Kings and Parliaments: Ruling by Building Consensus*

Charles Angelucci (Columbia) Simone Meraglia (Exeter) Nico Voigtländer (UCLA, NBER, and CEPR)

August 20, 2018

Abstract

We investigate the conditions under which a principal delegates authority over the financing of a public project to an assembly of agents. The principal is privately informed about the value of a public project which, if financed, affects his payoff as well as the agents'. Each agent receives a private and noisy signal about the value of the project. The principal is cash-constrained, and the agents choose whether to invest their endowments in the public project or in their own private projects. The principal's inability to grab the agents' resources means she is tempted to exaggerate the value of the public project. We show that the principal may find it optimal to implement an assembly in which agents exchange their private information and decide whether to finance the public project. We study the conditions under which this mechanism dominates alternative mechanisms in which the principal either (i) relies on the agents' purely voluntary contributions or (ii) signals the projects profitability at a cost. We apply this model to the case of medieval parliaments. We argue that towns' self-governance made (i) contributions to the king's public projects voluntary and (ii) difficult for kings to unilaterally appropriate towns' wealth. The latter issue made towns more concerned about the profitability of public projects sponsored by increasingly cash-constrained rulers. Rulers therefore resorted to national assemblies as a way to raise more resources for socially efficient projects.

Keywords: committee, assembly, governance, delegation

JEL Classification Numbers: ...

*We thank Matthew Backus, Wouter Dessein, Robert Gibbons, Alessandro Lizzeri, Jacopo Perego, Andrea Prat, Paolo Siconolfi, Ennio Stacchetti, and seminar participants at Columbia University, the University of Exeter, and the 2018 Quebec Political Economy. All remaining errors are ours.

1 Introduction

From ancient history, assemblies and committees have played a crucial role in many governance structures. A central function of assemblies is aggregate dispersed information useful for decision-making purposes. Assemblies also help distinct agents to coordinate their behavior and achieve greater collective goals. This paper investigates the impressive surge in parliaments that occurred in Europe from the 12th century onwards, when kings and overlords often raised money by summoning general assemblies. This evolution is regarded as a major institutional turning point, particularly because of assemblies' later role in constraining monarchs. We study the reasons why assemblies – as opposed to other available mechanisms – emerged as the key channel through which kings raised finances.

The premise of our analysis lies with Europe's Commercial Revolution that started in the 11th century (Lopez, 1976). Many merchant towns were granted the right of self-governance by their overlords, chiefly because of the need for an efficient and specialized administration to reap the benefits of trade. Municipal autonomy, in turn, made it difficult for kings and lords to raise money coercively and unilaterally. Contributions to national projects became almost voluntary in nature, and kings had to rely on persuasion to raise the necessary funds. Often, kings insisted that towns send representatives to general assemblies, where the decision whether to finance their projects were made.

Consulting towns and merchants to receive their guidance and advice is unlikely to have constituted the primary motive behind kings' summoning of general assemblies. Most projects under discussion were wars, which kings specialized in and from which they derived their legitimacy.[1] Why then did kings create parliaments? We argue that kings suffered from a credibility problem: they were perceived as too eager to have

[1]Moreover, separate councils composed of military specialists (e.g., knights) existed alongside parliaments.

their projects financed. As Harriss (1975) put it, there was "difficulty in separating the necessity of the king from that of the realm." This credibility problem made it costly to persuade each town separately, even when projects were truly worth pursuing. By setting up assemblies and letting towns share information with each other, kings relieved the burden that otherwise was theirs to engage in persuasion. Ensuring assemblies functioned well, though, also came at cost: Kings had to concede defeat frequently enough.

We develop a model in which a principal (king) interacts with two agents (self-governed towns). Each agent has a unit endowment of wealth that he can invest across two projects. The first project is managed by the principal but affects all players – it is a "public project" (e.g., a war). Each agent also manages a "local project" which benefits himself mostly (e.g., local infrastructure). Local projects generate certain returns. By contrast, the returns to the public project are uncertain and initially unknown to all players. The principal privately observes a signal about the quality of her project during the course of the game. Agents also privately acquire information, but their signals are a garbling of the principal's information. Under this information structure, the principal does not gain *per se* from setting up an assembly in which the agents' information is aggregated. The principal is able to coercively extract part of the agents' endowments. She must however persuade them to make any additional contributions. We assume that the principal is biased from the perspective of the agents: she is too eager to have her projects financed. This credibility problem means that truthfully communicating her (superior) private information to the agents is challenging.

In our model, the principal effectively contemplates three mechanisms (or "governance structures") through which to raise revenues. In the first mechanism, the principal does not attempt to convey her private information and instead sets up an assembly in which the agents (strategically) share their private information with each other. This

mechanism works only if the principal succeeds in ensuring that agents truthfully reveal their information (indeed, they are tempted to lie in order to increase the other agent's investment in the public project). This is achieved by committing to accept defeat and letting the agents invest a large share of their endowment in their own projects when agents refuse to finance the public project. In the second mechanism, the principal does not attempt to persuade agents, and instead relies on agents' voluntary contributions. Agents do not coordinate their investment decisions and make their choices based solely on their private information. In the third mechanism, the principal – who has observed private information suggesting that the project is worth pursuing – signals her private information by committing to compensate the agents (through lower final taxes) in case the project turns out to be disappointing. This arrangement is reminiscent of standard financial contracts in which borrowers pledge collateral. We provide conditions under which the "assembly mechanism" is optimal from the perspective of the principal.

1.1 Related Literature

2 Historical Background

In medieval times, kings and lords were entitled to *ordinary* taxation on land, trade, and justice. Kings were also entitled to *extra-ordinary* taxation in cases of *necessity to advance the common good*. Obvious threats to the realm were considered as legitimate cases of necessary. In practice, though, what constituted a case of necessity was often blurry.

The process by which cases of necessity were selected evolved with time. Medieval England is instructive, and representative of a broader pattern applying to the rest of Western Europe. Following the Norman Conquest, and until Magna Carta in 1215, kings decided almost unilaterally which projects constituted cases of necessity. Perhaps

not surprisingly, kings were often perceived as passing for cases of necessity projects of personal benefit to them. There existed a real *difficulty in separating the necessity of the king from that of the realm* (Harriss 1975). Kings' abuses in part led to baronial revolts and Magna Carta, which in turn instituted the practice whereby kings' *pleas of necessity* needed to receive consent from the barons and the high clergy. The latter exerted real constraints on monarchs, as evidenced by the Sicilian Affair (1260) in which Henry III failed to raise the necessary funds to conquer Sicily.

During the same period, kings experienced with various mechanisms through which to raise extra-ordinary taxation from towns involved in trade. The Commercial Revolution that shook Europe from the 11th century onwards led to an impressive surge in municipal self-governance. Local administrative autonomy from the royal administration, in turn, meant that kings had to persuade towns to raise the necessary funds.[2] The old practice of unilaterally and coercively extracting resources had become harder, for it would violate towns' privileges. At first, kings dispatched royal officials to self-governed towns to persuade the latter (often under some degree of coercion). Towns were approached separately and sometimes sequentially, with royal officials claiming that other towns had already pledged resources. To persuade towns to cooperate, it was not uncommon for kings to promise lower *ordinary* taxation in case of projects' negative repercussions on the local economy. In our theoretical analysis, this type of mechanism—through which kings could signal the legitimacy of their request by promising lower taxation in cases of failure—will represent a powerful (but costly) alternative to setting up parliaments.

An alternative means through which to raise money from towns emerged in the late 13th century. From 1295 onwards, kings started frequently summoning parliaments in which towns sent representatives. Once in parliament, representatives would bargain

[2]Not only did towns need to be persuaded to raise the necessary revenues to fund kings projects, their cooperation in collecting the money in a speedily manner was also central.

and communicate with each other and eventually reach a yes/no answer to kings' pleas. Kings insisted that towns elect representatives with *plena potestas* to speed up the implementation of the decisions made in parliament. This meant that the promises made by representatives were binding for the communities they represented.[3] Prior to summoning parliaments, kings would dispatch royal official across England to inform towns of the projects to be discussed and prime them into consenting to the kings pleas. It was not uncommon for parliaments to refuse to finance projects, much to kings despair.

This process is fairly representative of Western Europe more generally. Everywhere self-governance emerged in the wake of the Commercial Revolution, and everywhere towns' autonomy made it harder for kings to unilaterally raise money. Regional and national assemblies in which towns participated emerged, though the exact mechanism by which assemblies functioned (and their strength) varied from one country to the other.

3 Setting

We consider a setting with three risk-neutral players: a Principal P (e.g., the king) and two agents A_1 and A_2 (e.g., two towns). Each agent has a unit endowment which he can invest across two projects. One project is managed by P but benefits all players (e.g., a war). We refer to P's project as a "public project." It is a public good: an agent benefits from it even if it does not finance it itself. As we show below, the public good nature of P's project means that agents have incentives to behave strategically when communicating with each other.

Each agent also manages a "local project" which benefits himself only–for instance,

[3]Interestingly, decisions made in parliament applied to towns not represented in parliament.

improvements in towns' market infrastructures.[4] We denote by $I_i \in [0,1]$ the investment made by A_i in the public project (where $i = 1, 2$). In our example, this transfer of endowment denotes the "extra-ordinary" tax collected by P to finance her wars.

Technologies and Information. Local projects guarantee a constant marginal return equal to $R > 1$ to the agents, that is, an extra dollar of investment generates an extra R dollars of local wealth. The return R is common knowledge.

By contrast, the constant marginal returns ω of the public project are unknown to all players. The public project is either good ($\omega = \overline{\omega}$) or bad ($\omega = \underline{\omega}$), where $\overline{\omega} > \underline{\omega}$ and $\Pr(\omega = \overline{\omega}) = p$. An agent enjoys $\overline{\omega}(I_1 + I_2)$ of local wealth from the public project when it is good, and $\underline{\omega}(I_1 + I_2)$ when it is bad.

Although all players initially share the common prior p, we suppose they each observe a private signal in the course of the game. In particular, we suppose P privately observes signal $\sigma_P \in \{\underline{\sigma}, \overline{\sigma}\}$, where $\Pr(\omega = \overline{\omega} \mid \sigma_P = \overline{\sigma}) = \overline{p}$, $\Pr(\omega = \overline{\omega} \mid \sigma_P = \underline{\sigma}) = \underline{p}$, and $\overline{p} > \underline{p}$. We denote by $\alpha < 1$ the prior probability that P observes $\overline{\sigma}$, where $p = \alpha\overline{p} + (1-\alpha)\underline{p}$ by the law of iterations.

Further, A_i privately observes signal $\sigma_i \in \{\underline{\sigma}, \overline{\sigma}\}$, a garbling of P's information. Specifically, $\Pr(\sigma_i = \sigma_P) = \rho \in (1/2, 1)$ and agents' signals are conditionally independent (conditional on the realization of σ_P). In words, each agent observes P's signal realization with probability ρ. With probability $1 - \rho$, it observes the "wrong" signal realization. The higher ρ is, the more correlated with the principal's is the agents' information. This information structure has one important implication, namely that the principal is not interested in the agents' private information *per se*. Her information is *sufficient* in the sense of Blackwell. This assumption–though admittedly stark–captures the key idea that kings were military experts, and that it is thus unlikely that

[4] What matters for our purposes is that the local project benefits disproportionately more the agent in charge of it than the other players.

they summoned parliament to benefit from towns' guidance and local knowledge.

Finally, we suppose that the return ω to the public project is publicly observed at the end of the game (e.g., whether a foreign country posed a real threat becomes public). This will allow P to offer the agents incentives that are contingent on the *realized* value of ω. In particular, P may be tempted to persuade the agents that investing in the public project is worth pursuing by promising a low final tax t in case $\omega = \underline{\omega}$. As we show below, this simple mechanism—reminiscent of standard financial contracts in which borrowers pledge collateral–will constitute a powerful alternative to setting up an assembly.

Payoffs. We suppose A_i's ex post payoff takes the form:

$$U_i = \left[1 - \left(I_i + e_{I,i}\right)\right] R + \omega \left[\left(I_i + e_{I,i}\right) + \left(I_j + e_{I,j}\right)\right] - \left(t_i + e_{t,i}\right), \tag{1}$$

where t_i denotes a final transfer of wealth from A_i to P occurring at the end of the game. As will become clear below, transfers t are contingent on the entire history of the game. Moreover, the transfer t_i can take negative values. It is however bounded from below by the amount of private gains the public project generates for P (see (2) below). In other words, the king cannot transfer more wealth than it possesses. In our example with kings and towns, this transfer of wealth denotes the "ordinary" taxation collected by kings from towns' local economy.

We suppose that P is able to coercively extract wealth from the agents twice during the game.[5] First, P can extract $e_{I,i}$ from A_i early in the game to finance the public project. Second, P can extract $e_{t,i}$ from A_i at the very end of the game, when all projects' returns have materialized. The timing of the game is described below in

[5]Whether transfers of wealth occur coercively or under the threat of coercion is unimportant for our purposes.

greater detail.

We impose limits on P's ability to coercively extract resources from A_i. We suppose that P is never able to extract more endowment and/or wealth from A_i than an upper bound we denote $x < 1$, from which A_i's voluntary transfers must also be subtracted. Specifically, $e_{I,i} \in [0, \max\{0, x - I_i\}]$ and $e_{t,i} \in [0, \max\{0, x - t_i\}]$, with $x < 1$, for $i = 1, 2$.

We suppose P's ex post payoff takes the form:

$$V = \theta \sum_{i=1}^{2} \left(I_i + e_{I,i}\right) + \sum_{i=1}^{2} \left(t_i + e_{t,i}\right), \tag{2}$$

where $\theta > 1$ represents P's private gains from the public project (see below). For instance, the king could privately gain from waging a war. This private gain will lead to P suffering from a credibility problem when communicating with the agents about the signal σ_P she has observed.

Communication and Mechanisms. Let $\hat{\sigma}_P \in \{\underline{\sigma}, \overline{\sigma}\}$ and $\hat{\sigma}_i \in \{\underline{\sigma}, \overline{\sigma}\}$ denote cheap-talk messages sent by P and A_i, respectively. We explore various patterns of communication channels during the course of the analysis. To each agent i, P offers a contract that specifies:

1. an investment I_i to be made by A_i, contingent on all messages publicly exchanged,
2. a transfer t_i to be paid by A_i contingent on relevant messages, the investments made by both agents in the public project, and realized wealth, and
3. the amount P coercively extracts from A_i's endowment ($e_{I,i}$) and wealth ($e_{t,i}$), contingent on the history of the game.

Importantly, we suppose P is able to commit to the contracts he offers. A further assumption we make concerns the timing of contract announcements: we suppose P

offers her contract *prior* to observing σ_P. This assumption alleviates signaling concerns and allows for a more transparent welfare analysis.[6] Because P offers her contract *prior* to observing σ_P, she has the ability to design a menu of two contracts, where the two contracts are chosen so that it is incentive compatible for herself to truthfully communicate her signal. In other words, P has the ability to tie her own hands by announcing contracts that will ensure that the "good principal" (the one observing $\sigma_P = \overline{\sigma}$) separates from the "bad principal" (the one observing $\sigma_P = \underline{\sigma}$) once σ_P is observed. Similarly, if she chooses a single contract—so that she does not need to exercise discretion after having observed σ_P, P essentially commits to not revealing her information to the agents. Given our information structure, only in the latter case will setting up an assembly have any scope.[7]

Timing. We summarize the model by presenting the timing of moves.

1. Nature draws the value ω of the public project and players' signals $\sigma_{_P}$, $\sigma_{_1}$, and $\sigma_{_2}$.

2. P decides whether to allow for public communication between $A_{_1}$ and $A_{_2}$—that is, she decides whether to set up an assembly—and announces a menu of contracts specifying $\left(I_i, e_{_{I,i}}, t_i, e_{_{t,i}}\right)$, for $i = 1, 2$.

3. P, A_1, and A_2 privately observe their signals. P chooses a contract from her menu of contracts and agents simultaneously send messages $\hat{\sigma}_1$ and $\hat{\sigma}_2$ (if bilateral communication is allowed).

4. Agents simultaneously choose their investments I_1 and I_2 in the public project.

5. P chooses to extract $e_{_{I,i}}$ from A_i's endowment, for $i = 1, 2$.

[6] For instance, this approach greatly diminishes the issue of equilibrium multiplicity.

[7] If P succeeds in revealing her information truthfully, the agents' information becomes useless and so does any bilateral communication amongst them.

6. The quality of the public project ω is observed and payoffs realize. Each A_i transfers t_i to P, for $i = 1, 2$.

7. P chooses to extract $e_{t,i}$ from A_i's remaining wealth, for $i = 1, 2$.

Assumptions. We end the description of the setting with two last assumptions:

- **A1**: $2\overline{\omega} + \theta > R > 2\underline{\omega} + \theta$.
- **A2**: $x < 2\underline{\omega}$.

A1 ensures that investing the entirety of the agents' endowment in the public project is socially efficient (resp. inefficient) when $\omega = \overline{\omega}$ (resp. $\omega = \underline{\omega}$). **A2** implies that—regardless of whether A_i invests in the public project or his local economy—P is always able to extract an amount of wealth up to x from the former at the last stage of the game (i.e., even when the entirety of the agents' endowments is invested in the public project, and the latter turns out to be bad). **A2**, in combination with the fact that $\theta > 1$, further implies that P invests in the public project the entirety of the share of the agents' endowment she is able to extract. In other words, P's chief concern is to invest as much resources as possible in her public project. As mentioned earlier, this will imply P lacks credibility when communicating about σ_P: she will always be tempted to claim that $\sigma = \overline{\sigma}_P$.

4 Main Analysis

4.1 Benchmarks

We begin our analysis by developing several benchmarks in which players do not observe private signals. We maintain the assumption that the value ω of the public project is unknown to all, though observed *ex post*. Benchmarks will differ depending

on the severity of the agency problem between the principal and the agents. These different scenarios allow us to highlight the main frictions at play in our model.

Obedient Agents. Suppose that the agents are perfectly obedient: they transfer their endowment and realized wealth to P as the latter wishes (i.e., even above x, the amount P is able to extract coercively). Stages 5 and 7 in the timing are no longer relevant. In this version of the model, P chooses I_i and t_i to maximize:

$$V = \theta \sum_i I_i + \sum_i t_i, \tag{3}$$

subject to:

$$t_i \leq (1 - I_i) R + \omega \sum_i I_i, \quad i = 1, 2. \tag{4}$$

Recall that $I_i \in [0, 1]$. Inequality (4) is a feasibility constraint which captures the fact that P cannot extract from A_i more than his realized wealth. Binding (4) and plugging t_i into P's objective function yields the solution:

$$I_i^{fb} = \begin{cases} 1 & \text{if } \theta + 2\mathbb{E}[\omega] \geq R \\ 0 & \text{if } \theta + 2\mathbb{E}[\omega] < R \end{cases} \tag{5}$$

In this benchmark, because P can extract the entirety of the agents' realized wealth, she is *de facto* residual claimant and thus makes the socially efficient investment in the public project. In our linear model, P behaves as a social planner and finds that investing the entirety of the agents' endowments is optimal whenever the expected social marginal returns from the public project are higher than the certain returns R from the local projects.

Partially-obedient Agents. We now analyze an intermediate benchmark in which P is able to extract I_i as she wishes, but not the final tax t_i. Accordingly, we reintroduce the possibility for P to employ coercion ($e_{t,i}$) at the final stage of the game. We consider this artificial case to isolate the consequences of agents' inability to commit to the final transfer t on P's investment in the public project.

Formally, P chooses I_i and t_i to maximize:

$$V = \theta \sum_i I_i + \sum_i t_i, \tag{6}$$

subject to:

$$t_i \leq \min \left[(1 - I_i) R + \omega \sum_i I_i, x \right], \quad i = 1, 2, \tag{7}$$

where, unlike the previous case, the feasibility constraint (7) now takes into account the fact that P is unable to extract more than x at the final stage. Assumption **A2** ensures that the right-hand side of (7) is equal to x for all possible choices of I_i and realizations of ω. Thus, the solution to P's problem is given by $I_i = 1$ and $t_i = x$ (for $i = 1, 2$) for any realization of ω. In this benchmark, P's inability to tax the final wealth is so limited that she prefers to shift the entirety of the agents' endowments towards the public project in order to enjoy her private gains (θ).[8] When compared to the previous benchmark, an inefficiency arises when $\theta + 2\mathbb{E}[\omega] < R$. Returning to our main application, kings' inability to perfectly tax towns gave them incentives to shift resources to national projects such as wars for which they enjoyed private gains.

[8] If we relaxed **A2**, the solution would be as in the first-best if $\theta + 2\mathbb{E}[\omega] \geq R$. If instead $\theta + 2\mathbb{E}[\omega] < R$, then the optimal investment would be $I = \min\left[\tilde{I}, 1\right]$, where:

$$\tilde{I} : \left(1 - \tilde{I}\right) R + \mathbb{E}[\omega] 2\tilde{I} = x \;\rightarrow\; \tilde{I} = \min[\frac{R - x}{R - 2\mathbb{E}[\omega]}, 1]. \tag{8}$$

Voluntary Investments. We consider a final benchmark in which both transfers of endowment and wealth occur voluntarily (though under the threat of coercion). The solution to this case will allow us to isolate the consequences for efficiency of P's need to persuade towns to make investments in the public project.

In this benchmark, P chooses I_i, $e_{I,i}$, t_i and $e_{t,i}$ to maximize:

$$\theta \sum_i \left[I_i + e_{I,i}(I_i) \right] + \sum_i \left[t_i(I_i, I_j, e_{I,i}, e_{I,j}) + e_{t,i}(I_i, I_j, e_{I,i}, e_{I,j}) \right] \tag{9}$$

subject to

$$(I_i, t_i) = \arg\max_{\hat{I}_i, \hat{t}_i} \left(1 - \hat{I}_i - e_{I,i}(\hat{I}_i) \right) R + \tag{10}$$

$$+ \mathbb{E}[\omega] \left[\hat{I}_i + e_{I,i}(\hat{I}_i) + I_j + e_{I,j}(I_j) \right] - \mathbb{E}_\omega \left[\hat{t}_i + e_{t,i}(\hat{I}_i, e_{I,i}, I_j, e_{I,j}) \right],$$

$$t_i + e_{t,i} \leq \left(1 - I_i - e_{I,i} \right) R + \omega \sum_i \left[I_i + e_{I,i} \right], \tag{11}$$

$$e_{I,i}(I_i) \leq \max[x - I_i, 0], \tag{12}$$

$$e_{t,i}\left(I_i, e_{I,i}, I_j, e_{I,j} \right) \leq \max[x - t_i, 0], \text{ for } i, j = 1, 2 \text{ and } i \neq j. \tag{13}$$

Recall from our previous benchmark that P has an incentive to over-invest in the public project (compared to efficiency). In this setting with voluntary contributions, the principal must motivate the agents to contribute to her project. To do so, the principal can use two tools: whether and when to employ coercion and the choice of the final tax t as a function of the history of moves.

Constraint (10) determines each agent's choices of investment in the public project and transfer of final wealth to the principal, anticipating the latter's potential use of coercion. Further, (11) ensures that the final amount of wealth extracted from each agent is lower than or equal to the realized wealth. Finally, (12) states the upperbounds on P's coercive ability, taking into account each agent's transfers.

There are three cases to consider. If $\mathbb{E}[\omega] \geq R$, it is individually and socially optimal to set $I_i = 1$. Even though the agents do not internalize the positive externalities generated by their investments in the public project, they find it optimal to invest all of their endowments because the returns to the local project are relatively low. Returning to our example from medieval times, this could capture an imminent threat of invasion by a foreign power.

The solution to this case is straightforward. Although the principal threatens to coercively extract up to x of agents' endowment, agents voluntary transfer the entirety of their endowment so that no coercion occurs in equilibrium ($I_i^* = 1$). Finally, P is able to extract $t_i^* = x$, $\forall\omega, \forall I_i, \forall I_j$, by setting $e_{t,i}^*(\hat{t}_i) = x - \hat{t}_i \ \forall \hat{t}_i \leq x$.

Suppose now $\mathbb{E}[\omega] < R$ and $\theta + 2\mathbb{E}[\omega] < R$. Agents do not have individual incentives to contribute to the public project, and investing in the public project is socially inefficient. Despite the public project's inefficiency, the principal desires a positive investment on the agents' part because of her imperfect ability to tax final local wealth. Recall that the principal can employ (i) coercion and (ii) the schedule of final taxes (t) to motivate investments (I). If P relies on coercion only–that is, if t_i does not vary with A_i's voluntary contribution $\hat{I}_i$, the most P can raise is $I_i = x$ and $t_i = x$. This turns out to be the solution and the reason is as follows. P could induce greater investments by committing to lower final taxes. However, the rents necessary to convince the agents would be too high to make this profitable.[9] A consequence of P's imperfect ability to coercively extract agents' endowments is that socially inefficient projects are not fully financed (though there is still over investment relative to efficiency).

Finally, suppose $\mathbb{E}[\omega] < R$ and $\theta + 2\mathbb{E}[\omega] \geq R$, that is, $I_i = 1$ is socially efficient for $i = 1, 2$. As before, to achieve full investments, P cannot rely on coercion only.

[9]To induce one extra dollar of voluntary investment in the public project, P needs to offer A_i a discount on the final tax t_i equal to $R - \mathbb{E}[\omega]$ (so that $t_i = x - (1 - x)(R - \mathbb{E}[\omega])$). The value to P of this extra investment is equal θ. Therefore, inducing an extra dollar of investment is profitable if and only if $\theta + \mathbb{E}[\omega] \geq R$, which is violated because the public project is socially inefficient by assumption.

However, P can induce an efficient investment by setting:

$$t_i\left(\hat{I}_i\right) = x - \underbrace{(1-x)\left(R - \mathbb{E}\left[\omega\right]\right)}_{\text{Agent's rent}} \tag{14}$$

and $e_{t,i}(\hat{I}_i, \hat{t}_i) = 0$ if and only if $\hat{I}_i = 1$ and $\hat{t}_i \geq t_i(1)$. Otherwise, coercion is employed and all transfers are equal to x.

As in the previous case, inducing $I_i = 1$ is profitable if and only if $\theta + \mathbb{E}\left[\omega\right] \geq R$. This inequality may or may not hold. Because agents fail to internalize the social value of the investment, P needs to over-compensate them for an extra dollar of contribution to the public project. Therefore, even if socially efficient, public projects may fail to be fully financed.

To summarize this final benchmark's findings, the principal's imperfect ability to tax local production and extract investments means that (i) inefficient public projects are not fully financed (though P would like to) and (ii) some but not all efficient public projects are fully financed.

4.2 Private Signals

We now consider the main version of the model in which P and A_i privately observe σ_P and σ_i, respectively. We focus on the most interesting case in which investing the entirety of the agents' endowments is socially efficient if and only if $\sigma_{_P} = \overline{\sigma}$. Also, recall that we model the agents' signals as a garbling of the principal's signal. Many cases can arise depending on the degree of correlation ρ between the principal and agents' information. For the moment, we focus on the case which generates the most insights. In particular, conditional on σ_1 and σ_2, we suppose that:

$$\textbf{A3}: \qquad \theta + 2\mathbb{E}\left[\omega \mid \underline{\sigma}, \underline{\sigma}\right] < R < \theta + 2\mathbb{E}\left[\omega \mid \overline{\sigma}, \overline{\sigma}\right]$$

$$\textbf{A4}: \qquad \mathbb{E}[\omega \mid \underline{\sigma}] < R < \mathbb{E}[\omega \mid \underline{\sigma}, \overline{\sigma}] = p\overline{\omega} + (1-p)\,\underline{\omega} < \mathbb{E}[\omega \mid \overline{\sigma}]$$

The first chain of inequalities states that if both agents were to truthfully share their private signals with each other (and not rely on the principal's information), they would conclude that the public project is socially efficient (resp. inefficient) if both signals are good (resp. bad). Similarly, if both agents were to truthfully share their private signals with each other, the second chain of inequalities implies that an agent would find it individually rational to invest all of his endowment in the project if one or more signals are good.[10] However, if he relied on his private information only, then investing in the public project is not rational if his signal is bad. Notice that **A4** implies that the project is socially efficient (in expectation) even when both signals are conflicting.

We start our analysis with the simple case in which $\sigma_{_P}$ is observed by everyone. By assumption, agents' signals are therefore useless. Suppose first $\sigma_{_P} = \overline{\sigma}$. From **A4**, agents find it individually rational to invest the entirety of their endowments in the public project.[11] Our benchmark analysis with "voluntary contributions" implies that $I_{_i} = 1$ and $t_{_i} = x$, for $i = 1, 2$. As a result, P obtains payoff:

$$\overline{V} = 2[x + \theta]. \tag{15}$$

Suppose now $\sigma_{_P} = \underline{\sigma}$. Because the project is socially inefficient (in expectation), again our benchmark analysis with "voluntary contributions" implies that P is unable to induce contributions above what she can coercively extract (though she would like to). Hence, $I_{_i} = x$ and $t_{_i} = x$, for $i = 1, 2$. P obtains payoff:

$$\underline{V} = 2[x + \theta x], \tag{16}$$

[10] Although strong, this last assumption simplifies the analysis without modifying the results qualitatively.

[11] Formally, $\mathbb{E}[\omega \mid \sigma_P = \overline{\sigma}] > R$.

which is lower than $\overline{V}$. This simplified "symmetric information" environment identifies the temptation to lie P will face when $\sigma_{_P}$ is unobservable to the agents.

Finally, we compute P's expected payoff when $\sigma_{_P}$ is observable by all players:

$$\tilde{V} = \alpha\overline{V} + (1-\alpha)\,\underline{V} = 2x + 2\theta\left[\alpha + (1-\alpha)\,x\right]. \tag{17}$$

We now turn to the main setting in which each player privately observes her/his signal. Notice that our setting closely resembles a standard borrower-lenders setting under asymmetric information, except that P offers her contract prior to observing her private signal. This assumption is reasonable given the applications in mind, in which lasting institutions are being designed. It also allows for a more transparent comparison of ex ante expected payoffs. Another difference lies in the fact that in our setting agents are also privately informed about the quality of the project.

In this setting, P considers three mechanisms. In the first mechanism, P offers a single contract—thereby committing not to reveal her private information—and also forbids the agents from communicating with each other about their private signals. In the second mechanism, P announces a menu of two contracts and chooses these contracts so as to reveal truthfully σ_P once observed (in the sense that each contract is chosen by one "type" of principal only). Under this mechanism, the agents' information becomes redundant and there is thus no scope for assemblies. In the third mechanism (the mechanism that corresponds to setting up an assembly), P offers a single contract—thereby committing not to reveal her private information—and allows the agents to communicate with each other about their private signals. In this mechanism, P must provide incentives to the agents to communicate truthfully amongst themselves.

We compute the best mechanism within each class of mechanisms listed above. We then determine the optimal mechanism by comparing P's expected payoffs.

4.2.1 No Communication

We analyze the design of a mechanism in which P commits to offer a single contract that only specifies final transfers contingent on (i) agents' report (to P) of their private information and (ii) the returns from the public project. In this mechanism, P does not reveal her private information (because she restricts her menu of available contracts to contain only one option) and the agents are not allowed to communicate to each other. A key difference with our benchmark with "voluntary investments" lies in the fact that the agents now have private information at the stage in which they must decide how much to contribute to the public project. Another important aspect of this analysis is that P's private information goes unexploited.

The solution to this pooling mechanism is intuitive. If agents did not observe private signals, we know from **A4** that the prior probability p is sufficiently high that agents would voluntarily contribute the entirety of their endowments to the public project. In the presence of agents' private signals, if P were to rely on coercion only, **A4** implies that A_i voluntarily contributes (i) $I_i = 1$ when $\sigma_i = \overline{\sigma}$ and (ii) $I_i = x$ when $\sigma_i = \underline{\sigma}$, for $i = 1, 2$. P can achieve this outcome by setting $t_i = x$, for all contributions to the public project and realizations of ω. Although P could make final transfers contingent on the realization of ω to induce full investments ($I_i = 1$) also when agents observe $\underline{\sigma}$, our benchmark analysis (see Section (4.1)) established that inducing such behavior is not profitable to P.[12]

To sum up, when P commits to offer a single contract and does not allow for communication between agents, final taxes are equal to x and each agent invests his entire endowment in the public project if and only if he observes a good signal $\overline{\sigma}$. As

[12]Furthermore, if P were to offer a discount on the final tax t to induce full investment in the public project when A_i reports $\hat{\sigma}_i = \underline{\sigma}$, agents who observe $\overline{\sigma}$ will be tempted to lie about their signal. This additional issue makes it even less tempting to P to induce full investment in the public project by both types of agents.

a result, P's expected payoff is equal to:

$$\begin{aligned} V^{PM} = & \left[\alpha\rho^2 + (1-\alpha)(1-\rho)^2\right] 2(\theta + x) + \\ & + 2\left[\alpha\rho(1-\rho) + (1-\alpha)\rho(1-\rho)\right](2x + \theta(1+x)) + \\ & + \left[\alpha(1-\rho)^2 + (1-\alpha)\rho^2\right] 2(x + \theta x). \end{aligned} \tag{18}$$

Rearranging (18), we obtain:

$$V^{PM} = 2x + 2\theta\{\alpha\left[\rho^2 + (1-\rho)^2 x\right] + (1-\alpha)\left[\rho^2 x + (1-\rho)^2\right] + \rho(1-\rho)(1+x)\}, \tag{19}$$

where V^{PM} lies in between $\underline{V}$ and $\overline{V}$. Intuitively, the noisiness of agents' information relative to P's benefits the latter when $\sigma_P = \underline{\sigma}$ and hurts her when $\sigma_P = \overline{\sigma}$.

To gain more insights about the consequences, we compare (17) and (19). Uncertainty about the quality of the public project hurts P – i.e., $\tilde{V} \geq V^{PM}$ – when:

$$\alpha + (1-\alpha)x \geq \alpha\left[\rho^2 + (1-\rho)^2 x\right] + (1-\alpha)\left[\rho^2 x + (1-\rho)^2\right] + \rho(1-\rho)(1+x). \tag{20}$$

By inspection of (20), as expected, $\tilde{V} = V^{PM}$ in the extreme case in which $\rho = 1$ – i.e., when agents' information is perfectly positively correlated with P's. Also, $\tilde{V} \geq V^{PM}$ (resp. $\tilde{V} < V^{PM}$) for $\alpha \geq 1/2$ (resp. $\alpha < 1/2$) and $\rho \in (1/2, 1)$.[13] Hence, we conclude that P's expected payoff under the optimal "no communication" mechanism is particularly low relative to that under symmetric information when the prior probability (α) that the project is good is high and agents' signals are poorly correlated with P's information (i.e., ρ is low).

Because we are interested in studying the case in which uncertainty about ω is

[13]The left-hand-side (LHS henceforth) in (20) is increasing (resp. decreasing) in ρ for $\alpha \geq 1/2$ (resp. $\alpha < 1/2$). The statement then directly follows from the fact that LHS and the right-hand-side (RHS henceforth) in (20) are equal for $\rho = 1$.

(ex-ante) costly to P, we restrict attention to the case in which $\alpha \in [1/2, 1)$ (**A5**).

4.2.2 Costly Persuasion

The analysis we just conducted left unexplored two further options at P's disposal. First, P can signal her type (i.e., the value of $\sigma_{_P}$ she has observed) to the agents by offering state-contingent taxes (t) on realized wealth. By doing so, the principal who has observed a good signal will be able to separate herself from the principal who has observed the bad signal. Given our information structure, if P succeeds in truthfully revealing her information, the agents' information becomes useless and there is thus no scope for bilateral communication among them. Second, in the next section we explore the case in which P opts not to reveal her information and instead relies on agents exchanging information to each other about their private signals.

Suppose P commits to offer two contracts, where each contract is offered only by one 'type' of P. We refer to the 'good type' (resp. 'bad type') as the principal who has observed $\sigma_P = \overline{\sigma}$ (resp. $\sigma_P = \underline{\sigma}$). Recall that we assume ω is observed ex post, if the public project receives some funding.

We introduce additional notation. For $\sigma_{_P} = (\underline{\sigma}, \overline{\sigma})$, we define:

- $I_i(\overline{\sigma}) = \overline{I}$ and $I_i(\underline{\sigma}) = \underline{I}$,
- $t_i(\overline{\sigma}, \omega) = \overline{t}(\omega)$, and $t_i(\underline{\sigma}, \omega) = \underline{t}(\omega)$.

We maximize the expected payoff of the principal by characterizing the optimal menu of two contracts. We first characterize the contract chosen by the bad type. To do so, we maximize the expected payoff of the principal who observed $\sigma_P = \underline{\sigma}$. This is unambiguously optimal because it also relaxes the most the 'mimicking constraint", that is, the constraint that ensures both types of principal successfully separate.

The solution to the 'bad' principal's problem corresponds to the full-information

benchmark with 'voluntary contributions," for the case in which the public project is socially inefficient. In particular, $\underline{I} = x$ and $\underline{t}(\omega) = x$, $\forall\omega$. The principal is unable to raise more investments than what he can extract coercively.

Now consider the 'good' principal. Anticipating that both agents are offered the same incentives, P maximizes:

$$\theta \sum_i \overline{I} + \overline{p}[\sum_i \overline{t}\,(\overline{\omega})] + (1-\overline{p})[\sum_i \overline{t}\,(\underline{\omega})] \tag{21}$$

subject to:

$$\overline{t}\,(\omega) \leq x, \;\; \forall\omega, \tag{22}$$

and

$$\overline{p}[\overline{\omega}(\overline{I}+\overline{I}) - \overline{t}(\overline{\omega})] + (1-\overline{p})[\underline{\omega}(\overline{I}+\overline{I}) - \overline{t}(\underline{\omega})] + (1-\overline{I})R \geq \tag{23}$$

$$\overline{p}[\overline{\omega}(x+\overline{I}) - x] + (1-\overline{p})[\underline{\omega}(x+\overline{I}) - x] + (1-x)R,$$

and

$$2[\underline{I}\theta + \mathbb{E}[\underline{t}(\omega) \mid \underline{\sigma}]] \geq 2[\overline{I}\theta + \mathbb{E}[\overline{t}(\omega) \mid \underline{\sigma})]]. \tag{24}$$

Constraint (22) anticipates that P is unable to extract more than x at the final transfer stage by relying on the threat of coercion. We introduce this constraint to save on notation.[14] Inequality (23) ensures that the agents prefer to contribute $\overline{I}$ in the public project, rather than adopting their best deviation consisting of transferring x under the threat of coercion at both the investment and final tax stages. Inequality (24) is the 'mimicking constraint", which ensures the 'bad' principal does not mimic the 'good' principal.[15] As is standard, this constraint inevitably binds because, if the 'good" principal was to offer her associated full-information optimal contract (where $I = 1$

[14]If P sets t strictly higher than x, it is not sequentially rational for an agent to pay t. Anticipating this, P may as well choose $t \leq x$.

[15](Solution similar to 'Borrower-Lenders analysis with collateral'.)

and $t = x$), the 'bad" principal would always be tempted to pretend that she observed the good signal to increase the investments in the public project.

The solution to this problem involves $\overline{I} = 1$, $\overline{t}(\overline{\omega}) = x$, and $\overline{t}(\underline{\omega}) = x - \frac{\theta(1-x)}{1-\underline{p}}$, where we assume $x \geq \underline{p}$ to ensure that the good principal has enough private wealth to pay agents off when $\omega = \underline{\omega}$ (**A6**).[16] Intuitively, for any investment in the public project above x, the principal is essentially acting as a borrower and the agents as lenders. In the presence of asymmetric information, the optimal way for the good principal to signal the high quality of her project is to offer a discount in the final tax when the returns from the public project turn out to be low. Doing so makes it very costly for the bad principal to mimic the good one, because it would then be likely that the discount would have to be granted. Finally, the higher θ is, the more attractive it is for the bad principal to invest in the public project, and thus the more costly it is for the good principal to separate herself.

To summarize, P's expected utility when $\sigma_P = \underline{\sigma}$ is:

$$V^{SM}(\underline{\sigma}) = 2\left[x + \theta x\right]. \tag{25}$$

Similarly, P's expected utility when $\sigma_P = \overline{\sigma}$ is:

$$V^{SM}(\overline{\sigma}) = 2\left[x + \theta\left(1 - (1-x)\frac{1-\overline{p}}{1-\underline{p}}\right)\right]. \tag{26}$$

Thus, P's expected payoff under the optimal menu with two contracts is

$$V^{SM} = 2x + 2\theta\left[x + \alpha(1-x)\frac{\overline{p}-\underline{p}}{1-\underline{p}}\right]. \tag{27}$$

[16] **A6** is a sufficient but not a necessary condition for our analysis. In particular, for $\overline{t}(\underline{\omega})$ to be feasible, the following inequality $\theta\left[1 - \frac{1-x}{1-\underline{p}}\right] \geq -x$ needs to hold.

We first compare P's expected payoff under the optimal menu of two contracts to that when σ_P is publicly observable. From (17) and (27), because signalling is costly to P, it is straightforward to show that $\tilde{V} \geq V^{SM}$. In particular, the lower the ratio $\frac{\overline{p}-\underline{p}}{1-\underline{p}}$, the lower V^{SM} is. Intuitively, all else equal, lower values of $\overline{p}$ or higher values of $\underline{p}$ make it more costly for P to signal her type.[17]

Comparing P's expected payoff under the optimal "no communication" mechanism in (19) to that under the optimal menu of two contracts in (27) is also instructive. Given **A5**, both solutions give P a lower expected payoff with respect to the case in which σ_P is publicly available, but for two different reasons. The "no communication" mechanism performs badly when agents' private signals are poorly correlated with P's information, whereas the menus of two contracts performs badly when the probability of a low return ($\underline{\omega}$) from the public project is (i) (relatively) low for the bad principal and (ii) (relatively) high for the good principal.[18] Overall, the "no communication" mechanism dominates the separating one when agents' private signals are sufficiently correlated with P's private information, thereby making signalling less attractive to P.

4.2.3 Assembly

Rather than conveying her own private information via a menu of contracts, P can let agents communicate with each other. We refer to this setting as an assembly. As we formally show below, communication between agents can improve the principal's expected payoff compared to the "no communication" mechanism, and the more so the more correlated agents' signals are with P's own signal. Intuitively, when agents' signals are highly correlated with P's information, P anticipates that, when $\sigma_{_P} = \overline{\sigma}$, there is a high probability that at least one agent observes $\sigma_{_i} = \overline{\sigma}$. Provided this agent

[17] When $\frac{\overline{p}-\underline{p}}{1-\underline{p}} = 1$, that is, when signalling comes at no cost to P, we have $\tilde{V} = V^{SM}$.

[18] Still, recall that $\overline{p} \geq \underline{p}$.

truthfully reports his information to the other agent, from **A4**, having at least one agent observing $\overline{\sigma}$ is enough to induce full investment in the public project. Thus, because $\alpha \geq \frac{1}{2}$, allowing for communication between agents has the potential to improve on the two previous mechanisms we have studied. This conclusion is subject to one caveat: truthful communication does not come for free. Because an agent benefits from the investment in the public project made by the other agent, he may be tempted to lie.

We begin our formal analysis by introducing some further notation:

- $\Pr(\sigma_1 = \sigma_2 = \overline{\sigma} \mid \sigma_P) \equiv p_1(\sigma_P)$;
- $\Pr(\sigma_1 \neq \sigma_2) \equiv p_2(\sigma_P)$;
- $\Pr(\sigma_1 = \sigma_2 = \underline{\sigma}) \equiv p_3(\sigma_P)$;
- $\Pr\left(\sigma_j = \overline{\sigma} \mid \sigma_i\right) \equiv q_j(\sigma_i)$,

for σ_p and σ_i belonging to $(\underline{\sigma}, \overline{\sigma})$, $i, j = 1, 2$ and $i \neq j$.

We proceed by first assuming that agents truthfully report their information to each other. Under this assumption, the solution to P's problem is intuitive. Recall P wishes to implement $I_i = 1$ independently of σ_P, σ_1 and σ_2. Given **A3-A4**, regardless of the signal she observes, P can implement $I_i\left(\sigma_i, \sigma_j\right) = 1$ at no cost if at least one of the agents observes $\overline{\sigma}$, for $i, j = 1, 2$ and $i \neq j$. When $(\sigma_1, \sigma_2) = (\underline{\sigma}, \underline{\sigma})$, we also know from the benchmark analysis that the expected rent P would have to pay to induce $I = 1$ is too high to be tempting. Therefore, $I_i(\underline{\sigma}, \underline{\sigma}) = x$ (via coercion). Finally, P sets the final transfer $t_i\left(\sigma_i, \sigma_j, \omega\right)$ equal to x, for all realizations of σ_i, σ_j and ω.

To summarize, if we disregard A_i's incentive compatibility constraint when sending a message $\hat{\sigma}_i$ to A_j, we have that (i) agents invest the entirety of their endowments in the public project if at least one of the agents observe $\overline{\sigma}$, (ii) agents invest x otherwise, and (ii) P extracts x from agents' realized wealth. It is straightforward to show that,

under this assumption, P's expected payoff is strictly higher than her expected payoff under the optimal "no communication" mechanism. Relative to the case in which communication does not occur, communication between agents allows P to achieve a higher investment in the public project when agents receive contrasting signals.

However, this solution does not induce truth-telling by the agents. Formally, P must set $I_i\left(\sigma_i,\sigma_j\right)$ and $t_i\left(\sigma_i,\sigma_j,I_i,\omega\right)$ to satisfy A_i's incentive constraint at the communication stage:[19]

$$q_j\left(\sigma_i\right)\left[\mathbb{E}\left(\omega\mid\sigma_i\right)\left(I_i\left(\sigma_i,\overline{\sigma}\right)+I_j\left(\overline{\sigma},\sigma_i\right)\right)+\left(1-I_i\left(\sigma_i,\overline{\sigma}\right)\right)R-\mathbb{E}_\omega\left(t_i\left(\sigma_i,\overline{\sigma},I_i,\omega\right)\mid\sigma_i\right)\right]+ \tag{28}$$

$$\left(1-q_j\left(\sigma_i\right)\right)\left[\mathbb{E}\left(\omega\mid\sigma_i\right)\left(I_i\left(\sigma_i,\underline{\sigma}\right)+I_j\left(\underline{\sigma},\sigma_i\right)\right)+\left(1-I_i\left(\sigma_i,\underline{\sigma}\right)\right)R-\mathbb{E}_\omega\left(t_i\left(\sigma_i,\underline{\sigma},I_i,\omega\right)\mid\sigma_i\right)\right]\geq$$

$$q_j\left(\sigma_i\right)\left[\mathbb{E}\left(\omega\mid\sigma_i\right)\left(I_i^D\left(\tilde{\sigma}_i,\overline{\sigma}\right)+I_j\left(\overline{\sigma},\tilde{\sigma}_i\right)\right)+\left(1-I_i^D\left(\tilde{\sigma}_i,\overline{\sigma}\right)\right)R-\mathbb{E}_\omega\left(t_i^D\left(\tilde{\sigma}_i,\overline{\sigma},I_i^D,\omega\right)\mid\sigma_i\right)\right]+$$

$$\left(1-q_j\left(\sigma_i\right)\right)\left[\mathbb{E}\left(\omega\mid\sigma_i\right)\left(I_i^D\left(\tilde{\sigma}_i,\underline{\sigma}\right)+I_j\left(\underline{\sigma},\tilde{\sigma}_i\right)\right)+\left(1-I_i^D\left(\tilde{\sigma}_i,\underline{\sigma}\right)\right)R-\mathbb{E}_\omega\left(t_i^D\left(\tilde{\sigma}_i,\underline{\sigma},I_i^D,\omega\right)\mid\sigma_i\right)\right],$$

for $\tilde{\sigma}_i\neq\sigma_i$, with $\sigma_i=(\underline{\sigma},\overline{\sigma})$, and where we include P's potential use of coercion in the choices of I and t to ease notation. Also, to reflect the sequentiality in A_i's moves, I_i^D and t_i^D in (28) denote A_i's optimal choice of investment and final tax payment when lying about his signal.[20]

Suppose P wishes to enforce $I_i\left(\overline{\sigma},\overline{\sigma}\right)=I_i\left(\overline{\sigma},\underline{\sigma}\right)=1$, $I_i\left(\underline{\sigma},\underline{\sigma}\right)=x$, and $t_i\left(\sigma_i,\sigma_j,I_i,\omega\right)=x$. From (28) seeing that A_i has no incentive to lie when $\sigma_i=\overline{\sigma}$ is easy: lying can only jeopardize A_j's investment in the public project when $\sigma_j=\underline{\sigma}$. However, A_i has an incentive to lie when $\sigma_i=\underline{\sigma}$. Formally, when $\sigma_i=\underline{\sigma}$, rearranging

[19]Notice that, unlike our definition of t in the set-up section, we include I among the variables affecting t. We do so because we have reduced notation by anticipating P's coercive choices.

[20]Here, we anticipate on the analysis to come that P can always unilaterally enforce $I_i=t_i=x$ when A_i does not behave in a way consistent with the equilibrium path.

and simplifying (28) yields:

$$\mathbb{E}(\omega \mid \underline{\sigma})(x+x) + (1-x)R - x \geq \mathbb{E}(\omega \mid \underline{\sigma})(x+1) + (1-x)R - x, \tag{29}$$

which is clearly violated given $x < 1$. When $\sigma_j = \underline{\sigma}$, by reporting $\hat{\sigma}_i = \overline{\sigma}$ – and then investing $I_i^D = x$ (under the threat of coercion) – A_i induces A_j to invest $I_j = 1$ rather than $I_j = x$ in the public project, which also benefits him.

This analysis makes it clear that agents' incentive constraint at the communication stage must bind. A close inspection of (28) and (29) reveals that P has two tools at her disposal: P can either sets $I_i(\underline{\sigma}, \underline{\sigma}) < x$ and/or $t_i(\underline{\sigma}, \underline{\sigma}, I_i, \omega) < x$, for some ω.[21] In our linear model, P will try to employ only one of the two tools. We can therefore proceed to analyze them separately.

Investment-discount. Let us first analyze P's choice of $I_i(\underline{\sigma}, \underline{\sigma}) < x$. Intuitively, by promising to let A_i keep a higher share of his endowment (than what P could coercively extract) to be invested in the local economy when $\hat{\sigma}_1 = \hat{\sigma}_2 = \underline{\sigma}$, P can induce agents not to lie when observing a bad signal. In words, by committing to accept defeat in parliament (thereby letting agents invest a large share of their endowment in their own projects), the principal is able to foster truthful bilateral communication amongst the agent. Only by doing so can the principal relieve herself from the burden of persuasion. Formally, by substituting $I_i(\underline{\sigma}, \underline{\sigma})$ for x in the first two terms of LHS and RHS in (29), we obtain:

$$I_i(\underline{\sigma}, \underline{\sigma}) \leq \frac{x(R - \mathbb{E}(\omega \mid \underline{\sigma})) - \mathbb{E}(\omega \mid \underline{\sigma})}{(R - \mathbb{E}(\omega \mid \underline{\sigma})) - \mathbb{E}(\omega \mid \underline{\sigma})}, \tag{30}$$

[21] Given **A4**, it is easy to show that distorting downwards $I_i(\overline{\sigma}, \overline{\sigma})$ and/or $I_i(\overline{\sigma}, \underline{\sigma})$ is suboptimal, as agents find it individually rational to invest the entiretyl of their endowments in the public project.

where the RHS is lower than x provided $R > 2\mathbb{E}(\omega \mid \underline{\sigma})$ (**A7**), and is greater than zero provided $x \geq \frac{\mathbb{E}(\omega|\underline{\sigma})}{R-\mathbb{E}(\omega|\underline{\sigma})}$ (**A8**).[22] Because P's payoff increases with the investment in the public project, at optimum (30) binds and:

$$I_i^A(\underline{\sigma}, \underline{\sigma}) = \frac{x(R - \mathbb{E}(\omega \mid \underline{\sigma})) - \mathbb{E}(\omega \mid \underline{\sigma})}{(R - \mathbb{E}(\omega \mid \underline{\sigma})) - \mathbb{E}(\omega \mid \underline{\sigma})}, \tag{31}$$

where I_i^A is increasing in R. Intuitively, the higher the return to A_i's local economy (R) relative to the return from the investment in the public project, the more A_i gains from moving a marginal unit of his endwoment from the public project to the local economy, and the lower is the discount on the investment (relative to x) that P needs to offer A_i to induce truthtelling.

To sum up, a possible solution for the "assembly mechanism" consists in P requesting A_i to (i) invest the entirety of his endowment in the public project if at least one agent claims to have observed $\overline{\sigma}$, (ii) invest $I_i^A(\underline{\sigma}, \underline{\sigma})$ if both agents communicate $\underline{\sigma}$, and (iii) pay a final transfer $t = x$ (under the threat of coercion) independent of the history of the game and the realization of ω. P's expected payoff is then equal to:

$$V^A = \alpha\left[p_1(\overline{\sigma})\,2(x+\theta) + 2p_2(\overline{\sigma})\,2(x+\theta) + p_3(\overline{\sigma})\,2\left(x+\theta I^A\right)\right] + \tag{32}$$

$$(1-\alpha)\left[p_1(\underline{\sigma})\,2(x+\theta) + 2p_2(\underline{\sigma})\,2(x+\theta) + p_3(\underline{\sigma})\,2\left(x+\theta I^A\right)\right].$$

Rearranging terms in (32), we obtain:

$$V^A = 2x + 2\theta\left[(p_1(\alpha) + 2p_2(\alpha)) + p_3(\alpha)\,I^A\right], \tag{33}$$

where $p_z = p_z(\overline{\sigma}) + p_z(\underline{\sigma})$, for $z = 1, 2, 3$, denotes the total probability that a given combination of agents' private signals realize.

[22] From **A7**, we have that the RHS in **A8** is lower than 1.

Final tax-discount. From the incentive constrain in (29), P can also induce truthtelling by choosing different values of $t_i\left(\hat{\sigma}_i, \hat{\sigma}_j, \hat{I}_i, \omega\right)$, which affect the last term in both LHS and RHS, and where $\hat{I}_i$ denotes A_i's choice of I_i. P does not modify her choice of all the remaining variables: In particular, P requests agents to invest the entirety of their endowments if at least one agent reports $\overline{\sigma}$, and invest x otherwise.

We proceed by describing the candidate solution, as the constrained maximization problem may look cumbersome. Intuitively, P can commit to extract $t_i < x$ when $\hat{\sigma}_i = \hat{\sigma}_j = \underline{\sigma}$. P sets $t_i = x$ in all the remaining instances, including the one in which $\hat{\sigma}_i = \overline{\sigma} \neq \hat{\sigma}_j$ *and* $\hat{I}_i \neq 1$. By promising a discount on final taxation when both agents truthfully reveal their bad signals and both invest x, P can punish A_i's deviation which consists in reporting $\hat{\sigma}_i = \overline{\sigma} \neq \sigma_i$ and investing $\hat{I}_i = x$ (rather than 1). From (28), truthtelling is induced provided that:

$$\mathbb{E}_{\omega}\left(t_i\left(\underline{\sigma}, \underline{\sigma}, x, \omega\right) \mid \underline{\sigma}\right) \leq x - (1-x)\,\mathbb{E}\left(\omega \mid \underline{\sigma}\right). \tag{34}$$

Because P's payoff is increasing in t_i, at optimum (34) must bind. Therefore, P's expected payoff from offering this mechanism is:

$$\begin{aligned} V^{AT} = \alpha\left[p_1\left(\overline{\sigma}\right) 2\left(x+\theta\right) + 2p_2\left(\overline{\sigma}\right) 2\left(x+\theta\right) + p_3\left(\overline{\sigma}\right) 2\left(x - (1-x)\,\mathbb{E}\left(\omega \mid \underline{\sigma}\right) + \theta x\right)\right] + \\ (1-\alpha)\left[p_1\left(\underline{\sigma}\right) 2\left(x+\theta\right) + 2p_2\left(\underline{\sigma}\right) 2\left(x+\theta\right) + p_3\left(\underline{\sigma}\right) 2\left(x - (1-x)\,\mathbb{E}\left(\omega \mid \underline{\sigma}\right) + \theta x\right)\right], \end{aligned} \tag{35}$$

where AT stands for "assembly with tax discount".

By comparing (32) to (35), we have that $V^{A} \geq V^{AT}$ whenever $\theta + 2\mathbb{E}\left(\omega \mid \underline{\sigma}\right) \leq R$, which holds from **A3-A4**. Intuitively, using a discount on the final tax to induce truthtelling is equivalent to using discounts on taxes to induce agents to fully invest in the public project when the project is socially inefficient (compare (34) to (14)). From

the benchmark analysis, we know this is not profitable to P.

We conclude our analysis with the main proposition:

Proposition 1 *The "assembly mechanism" dominates the "no communication" mechanism if:*

$$\rho\left(1-\rho\right)\left(1-x\right)\geq\left(x-I^{A}\right)n\left[\alpha\left(1-\rho\right)^{2}+\left(1-\alpha\right)\rho^{2}\right]. \tag{36}$$

Therefore, the "assembly mechanism" is the principal's preferred choice when (36) holds and $\overline{p}$ is sufficiently low and/or $\underline{p}$ is sufficiently high to make the "costly persuasion" mechanism inferior to the "no communication" mechanism.

Proof. By rewriting $p_{1}\left(\sigma_{P}\right)$, $p_{2}\left(\sigma_{P}\right)$ and $p_{3}\left(\sigma_{P}\right)$ in (32), we obtain:

$$V^{A}=2x+2\theta\{\alpha\left[\rho^{2}+\left(1-\rho\right)^{2}I^{A}\right]+\left(1-\alpha\right)\left[\rho^{2}I^{A}+\left(1-\rho\right)^{2}\right]+\rho\left(1-\rho\right)\left(1+x\right)\}. \tag{37}$$

Comparing (19) to (37) we obtain that $V^{A}\geq V^{PM}$ when (36) holds. ■

In our model in which agents share a common prior and identical preferences, setting up an assembly in which agents' private information becomes public leads the latter to make identical investment decisions: They either both invest the entirety of their endowment, or both invest a relatively low amount (when they refuse P's request for funds). In other words, assemblies—by fostering consensus among agents—leads to perfectly coordinated investment behavior. This may or may not benefit the principal, depending on the prior probability that they both observed the bad signal. Intuitively, the "assembly mechanism" benefits P more than the "no communication" mechanism it is ex ante likely that agents observe conflicting signals.