The Optimal State Aid Control: No Control

Martin Gregor[*], Dalibor Roháč[**]

Abstract We extend a model of wasteful state aid in Dewatripont and Seabright (2006, *Journal of the European Economic Association* 4, 513–522) by a supranational controlling authority. The model combines moral hazard and adverse selection to show that politicians fund wasteful projects to signal their effort. Voters, unable to observe project benefits or effort, reward funding with a reelection premium that separates a high-effort politician from a low-effort politician. We examine state aid control by a benevolent authority which receives extra signals about the state of the world. We find that signals on the politician type are worthless. For signals on the project type, we derive a sufficient condition for aid control to unambiguously decrease welfare. We also prove that politicians do not respond to marginal changes in incentives. In this setup, the optimal state aid control is fairly often no control.

Keywords State aid, signaling, career concerns, aid control
JEL classification D72, D78, D82, H25

1. Introduction

In this paper, we investigate the possibility and desirability of supranational control of state aid in a framework where wasteful state aid serves as a signal of effort by national politicians. Based on the assumption that state aid can be both profitable or wasteful, we examine why a supranational controller should not be willing to ban state aid projects funded by the national authorities. We assume a benevolent controller, hence the topic can be treated as an optimal ex post control problem. Our main result is that in this setup, the case for the welfare-improving state aid control is rather narrow.

The costs and benefits of state aid are topics of joint interest of international economics, industrial organization, and political economy. In strategic trade theory, competition of countries through state aid is seen as detrimental to welfare (Spencer and Brander 1983; Krugman 1984; Dixit 1984; Eaton and Grossman 1986). There are nonetheless significant exceptions: With sufficient product differentiation and Bertrand and Cournot oligopoly, subsidies to domestic firms might be welfare enhancing if the negative effect of subsidies on profits of foreign firms can be outweighted by positive effect on foreign consumer surplus (Collie 2005).

[*] Charles University, Institute of Economic Studies, Opletalova 26, 110 00 Prague 1, Czech Republic. Phone: +420 222 112 317, E-mail: gregor@fsv.cuni.cz.
[**] Ph.D. Candidate, University of Oxford, Department of Economics, Manor Road, OX1 3UQ Oxford, United Kingdom. Phone: +44 1865 271073 , E-mail: dalibor.rohac@economics.ox.ac.uk.

From political economy point of view, the existence of asymmetric incentive to lobby on part of the losers (Baldwin and Robert-Nicoud 2007) also suggests that state aid must involve a significant share of wasteful projects. Empirically, there is indeed anecdotal evidence stating that state and regional aids largely fail to take into account the comparative advantage (Midelfart-Knarvik and Overman 2002).

Yet in the European Union, state aid in the form of direct transfers, equity participation, debt conversion, tax deferrals, or loan guarantees is strictly regulated. Each individual bailout must be approved by the EC Commission and the approval is conditional on a set of criteria gathered in the "Community Guidelines on State Aid for Rescuing and Restructuring Firms in Difficulty" (Official Journal of the European Union, 2004). In light of this, it is interesting that the proportion of negative decisions of the European Commission during the 1990s amounted to less than 2 percent of all cases under investigation (Besley *et al.* 1999).

We aim to show that, in a large set of circumstances, the optimal state aid control is indeed no control. We build on the signaling model of wasteful state aid in Dewatripont and Seabright (2006). This is a single country model where a politician exerts costly effort, and a representative voter lacks information on the aid benefits and the politician's effort. Wasteful state aid then emerges as a signal of effort by which a high-effort politician separates from a low-effort politician. The signal is however costly for the voter since the high-effort politician — who is more likely reelected — funds also wasteful projects, whereas the low-effort politicians funds only profitable projects. This contrasts to a dynamic framework in Casamatta and De Paoli (2007), where the politician with a stronger taste for the public investment is less likely to adopt a wasteful policy.

This line of reasoning follows classic career concern models of pre-electoral signaling (cf., Persson and Tabellini 2000). Pre-electoral signaling dates back to Rogoff's (1990) political budget cycle. With lack of evidence on cycles in fiscal aggregates (Brenden and Drazen 2008), recent research aims to restate the model away from total spending towards signaling through the structure of spending (Drazen and Eslava 2007, 2008). In the context of career concerns, another important variable serving as a signal of the politician type is the volume of campaign spending (Roumanias 2005).

Technically, a very close setup to ours offers Gersbach (2004), where money-burning refinement (e.g., costly uninformative advertising) is applied to eliminate pooling equilibria. Streb (2005) extends the setup by incomplete information on both competence and opportunism (lack of honesty), whereby extra spending loses part of its appeal as it serves as a signal of manipulation. Incentives remedying career concerns through change in the candidate quality in a citizen-candidate framework have been furthermore analyzed in Candel-Sanchez (2007), Poutvaara and Takalo (2007), and Gersbach (2009).

In the context of industrial policy, an alternative model of wasteful pre-electoral public investment is a model of 'white elephants' in Robinson and Torvik (2005). It shows that in order to win elections, incumbent governments might undertake projects with a negative surplus. The reason is that only the incumbent can credibly commit to unprofitable projects, which creates an electoral advantage of extra constituency of the

beneficiaries.

The paper proceeds as follows: Section 2 outlines the setup. Section 3 derives equilibria of the baseline case without aid control, including equilibria omitted in Dewatripont and Seabright (2006). On top of that, it discusses design of incentives aiming at the elimination of waste. Section 4 introduces the state aid controller into the model and proves the central results of the paper. Section 5 concludes.

2. The setup

Consider a politician providing state aid. The politician observes a pool of aid projects, investigates into their cost-benefit ratios, and decides on financing. Suppose each project costs $c > 0$, but projects differ in benefit $v \in \{\underline{v}, \overline{v}\}$, where $\underline{v} < c < \overline{v}$, thus a project is either wasteful or profitable.

The politician has to invest effort to find a profitable project. More precisely, suppose that the politician faces a menu of lotteries over profitable and wasteful projects. A lottery with a higher likelihood of a profitable project is available at the cost of higher effort than a lottery with a lower likelihood of the profitable project. Specifically, to find a profitable project with probability $i \in [0,1]$, let the effort be $\psi(i)$, where $\psi(0) = 0$, $\psi_i > 0$, $\psi_{ii} > 0$, and $\lim_{i \to 1^-} \psi(i) = +\infty$, where the last term guarantees the existence of an interior optimum of effort. Once effort is exerted, the corresponding lottery is carried out, the politician observes true v, and finally determines whether to fund the project ($a = 1$) or not ($a = 0$).

The politician pays entire cost c, but internalizes only a portion of the benefit, αv. We assume two types of politicians with the rates of internalization $\alpha \in \{\underline{\alpha}, \overline{\alpha}\}$ that are private information, where $0 < \underline{\alpha} < \overline{\alpha} < 1$. We call the high-type H-politician, and low-type L-politician. Effort and true (ex post) profitability of the project are also private information of the politician.

Timing is as follows: (0) Nature chooses H-politician with apriori probability $p \in [0,1]$, and L-politician with probability $1 - p$. (1) The politician chooses lottery i, and exerts effort $\psi(i)$. (2) Nature chooses profitable project with probability i, and wasteful project with probability $1 - i$. (3) Upon realization of the lottery, the politician observes v, and determines funding, $a \in \{0,1\}$. (4) A representative voter observes funding choice and reelects.

Since the voter does not observe project type, effort, or politician type, only the funding choice, there is just a pair of posterior beliefs of the voter: $p_0 = \Pr(\alpha = \overline{\alpha}|a = 0)$, and $p_1 = \Pr(\alpha = \overline{\alpha}|a = 1)$. The pair of re-election rates he or she selects is thus $(r_0, r_1) \in [0,1] \times [0,1]$, where r_0 applies in the case of no funding, and r_1 in the case of funding.

Since the setup is finite, let the continuation value of reelection for both politicians be fixed and positive, $B > 0$. This gives us that the politician's infoset value in the case of no funding is $r_0 B$, and in the case of funding writes $\alpha v - c + r_1 B$. For convenience, we denote the funding function of H-politician as $\overline{a}(v)$ and the funding function of L-politician as $\underline{a}(v)$.

Figure 1 illustrates the game tree. Given the voter's limited way of making be-

lief updates, this incomplete information game features no proper subgame, hence any equilibrium can be characterized as a Bayesian equilibrium (possibly with refinements). Notice that, unlike in many retrospective voting models, the voter is not able to commit to (pre-announce) a pair of reelection rates (r_0, r_1). If so, the voter as a Stackelberg leader would select from a set of proper subgames, and perfectness would have to be imposed.

Figure 1. Game tree (H: high-type politician, L: low-type politician, V: voter)
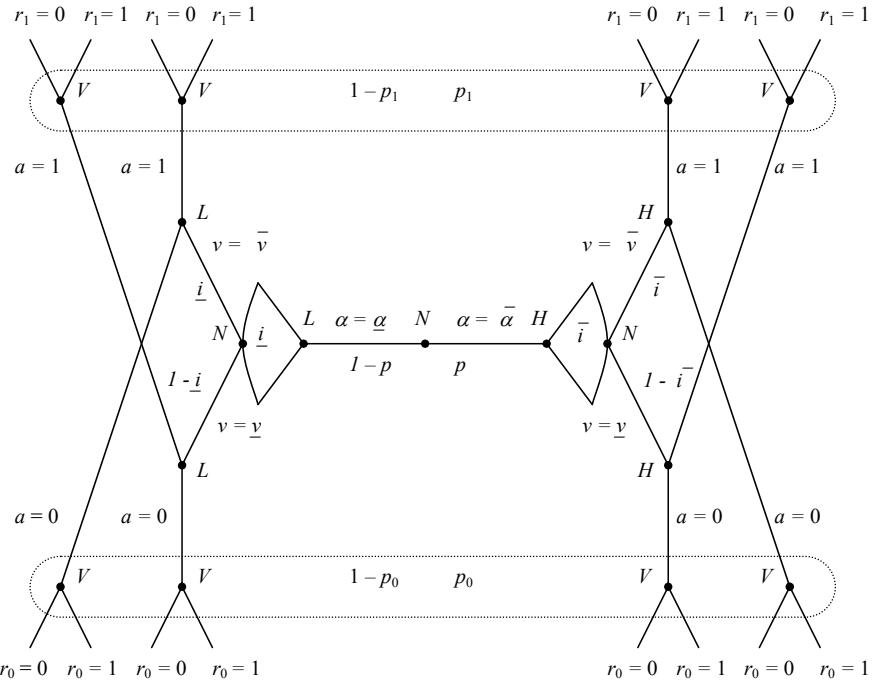
3. Equilibria

3.1 Preliminaries

To understand incentives of politicians, notice that a politician has exactly two instruments, *effort* and *funding*. Absent from reelection incentives, H-politician would use both instruments at a socially more preferred level than L-politician: Effort would be larger given the larger internalization of the benefit, and funding choice would be efficient (profitable projects funded, and wasteful projects stopped). With reelection, however, politicians additionally respond to a *reelection premium for funding*, $(r_1 - r_0)B$; if positive, politicians have an extra incentive to fund.

Dewatripont and Seabright (2006) identify a wasteful semi-separating equilibrium, characterized such that (i) L-politician exerts less effort than H-politician, but (ii)

H-politician funds all projects, including wasteful ones, whereas L-politician funds only profitable projects, and (iii) the voter maintains a positive reelection premium that induces wasteful spending as a signaling device of the high-type politician.

Thus, a tradeoff is associated with H-politician: The politician is able to access a better lottery, yet — facing a better lottery — overfunds. He or she keeps unobservable instrument (effort) at a socially more preferred level, but distorts the observable instrument (funding). Distortion of an observable instrument is accepted by the voter as long as the expected payoff from distortion compensated by better selection (as delivered by H-politician) exceeds expected payoff from non-distortion combined with worse selection (as delivered by L-politician).

The setup where benefits are uncertain, with uncertainty reducible by the politician's effort, is not only relevant to the provision of state aid. It applies to virtually all public policies where politician's effort is necessary to avoid risk of funding a wasteful project. Provision of state aid is only special due to the existence of a supranational authority that corrects for external effects of national state aid. Thus, the semi-separating equilibrium lends itself to a broad interpretation: Policy activism distinguishes competent governments, hence is a valuable signal, but also inevitably brings overspending compared to the social optimum.

Dewatripont and Seabright (2006) describe this equilibrium only implicitly. For comparative statics as well as the comprehensive analysis of the aid control, a full and explicit description of all feasible Bayesian equilibria is a precondition. This is subject of the following subsections.

3.2 The politicians' best responses

From the infoset values in the funding nodes, where project type is disclosed to the politician, it is straightforward that a politician's decision to fund is represented by $\alpha v - c + r_1 B \geq r_0 B$. We apply this inequality when characterizing the politician's best response. Before that, we introduce Assumption 1 by which politicians' valuations are such that politicians do not completely separate. The reverse case (where H-politician always internalizes more benefits than L-politician) doesn't directly feature the key tradeoff related to a high-type as suggested by Dewatripont and Seabright (2006), hence is not analyzed in the paper. We can provide solution to this case upon request.

Assumption 1 (Overlap). *H-politician internalizes the benefit of the low-value project less than L-politician internalizes the benefit of the high-value project, $\underline{\alpha}\bar{v} > \bar{\alpha}\underline{v}$.*

Let $\rho := r_1 - r_0 \in [-1, 1]$ be the *reelection rates difference*, expressing the difference between reelection for a funding and non-funding politician. The value ρB is to be called *reelection premium*. Table 1 uses the politician's optimal decision to fund to characterize five subsets of the reelection rates r_0, r_1 (or, equivalently, five subintervals of the reelection difference ρ):

Table 1. Partition of the feasible reelection rates

$$\Phi^1 = \{r_0, r_1 : \overline{\alpha}\overline{v} - c + \rho B \le 0\}$$
$$\Phi^2 = \{r_0, r_1 : \underline{\alpha}\overline{v} - c + \rho B < 0 \le \overline{\alpha}\overline{v} - c + \rho B\}$$
$$\Phi^3 = \{r_0, r_1 : \overline{\alpha}\underline{v} - c + \rho B < 0 \le \underline{\alpha}\overline{v} - c + \rho B\}$$
$$\Phi^4 = \{r_0, r_1 : \underline{\alpha}\underline{v} - c + \rho B < 0 \le \overline{\alpha}\underline{v} - c + \rho B\}$$
$$\Phi^5 = \{r_0, r_1 : 0 \le \underline{\alpha}\underline{v} - c + \rho B\}$$

Throughout the paper, we assume that all subsets are feasible (Assumption 2). In other words, the set of reelection premia is large enough to permit any funding choice of any politician. A necessary condition for feasibility of all subsets is twofold: First, the condition characterizing Φ^1-set holds for the lowest reelection difference ($\rho = -1$), where funding is maximally punished, $(r_0, r_1) = (1, 0)$. Second, the condition characterizing Φ^5-set holds for the largest reelection difference ($\rho = 1$), where funding is maximally rewarded, $(r_0, r_1) = (0, 1)$.

Assumption 2 (Feasible subsets). *The game parameters $(\underline{\alpha}, \overline{\alpha}, \underline{v}, \overline{v}, c, B)$ satisfy $\overline{\alpha}\overline{v} - c - B \le 0 \le \underline{\alpha}\underline{v} - c + B$.*

Our final restriction on parameters states that the Φ^1-set entirely belongs to the subspace of a negative reelection premium, where $\rho B = (r_1 - r_0)B < 0$, or $\rho < 0$. As we will immediately see, this is equivalent to say that for a zero reelection difference, at least H-politician funds the profitable project. This assumption is entirely for the sharpness of prediction in comparative statics.

Assumption 3 (Negative Φ^1-set). *Assume $\overline{\alpha}\overline{v} - c > 0$ to obtain $(r_0, r_1) \in \Phi^1 : \rho < 0$.*

Given the subsets in Table 1, funding choices in the best responses of the politicians are in Table 2. Notice in this context that Dewatripont and Seabright (2006) implicitly restricted their investigation to the Φ^4-set, disregarding the other best responses.

Table 2. The optimal funding choices of the politicians

Subset	$\underline{a}(\underline{v})$	$\underline{a}(\overline{v})$	$\overline{a}(\underline{v})$	$\overline{a}(\overline{v})$
Φ^1	0	0	0	0
Φ^2	0	0	0	1
Φ^3	0	1	0	1
Φ^4	0	1	1	1
Φ^5	1	1	1	1

In addition to funding, the other politician's instrument is effort. The optimal level of effort depends on whether — facing reelection rates — it is optimal for the politician to fund *no* project, only *profitable* project, or *both* projects. The optimal effort is thus subset-dependent, as Table 2 shows: L-politician funds no project on Φ^1 and Φ^2, single project on Φ^3 and Φ^4, and both projects on Φ^5. H-politician differs by funding single project on Φ^2, and both projects on Φ^4. Clearly, given the larger internalization rate,

H-politician funds relatively more than L-politician.

For no project funded, the optimal level of effort is obviously zero. For only a profitable project to be funded, the optimal effort satisfies for any $\alpha \in \{\underline{\alpha}, \overline{\alpha}\}$:
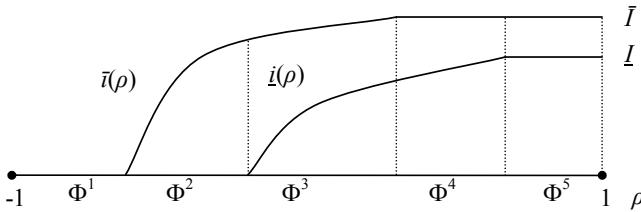
$$i = \arg\max\{i(\alpha\overline{v} - c + r_1 B) + (1 - i)r_0 B - \psi(i)\} = \psi_i^{-1}(\alpha\overline{v} - c + \rho B)$$

For both projects to be funded, the optimal effort satisfies for any $\alpha \in \{\underline{\alpha}, \overline{\alpha}\}$:

$$i = \arg\max\{i(\alpha\overline{v} - c + r_1 B) + (1 - i)(\alpha\underline{v} - c + r_1 B) - \psi(i)\} = \psi_i^{-1}(\alpha(\overline{v} - \underline{v}))$$

Denote the optimal effort of H-politician as $\overline{i}(\rho)$, and the effort of L-politician as $\underline{i}(\rho)$, and impose $\overline{I} := \max\{\overline{i}\} = \overline{i}(1), \underline{I} := \max\{\underline{i}\} = \underline{i}(1)$. Figure 2 illustrates the optimal levels of effort.

Figure 2. The optimal effort of the politicians

3.3 Multiple equilibria

The previous subsection derived best-responses of the politicians for all pairs of reelection rates. A necessary equilibrium condition is that the voter expecting the politicians' best responses does not deviate from his or her reelection rates. Thus, equilibria are identified simply by checking for deviations of the voter. To do so, Table 3 shows for each subset if H-politician is preferred to L-politician in terms of effort, funding, and overall. To get the table, we use funding choices in Table 2 and efforts in Figure 2. It also shows whether a belief update over politician types is feasible. Based on the overall preference and possibility of update, we can conjecture whether the voter deviates in terms of changing his or her reelection rates.

Table 3. When does the voter deviate?

Subset	Effort	Funding	Overall	Update	Deviation
Φ^1	H, L	H, L	H, L	no	no
Φ^2	H	H	H	$p_1 > p > p_0$	yes
Φ^3	H	H,L	H	$p_1 > p > p_0$	yes
Φ^4	H	L	ambiguous	$p_1 > p > p_0$	ambiguous
Φ^5	H	H,L	H	no	no

An important part of analysis in Table 3 is to check the voter's posteriori beliefs. Obviously, in Φ^1 and Φ^5-set, updates based on equilibrium choices are impossible, since observable choices of both types are identical (for out-of-equilibrium posteriors, see Proposition 1 below). For Φ^2, Φ^3, and Φ^4-set, H-politician exerts strictly higher effort, $\bar{i}(\rho) > \underline{i}(\rho)$ (see Figure 2) and/or strictly higher funding choice. This yields that the overall probability of funding by H-politician is strictly higher, hence funding is a signal that reveals more likely to encounter H-politician, and the absence of funding reveals more likely to encounter L-politician, $p_0 < p < p_1$.

To understand the voter's best responses, recall that from the perspective of the voter, to re-elect is to choose a lottery of politicians with posterior $(p_0, 1 - p_0)$ if funding is not observed, respectively $(p_1, 1 - p_1)$ if funding is observed. In contrast, not to reelect means to select a lottery of politicians with the prior distribution $(p, 1 - p)$. Hence, if the belief update along equilibrium path leads to an improvement in information ($p_0 \neq p \neq p_1$), the voter strictly prefers either prior or posterior lottery, unless he or she is exactly indifferent between the politicians. In other words, the voter is indifferent between the lotteries if and only if (i) the belief update is not informative, or (ii) he or she is indifferent between the politicians.

Ambiguity of the voter's preference over types in Φ^4-set deserves a closer look. For the voter, denote the expected value of having H-politician in this set as

$$\bar{u}(\rho) := \bar{i}(\rho)(\bar{v} - c) + (1 - \bar{i}(\rho))(\underline{v} - c) = \bar{I}(\bar{v} - c) + (1 - \bar{I})(\underline{v} - c),$$

and the expected value of having L-politician as

$$\underline{u}(\rho) := \underline{i}(\rho)(\bar{v} - c) > 0.$$

Notice that $\bar{u}(\rho)$ is constant in ρ, whereas $\underline{u}(\rho)$ grows in ρ, because L-politician is incentivized by larger reelection premium, $d\underline{i}(\rho)/d\rho > 0$. To sum up, the relative attractiveness of H-politician, $\bar{u}(\rho) - \underline{u}(\rho)$, falls in ρ.

Due to monotonicity of the relative attractiveness of H-politician, we have a unique *cutoff* value of the reelection difference, where the voter anticipating Φ^4-funding is exactly indifferent between the politicians. The cutoff value $\hat{\rho}$ satisfies $\bar{u}(\hat{\rho}) = \underline{u}(\hat{\rho})$. From indifference in the cutoff value, it is useful to express

$$\frac{\bar{I} - \underline{i}(\hat{\rho})}{1 - \bar{I}} = \frac{c - \underline{v}}{\bar{v} - c}.$$

Proposition 1 (Bayesian equilibria). *If Assumptions 1 and 2 hold, then there exist two sets of pooling equilibria:*

1. *No funding:* $(r_0, r_1) \in \Phi^1, \underline{a}(v) = \bar{a}(v) = 0, v \in \{\underline{v}, \bar{v}\}, \underline{i}(\rho) = \bar{i}(\rho) = 0, p_1 \in [0, 1]$

2. *Total overfunding with* $\underline{a}(v) = \bar{a}(v) = 1, v \in \{\underline{v}, \bar{v}\}, \underline{i}(\rho) = \underline{I}, \bar{i}(\rho) = \bar{I}$, *where (i)* $(0, r_1) \in \Phi^5, p_0 < p$, *(ii)* $(r_0, r_1) \in \Phi^5, p_0 = p$, *and (iii)* $(1, r_1) \in \Phi^5, p_0 > p$.

If an entire Φ^4-set is feasible, then there exists a set of semi-separating equilibria with $\underline{a}(\underline{v}) = 0, \underline{a}(\bar{v}) = 1, \bar{a}(\underline{v}) = \bar{a}(\bar{v}) = 1$ *if and only if* $(r_0, r_0 + \hat{\rho}) \in \Phi^4$.

Proof. First of all, feasibility of all sets defined by Assumption 2 implies that equilibrium is not in Φ^2 or Φ^3-set. From Table 3, we know that in both of these sets, the voter strictly prefers a high-type politician, and both belief updates are informative ($p_0 < p < p_1$), hence the best response of the voter writes $(r_0, r_1) = (0, 1)$, but this pair of actions belongs to the Φ^5-set. Note that in the Φ^3-set, albeit funding choices are identical, updates are still informative, because H-politician plays a better lottery, $\bar{i}(\rho) > \underline{i}(\rho)$, hence funds more frequently.

- Existence of pooling equilibrium in the Φ^1-set: The posterior for $a = 0$ is $p_0 = p$. The voter is indifferent between the high-type and low-type politician because both deliver the identical effort, $\underline{i} = \bar{i} = 0$, as well as identical funding, $\underline{a}(v) = \bar{a}(v) = 0, v \in \{\underline{v}, \bar{v}\}$. As a result, observing $a = 0$, the voter is indifferent between reelection (i.e., a lottery with the high-type occurring with posterior p) and no reelection (i.e., a new draw with the high-type occurring with prior p), and r_0 is restricted only by belonging to the Φ^1-set.
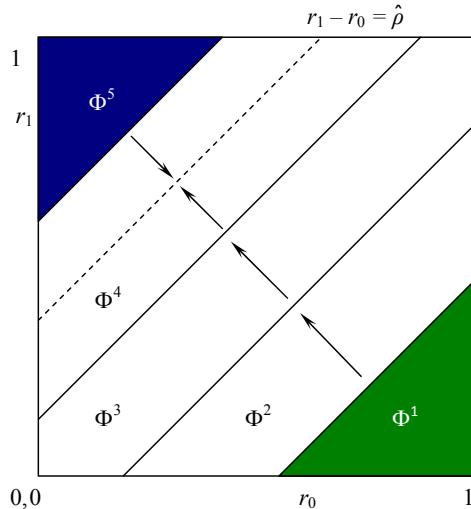
  Out-of-equilibrium belief p_1 in this pooling equilibrium is not restricted, $p_1 \in [0, 1]$, because the voter observing out-of-equilibrium action $a = 1$ is still indifferent over types, hence an informative posterior p_1 doesn't lead to a change in his or her reelection rate r_1.

- Existence of pooling equilibrium in the Φ^5-set: The posterior for $a = 1$ played along the equilibrium path is not informative ($p_1 = p$), hence the voter setting r_1 is indifferent between reelection (current lottery) and new election (new lottery). Thus, r_1 restricted only by belonging to the Φ^5-set.

  In contrast to the Φ^1-equilibrium, however, the voter *strictly* prefers the high-type, hence an informative out-of-equilibrium belief $p_0 \neq p$ leads to a strict preference, $r_0 = 0$ or $r_0 = 1$. Specifically, if $p_0 < p$, we have to have $r_0 = 0$; if $p_0 > p$, there must be $r_0 = 1$, and only for $p = p_0$ is r_0 restricted only by belonging to the Φ^5-set.

- Sufficient and necessary condition for semi-separating equilibria if an entire Φ^4-set is feasible: A semi-separating equilibrium is characterized by (i) Φ^4-set and (ii) the cutoff value of the reelection difference. As to (i), Table 2 shows that the Φ^4-set is a necessary condition for the politicians' semi-separating best responses. As to (ii): If $\rho \neq \hat{\rho}$, the voter deviates to $\rho = -1$ or $\rho = 1$, but due to feasibility of a full Φ^4-set, none of this is in the Φ^4-set. Thus, if Φ^4-set is feasible, a sufficient and necessary condition for the existence of an interior semi-separating wasteful spending equilibrium is that the cutoff value of a reelection difference falls exactly in the Φ^4-set. $\square$

Figure 3 depicts the equilibria in the space of re-election rates (r_0, r_1), with arrows indicating the direction of the deviation of the voter. Shaded areas in Φ^1 and Φ^5 indicate indifference. Notice that some of the pooling equilibria might be eliminated by standard refinements. Applying *passive conjectures* (out-of-equilibrium posteriors set equal to priors), we eliminate subsets (i) and (iii) of the Φ^5-pooling equilibria. Exactly the same outcome brings a test for *complete robustness* (responses are best

Figure 3. Bayesian equilibria and the voter's deviations

given all out-of-equilibrium beliefs): Φ^1-equilibria are completely robust, whereas Φ^5-equilibria are robust only if $p_0 = p$. Equilibrium dominance known as the *intuitive criterion* (Cho and Kreps 1987) is not very helpful, because all pooling equilibria satisfy the criterion. This is a property of feasibility of all sets in Assumption 2: It implies that for both politicians, both funding choices $a = 0$ and $a = 1$ may appear in their best responses. Hence, when setting out-of-equilibrium beliefs, the voter cannot rule out any type of the politician on the basis of payoff dominance over an out-of-equilibrium action.

Finally, by Assumption 3, we know that Φ^1-pooling equilibria exist if and only if politicians expect an extra reward from the absence of funding, $r_0 B > r_1 B$. This may be used as a further refinement on the Φ^1-pooling equilibria: Since a voter gets nothing in the Φ^1-equilibrium, it is very unlikely that he or she tends to coordinate on a perverse incentive of *strictly* rewarding the absence of funding, $r_0 > r_1$.

3.4 Comparative statics

In the model, one of the key question is whether accountability remedies wasteful spending or not. Dewatripont and Seabright (2006) argue that improvements in accountability do not address overfunding, rather exacerbate the career concerns of the politicians. This is a strong statement given the evidence on the high levels of public investments in countries with less competitive elections, hence lower accountability (Keefer and Knack 2007).

In formalizing this intuition, it is useful to examine two measures shaping incentives of the politicians, both arguably available to the voter — a change in the project cost c the politician pays (i.e., compensating or punishing the politician for funding),

and an increase in the value of reelection B. Given the large population size, we may consider both changes costless for a representative voter, and focus only on the benefits involved.

To start with, recall Table 1 where the five Φ-sets are defined by four boundaries, satisfying $\rho := r_1 - r_0 = (c - \alpha v)/B, v \in \{\underline{v}, \overline{v}\}, \alpha \in \{\underline{\alpha}, \overline{\alpha}\}$. This helps us to identify the location of the equilibria sets, Φ^1, Φ^4, and Φ^5.

By Assumption 1 and the starting assumptions of project and politician types, we have $\overline{\alpha}\overline{v} > \underline{\alpha}\overline{v} > \overline{\alpha}\underline{v} > \underline{\alpha}\underline{v}$. Inserting into the definition of the wasteful project, $\underline{v} < c$, we immediately get $0 < c - \underline{v} < c - \overline{\alpha}\underline{v} < c - \underline{\alpha}\underline{v}$. As a result, both the Φ^5-set and Φ^4-set are subsets of the subspace of a *positive* reelection premium, $\rho B > 0$ (the northwest triangle on Figure 3). From Assumption 3, we also know that the Φ^1-set implies a *negative* reelection premium (the south-east triangle on Figure 3).

Recalling once again that the boundaries are defined by $\rho = r_1 - r_0 = (c - \alpha v)/B$, and identifying that $\Phi^4 \cup \Phi^5$ lies above the zero-premium line $\rho = 0$, whereas Φ^1 lies below the line, it is now straightforward to analyze the effects of parametric changes in c and B:

(i) An increase in the project cost the politician pays shifts boundaries upwards, to the higher levels of reelection difference. With a larger cost, a reelection difference (and reelection premium) must grow to induce switch to a more pro-funding choice. A consequence is that the Φ^5-set of overfunding pooling equilibria shrinks, and the Φ^1-set of no-funding pooling equilibria enlarges.

(ii) An increase in the reelection value decreases the *absolute* values of the boundaries. A larger value of the reelection thus makes politicians' funding more sensitive to the absolute value of the reelection difference. The boundaries move towards the zero-premium line, $\rho = 0$, hence both sets of pooling equilibria, Φ^1-set and Φ^5-set, get larger.

Our main interest rests with the semi-separating equilibria. Proposition 2 delivers two important comparative statics results regarding these equilibria. First, minor changes in the boundaries that keep the cutoff value $\hat{\rho}$ within the Φ^4-set are irrelevant, as they do not change the voter's utility. Although minor changes in parameters c or B change the equilibrium cutoff value $\hat{\rho}$, this is fully offset by change in efforts. Second, by manipulating boundaries such that the Φ^4-set is infeasible (hence Assumption 2 no longer holds), it is possible to get rid of the wasteful spending for good. The intuitive argument by Dewatripont and Seabright (2006) on uselessness of accountability is thus perfectly valid unless the voter can use relatively harsh punishments for funding in terms of extra project cost, and/or reduction the value of reelection.

Proposition 2 (Neutrality and cornering-out). (i) *Any change in project cost c paid by the politician or reelection rent B received by the reelected politician that preserves the existence of semi-separating equilibria, $\exists (r_0, r_0 + \hat{\rho}) \in \Phi^4$, does not change efforts $(\underline{i}(\hat{\rho}), \bar{I})$ or funding choices of the politicians, hence the voter's utility remains unchanged in the semi-separating equilibrium.*

(ii) *By imposing a sufficiently high project cost c or sufficiently low reelection rent B, the Φ^4 and Φ^5-sets become infeasible, hence all Φ^4 and Φ^5-equilibria disappear. As a corollary, there exist pairs (c, B) that induce a corner Φ^3-equilibrium with efficient funding choice of both types, $\underline{a}(\underline{v}) = \bar{a}(\underline{v}) = 0, \underline{a}(\bar{v}) = \bar{a}(\bar{v}) = 1$.*

Proof. Part (i) (Neutrality): Funding choices are constant since a sufficient and necessary condition for a set of semi-separating equilibria is preserved. Next, Proposition 1 proves that each semi-separating equilibrium is characterized by a reelection difference equal to the cutoff value, $\hat{\rho}$, where the voter is indifferent over types, $\underline{u}(\hat{\rho}) - \bar{u}(\hat{\rho}) = \bar{I}(\bar{v} - \underline{v}) + \underline{v} - c - \underline{i}(\hat{\rho})(\bar{v} - c) = 0$. Since $\bar{I} = \psi_i^{-1}(\overline{\alpha}(\bar{v} - \underline{v}))$ is constant in ρ, and the cost c in the argument of the voter's utilities are constant (voter's, not politicians') costs, we have to have that also $\underline{i}(\hat{\rho})$ must remain unchanged, even if $\hat{\rho}$ changed. With all arguments constant, also $\underline{u}(\hat{\rho})$ and $\bar{u}(\hat{\rho})$ are constant, and the expected voter's utility is constant (equal zero).

Part (ii) (Cornering-out): From Table 1, both Φ^4 and Φ^5-sets are infeasible if Φ^4-set is not feasible for the maximal $\rho = 1$, i.e. if $\overline{\alpha}\underline{v} - c + B < 0$. In such a case, the reelection rates $(r_0, r_1) = (0, 1)$ that are equivalent to the maximal reelection difference $\rho = 1$ belong into the Φ^3-set, where funding choices of the politicians are efficient. In the Φ^3-set, as known from proof to Proposition 1 and Table 3, the voter strictly prefers $(r_0, r_1) = (0, 1)$, hence doesn't deviate and this pair of reelection rates is an equilibrium. $\square$

Another interesting property of boundary manipulations is an *equilibrium switch*. Consider a decrease in c or increase in B that enlarges Φ^5-set such that the pre-change reelection rates characterized by the initial $\hat{\rho}$ become now elements of the enlarged Φ^5-set. Then, if voters are less flexible in changing the actions than politicians (e.g., there might be a coordination problem in the group of representative voters), and do not adapt their reelection rates, these become equilibrium rates, but now of a pooling equilibrium, not a semi-separating equilibrium. Although semi-separating equilibria with a new (lower) cutoff values will be feasible, they need not to be played.

To summarize the entire section on Bayesian equilibria of the baseline game: (i) Multiple equilibria exist. (ii) Wasteful spending preserves only in a weak equilibrium, where the voter is indifferent over types, hence H-politician doesn't gain any electoral advantage. (iii) Minor incentives do not change the politicians' strategies: As long as the wasteful signaling equilibrium exists, the levels of politicians' efforts cannot be changed. (iv) The only way to remedy wasteful spending is to impose sufficiently large incentives that completely eliminate wasteful signaling in the range of best responses of the politicians.

4. Wasteful aid control

4.1 Benevolent controller

In this section, we restrict ourselves to the state aid control imposed on the interior semi-separating Φ^4-equilibrium. Although it might be interesting to look on the aid control as a device to resolve multiplicity of equilibria or eliminate total overfunding in Φ^5-pooling equilibrium, our main goal is to show that state aid control is often impossible as a remedy to wasteful signalling, and if possible, it is not desirable given the adverse effects on politician' effort.

Setting an objective of the controller is of course critical to modeling aid control. We restrict ourselves to a benevolent state aid controller, who maximizes utility of the representative voter. This limits the analysis to essentially a normative, second-best problem. Motivation is twofold: (i) If the optimal aid control under a benevolent controller is no control, then — except for a dynamic inconsistency problem — a constrained or biased policy-maker should not be able to deliver a better outcome. Therefore, optimality of no-control should be robust to more realistic objectives. (ii) To reveal the project type or politician type, information must be sought at a cost. In a group of representative voters, this costly information is thus a public good. Hence, it is interesting to see what happens if the representative voter can instal a citizen-candidate, sharing policy preferences of the representative voter, and optimally providing this public good through tax revenues.

The state-aid control is meaningful only if a project is funded, i.e. for nodes where $a = 1$. To solve for equilibria in these nodes, we use that in a Φ^4-equilibrium, it is common knowledge that H-politician funds all projects and L-politicians funds only $\underline{i}(\hat{\rho}) < 1$ projects. This allows the controller to use equivalently a posterior probability of having H-politician, π, or a posterior probability of having a profitable project, $q(\pi)$. Updating posteriors on the politician type is thus instrumental only to updating posteriors on the project type; if H-politician is more likely, then a profitable project is less likely:

$$q(\pi) := \pi\bar{I} + 1 - \pi, q'(\pi) = \bar{I} - 1 < 0.$$

We introduce a benevolent aid controller as follows: If funding takes place, an extra Stage 5 with the controller's node follows. The controller starts with a posterior belief on the project quality $q(p_1)$, and decides only on investing into a single costly signal. The signal is either *direct* (on the project quality, $S^v \in \{\underline{v}, \bar{v}\}$), or *indirect* (on the politician quality, $S^\alpha \in \{\underline{\alpha}, \bar{\alpha}\}$). Once a signal is observed, the controller updates his or her belief on the profitable project type to either $\bar{q}$ or $\underline{q}$. (For convenience, we keep this notation irrespective of the signal type; it will be clear in the context which signal type is being examined.) Lastly, the controller approves funding of the project with probability $f \in [0, 1]$.

Theoretically, we could allow the controller lead the game and make an investigation with an observable commitment to the approval rate f prior the reelection stage. This would nevertheless complicate the analysis, because the reelection rates would have to reflect the observed actions of the controller. The voter would not only use the approval rate as a signal, but possibly would also infer realization of the signal, since

the voter and the controller share the objectives, and their information sharing should be trivial. In this extension of the strategy set of the voter, the controller's action would become a direct tool of domestic politics. At this moment, however, we are not interested in the interplay between domestic accountability and the control of an external authority, albeit it creates a direct avenue for further research.

The approval rate f depends only on whether it is better to accept a lottery over payoffs $(\overline{v}-c, \underline{v}-c)$ with probabilities $(q, 1-q)$ or remain in the status quo with certain zero payoff. In other words, the controller is minimizing the expected loss of the Type I and Type II errors (approve a wasteful project, ban a profitable project). Given that the expected payoff is linear in q, this clearly yields a step-wise correspondence $f(q)$, where $f(q) = 1$ if $q > q^*$, $f(q) \in [0, 1]$ if $q = q^*$, and $f(q) = 0$ if $q < q^*$. The threshold level of the belief q^* satisfies $0 < q^* < 1$, because

$$q^* := \frac{c - \underline{v}}{\overline{v} - \underline{v}}.$$

Next, it is convenient to define a worthless signal. A signal σ is called *worthless* if $f(q(p_1)) = f(\underline{q}) = f(\overline{q})$. Such a signal has no value since any realization of the signal leads to only small changes in beliefs that keep the initial approval rate $f(q(p_1))$ unchanged, irrespective of the realization of the signal. A worthless signal will not be purchased by the controller.

A final interesting point is that for the Φ^4-equilibrium without aid control, it is ex ante socially optimal to approve the funded project, $f(q(p_1)) = 1$. Using property of the cutoff value $\hat{\rho}$ and the definition of $q(p_1)$,

$$\frac{q(p_1)}{1 - q(p_1)} = \frac{\overline{I} + \left(\frac{1-p}{p}\right)\underline{i}(\hat{\rho})}{1 - \overline{I}} > \frac{\overline{I} - \underline{i}(\hat{\rho})}{1 - \overline{I}} = \frac{c - \underline{v}}{\overline{v} - c} = \frac{q^*}{1 - q^*}.$$

As a result, $q(p_1) > q^*$, from which $f(q(p_1)) = 1$ clearly follows. In other words, a controller without a signal, like a voter, is willing to approve any funded project. Thus, the introduction of a controller affects wasteful spending if and only if the controller is able to get extra information, and the signal is strong enough not to be worthless.

4.2 Indirect signals

Suppose a signal about the politician's type $S^\alpha \in \{\underline{\alpha}, \overline{\alpha}\}$, true with probability $\sigma \in [1/2, 1]$, and false with probability $1 - \sigma$,

$$\sigma := \Pr(S^\alpha = \underline{\alpha} | \alpha = \underline{\alpha}) = \Pr(S^\alpha = \overline{\alpha} | \alpha = \overline{\alpha}).$$

For the purpose of Proposition 3, we introduce the controller's updated beliefs over H-politician, $\overline{p}$ and $\underline{p}$:

$$\overline{p} := \Pr(\alpha = \overline{\alpha} | a = 1, S^\alpha = \overline{\alpha}) = \frac{p_1 \sigma}{p_1 \sigma + (1 - p_1)(1 - \sigma)} \geq p_1$$

$$\underline{p} := \Pr(\alpha = \overline{\alpha} | a = 1, S^\alpha = \underline{\alpha}) = \frac{p_1(1 - \sigma)}{p_1(1 - \sigma) + (1 - p_1)\sigma} \leq p_1$$

Applying the $q(\pi)$ function, we may write $\bar{q} = q(\bar{p})$ and $\underline{q} = q(\underline{p})$.

Proposition 3 (No indirect control). *Indirect signal S^{α} is worthless for all $\sigma \in [1/2, 1]$. The controller never purchases such signals and approves all funded projects with probability $f(q(p_1)) = 1$.*

Proof. We aim to show that $\underline{q} \geq q(p_1) \geq \bar{q} > q^*$. Observing $S^{\alpha} = \underline{\alpha}$ implies $\underline{p} \leq p_1$, hence $\underline{q} \geq q(p_1)$. This leads to $f(\underline{q}) = 1$, because $\tilde{q} > q^*$. Observing $S^{\alpha} = \overline{\alpha}$ implies $\bar{p} \geq p_1$, and $\bar{q} \leq q(p_1)$. Hence, there is a chance that $\bar{q}$ falls below the critical level q^*. Since $q'(\pi) < 0$, it is sufficient to examine only the extreme of $\bar{p} = 1$, which corresponds to the extreme (truth-revealing) signal $\sigma = 1$. Imposing into $q(\pi)$, we have $\bar{q} = q(1) = \bar{I}$.

Consider now the property of the cutoff value $\hat{\rho}$ that characterizes the Φ^4-equilibrium. Here, the expected payoff from having H-politician is equal to that of L-politician, and both are positive:

$$\bar{I}(\bar{v} - c) + (1 - \bar{I})(\underline{v} - c) = \underline{i}(\hat{\rho})(\bar{v} - c) > 0$$

We use positivity of the left-hand side to rewrite

$$\bar{q} = \bar{I} > \frac{c - \underline{v}}{\bar{v} - \underline{v}} = q^*.$$

With $\bar{q} > q(p_1)$, the situation is simple since $f(\bar{q}) = 1$. To sum up, $f(q(p_1)) = f(\underline{q}) = f(\bar{q}) = 1$. The signal is indeed worthless and is never purchased. □

4.3 Direct signals

Alternatively, assume that the controller can purchase a symmetric signal $S^v \in \{\underline{v}, \bar{v}\}$, true with probability σ, and false with probability $1 - \sigma$,

$$\sigma := \Pr(S^v = \underline{v}|v = \underline{v}) = \Pr(S^v = \bar{v}|v = \bar{v}).$$

The updates on the profitable project type are now redefined as follows:

$$\bar{q} := \Pr(v = \bar{v}|a = 1, S^v = \bar{v}) = \frac{q(p_1)\sigma}{q(p_1)\sigma + (1 - q(p_1))(1 - \sigma)} \geq q(p_1)$$

$$\underline{q} := \Pr(v = \bar{v}|a = 1, S^v = \underline{v}) = \frac{q(p_1)(1 - \sigma)}{q(p_1)(1 - \sigma) + (1 - q(p_1))\sigma} \leq q(p_1)$$

Now, the key difference to the case of indirect signal is that the range of posteriors $\underline{q}$ and $\bar{q}$ for different strength of the signal σ is not $[\bar{I}, 1]$, but includes an entire unit interval $[0, 1]$. This becomes evident once we calculate the realizations of a perfect signal, $\sigma = 1$: $(\underline{q}, \bar{q}) = (0, 1)$. For optimistic realizations of the signals (those increasing q), ranges of both types of signal are identical, $[q(p_1), 1]$, and signaling works identically. A signal of one type can always be replaced by a feasible signal of the other type. For pessimistic realization of the signals (those decreasing in q), the ranges differ, $[\bar{I}, q(p_1)] \subset [0, q(p_1)]$. Signals over the project type are thus more informative than

Figure 4. The updates $\overline{q}$ and $\underline{q}$ for direct and indirect signals of various precision
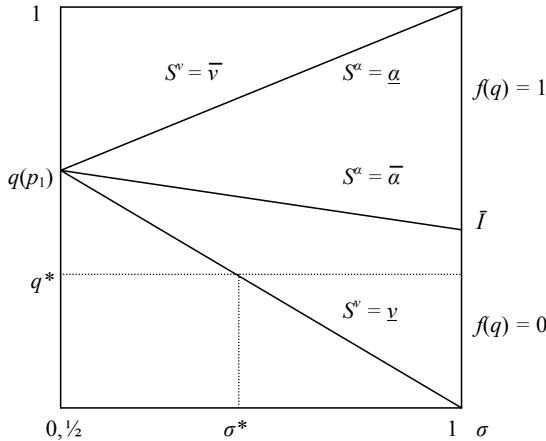
signals over the politician type. Unlike a signal on the politician type, a signal over the project type is not always worthless, i.e. may revert the approval rate $f(q(p_1)) = 1$ to $f(\underline{q}) = 0$. Figure 4 illustrates.

Notice that a signal is worthless as long as $\underline{q} \geq q^*$, or $\sigma \leq \sigma^*$, where

$$\sigma^* := \frac{q(p_1)(\overline{v} - c)}{q(p_1)(\overline{v} - c) + (1 - q(p_1))(c - \underline{v})}.$$

The threshold level of σ^* allows for an interesting interpretation. The denominator comprises a sum of all net benefits related to a correct choice. It is a weighted sum of the net benefit of a correct approval and the net benefit of a correct ban, where the weights are pre-signal beliefs on the project type, i.e. $q(p_1)$. The nominator is just the first type of net benefits, related to the correct approval. The critical ratio is thus *the pre-signal relative importance of approval*. Clearly, if $q(p_1)$ is large, and the controller is optimistic prior obtaining a signal, the signal must be very strong to temper optimism. With optimism, only very precise signals are purchased.

4.4 The game with aid control

The no-control Φ^4-equilibrium is control-proof as long as the signal is worthless for $q(p_1)$. Thus, it remains to analyze cases with sufficiently strong signals, $\sigma > \sigma^*$. We proceed by backward induction, considering the controller's choice.

A signal that is not worthless yields $f(\underline{q}) = 0 < 1 = f(\overline{q})$. Up the game tree, this is anticipated by the politicians. We introduce the anticipated approval rates for each value of the project:

$$\Pr(f = 1 | v = \underline{v}) = \Pr(S^v = \overline{v} | v = \underline{v}) = 1 - \sigma$$
$$\Pr(f = 1 | v = \overline{v}) = \Pr(S^v = \overline{v} | v = \overline{v}) = \sigma$$

Since each politician observes the project type, he or she anticipates type-dependent approval rates σ and $1 - \sigma$. Funding choices of the politicians rewrite into

$$(1 - \sigma)(\alpha \underline{v} - c) + r_1 B \geq r_0 B,$$
$$\sigma(\alpha \overline{v} - c) + r_1 B \geq r_0 B,$$

where $\alpha \in \{\underline{\alpha}, \overline{\alpha}\}$. Since $\sigma \leq 1$ and $1 - \sigma < 1$, the boundaries between Φ^1 to Φ^5-sets now shrink towards the zero premium line, $\rho = 0$. Interestingly, a drop in the approval rate has a similar effect on the individual boundaries as an increase in the reelection rent B.

It is necessary to analyze whether the boundaries preserve their ordering so that the structure of the optimal funding choices as in Table 2 remains unchanged. This is a relevant concern given that the approval rates differ, $1 - \sigma < \sigma$, which stems from $\sigma > \sigma^* > 1/2$. We require

$$(1 - \sigma)(c - \underline{\alpha} \underline{v}) > (1 - \sigma)(c - \overline{\alpha} \underline{v}) > \sigma(c - \underline{\alpha} \overline{v}) > \sigma(c - \overline{\alpha} \overline{v}).$$

The left and right inequalities hold by standard assumptions, so the only issue is if $(1 - \sigma)(c - \overline{\alpha} \underline{v}) > \sigma(c - \underline{\alpha} \overline{v})$. By Assumption 3, we have $\overline{\alpha} \underline{v} - c < \underline{v} - c < 0 < \underline{\alpha} \overline{v} - c$, which secures that the middle inequality holds for any signal.

In a semi-separating equilibrium with aid control, effort levels will differ from the equilibrium without control. For H-politician, denote the new optimal value $I(\sigma)$, to be compared with $\overline{I}$ of the case without aid control:

$$I(\sigma) := \arg\max\{i\sigma(\overline{\alpha} \overline{v} - c) + (1 - i)(1 - \sigma)(\overline{\alpha} \underline{v} - c) + Br_1 - \psi(i)\}$$
$$= \psi_i^{-1}\{\overline{\alpha}[\sigma \overline{v} - (1 - \sigma)\underline{v}] - (2\sigma - 1)c\}$$

To see that $I(\sigma) < \overline{I}$, notice the argument of a monotonic increasing function $\psi_i^{-1}(\cdot)$ is linear in all variables, hence we examine only the extrema of $\sigma \in [1/2, 1]$:

$$I(\tfrac{1}{2}) = \psi_i^{-1}\left\{\tfrac{1}{2}\overline{\alpha}(\overline{v} - \underline{v})\right\} < \psi_i^{-1}\{\overline{\alpha}(\overline{v} - \underline{v})\} = \overline{I}$$
$$I(1) = \psi_i^{-1}\{\overline{\alpha}\overline{v} - c\} < \psi_i^{-1}\{\overline{\alpha}(\overline{v} - \underline{v})\} = \overline{I}$$

For L-politician, denote the optimal level $i(\sigma)$, to be possibly compared to $\underline{i}(\hat{\rho})$ of the no-control regime:

$$\underline{i}(\sigma) := \arg\max\{i\sigma(\underline{\alpha} \overline{v}) + ir_1 B + (1 - i)r_0 B - \psi(i)\}$$
$$= \psi_i^{-1}\{\sigma(\underline{\alpha} \overline{v} - c) + (r_1 - r_0)B\}$$

At last, we can proceed to the welfare evaluation of the state aid control. Recall that in any Φ^4-equilibrium, expected payoffs from both politician types are equal, hence we may write the voter's expected payoff in two equivalent ways:

$$\overline{w}(\sigma) := \sigma I(\sigma)(\overline{v} - c) + (1 - I(\sigma))(1 - \sigma)(\underline{v} - c)$$
$$\underline{w}(\sigma) := \sigma i(\sigma)(\overline{v} - c)$$

These compare with the voter's expected payoff under the case of no control:

$$\bar{u}(\hat{\rho}) = \bar{I}(\bar{v} - c) + (1 - \bar{I})(\underline{v} - c)$$
$$\underline{u}(\hat{\rho}) = \underline{i}(\hat{\rho})(\bar{v} - c)$$

The voter's indifference in Φ^4-equilibrium implies $\underline{w}(\sigma) = \bar{w}(\sigma)$, and $\underline{u}(\hat{\rho}) = \bar{u}(\hat{\rho})$. From comparison of $\bar{w}(\sigma)$ with $\bar{u}(\hat{\rho})$, it can be seen that aid control combines three effects, one positive and two negative. The first beneficial effect is *diligence*, since only $1 - \sigma$ wasteful projects are funded. The other side of the coin is *overcautiousness*, since some profitable projects (again share $1 - \sigma$) are not approved for funding. The third effort is *lower effort* of H-politician, $I(\sigma) < \bar{I}$, hence the pool of projects proposed by H-politician deteriorates.

The tradeoff may lead to welfare superiority of no-control regime as well as superiority of the aid control regime. The following two examples illustrate two extreme cases: In Example 1, no-control regime dominates any control regime. In Example 2, both extreme control regimes – one with a useless signal ($\sigma = 1/2$) and one with a perfect signal ($\sigma = 1$) – dominate the no-control regime.

Example 1. Assume $\underline{v} = 0 < 1 = c < 5 = \bar{v}$. Let $\psi(i) = -i - \log(1 - i)$, where for $i \in (0, 1)$, $\psi_i = i/(1 - i) > 0$, $\psi_{ii} = (1 - i)^{-2} > 0$, and the inverse marginal cost function is increasing and within the unit interval, $\psi_i^{-1}(x) = x/(x + 1) \in [0, 1]$. Let $\bar{\alpha} = 1/2$, so that $I(1) > I(1/2)$. This implies that $\arg\max_\sigma \bar{w}(\sigma) = 1$. The efforts are $\bar{I} = 5/7 > 3/5 = I(1)$. The expected payoffs are $\bar{u}(\hat{\rho}) = 90/35 > 84/35 = \bar{w}(1)$.

Example 2. Assume $\underline{v} = 0 < 4 = c < 5 = \bar{v}$. The cost function again satisfies $\psi_i^{-1}(x) = x/(x + 1)$. Let $\bar{\alpha} = 9/10$. The efforts are $\bar{I} = 9/11 > I(1/2) = 9/13 > I(1) = 1/3$. The expected payoffs are $\bar{w}(1/2) = 9/13 > \bar{w}(1) = 1/3 > \bar{u}(\hat{\rho}) = 1/11$.

We identify a sufficient condition for the no-control regime to dominate any control regime. This will be useful for the ensuing discussion on the (non)desirability of state aid control.

Proposition 4 (No direct control). *Suppose that Φ^4-equilibria with wasteful spending as signaling exist in regimes with and without aid control. In these equilibria, the regime of no state aid control involves a larger expected payoff of the voter than any regime with state aid control, $\bar{u}(\hat{\rho}) > \max \bar{w}(\sigma), \sigma \in [1/2, 1]$, if*

$$\underline{\alpha}\bar{v} - \bar{\alpha}\underline{v} > \max\{\overline{\alpha}\bar{v} - c; \frac{\bar{\alpha}}{2}(\bar{v} - \underline{v})\}.$$

Proof. First, we bind $\bar{w}(\sigma)$ from above. The effort $\tilde{I} := \max_{\sigma \in [1/2, 1]} I(\sigma) = \psi_i^{-1}\{\max$ $[\overline{\alpha}\bar{v} - c; \frac{\bar{\alpha}}{2}(\bar{v} - \underline{v})]\}$ is the maximal effort of H-politician under the case with control. For the voter, the best lottery (given constant effort) in the case with control is $\sigma = 1$, hence we can set upper bound on the expected payoff $\bar{w}(\sigma)$ as $\tilde{I}(\bar{v} - c) \geq \bar{w}(\sigma)$.

Second, a sufficient condition for the strict dominance of no-control is to ensure $\bar{u}(\hat{\rho}) = \underline{u}(\hat{\rho}) = \underline{i}(\hat{\rho})(\bar{v} - c) > \tilde{I}(\bar{v} - c) \geq \bar{w}(\sigma)$. This is equivalent to $\underline{i}(\hat{\rho}) > \tilde{I}$, or

$$\underline{\alpha}\bar{v} - c + \hat{\rho}B > \max\{\overline{\alpha}\bar{v} - c; \frac{\bar{\alpha}}{2}(\bar{v} - \underline{v})\}.$$

Using $(r_0, r_1) \in \Phi^4$, we establish that for the case of no control $c - \overline{\alpha}\underline{v} \le B(\hat{\rho})$. This creates a lower bound on $\underline{i}(\hat{\rho})$, which can now be compared with $\tilde{I}$,

$$\underline{\alpha}\overline{v} - c + \hat{\rho}B \ge \underline{\alpha}\overline{v} - \overline{\alpha}\underline{v} > \max\{\overline{\alpha}\overline{v} - c; \tfrac{\overline{\alpha}}{2}(\overline{v} - \underline{v}).$$

Thus, a condition $\underline{\alpha}\overline{v} - \overline{\alpha}\underline{v} > \max\{\overline{\alpha}\overline{v} - c; \tfrac{\overline{\alpha}}{2}(\overline{v} - \underline{v})$ is sufficient to imply $\underline{i} \ge I^{\max}$, and $\overline{u}(\hat{\rho}) \ge \overline{w}(\sigma)$. $\square$

As the final step, we use the sufficient condition for explicit comparative statics of the optimality of no control. The condition rewrites into two subconditions,

$$\underline{\alpha}\overline{v} - \overline{\alpha}\underline{v} - \overline{\alpha}\overline{v} + c \ge 0,$$
$$2\underline{\alpha}\overline{v} - \overline{\alpha}\underline{v} - \overline{\alpha}\overline{v} \ge 0.$$

It is easy to deduce that the two conditions are more likely satisfied, the higher is c, the lower is $\underline{v}$, the higher is $\underline{\alpha}$, and the lower is $\overline{\alpha}$. To interpret: Aid control is not desirable when (i) the project cost is large, (ii) losses of the unprofitable project go up, and (iii) the politicians are relatively homogenous.

5. Conclusion

We have analyzed a signaling game where competent politicians strategically use state aid to manifest competence. We focused entirely on interior equilibria. In the regime of no state aid control, as introduced by Dewatripont and Seabright (2006), we conjecture the following: (i) Multiple equilibria exist. In overfunding pooling equilibria, politicians fund all projects, hence spending cannot signal competence. In zero-funding pooling equilibria, nothing is funded, hence a loss entails underfunding rather than wasteful funding. (ii) Wasteful spending preserves in a weak equilibrium, where the voter is indifferent over types, hence electoral advantage of the high-type politician is completely wiped out. (iii) Marginal incentives do not change the politicians' strategies: As long as the wasteful signaling equilibrium still exists, the politicians' levels of effort are unchanged. (iv) The only way to remedy wasteful spending is to impose sufficiently large incentives that completely eliminate wasteful signaling. This also eliminates overfunding pooling equilibria and introduces efficient funding choices of all politicians. If that is achieved by means of a lower reelection rent, then in contrast to compensating the project cost, it is also possible to eliminate underfunding equilibria and install a unique equilibrium. Hence, a change in the reelection rent is a better tool than a compensation of the project cost. In other words, the disciplinary incentives should be future-oriented.

In the regime with aid control, our results are as follows: (i) The benevolent controller who resorts to extra information on the politician's type (indirect signal) will approve all projects as if having no signal, hence the signal turns to be useless. (ii) Information on the project type (direct signal) may be also useless, if the signal is not strong enough. (iii) With signals that are strong enough, effort levels — given constant reelection premium — decrease. As a result, the existence of aid control brings a

tradeoff combining three effects: diligence, overcautiousness, and deterioration of the pool of funded projects. (iv) We identify a sufficient condition for the optimal state aid control to be no control, regardless of the precision of the signal. The absence of state aid control is socially desirable when the project cost is large, losses of the unprofitable project are high, and the politicians are relatively symmetric.

To sum up, in this setup the case for pro-active state aid control of a benevolent supranational authority is limited. Marginal changes in politicians' incentives do not work either. Only a major reform in terms of much larger internalization of the project cost, or much lower reelection rent, is an unambiguous way to discipline wasteful spending as pre-electoral signalling.

References

Baldwin, R.E. and Robert-Nicoud, F. (2007). Entry and Asymmetric Lobbying: Why Governments Pick Losers. *Journal of the European Economic Association*, 5(5), 1064–1093.

Besley, T., Seabright, P., Rockett, K. and Sorensen, P. B. (1999). The Effects and Policy Implications of State Aids in Industry: An Economic Analysis. *Economic Policy* 14, 13–53.

Brenden, A. and Drazen, A. (2008). How Do Budget Deficits and Economic Growth Affect Reelection Prospects? Evidence from a Large Panel of Countries. *American Economic Review*, 98(5), 2203-2220.

Cho, I. K., and Kreps, D. M. (1987). Signalling Games and Stable Equilibria. *Quarterly Journal of Economics* 102, 179–221.

Candel-Sanchez, F. (2007). Incentives for Budget Discipline in the Presence of Elections. *European Journal of Political Economy*, 23(4), 863–884.

Casamatta, G. and De Paoli, C. (2007). Inefficient Public Provision in a Repeated Elections Model. *Journal of Public Economic Theory*, 9(6), 1103–1126.

Collie, D. R. (2005). State Aid to Investment and R&D. European Economy. Brussels, European Commission, Economic Papers No. 231.

Dewatripont, M. and Seabright, P. (2006). 'Wasteful' Public Spending and State Aid Control. *Journal of the European Economic Association*, 4, 513–522.

Dixit, A. (1984). International Trade Policy for Oligopolistic Industries. *Economic Journal*, 94, Supplement, 1–16.

Drazen, A. and Eslava, M. (2007). Electoral Manipulation via Voter-Friendly Spending: Theory and Evidence. mimeo. (Also available as 'Electoral Manipulation via

Expenditure Composition: Theory and Evidence'. New York, National Bureau of Economic Research, Working Paper No. 11085.)

Drazen, A. and Eslava, M. (2008). Special Interest Cycles. mimeo. (Also available as 'Pork Barrel Cycles'. New York, National Bureau of Economic Research, Working Paper No. 12190.)

Eaton, J. and Grossman, G. (1986). Optimal Trade and Industrial policy under Oligopoly. *Quarterly Journal of Economics*, 101, 383–406.

European Union (2004). Community Guidelines on State Aid for Rescuing and Restructuring Firms in Difficulty. Official Journal of the European Union, C 244/02, 01.10.2004, 2–17.

Gersbach, H. (2004). The Money-burning Refinement: With an Application to a Political Signalling Game. *International Journal of Game Theory*, 33, 67-87.

Gersbach, H. (2009). Competition of Politicians for Wages and Office. Forthcoming in *Social Choice and Welfare*, DOI 10.1007/s00355-008-0345-5.

Keefer, P. and Knack, S. (2007). Boondoggles, Rent-Seeking, and Political Checks and Balances: Public Investment under Unaccountable Governments. *The Review of Economics and Statistics*, 89(3), 566–572.

Krugman, P. (1984). Import Protection as Export Promotion: International Competition in the Presence of Oligopoly and Economies of Scale. In Kierzkowski, H. (ed.), *Monopolistic Competition and Product Differentiation and International Trade*. Oxford, Oxford University Press, 180–193.

Midelfart-Knarvik, K.-H. and Overman, H. (2002). Delocation and European Integration: Is Structural Spending Justified? *Economic Policy*, 17, 322–359.

Persson, T. and Tabellini, G. (2000). *Political Economics: Explaining Economic Policy*. Cambridge, Mass., MIT Press.

Poutvaara, P. and Takalo, T. (2007). Candidate Quality. *International Tax and Public Finance*, 14, 7–27.

Robinson, J. A. and Torvik, R. (2005). White Elephants. *Journal of Public Economics*, 89, 197–210.

Rogoff, K. (1990). Equilibrium Political Budget Cycles. *American Economic Review*, 80, 21–36.

Roumanias, C. (2005). Signaling through Political Campaigns: Elections as a Revelation Mechanism. *Economics & Politics*, 17(3), 367–392.

Spencer, B. J. and Brander, J. A. (1983). International R&D Rivalry and Industrial Strategy. *Review of Economic Studies*, 50, 707–22.

Streb, J. M. (2005). Signaling in Political Budget Cycles: How Far are You Willing to Go? *Journal of Public Economic Theory*, 7(2), 229–252.