such that the optimal upper bound is M_2^* and (b, y_0) is south of the curve $EU^P(M_2^*) = -b^2$.
- y_0 and b are such that the optimal upper bound is M_1^* and (b, y_0) is south of the curve $EU^P(M_1^*) = -b^2$.
- y_0 and b are such that it is optimal to make an uninformed decision and $b^2 < \frac{1}{12}$.

The principal is indifferent between full delegation and veto-power delegation with limited discretion if $\delta \geq \delta^$ and $y_0 - b \geq 0$.*

The results in the above lemma are graphically shown in figure 11. Note that in this case full delegation is preferred only when the status quo is relatively small, which is the case where the inability to give up veto rights damages communication the most, due to the status quo being the furthest away from the agent's preferences.

The optimal upper bounds in this subsection increase the principal's expected utility with respect to unbounded delegation with veto power, but this is not a pareto improving change. Indeed, the principal, by limiting ex-ante the agent's signals and thus introducing noise into the information transmission can credibly commit not to accept a high proposal, that would have otherwise been optimal to accept ex-post thus introducing an ex-ante gain for the principal and a loss for the agent.

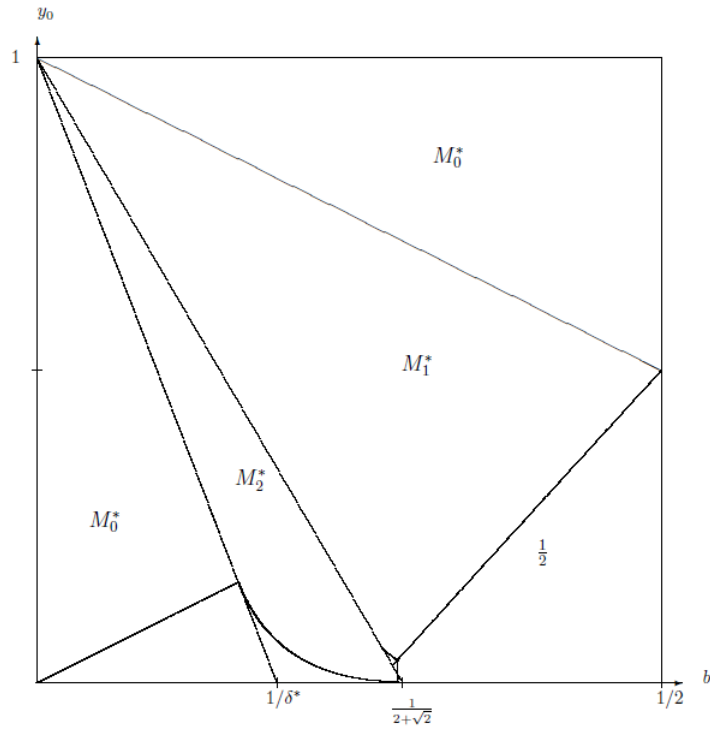


Figure 11: Representation of the principal's preferences between veto-power delegation with limited discretion and full delegation.

V Concluding remarks

In this dissertation, different models of decision making that do not involve monetary transfers have been analyzed, using the simple framework of a constant bias and a

uniform distribution.

We have seen that different types of commitment have different effects, varying with the value of the underlying parameters b and y_0 . If the principal has full commitment power, the optimal delegation solution consists of fully separating signals for low states of the world and pooling for high states, where the loss in informational efficiency is recovered by distributive gains for the principal. This is a form of contract widely observed in real-life situations (price-cap monopoly regulation, and board-approval of high expenses in corporations are two examples), which suggests it is an appropriate solution. Note that the optimality of threshold regulation depends on the probability distribution of the state of the world.

Full delegation is the optimal situation for the agent, and is a type of commitment that is beneficial for the principal if compared to the no-commitment (cheap talk) outcome, but unless the conflict of interest is very small, it entails a loss for the principal with respect to keeping some kind of control. In particular, if the principal can decide whether to hold or give up a veto power, then she will choose to keep it for values of the bias that are not particularly high, depending on the value of the status quo: if the status quo is high, then the values of the bias for which the principal will want to give up veto power are more restricted.

For low values of the status quo, however, not being able to give up the veto power can be very harmful for the principal, to the point of preferring to give up *any* sort of commitment and to communicate with the agent via cheap talk.

The loss brought by not being able to give up veto rights can be reduced if the principal can restrict communication from the agent. By setting upper bounds on the feasible proposals from the agent, the principal can make sure of doing better than with communication, and in most cases will do better than by giving away all control.

Also, when the principal holds a veto right, the agent is allowed less discretion than if compared to the case of no veto power. This is a prediction of this model whose generality and reliance on the model's hypotheses ought to be analysed in future research.

From the analysis in this dissertation, we can distinguish three levels of commitment. In the lowest level of commitment, the principal is able to choose ex-post among all the possible decisions that were available ex-ante. In an intermediate level of commitment, the principal can credibly commit to choose between a status quo policy and

the agent's proposal, without overruling the agent by choosing a policy different to these two. In the third, and highest, level of commitment, the principal can commit ex-ante to respect the decision made by the agent.

Which one of these levels of commitment will be preferred by the principal will depend on the level of the conflict of interest and on the status quo. Also, it will depend on whether the principal can limit ex-ante the agent's communication space. If she cannot do so, then, in general, full delegation (high commitment) is preferred for low bias levels, veto power (intermediate commitment) is preferred for intermediate bias and cheap talk (no commitment) is preferred for a high conflict of interest. The exception, as seen in section III, is when the status quo is low, in which case full delegation is preferred for low bias, communication for high bias, and keeping a veto right is never optimal. This is because a low status quo outcome is equivalent to an outcome that is very bad for the agent, and thus harms information transmission the most. This puts in perspective the results in Dessein (2002), who argues that full delegation is preferred to veto power, Marino (2008), who shows that veto can dominate delegation depending on the probability distribution of the private information, and Mylovanov (2007), who shows that if the veto is properly chosen, than veto delegation always dominates full delegation.

If the principal can limit communication ex-ante, then more commitment is generally preferred (except, again, when the status quo is low and for particular values of the bias). Indeed, the principal does not need more commitment than limiting the communication space ex-ante and giving up her veto power: this yields the second-best outcome.

Adding up, we see that the solution to the efficiency versus control trade off is not unique, and particular settings yield different conclusion with respect to the value of commitment and the value of information.

Delegation models are then a useful framework that, using a simple, tractable model, can deliver easily interpretable conclusions and predictions. Many branches of it are yet unexplored or are subject of current research, such as multidimensional delegation, multiple agents and intertemporal delegation. It is a setting that is very effective in delivering qualitative predictions in domains such as lobbying, organizational design and economics of regulation. For this, however, the basic model has to be modified into an ad-hoc model to fit the situation in mind, while keeping the results tractable. This is an important setback, since so far it has not been possible to study how the simplifying assumptions that are made affect the conclusions reached.

VI References

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