Efficient Regulatory Mandates*

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Abstract

This paper shows why, under incomplete information, regulatory practices that alter market prices can redistribute resources more efficiently than cash transfers. In our model the representative citizen cares about a project that benefits a special interest. An example of such a project is the adoption of accessibility devices regulated by the American with Disabilities act. The project can be funded either by transfering cash to the special interest, or by mandating businesses to bundle the project with the goods they are selling. When the cost of the project is unknown to the citizen, the cash transfer may involve overpayments that make mandates more efficient despite the associated deadweight loss.

1 Introduction

This paper provides an efficiency rationale for policies mandating firms to bundle their products with additional goods that benefit only a subset of their customers. For Example, the Americans with Disabilities Act requires private establishments to "design and construct facilities [...] that are readily accessible to [...] individuals with disabilities." A different example is given by the recent debate over the adoption of drinking water standards. Standards regulate water companies to deliver water containing small quantities of substances such as Arsenic. If assumed in small quantities, such substances do not affect most people, but may harm particularly sensitive individual. The Environmental Protection Agency

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seeks a standard ensuring that even relatively sensitive people can drink tap water in every municipality.

Essentially, we focus on policies whose primary goal is to provide a subset of the population (which we will refer to as "special interest": in the examples persons with disabilities or Arsenic-sensitive individuals) with a specific good (which we will refer to as "project": accessibility to business facilities or purified water). Such policies effectively redistribute resources from the general public to the "special interest."[1] Even when the provision of the project is desired by the general public, standard economic theory suggests that it could be efficiently performed using cash transfers. When the project is mandated to firms instead, market prices are altered and a deadweight loss occurs because firms cannot price discriminate between customers depending on whether they belong or not to the special interest.

We argue in this paper that in many situations citizens do not know the cost of the project that benefits the special interest. Thus, cash transfers may be worse than mandates because of the risk of over-transferring funds. When citizens do not know the cost of provision, but firms do, it may be efficient to mandate firms to provide the good, since competition encourages provision at cost. Cost minimizing firms efficiently provide the good when the cost of production of such good is unknown to the citizens. When the cost savings are greater than the deadweight loss generated by the mandate then indeed the mandate is more efficient than cash transfers.

This intuition is spelled out in Section 4 using a simple parametric model under the assumption that neither the general public nor the special interest know the true cost of provision. In Section 5 we extend this intuition to an environment with asymmetric information where the special interest knows the cost of the project, but citizens do not. The characterization of the optimal outcome provides us with guidance over which policies are more likely to be implemented. The main result is that the optimal provision may involve mandating high cost projects and implementing low cost project with a cash transfer that is constant in the implementation cost of the project. It is also possible however that only cash transfers only are used.

This characterization is robust whether or not the policy maker has the capacity to commit to a policy. We consider in Subsection 5.1 the mechanism design problem, in which

[1]Insofar as they increase a special group's welfare by taking resources from the general public.

the policy maker can choose *ex ante* a policy that depends on the special interest's report on the cost of the project.

The basic intuition is that whenever the policy maker chooses a cash transfer to a special interest reporting a given cost, it must also transfer the same amount of cash to special interests reporting a lower cost. Whenever the overpayment is larger than the deadweight loss deriving from the mandate, a cash transfer is not the information-constrained optimal policy. Whenever both cash transfers and mandates are used, the transfer must be equal to the cost of the highest project the policy-maker commits to funds via cash transfer. Higher cost projects are funded via mandate.

While it may be reasonable to assume that the policy maker can commit to a policy, we also take an equilibrium approach in Subsection 5.2 and ask what are the possible equilibrium outcomes in the asymmetric information case when there is no commitment. This model displays a large number of equilibria, but the characterization of the outcomes is the same as in the commitment case. In these equilibria essentially two signals are used. The policy maker mandates the project when the special interest sends a high signal and gives a cash transfers to the special interests reporting a low signal. Such transfer must be equal to the highest cost of those reporting the low signal (otherwise if the transfer is lower those with higher cost send the high signals that guarantees the mandate). From the policy maker's point of view it may be better use the mandate and pay the deadweight loss rather than choose to send a cash transfer to everyone sending a low signal.

In section 6 we extend the model and allow the special interest to be a strictly positive fraction of the population. The extension shows how our model can rationalize the use of other types of price regulation such as minimum wage legislation.

2 Alternative Explanations and Related Literature

Weitzman (1974) originated a strand of literature analyzing the relative efficiency of price vs. quantity controls. In his setup it is assumed that some policy *must* be chosen. Command or price controls are equivalent under complete information, while under imperfect information either type of policy can be optimal depending on the nature of the imperfection. We take a slightly different perspective by asking why seemingly inefficient instruments are used when under complete information one policy is always optimal.

Glaeser and Shleifer (2001) suggest that some activities are easier to regulate by controlling quantities rather than charging taxes because quantity violations are less costly to monitor. This explanation is more convincing when the authority intends to regulate *undesirable* activities such as liquor sales on Sundays or smoking in public facilities. In these examples one can argue that taxing such activities has a high monitoring cost which may be larger than the inefficiency arising from a quantity restriction. We view this explanation as complementary or alternative to ours. Without monitoring costs regulating using taxes (or subsidies) is always optimal, as in our model. However, we argue that in some cases there is an additional (or different) cost of using such instruments which is driven by incomplete information.

Another common view is that the use of mandates can be explained by paternalism. The idea is that when the general public cares not about the welfare of the special interest but about the direct effects of the mandate, then a mandate is preferable to a cash transfer. The implicit assumption however is that the special interest and the general public have conflicting interests about the implementation of the mandate, and that if given a direct cash transfer, the special interest would not use the resources to purchase the good associated with the mandate. Our model uses a preference specification that assumes away such conflict of interest, therefore our focus is not on whether the project should be provided or not, but on the form of provision.

Our result can be viewed as supporting the "Chicago" view of public choice (see Becker (1958) or Stigler (1982)) maintaining that politicians cannot persistently fool voters using inefficient instruments (Becker (1976)). If seemingly inefficient policies are observed, then something must be missing in the analysis. We suggest that what is missing is the observation that citizens may not know the cost of providing the project that benefits the special interest. Cost minimizing firms efficiently provide the good when the cost of its production is unknown to the citizens. Our explanation is consistent with the "Chicago" view in the sense that the constrained-efficient policy is always adopted.

Proponents of the "Virginia" view on public choice (see, for example, Tullock (1983)) have argued that inefficient policies may persist when citizens are poorly informed about which transfers are efficient. Coate and Morris (1995) formalize this idea in an equilibrium model with rational agents by considering "disguised transfer mechanisms." Their leading example is a road which may or may not be useful to the public at large, but is in any case a transfer to the construction company or people near the road. "Bad" politicians favor policies that serve to transfer resources to the special interest; cash transfers would in principle be the efficient transfer instrument, but they reveal the politician's type to the electorate. They show that such disguised mechanisms may be adopted in equilibrium when citizens are not sure both about the efficiency of the policy (policy uncertainty) *and* about the objectives of the politician (politician uncertainty). In such equilibria bad politicians adopt the disguised transfers mechanisms even when they are inefficient, in order to maintain their reputation and be re-elected. Citizens re-elect them because they don't know if the policy is inefficient or not.[2]

The set of policies we consider in this paper, which can be labeled as "transfer policies with concealed costs", are hardly justifiable on the same grounds. The reason is that we consider situations without policy uncertainty: under complete information a cash transfer is always the preferred policy. We also do not *need* politician uncertainty. In our model policies are chosen via "referendum voting" by a representative citizen so inefficiencies cannot arise from political failure.[3]

Our characterization of the result under the commitment case parallels the result in Townsend (1979), which considers optimal insurance in an exchange economy with costly state verification and random endowments. In the optimal contract, monitoring is used when there is a low realization of the random variable, while no verification is used when the realization is high[4]. In our framework bad news correspond to the project having high cost, and if this is the case monitoring takes the form of a mandate that leads to provision at cost by the firms. The cost of monitoring is the deadweight loss induced by the mandate. In our framework the optimal policy is qualitatively the same: monitoring is used when the cost of the project is high.

This form of solution has been shown to be optimal in other contexts. Mookherjee and Png (1989a) have shown that when monitoring criminal activity it is optimal for enforcement agencies with limited resources to prosecute harmful crimes with higher probabilities

[2]In a different environment, Coate (1995) shows that providing income insurance to the poor may dominate cash transfers. Such *in kind* transfer solves the free rider problem faced by the altruistic rich when they can privately transfer resources. In this case, cash transfers are not efficient because markets are not competitive.

[3]Our results can be extended to a setup where an elected politician chooses the policy. In such an environment, citizens can use the threat of non re-election to enforce the constrained efficient policy.

[4]Mookherjee and Png (1989b) analyze the optimal solution with randomization.

than less harmful acts. Reinganum and Wilde (1985) consider optimal enforcement of tax compliance and show that it is optimal to audit when the tax report is low (low income is bad news for a tax agency that wants to maximize revenues). Finally, Reinganum and Wilde (1986) characterize similar equilibrium policies in a model of tax compliance with no commitment.

The spirit of our paper is similar to a long line of papers, including work such as Baron and Myerson (1982), showing that asymmetric information can lead to an important tension between efficiency and division of surplus. Here, inefficient policies are adopted to avoid over-transferring resources to the special interest. If the special interest were simply transferred the highest possible cost of the project, an efficient allocation could always be attained, but at high cost to the citizen.

3 Regulatory Mandates in a Competitive Model

The Americans with Disabilities Act requires businesses to allow access by persons with disabilities to all public facilities. This mandate appears to be inefficient because accessibility devices are paid for by consumers through higher prices, regardless of their usage. As a result, the mandate distorts consumption decisions.

Consider also the recent debate over some provisions in the Safe Drinking Water Act requiring the adoption of a stricter standard for Arsenic in drinking water. Substances such as Arsenic, if assumed in small quantity, do not affect to most people, but may harm others who are particularly sensitive.[5] The new standard ensures that even relatively sensitive people can drink tap water in every municipality. Another possible remedy would be to transfer funds to the arsenic sensitive, which would allow them to pay for purified water. Depending on the water source, the cost of purification can vary greatly. That cost must be paid by the users of the water, as the mandate is unfunded, through higher prices.

The formal model intends to capture the common features of this non-exhaustive list of examples. The general public, modeled as a *representative citizen,* wants to achieve a goal that benefits a small group people. For lack of better terminology we will refer to the small group of people as "*special interest*" and use the term "*project*" to refer to the goal the citizen wants to achieve (being in our examples "safely drinkable water" or "accessibility

[5]For these people, prolonged exposure usually leads to drowsiness and pain, but they return to normal when exposure ends. Arsenic is rarely fatal at these low levels.

to public facilities"). The special interest has no resources of their own. We model the political process of policy choice assuming referendum voting to excludes efficiencies arising from political failure. To make sure the project is implemented, the citizen can transfer cash to the special interest. Alternatively, the citizen can choose to mandate firms to implement the project and pay for it through higher prices of the products they are selling.

Formally, we consider a competitive production economy where there is a continuum of firms which produces a consumption good c according to $c = f(h) = h^{\gamma}$, where h is labor input and $\gamma < 1$. Operating the technology requires the payment of a fixed cost F. There is free entry. The consumption good has price p and the wage rate is the numeraire. Denote leisure with l. Notice that free entry will lead to an equilibrium where price is at the minimum of the average cost curve; firms make zero profits at that point. The measure of firms N is determined by the number required to clear the market, since any number of firms are willing to enter the market at the zero profit point.

The economy is populated by a continuum of identical households endowed with one unit of time. Households benevolently wish to fund a project for a special interest. If the project is funded, the households receive utility $u(c, l) + b$, while they receive $u(c, l)$ if the project goes unfunded.[6] Function $u(\cdot)$ is bounded and strictly concave. The cost of the project in terms of the numeraire, a, is unknown to the households; the households know only that it is drawn from some distribution $F(a)$ with support on $A \subset [a_l, a_h]$.

The special interest are a negligible fraction of the population.[7] They are assumed to have no resources of their own and place special value to the implementation of the project. Denote with $v(c, q)$ the utility function of the special interest when the aggregate cost of the project is a, where c is the special interests' consumption and $q \in \{\text{project,no project}\}$ indicates whether the project is implemented or not. We assume that v is strictly increasing in the first argument, $v(\cdot,\text{no project}) \leq v(\cdot,\text{project})$, and

$$v(c, \text{no project}) \leq v(c - a, \text{project}) \quad \forall a \in A, c \geq a \tag{1}$$

The assumption implies that if they have enough resources to purchase the project they

[6]The households are altruistic, in the sense that b can be thought of as an altruistic benefit. On the other hand, they do not have any particular desire to be the ones responsible for the project, they care only that someone does it.

[7]Section 6 will extend the model to the case where the special interest is a positive fraction of the population.

will do so.[8] Assumption (1) implies that there is no conflict of interest between citizens and special interest on whether the project should be implemented or not. We adopt this specification to make sure that citizen's paternalism (a common argument for why unfunded mandates are adopted) is not what is driving our result: when choosing between a cash transfer or a mandate citizens are not concerned on whether the project is going to be implemented or not, but on which of the policies is more efficient. The special interest will always choose to implement the project if their resources cover the costs.

There might be other reasons to suspect that transfers are more efficient. One common argument is that the recipient of a cash transfer can optimally decide how to allocate the transfer to the purchase of different good. For clarity, we focus only on the fact that mandates distort prices for the households. By asserting that the special interest always prefers implementation to consumption in the amount of the cost of the project, we assume away the possibility that cash transfers are better for the special interest because of a "freedom to choose" argument.

Since the special interest project is beneficial to the households (through conferring b) but is nonrivalrous and nonexcludable, it must be facilitated by a central government. The government has access to two policies with which to fund the project. The first is to allow the special interest to purchase the special interest good at its own price. In order to accomplish this, resources of at least a must be transferred to the special interest to pay for the project. The government can tax, lump sum, an amount t to accomplish the transfer. The second is to *mandate* the representative firm *producing good* c to provide the project, forcing it to finance the project through increased the price p. As a result, the consumer's budget constraint is $pc = 1 - l - t$. Denote the solution to the consumer's problem by $X^*(p,t) = (c^*(p,t), l^*(p,t))$.

We normalize γ and F such that, under the cash transfer, the competitive price of the consumption good c, determined by the minimum point on the average cost curve, is $p_t = 1$. Under the mandate, profit maximizing implies $h = (\gamma p_m(a))^{1/(1-\gamma)}$. The price is $p_m(a)$ and

[8] We could introduce a separate v_a for each type a and then require $v_a(c,\text{no project}) \leq v_a(c-a,\text{project})$ $\forall c \geq a$ for every a. We make the simplification to conserve on notation; none of the results are affected by using the more general, type dependent utility v_a.

the number of firms is $N_m(a)$ solve

$$\begin{aligned} p_m(a)^{\frac{1}{1-\gamma}}\left(\gamma^{\frac{\gamma}{1-\gamma}}-\gamma^{\frac{1}{1-\gamma}}\right) &= F+\frac{a}{N_m(a)} \\ c^*(p_m(a),0) &= N_m(a)(\gamma p_m(a))^{\frac{\gamma}{1-\gamma}} \end{aligned}$$

The first equation guarantees that the firms profits are exactly zero, given their share of the fixed cost a;[9] i.e. they are at the minimum of their average cost curve. The second equation clears the market for consumption.We will assume there is some $p_m(a)$ that solves this for each a in A, otherwise mandates can never be possible. Notice that the firm pays only the true cost a. This is what makes transfers useful. Define $u^T(t) = u(X^*(1,t)) + b$ the indirect utility of the household if the project is funded through transfer $t > a$, and $u^M(a) = u(X^*(p_m(a), 0)) + b$ the indirect utility of the household when the project is funded through mandate.

4 Symmetric Information

Consider first as a benchmark the case with complete information. If the citizen could fund the project through a transfer of exactly a (the minimum transfer that funds the project), she would prefer the transfer mechanism, since it does not distort prices:

Proposition 1 *If there is complete information the cash transfer is always the efficient policy, that is* $u^T(a) > u^M(a)\ \forall\ a > 0$.

The proof is in Appendix B. The inefficiency induced by mandates is natural: it raises the price of the consumption good and lowers its quantity. This leads to lost consumer surplus from c and reduced employment.

In practice, funds might have to be raised through distortionary taxes to perform the cash transfer, which might seem like an argument explaining mandates. However, note that here a consumption tax has the identical effect of a mandate (for a fixed known value of a). It is sufficient for our analysis that the policy maker has access to some set of tax instruments that are less distortionary than a consumption tax.

As Proposition 1 shows, however, this alone cannot motivate regulatory mandates legislation on efficiency grounds: if the cost of the project were known to the citizen, then a

[9] For expositional simplicity, we assume that the fixed cost is not proportional to the mass of firms.

direct transfer to the special interest or direct purchase by the citizen would be the efficient policy.

The simplest environment in which mandates can be the efficient instrument is one with incomplete but symmetric information at the time the policy is chosen. If cash is transferred, there is no obvious way for the citizen to decide how much cash should be transferred, with overpayment resulting in some states of the world. On the other hand, when mandates are used, the firms pay only the true cost of providing the project.

5 Asymmetric Information

The simple example in the previous section clearly illustrates how the trade-off between overpayment and deadweight loss determines which type of policy is preferable from the citizen's point of view. However, it is based on the rather awkward assumption that the policy must be chosen before *anybody* learns the true cost of the project. If such cost is revealed at some point to somebody (as it must be in order that the project be implemented), we find it reasonable to assume the special interest is better informed. One reason is that a free rider problem may prevent the general public to efficiently assign resources to the learning about the true cost. This motivates extending the analysis to an environment of asymmetric information where the policy is chosen conditional on the special interest knowing the true cost of the project.

In addition to showing that mandates have informational content and may be adopted even in environments where information is revealed, we can characterize which projects are more likely to be mandated. We show that mandates are in some sense more likely to be used when the cost of the project is high, whereas cash transfers are used to implement low cost projects. Such characterization is robust to different assumptions about the citizen's ability to commit to a policy. We first analyze the mechanism design problem where the citizen can commit to a policy *ex ante* (Subsection 5.1). While there may be compelling reason for assuming that the policy maker can pre-commit to a policy, we also analyze the equilibrium outcome in the no-commitment case (Subsection 5.2) and derive a qualitatively similar characterization.

5.1 The Mechanism Design Problem

Since there is one type of household which makes up a full measure of voters, voting can be thought of as an incentive contract, where the optimal contract is the unanimous choice of the voters. We consider the case where the citizen chooses a transfer and a mandate system without randomization. Appendix A shows that the results are qualitative similar when randomization is allowed.

The special interest reports a cost $\hat{a}$ from which the representative household chooses a vote for a transfer $t(\hat{a}) \geq 0$ and a mandate $m(\hat{a}) \in \{0, 1\}$, with the interpretation that if $m(\hat{a}) = 1$ firms must provide the project and finance it through higher prices of the good they are selling. Since we are assuming that the special interest is without funds, the transfer cannot be negative.

Denote with $R_a(t, m)$ the indirect special interests utility induced by a policy (t, m), that is

$$R_a(t,m) = \max_{c,q} v(c,q)$$

$$\text{subject to}: \begin{array}{ll} c + qa \leq t & \text{if } m = 0 \\ c \leq t,\, q = 1 & \text{if } m = 1 \end{array}$$

Given (1) the special interest places special value on the implementation of the project and always wants the project to be funded rather than receive slightly less as cash. Under our assumption on v, the special interest is as happy with the project and no transfer as with the transfer that can exactly purchase the project,

$$R_a(a', 0) = R_a(a' - a, 1),\; a' > a \tag{2}$$

If any resources are left after buying the special interest good, the special interest spends them on the consumption good.

Since we will focus on revelation mechanisms, the household's choice of policy $t(\hat{a}), m(\hat{a})$ must be incentive compatible, i.e. it must lead to truthful revelation of a :

$$a = \arg\max_{\hat{a}} R_a(t(\hat{a}), m(\hat{a}))$$

The following proposition characterizes formally the optimal policy.[10]

[10] We are implicitly assuming the following timing. First, the voters can ask for a report from the special

Proposition 2 *The optimal provision takes one of the following forms:*

$$\begin{array}{ll} t(a) = \bar{t},\ m(a) = 0, & a \leq \bar{t} \\ t(a) = 0, m(a) = 1, & a > \bar{t} \end{array}, \quad \bar{t} \in A \tag{3}$$

or

$$t(a) = t_0, m(a) = 0, \quad \forall a, \qquad t_0 < a_h \tag{4}$$

The proof is in Appendix B. The first possibility (3) implies that all projects are funded. The second (4) allows for the possibility that some high cost projects have $m(a) = 0$ and $t(a) < a$, therefore some projects are not funded.

If the citizens choose to fund any projects by transfer, they must fund all projects at a constant amount, lest the special interest misreport to get the largest possible transfer. Therefore, for high cost projects, a mandate may be used instead. Although this generates deadweight loss, funding by transfer is costly as well since funding a high cost project through transfer leads to overpayment to lower types.

If the benefit b of the project is large enough, the project will always be funded, since not funding is very costly. In general, the optimality of funding large cost projects depends on many factors, including the benefits b, the probability distribution over such projects given by $F(a)$ and the deadweight loss associated with mandates.

Figure 1 illustrates the optimal policy in possibility (3). Low cost projects are funded through a transfer. Since there is no way to verify the true cost, the magnitude of the transfer cannot depend on a.[11] High cost projects may not be funded through transfers, though, because doing so encourages low-cost projects to be overfunded by claiming to be high-cost. The mandate is successful in financing the project at cost. If the household decides not to implement the project for some high a, it must still transfer t_0, lest the high a types claim a lower a to receive the transfer.

The form of the optimal policy is familiar from problems such as Townsend's (1979) costly state verification model. When the agent with information (in this case the special interest) reports bad news, (here in the form of high cost a), the citizen responds by paying

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interest on the cost. Then, voters choose a policy and the special interest disappears. Firms only appear after the special interest disappears, so that it is not possible to receive a report from the firms and punish (or reward) the special interest based on that report.

[11] If the populace had a noisy signal of a, the rule could include a transfer increasing in a. This does not affect our main point that high cost projects may be funded through mandates.

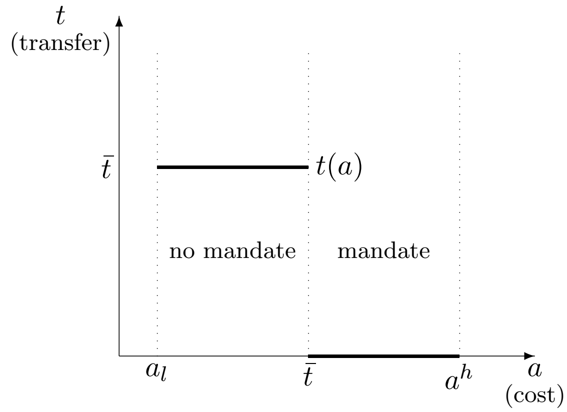

Figure 1: Optimal policy with mandates

a social cost (a deadweight loss) to verify the report. Since we assume that the firm provides the project at the true cost, a mandate acts as a costly state verification device.

While mandates may emerge as an optimal policy in the case with symmetric but incomplete information, the asymmetric case leads to a policy whereby, for different projects that cannot be distinguished by the citizens but can be by the special interest, the high cost projects are the ones funded by mandate.

The proposition establishes only that mandates might be used for high cost projects, not that it is optimal to do so. To see why mandates might in fact be optimal provision one needs to look at the citizen's problem. Define $D(a) = u^T(a) - u^M(a)$, the deadweight loss from a mandate, and consider the case where this difference is decreasing in a (this is true, for instance, if u is Cobb-Douglas). Imagine a case where b is large enough so that the project should be funded one way or the other. In choosing which funding method to use, the citizens solve

$$\max_{\bar{t} \in A} F(\bar{t}) u^T(\bar{t}) + \int_{\bar{t}}^{a_h} u^M(a) dF(a) \tag{5}$$

The optimality condition for an interior solution is (where prime denotes first derivative and $f(a)$ is the density function corresponding to F)

$$f(\bar{t}) D(\bar{t}) = F(\bar{t}) \frac{du^T(\bar{t})}{dt} \tag{6}$$

The left side is the benefit of choosing an efficient transfer for the marginal type times the density $f(\bar{t})$ of such type, the left side the marginal cost of providing a higher $\bar{t}$ to all of the types lower than $\bar{t}$, which have measure $F(\bar{t})$. The trade-off is clear: if the loss D is small enough, it is preferable to incur it rather than over-transfer in other states of the world, at a cost of $u'(t)$. Increasing the marginal project funded by transfer increases the transfer to all lower a's. This overpayment can be avoided by letting the firms provide the project at the lowest cost.

5.2 Equilibrium Provision Without Commitment

We now turn to the case where the citizen cannot commit to the announced policies. The problem is that once the cost is revealed, the citizen prefers to use this information to target the amount of the transfer and avoid the deadweight loss associated with using mandates. In this section we show that mandates may be used even in a pure "signalling" environment where there can be communication between the citizen and the special interest, but the citizen cannot commit to any specified policy.

In the environment we have in mind, after Nature's choice of $a \in A$ the special interest can then make an announcement $\sigma \in S$, where S has the same dimensionality as A. The strategy of the special interest is a function of its type $\sigma(a)$. The citizen's strategy is specified by functions $m(\sigma), t(\sigma)$ indicating whether or not a mandate is implemented and the amount of the cash transfer after each signal. We focus on Bayesian Nash Equilibria in pure strategies as a solution concept, but it is straightforward to extend our analysis to mixed strategies.

The following proposition establishes that the equilibrium strategy for the policy maker takes a form similar to the one in the case of the mechanism design problem, that is, either cash transfers to low cost types and mandate to high cost types, or a constant transfer to all types.

Proposition 3 *All pure strategy equilibria of the signalling game have either*

$$\begin{array}{lll} (t \circ \sigma)(a) = \bar{t}, & (m \circ \sigma)(a) = 0, & a \leq \bar{t} \\ (t \circ \sigma)(a) = 0, & (m \circ \sigma)(a) = 1, & a > \bar{t} \end{array}, \qquad \bar{t} \in A$$

or

$$(t \circ \sigma)(a) = t_0, \quad (m \circ \sigma)(a) = 0\ , \qquad \forall a \qquad t_0 < a_h$$

Naturally, the signaling game may display many equilibria. The proposition says that we characterize each equilibrium as one of two types. The first is a separating equilibrium where signals are used in equilibrium by different sets of types and mandates are used in correspondence to the signal sent by the higher cost types. The other is a pooling equilibrium where the signal is disregarded as uninformative and the policy is a constant transfer.

The following proposition states that if it is not optimal to "separate" in the mechanism design problem, then there cannot be a separating equilibrium in the signalling game, since the equilibrium of the signalling game is always incentive compatible, and therefore could be implemented by the citizen in the mechanism design problem.

Proposition 4 *Suppose the unique solution to the mechanism design problem is a constant transfer to all types. Then any equilibrium of the signalling game has a constant transfer to all types.*

This fact implies that, the set of models where mandates may arise under the signaling game is (weakly) a subset of the set of models where mandates can arise as an optimal mechanism. However, for a given model where a separating equilibrium exists, mandates may be used for a larger set of costs than in the commitment case. That is, it may be the case that the mechanism assigns a transfer to some low cost types and a mandate to others, but for the same underlying parameters the equilibrium of the signaling game either does not separate at all, or uses mandates more or less frequently (that is, for a larger or smaller subset of A), as compared to the mechanism.

6 Income Maintenance through a Minimum Wage

The same rationale provided with our model can be used to address the efficiency properties of minimum or "living" wage legislation. One textbook inefficiency of the minimum wage is exactly the kind of distortion that we assume to be the feature of the policies with "concealed costs" that we consider in this paper. Even if the minimum wage had no effect on the employment of low wage workers, the cost of the inflated wage must be paid for, in equilibrium, through distortions of other prices. Just as in our basic model, if the citizens want to redistribute a certain amount of income, they could do it more efficiently by transferring it in cash, leaving prices undistorted. However, we will show in the rest of the paper that this may not be the case if the income-generating ability of relatively poor agents is unknown.

The reason we cannot immediately apply the results established so far is that in order for the cost of the income maintenance program to be non negligible, the fraction of people to be supported must also be non negligible. This implies that when either policy is imposed, the price of the consumption good is also affected by the special interest own consumption, and this changes the relative costs and benefits of each policy.

We assume there are two types of workers in the population, of high and low skill. The low skill workers can be interpreted as the set of agents we previously labeled as "special interest." They are a fraction $\lambda < 1/2$ of the population, so that the rest of the citizens are the ones choosing the policy under majority rule majority rule. The "project" to be implemented is an income maintenance program that benefits the low skill workers.

The production technology is similar to the previous section, except that the only variable input is skilled labor l. However, the representative firm must employ a fixed overhead of ϕ low skill workers in order to produce a positive amount. Further hiring has no effect on output; it can be thought of as the fixed cost F in the previous section. Let $\phi < \lambda$, so that there are more low skill workers than required to cover the overhead[12]. Adopting a Leontief technology allow us to focus on the effects of the policy on output prices and therefore we do not want the policy to affect labor demand. The distortions we describe would also be present in a model with a more general technology where labor quantities are also affected. Each worker can either be employed or not.

The high skill workers' preferences are just like the voters preferences in the basic model. We assume that the high skill workers obtain benefit b if the low skilled workers are guaranteed a real consumption of at least $W \cdot p$. While not necessary, we assume that the condition assumed in (1) holds with strict equality (as it is reasonable in this environment since a project of cost a, if implemented, has the effect of increasing the low skill workers' income by a) .

The output price is p and the wage of the high skill input is the numeraire. Each low skill worker has preferences $c - h$, where $h < 1$ is the disutility from being employed and c is consumption. We assume that h is unknown to the high skill workers. The only know $h \in H \subset [0, \overline{h}]$, where $\overline{h} < 1$ and $W > \overline{h}$ so that the guarantee does in fact raise consumption of low skilled workers.

In absence of government regulation of wages, the wage of the low skill job is exactly

[12] As a result, some low skill workers will be unemployed. We find it reasonable, as a first approximation, to assume that the minimum wage legislation addresses the general public concern for the working poor and not for the unemployed. Note that the low skill worker size can be made an arbitrarily small fraction of λ in this example if ϕ is near λ.

their reservation wage ph. If it is any higher, all λ of the low skill workers wish to be employed, but only ϕ are required. If the wage is any lower, none are willing to work.

The cost of "implementing the project" a is the cost of guaranteeing the minimum level of consumption to low skilled workers, therefore $a = W - h$. There are two instruments that can be used to guarantee the minimum level of consumption. High skill workers can either transfer to the workers in that job a cash amount t, or they can adopt a minimum wage legislation that mandates firms to pay workers at least $W \cdot p$.

Denote with $c^*(p,t)$ the optimal aggregate consumption of the representative high skilled worker. In this case the representative high skill worker, as a function of price p and transfers t. In this example we also need to take the effect of the low skill workers' consumption on the price, therefore denote with $c^l(p,w)$ the optimal aggregate consumption of a low skill worker as a function of the consumption products' price and wage income w[13].

The effects of each policy on prices are as follows. If cash transfers are used, firms make zero profits net of payment to low wage workers, so $p(t)$ is the solution to the following zero profit condition under free entry:

$$\underbrace{p(t)\frac{\left(c^*(p(t),t)+c^l\left(p(t),p(t)\phi h+t\right)\right)}{N}}_{\text{revenues}} - \underbrace{\left(\frac{c^*(p(t),t)+c^l\left(p(t),p(t)\phi h+t\right)}{N}\right)^{\frac{1}{\gamma}}}_{\substack{\text{payments to}\\ \text{skilled workers}}} - \underbrace{p(t)\phi h}_{\substack{\text{payments to}\\ \text{unskilled workers}}} = 0$$

Under the minimum wage legislation, the price of output must adjust in order for firms to make zero profits and pay a wage of $W \cdot p$. The resulting price is $p_m(a)$ that solves the zero profit condition:

$$\underbrace{p_m(a)\frac{\left(c^*(p_m(a),0)+c^l\left(p_m(a),W\phi\right)\right)}{N}}_{\text{revenues}} - \underbrace{\left(\frac{c^*(p_m(a),0)+c^l\left(p_m(a),W\phi\right)}{N}\right)^{\frac{1}{\gamma}}}_{\substack{\text{payments to}\\ \text{skilled workers}}} - \underbrace{p_m(a)\phi W}_{\substack{\text{payments to}\\ \text{unskilled workers}}} = 0$$

The payoffs $u^T(t)$ and $u^M(a)$ can be defined just as in the basic model. Now since the low skill workers are not a negligible fraction of the population they contribute to paying off the cost of the "project" in case of a mandate, which means that it may be the case that $u^T(t) \leq u^M(a)$. If this is the case then the mandate is preferable to cash transfers even with perfect information. Whenever $u^T(t) \geq u^M(a)$ Propositions 2-4 concerning the optimal form of transfer apply without qualifications. Therefore, the minimum wage legislation

[13] Both $c^*(\cdot)$ and $c^l(\cdot)$ depend on relative group size λ. We do not indicate λ as an explicit variable to economize on notation.

can be rationalized as an efficient provision of income maintenance even though it distorts prices. The mandate has the beneficial feature that firm's pay only the difference between the workers' competitive wage and the income guarantee.

7 Conclusion

One may argue that ultimately regulatory mandates occur because of political concerns, especially considering the examples that we proposed in this paper. When making such arguments we must not confuse the question of *why* policy are chosen with the different question of *which* policy must be chosen. We agree that political concerns are driving the choice of transfering resources to special interests. However, it is not clear why politicians should chooose (seemingly) inefficient means of provision.

We have presented a model that explains why mandates and other seemingly inefficient transfer policies may in fact be the constrained efficient policy even in situations where cash transfer would be more efficient under perfect information. We emphasized the informational content of mandates: whenever citizens are not sure about the cost of the project, it may be optimal do mandate firms to implement such project. Competition between firms implies that under a mandate the project is provided at cost. Cash transfers instead may exceed the cost of implementing the project.

The examples in Section 3 should have clarified the key difference between our models and other models that rationalize the adoption in equilibrium of inefficient policies. In Coate and Morris (1995) it is crucial that the project may be efficient in some states of the world, while in this paper mandates are always inefficient under complete information. The other difference with the previous literature is that in our explanation politicians themselves are not central to the model. Indeed, we assume a referendum-like voting mechanism and the citizens do want to fund the project that benefits the special interest.

The effects highlighted by our model are not inconsistent with and complement explanations that have been suggested for the use of mandates that rely on the general public's paternalism. We have abstracted from any paternalistic motive by assuming that the special interest places special value to the implementation of the project. This guarantees that focus of our argument is on the form of implementation rather than on whether the project should be implemented or not.

The information structure is crucial to the results. If the citizen has full information, the mandate will never be used. It may be used, however, when information is incomplete. When the incompleteness is asymmetric, so that the special interest knows the cost of the project, the policy has the feature that low cost projects are funded by cash transfer and high cost projects are funded by mandate. Finally, when information is asymmetric, having the power to commit *ex ante* to a policy as a function of the reported cost is helpful but not crucial to the citizen in being able to use mandates.

A Appendix: The Mechanism Design Problem with Randomization

Even if the special interest values dollars linearly, there is a natural discontinuity in their payoff that suggests randomization might be useful. Our main point in this section is that mandates are still possible when we consider this more general strategy set. To simplify the analysis we specify the special interest preference and assume they get v dollars of utility from the project, which costs a. Simply using utility that is linear in dollars we have $v_a(c, q) = c + v$ if $q =$"project", and $v_a(c, q) = c$ if $q =$"no project." The indirect utility of a policy indicating a transfer and a mandate can therefore be written as:

$$R_a(t, m) = \begin{cases} v + t & \text{if } m = 1 \\ t & \text{if } m = 0 \text{ and } t < a \\ v + t - a & \text{if } m = 0 \text{ and } t \geq a \end{cases} \tag{A1}$$

When $v > 0$ the special interests values a transfer of exactly a much more than a transfer of $a - \varepsilon$, however small ε is. Given this discontinuity, threatening to not fund the project with some probability can be useful in generating truth telling.

Allowing for randomization, for each a, the special interest receives a lottery over transfers and mandates. Let G_a be a probability distribution on $\mathbb{R}_+ \times \{0, 1\}$. A report a is met by a distribution $G_a(t, m)$ of outcomes over possible transfers and mandates. Proposition 5 characterizes the optimal policy, and shows that it has a relatively simple form. Throughout, we write $\Pr_a(A)$ to denote the probability of a given measurable subset $A \subseteq \mathbb{R}_+ \times \{0, 1\}$ under G_a:

$$\Pr_a(A) = \int_A dG_a(t, m)$$

Proposition 5 *Suppose that the special interest has the utility function given in (A1). If any type receives either a positive transfer or a mandate with positive probability, then the optimal provision with randomization has the form:*

$$\left.\begin{array}{l}\Pr_a(m=0, t<a)=0 \\ \Pr_a(m=1) \textit{ increasing in } a\end{array}\right., a \leq \bar{t} \tag{A2}$$

and either

$$\Pr{}_a(t=0,\ m=1)=1,\ a>\bar{t} \tag{A3}$$

or

$$\left.\begin{array}{l}\Pr_a(t=0, m=0) \equiv p(a)>0 \\ \Pr_a(t=a, m=0) \equiv q(a) \\ \Pr_a(t=0, m=1) \equiv 1-p(a)-q(a)\end{array}\right., \ a>\bar{t} \tag{A4}$$

The proof is in Appendix B. The citizens will use transfers as well as either sure mandates or uncertain funding.

For low values of a (see A2), the proposition says that the project is funded through a mixture of transfer and mandate, with the probability of mandate increasing for higher reports a. The reason is identical to in the case without randomization: transfers to high cost projects has the additional cost of the overpayment they bring to lower cost projects.

For high values of a, the optimal mechanism may eventually use mandates with probability one (A3). However, another possibility (A4) is that under high reports of a the project is not always funded. In the region where funding is not sure, a particular sort of policy is used: with positive probability, no transfer is given and the remaining possibilities are mixed between funding of exactly the appropriate amount and mandate. When the project might go unfunded, the citizens can use that threat to avoid overpaying a given type a. Instead, exactly the appropriate amount is transferred. While this has a benefit of avoiding overpayment without always having to use inefficient mandates, it of course has a cost: the society cares to fund this project, so the threat to not fund it is costly to the citizens as well as the special interest.

A.1 A special case where mandates are used

Proposition 5 shows that it might be optimal to use mandates. A simple example shows that the proposition is not vacuous and that having a strictly positive probability of mandate is indeed optimal under some parametrizations of the problem.

We use a contradiction argument showing that, as compared to transfers funding a high cost project, mandates provide less incentive for lower cost types to claim to be high cost. We use the fact that a mandate is equally attractive to special interests of all types, since it provides them with the project and nothing further. A large cash transfer however is more attractive than a small one so if the deadweight loss is small the voter can more efficiently use mandates to satisfy the lower cost types' incentive compatibility constraints.

Consider the case where there are just two types, a_0 and a_1. Suppose (by way of contradiction) that mandates are not used, then by Proposition 5 $t(a_1) \geq a_1$. However, it is clearly not optimal to overpay the highest type a_1. It follows that if anything other than $[m(a) = 0, t(a) = 0$ for all $a]$, the optimal policy has the form

$$\begin{aligned} &t(a_0) = t_0 \geq a_0 && \text{with probability } p_0 \\ &t(a_1) = a_1 && \text{with probability } p_1 \\ &\text{where } t_0 = a_0 \text{ if } p_0 < 1 \end{aligned}$$

In the solution to the voter's problem when not using mandates, it is always the case that the incentive constraint of the a_0 type binds (details are in Appendix B), i.e.

$$p_0(v + t_0 - a_0) = p_1(v + a_1 - a_0)$$

whenever $b > 0$.

To show a case where mandates might be useful, suppose b is large enough to justify $p_1 > 0$. Consider replacing the lottery offered to type a_1 involving only transfers with one of the form

$$\begin{aligned} &t(a_1) = a_1, m(a_1) = 0 && \text{with probability } \tilde{p}_1 \\ &t(a_1) = 0, m(a_1) = 1 && \text{with probability } q \\ &t(a_1) = 0, m(a_1) = 0 && \text{otherwise} \\ &\text{where } \tilde{p}_1 + q = p_1 \end{aligned}$$

With some probability q, the project is funded by mandate instead of transfer a_1.

From the voter's perspective, the cost of this policy is enduring the deadweight loss of mandate $D(a_1)$ with probability q. The revised contract does not have any effect on the incentives of type a_1, since in some states of the world they go from a transfer of exactly their cost to a mandate, and in others they are unaffected. However, the use of mandates for type a_1 relaxes the incentive constraint of type a_0. That constraint is

$$\begin{aligned} p_0(v + t_0 - a_0) &\geq \tilde{p}_1(v + a_1 - a_0) + qv \\ &= p_1 v + \tilde{p}_1(a_1 - a_0) \end{aligned}$$

As $\tilde{p}_1$ is lowered, the right hand side falls. Since this constraint binds, the voter could benefit from relaxing it. If $u(c, l)$ is such that $D(a_1)$ is small enough, the benefit from relaxing this constraint outweighs the deadweight loss, and so mandates are better.

B Appendix: Proofs

Proof of Proposition 1

Define

$$AC(c) = \left(\frac{c}{N}\right)^{\frac{1-\gamma}{\gamma}} + \left(\frac{FN}{c}\right)$$

and

$$AC_m(c) = \left(\frac{c}{N_m(a)}\right)^{\frac{1-\gamma}{\gamma}} + \left(\frac{FN_m(a)}{c}\right)$$

to be the per-unit cost, in units of labor, excluding a, under transfer and mandate, respectively. Since $p_m(a) > 1$ for $a > 0$, $AC_m(X) > AC(X)$; firms are at the minimum of this average cost under the transfer, and increase their scale when the price rises above one under the mandate, increasing this average cost.

Consider the bundle $X^*(p_m(a), 0)$. In order for it to be feasible,

$$1 - l^*(p_m(a), 0) \geq c^*(p_m(a), 0) AC_m(c^*(p_m(a), 0)) + a$$

but, since $AC_m(X) > AC(X)$,

$$1 - l^*(p_m(a), 0) > c^*(p_m(a), 0) AC(c^*(p_m(a), 0)) + a$$

In other words, choosing $X^*(p_m(a), 0)$ is feasible under the transfer of a. Since $p_m(a) > 1$ for all $a > 0$, strict concavity of u implies that $c^*(1, a) \neq c^*(p_m(a), a)$ and so, again by strict concavity, $u^T(a) > u^M(a)$ ■

Proof of Proposition 2

The citizens' problem is

$$\max_{t(\hat{a}),m(\hat{a}),S(\hat{a},a)} \int \big((1-m(\hat{a}))\, u^T\,(t(\hat{a})) + m(\hat{a})u^M(\hat{a}) + B(\hat{a})b\big)\, dF(\hat{a}) \tag{B5}$$

$$\text{subject to: } a = \arg\max_{\hat{a}} R_a(t(\hat{a}), m(\hat{a}))$$

$$t(\hat{a}) \geq 0$$

$$B(\hat{a}) = \begin{cases} 1 \text{ if } m(\hat{a}) = 1 \text{ or } t(\hat{a}) \geq a \\ 0 \text{ otherwise} \end{cases}$$

We that only the two mechanism stated can be optimal by ruling out different possibilities using incentive compatibility (Claim 1-3) and citizen optimization (Claim 4).

Divide the set of feasible costs in two subsets A_0 and A_1 corresponding to different mandate policies i.e. such that $A_k = \{a : m(a) = k\}$, $k = 0, 1$.

Claim 1 *The transfer is constant whenever the mandate policy is constant, that is* $t(a) = t_k$ *for all* $a \in A_k$.

If this is not true, then there are $a, a' \in A_k$ such that $t(a) < t(a')$. But then the special interest with cost a has incentive to report cost a'.

This step implies that there are at most two regions: one with $m(a) = 0$ and some transfer t_0, and another with $m(a) = 1$ and some transfer t_1. Mechanism (4) in the statement of the proposition is the case where there is only the region with $m(a) = 0$ and a transfer t_0, and is consistent with this claim.

To prove the characterization of mechanism (3), we proceed considering the situation where there both regions A_0 and A_1 are nonempty (that is both policies are used).

Claim 2 $m(a)$ *must be increasing in* a*.*

If not, then there exists a and a' with $a' > a$ and $m(a') = 0$, $m(a) = 1$. Incentive compatibility requires $t_0 \geq a'$, otherwise type a' prefers the mandate. Incentive compatibility also requires

$$\begin{aligned} R_{a'}(t_0, 0) &\geq R_{a'}(t_1, 1) \\ R_a(t_1, 1) &\geq R_a(t_0, 0) \end{aligned}$$

Rewriting the first term in each inequality using (2):

$$\begin{aligned} R_{a'}(t_0 - a', 1) &\geq R_{a'}(t_1, 1) \\ R_a(t_1 + a, 0) &\geq R_a(t_0, 0) \end{aligned}$$

But that implies $t_0 - a' \geq t_1$ and $t_1 + a \geq t_0$, which cannot hold for $a' > a$. The contradiction implies $m(a)$ is increasing.

Claim 3 *If A_1 is nonempty, then $t(a) = \bar{t} = max_{a \in A_0} a \; \forall a \in A_0$*

If in A_0 the transfer is not equal to the maximum cost, every type in that region that does not have enough resources can attain project implementation by claiming to be $\tilde{a} \in A_1$. Therefore incentive compatibility that the transfer in A_0 be equal to the maximum cost in that set, so that all projects not funded by mandate ($m(a) = 0$) are fully funded ($t(a) \geq a$).

Claim 4 $t(a) = 0 \; \forall a \in A_1$.

This is obvious since eliminating transfers to mandated projects lowers payments without altering the incentives for types with $m(a) = 1$.

This completely characterizes mechanism (3) in the statement of the proposition. Which mechanism is adopted depends on the solution to the citizen's problem ■

Proof of Proposition 3

For a signal to be a best response for the special interest of type a it must be the case that

$$a = \arg\max_{\hat{a}} R_a((t \circ \sigma)(\hat{a}), (m \circ \sigma)(\hat{a})) \tag{B6}$$

As a result, any equilibrium must be one that is of the form that is incentive compatible in the mechanism design problem and Claims 1-3 in the proof of proposition 2 follow immediately. Since it is never for the citizen to respond to a signal with both a mandate and a transfer, it is also true that whenever there is a mandate the cash transfer is zero (as in Claim 4 of the proof of proposition 2). ■

Proof of Proposition 4

Suppose the solution to the mechanism design problem is a constant transfer t_0 to all costs and assume by contradiction that there exists an equilibrium of the signalling game $[\widetilde{t}(\cdot), \widetilde{m}(\cdot), \widetilde{\sigma}(\cdot)]$ where the citizen uses mandates after observing some signals, that is $\widetilde{m}(\sigma) = 1$ for some σ in the range of $\widetilde{\sigma}(\cdot)$. Now consider the policy $[t(\cdot), m(\cdot)]$ in the mechanism design problem with :

$$\begin{aligned} t(a) &= \widetilde{t} \circ \widetilde{\sigma}(a) \\ m(a) &= \ \widetilde{m} \circ \widetilde{\sigma}(a) \end{aligned} \qquad \forall a$$

and consider a strategy for the citizen in the signaling game $[t'(\cdot), m'(\cdot)]$ that mimics the solution to the mechanism design problem, i.e.

$$\begin{aligned} t'(\sigma) &= t_0 \\ m'(\sigma) &= 0 \end{aligned} \qquad \forall \sigma$$

Since in the signaling model the citizen is choosing a best reply, $[\widetilde{t}(\sigma), \widetilde{m}(\sigma)]$ must be weakly preferred to strategy $[t'(\sigma), m'(\sigma)]$ for all σ. This means that $[t(\cdot), m(\cdot)]$ must do at least as well as a constant transfer of t_0 from the citizen's point of view. Moreover, special interest equilibrium behavior (B6) implies that $[t(\cdot), m(\cdot)]$ is incentive compatible. This implies that the constant transfer cannot be the unique solution to the mechanism design problem, a contradiction ■

Proof of Proposition 5.

The proof is carried out through a collection of claims. Denote $G_a(t,m)$ to be the measure over transfers and mandates given a report of a. Denote δ_X the measure that places probability one on event X. The citizens problem is:

$$\begin{aligned} &\max_{G_{\hat{a}}} \int \left(\left(\int \left((1-m)u^T(t + \left(mu^M(\hat{a}) \right) \right) dG_{\hat{a}} \right) + B(\hat{a})b \right) dF(\hat{a}) \\ &\text{subject to: } a = \arg\max_{\hat{a}} \int R_a(t,m) dG_{\hat{a}}(t \times m) \\ &\qquad t(\hat{a}) \geq 0 \\ &\qquad B(\hat{a}) = \int_{\substack{t \geq a \\ m=1}} dG \end{aligned}$$

The first claim establishes that if a project is underfunded, i.e. a transfer less than a is given, the underfunding transfer must be zero.

Claim 1 $\Pr_a(t \in (0,a), m = 0) = 0.$

Suppose there was a positive probability of a transfer strictly between zero and a under G. Consider an alternate G'_a where that chance is removed and instead placed on zero and a so that

$$\int R_a(t,m)dG_a(t \times m) = \int R_a(t,m)dG'_a(t \times m) \tag{B7}$$

for all a. The new G' is constructed so that it leaves a just as well off as before. Note that $\int tdG'_a(t \times m) \leq \int tdG_a(t \times m)$, because the probability that the project is funded increases therefore the expected transfer can be lower. The change is incentive compatible since $\int R_{a'}(t,m)dG_a(t \times m) = \int R_{a'}(t,m)dG'_a(t \times m)$ for $a' > a$ (the probability that the project is funded remains the same and so does expected utility given (B7)) and $\int R_{a''}(t,m)dG'_a(t \times m) < \int R(t,m)dG_{a''}(t \times m)$ for $a'' < a$ (the probability that the project is funded remains the same but the expected overpayment is lower under G'). The citizens benefits from less expected transfer and a greater chance of funding the project, so G' dominates G and so such a G could not be optimal.

The next claim shows that when there is a positive probability of underfunding, there is no chance of overfunding. Therefore the randomized outcome in (A4) takes the form of the proposition, with either no transfer, transfer exactly a, or mandating without transfer.

Claim 2 *Suppose* $\Pr_a(t = 0, m = 0) > 0$. *Then* $\Pr_a(t > a, m = 0) = \Pr_a(t > 0, m = 1) = 0$.

Take any G_a where the statement does not hold. Consider G'_a where $\Pr_{a'}(t = 0, m = 0) < \Pr_a(t = 0, m = 0)$, and $\Pr_{a'}(t > a, m = 0 \text{ or } t > 0, m = 1) < \Pr_a(t > a, m = 0 \text{ or } t > 0, m = 1)$, but with

$$\int R_a(t,m)dG_a(t \times m) = \int R_a(t,m)dG'_a(t \times m)$$

G' is still incentive compatible since$\int R_{a'}(t,m)dG_a(t \times m) = \int R_{a'}(t,m)dG'_a(t \times m)$ for $a' > a$ and $\int R_{a''}(t,m)dG_a(t \times m) < \int R(t,m)dG'_{a''}(t \times m)$ for $a'' < a$. But G'_a involves less transfer and a higher probability of the project being funded than G_a, so the citizens prefers G'_a, and so G_a could not be optimal

Next it is shown that once there if there is a chance of underfunding a, there must be a chance of underfunding for all higher reports $a' > a$. Also, if mandates are used for sure given a, they must also be used for sure for $a' > a$.

Claim 3 *Suppose* $\Pr_a(t = 0, m = 0) > 0$. *Then* $\Pr_{a'}(t = 0, m = 0) > 0$ *for all* $a' > a$.

To do otherwise would violate incentive compatibility: by a previous claim, whenever $t \neq 0$, the project is funded. Moreover, by the last claim, whenever $t = 0$ is possible, there is no overfunding. Therefore if a' were funded for sure but a not, a would lie and claim to be a' since the option offered to a has no chance of overfunding and some chance of going unfunded

Claim 4 *Suppose* $\Pr_a(m = 1) = 1$. *Then* $\Pr_{a'}(m = 1) = 1$ *for all* $a' > a$.

The same argument as in the previous clam implies that $\Pr_a(t = 0, m = 0) = 0$ for all a if sure mandates are offered, since any type can guarantee funding by claiming to be the type that gets the mandate. As a result, an argument identical to the one in Proposition 2 can be applied

In the range where the project is funded by one method or another for sure and sometimes with a transfer, the probability of mandate must be increasing in a:

Claim 5 *Take* $a' > a$ *with* $\Pr_a(t = 0) = \Pr_{a'}(t = 0) = 0$. *Then* $\Pr_a(m = 1) \leq \Pr_{a'}(m = 1)$.

Suppose $\Pr_a(m = 1) > \Pr_{a'}(m = 1)$. Notice that IC for a requires that $\int (t-a)dG_a(t) \geq \int (t - a)dG_{a'}(t)$. But then if G_a is replaced by $G_{a'}$, the citizens overpay less, always fund the project, and face the deadweight loss of mandates less often, so it is always better to offer $G_{a'}$ to type a, contradicting optimality of G_a

The preceding claims establish that if any project is funded, there can at most two regions: One where the project is funded for sure using transfers and mandates (A2), followed for higher a by a region where either the project is always funded by mandate (A3) or where the project always has a chance of going unfunded, being exactly funded a, or being funded by mandate (A4) ■

Proof that constraint binds in Section A.1

Denote by λ the probability of type a_0. Notice that it clearly is never optimal to have $t_0 > a_1$. Moreover, unless $t_0 = t_1 = 0$ and the project is not funded, it is never optimal to have $t_0 < a_0$, since it would be better to offer a transfer of a_0 with probability $\tilde{p}_0$, where $t_0 p_0 = a_0 \tilde{p}_0$. The alternative of a_0 and $\tilde{p}_0$ remains incentive compatible for both types (it has no effect on the utility of type a_1, while it makes a_0 better off) and it improves social welfare since citizens now enjoy b with some probability. With this in mind, the problem using only transfers can be written as

$$\max_{t_0, p_0, p_1} \lambda \left[p_0(b - t_0)\right] + (1 - \lambda) \left[p_1(b - a_1)\right]$$

subject to:

$$p_0(v + t_0 - a_0) \geq p_1(v + a_1 - a_0) \text{ (IC for } a_0\text{)}$$

$$p_1 v \geq p_0 t_0 \text{ (IC for } a_1\text{)}$$

Denoting by μ_0 and μ_1 the Lagrange multipliers on the two constraints, the first order conditions are

$$\begin{aligned} -\lambda p_0 + \mu_0 p_0 - \mu_1 p_0 &= 0 \\ \lambda(b - t_0) + \mu_0(v + t_0 - a_0) - \mu_1 t_0 &= 0 \\ (1 - \lambda)(b - a_1) - \mu_0(v + a_1 - a_0) + \mu_1 v &= 0 \end{aligned}$$

If the first constraint does not bind, then $\mu_0 = 0$ and the first two conditions imply $b = 0$, a contradiction since $b > 0$. The first constraint, therefore, must bind ■

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