Wealth Constraints, Lobbying and the Efficiency of Public Allocation

Joan Esteban
Instituto de Análisis Económico (CSIC)

Debraj Ray
New York University and Instituto de Análisis Económico (CSIC)

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Abstract: In Esteban and Ray (1999) we formalize a model in which individuals lobby before the government in order to benefit from some productivity enhancing government action (infrastructures, direct subsidies,É, permissions, in short). The government honestly tries to allocate these permissions to the agents that will make the best use of them, as revealed by the intensity of their lobbying. If the marginal cost of resources varies with wealth, the amount of information transmitted through lobbying will depend on the degree of inequality. In this paper, we summarize the main approach and examine the special case of equal wealth. We show that the nature of signaling equilibria is critically affected by per-capita wealth.

Corresponding author: J. Esteban, Instituto de Análisis Económico, Campus de la UAB, 08193 Bellaterra-Barcelona, Spain tel. 34 93 580 6612, e-mail: esteban@uab.es.

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1 Introduction

The role of public action in fostering economic development cannot be overemphasized. This is especially true of developing economies. Such action may be in the form of direct public investment, in infrastructure or in certain key industries. Or government action may be enabling, in the sense that it fosters economic activity through licenses, tax breaks or other direct subsidies (such as directed credit). It will be useful to think of the government as granting — in the broadest sense — *permissions* to produce. These may be spatially directed (e.g., regional infrastructure provision), sectorally directed (e.g. an input subsidy on a specific input), or directed to certain individuals or groups (licenses).

Individuals — or production sectors — will be able to make different use of these resources. Some will have higher productivity than others. It is unlikely that the government will know who these agents are. This problem is specially acute for situations in which growth opportunities are accompanied by rapid structural change. In Esteban and Ray (1999) we study the role of lobbying as a form of political participation which conveys information to the government on the value attached by each player (individual, sector, region) to receiving a permission.[1] Specifically, we examine how this transmission of information through a costly signalling game is affected by the wealth level in an economy with borrowing constraints. Thus, our model marries political participation and imperfect capital markets. In this paper we characterize the different types of equilibria and the corresponding losses (allocational and conflictual) that can arise under different distributions of wealth.

The aim of these notes is to summarize the main approach taken in Esteban and Ray (1999), and then to study the special case of perfect wealth equality. While this special case cannot shed light on the relationship between inequality and resource allocation, it is of some intrinsic interest. We show that the nature of signaling equilibria is critically affected by per-capita wealth. If wealth is sufficiently high, the equilibrium is unique, separates productivity types, and the government is able to allocate permissions with full efficiency. Below this threshold level, there are multiple equilibria; the nature of such equilibria depends on how poor the country is. Roughly speaking, one might distinguish between three regions below the full-separation wealth threshold. In the very poorest of these regions, economies can only exhibit pooling. Lobbying expenditures are pure waste and the government cannot infer any relevant information to direct its allocation of permissions. In the second region, hybrid equilibria make an appearance along with the pooling equilibria. In these hybrid equilibria, the signalling process does convey information (albeit imperfectly so) to the government, which can use such information to achieve higher allocational efficiency. Finally, in the third region, fully separating

[1] The role of lobbying as a means to transmit information to the government has been analyzed by Austen-Smith and Wright (1992), Lohman (1994) and Rasmusen (1993), among others.

equilibria arise and coexist with the other two types. Hence, higher efficiency is possible.

In as much as growth performance depends on allocative efficiency, our results suggest the existence of a new form of “poverty trap”. Poor countries may stay poor because the transmission of information is costly and it is hard to use private knowledge in public allocation decisions.[2] We thus obtain allocational inefficiencies without presuming corrupt behaviour by government officers.

Finally, notice that separation, per se, may not be a desirable property: there are costs involved in the information transmission process. In general, there are two sorts of costs: (i) allocational (the wrong type may be granted permissions) and (ii) conflictual (the costs of lobbying). Our discussion attempts to track the *total* costs — allocative plus conflictual — incurred by the economy as its wealth level changes.

We end this paper with some preliminary remarks on inequality. The reader is referred to Esteban and Ray [1999] for a more complete analysis.

2 A Model of Information Transmission through Lobbying

2.1 Preliminaries

A government must allocate a publicly provided input (“permissions") to facilitate production. Permissions are in fixed supply. A single permission is necessary and sufficient for production.

There is a continuum of agents, each of whom may be one of two types. A low type produces a on receipt of a license, a high type b (so that $b > a > 0$). The probability that an agent is high is β.

An agent of type λ ($\lambda = a, b$) and wealth w who has expended resources r in lobbying and will be awarded a permission with probability p has an expected return of

$$p\lambda + (w - r), \tag{1}$$

Suppose that the distribution of wealth w over economic agents is given by some cumulative distribution function $F(w)$. We assume that this distribution is independent of the distribution of productivity types, so that conditional on being a high or a low type, the distribution is exactly the same.

[2] Notice that this result is in line with recent contributions on the role of capital market imperfections on development. This line of research dates back to Loury (1981). It has been recently expored, among others, by Greenwood and Jovanovic (1990), Banerjee and Newman (1991), Aghion and Bolton (1992) and (1997), Galor and Zeira (1993), Ray and Streufert (1993), Ljunqvist (1993), Piketty (1997), Lee and Roemer (1998) and Mani (1998). The essential point is that imperfect credit markets might prevent individuals with low wealth from accessing profitable investment opportunities (in either human or physical capital).

2.2 Equilibrium

The government cares about efficiency alone. It would like to single out the high types and give them permissions to produce. Individuals engage in lobbying in an attempt to persuade the government that they value a permission very highly. Thus, we view lobbying as a device to solve the informational problem. However, the device is of limited value: we assume that an individual of wealth w can spend no more than w in lobbying.

We proceed to a formal definition of equilibrium. Given some distribution function F (as well as the other parameters that we have already described) an *equilibrium* consists of three objects $\{\theta, \mu, p\}$, where

[1] θ maps wealth-productivity pairs into lobbying expenditure, which we denote by r. Moreover, θ is a best response in that for each such pair (w, λ), the announcement $r = \theta(w, \lambda)$ is optimal given the probability function p (see (3) below).

[2] μ maps all lobby expenditures r (not just the equilibrium ones) to posterior beliefs held by the planner regarding the proportion of high types at r. For announcements in the support of θ we require that μ must be obtainable using Bayes' Rule, applied to the prior belief that the proportion of high types is β, and then using information from the shape of the function θ. *Off* the equilibrium support the concept of a sequential equilibrium does not impose any restriction on μ.

[3] p maps all lobbying expenditures r to the probability $p(r)$ that an announcement at r will receive a permission from the planner. Given the posterior beliefs μ held by the planner, we require that the probability function p must be chosen in order to maximize the expected number of permissions that accrue to the high types.

Our equilibrium notion fails to put any restrictions on off-equilibrium beliefs. This generates an alarming variety of implausible equilibria. We rule these out in a completely standard way by applying the *intuitive criterion* of Cho and Kreps [1987]. Readers who wish to see how the intuitive criterion works in this context are referred to Esteban and Ray [1999].

Notice that our definition posits a *reactive* government which cannot commit to a particular line of action during the lobbying process. Thus, the signalling game we describe is a simultaneous move game.[3] We take this approach because we believe that the no precommitment case is a better description of reality when lobbying is involved. Numerous government officials are often involved in the allocation decisions, so that the reputational concerns that might underpin a commitment model (with screening) are attenuated. See Esteban and Ray [1999] for more discussion.

[3]This assumption on the government can be contrasted with a *mechanism design* approach in which the government commits first an allocation rule and agents then react. See Banerjee [1997] for a model along these lines.

3 Equilibria

It turns out (despite the intuitive criterion) that several equilibria are possible. Nevertheless, the multiplicity is contained enough so that the model still yields a great deal of predictive power. In what follows, we attempt an informal description of the equilibrium set, leaving formal arguments to Esteban and Ray [1999], where a complete analysis is to be obtained. But much intuition may be gleaned from what we call the *posterior principle*, an observation that applies to this class of situations (and several others).

3.1 The Posterior Principle

Look at the set of *all* possible posterior probabilities that the planner can hold in equilibrium. In terms of our notation, this is just the set of all $\mu(r)$'s, where the r's are equilibrium announcements. In Esteban and Ray (1999) we prove that an equilibrium can exhibit *no more* than three distinct equilibrium posteriors. Moreover, if there are exactly three levels of revelation, then one of them must correspond to the zero announcement. We call this the posterior principle.

The generality of this observation can be appreciated by running through an intuitive demonstration. Suppose that there are three or more *distinctly costly* announcements with different posteriors attached to them. To be sure, the (costly) announcement with the poorest posterior must be serviced (with positive probability), otherwise agents would prefer the zero announcement. But this means that the other two announcements must be fully serviced — that is, the probability of allocation at those announcements must *both* be unity. But now we have a contradiction to agent optimality — no one will wish to make the costlier of those two announcements. Esteban and Ray [1999] provide a formal proof.

Notice that this proposition does not rule out the possibility that many different *announcements* may be made in equilibrium. It only asserts that the planner can assign at most three different probability beliefs to such announcements. But such lack of congruence between beliefs and announcements can stand only if the planner uses *different* allocation probabilities for announcements which he believes to have been made by the *same* mix of productivity types.[4]

Our main equilibrium refinement — which we call *belief-action parity* — is that planner treats announcements over which he has the same beliefs in the same way. In that case, by the posterior principle, we may conclude that *no equilibrium can involve more than three announcements, and if there are exactly three, one of them must be at zero.*

[4]If the planner did not use two different allocation probabilities, both announcements cannot simultaneously be optimal.

3.2 Equilibrium Outcomes

It will be useful to think of the equilibrium set as a correspondence parametrized by α, the number of permissions available. In Esteban and Ray (1999) we show that there are three types of equilibria:

[1] EQUILIBRIA WITH TWO SIGNALS AND NO ALLOCATIVE LOSSES. Under a typical equilibrium of this kind, there is a bid at some value R and another bid at 0. Only high types with wealth $w \geq R$ are serviced at R, and no one else receives a permission. This equilibrium type therefore achieves full separation, and the only waste comes from signaling. There are restrictions on which values of R can serve as equilibria.

Equilibria of type 1 exist over an interval of α's of the form $[0, \alpha_1]$, but they *cannot* exist through the entire range of α's. Indeed, it should be obvious that α_1 must be strictly smaller than β (the extent to which this is so will depend on the shape of the distribution function of wealth).

[2] EQUILIBRIA WITH TWO SIGNALS AND ALLOCATIVE LOSSES. Under a typical equilibrium of this kind, there is a bid at some value R and another bid at 0. Among the players who can afford to bid R (with wealth $w \geq R$), all high types and some low types are serviced. In addition, some permissions are distributed to those that bid nothing. There are restrictions on which values of R can serve as equilibria, and on the amount of the permission spillover to 0.

Equilibria of type 2 exist over some interval of the form $[\alpha_*, 1]$, where $\alpha_* \equiv \beta[1-F(a)]$. Thus type 1 and type 2 equilibria coexist over some range. Moreover, type 2 equilibria patch into a member of the type 1 family at the starting point α_*.

Under type 2 equilibrium, there are losses both in terms of the efficacy of public allocation, and because of resources expended in signaling.

[3] EQUILIBRIA WITH THREE SIGNALS AND ALLOCATIVE LOSSES. Under a typical equilibrium of this kind, there are three bids. The highest bid *must* be at the choke price a. An intermediate bid occurs at some positive value less than a, and permissions are allocated there as well. Those who bid zero do not receive permissions. Once again, there are restrictions on the value of the intermediate bid, as well as on the permission allocation at that bid.

Equilibria of type 3 — like their type 2 counterparts — can only exist once $\alpha \geq \alpha_* \equiv [1 - F(a)]$. However, *unlike* their type 2 counterparts, such equilibria *cannot* exist over the full range $[\alpha_*, 1]$: existence fails at some upper bound for α that's strictly less than one.

As in type 2 equilibrium, there are losses both in terms of the efficacy of public allocation, and because of resources expended in signaling.

4 Equilibria with Equal Wealth

In these notes we outline some implications for the case in which F is a degenerate distribution — all probability is concentrated (or nearly so) on some fixed wealth w. For expositional simplicity we also assume that the number of high types exceeds that of permissions: $\beta > \alpha$.

Apart from describing equilibria, we wish also to evaluate the losses associated with each type of equilibrium. There are two types of losses: *conflictual* and *allocative.* Conflictual losses (denoted by C) arise because agents expend resources in an attempt to convince the government that they are productive. The rent-seeking literature focuses exclusively on this sort of loss. Allocative losses (denoted by A) arise when permissions are given to the wrong types. Each wrong allocation implies an output loss of $(b - a)$. So A is simply $(b - a)$ times the measure of wrong allocations.

We begin by observing that no equilibria with three distinct signals can exist in the equal wealth case. Suppose not; then there are two *costly* equilibrium signals — call these r and R, with $r < R$ — so that allocation probabilities must be positive at both these signals. This means that both signals are announced by high types, which implies that such types are indifferent between the two signals. But then it is easy to see that the low type *strictly* prefers r to R. But now, using the intuitive criterion and belief-action parity, some high type could make an announcement a shade below R and receive a permission with the same probability as he did at R. This contradicts the presumption that we had an equilibrium to start with.

Notice that the previous argument applies whenever the high type makes two announcements (the premise that both announcements are costly was simply used to *derive* this). This observation allows us to conclude, additionally, that when there are equilibria with just two announcements, the high types cannot make the lower announcement.

We are therefore left with the following three possibilities. Define $\gamma \equiv \alpha/\beta$, and note that $\gamma \in (0, 1)$. Let $r^* < R^*$ be the two equilibrium announcements.

[A] Separating equilibrium with two signals and no allocative losses. This equilibrium exist for $w \geq \gamma a$, and is unique (up to a possible variety of off-equilibrium beliefs). Set $R^* = \gamma a$, $r^* = 0$, $p(r) = 0$ for $r < R^*$ and $p(r) = \gamma$ for $r \geq R^*$. Finally, let $\mu(r) = 1$ for $r \geq R^*$ and $\mu(0) = 0$ for $r < R^*$ (there are other possible choices, none of which affects the outcome). The high types only make the high announcement and are thus candidates for the α permissions to be distributed. The conflictual loss is $C = \beta R^* = \alpha a$ and there are no allocative losses. The total loss L_s equals the conflictual loss.

It is easy to verify that this description constitutes an equilibrium. Furthermore, while there are other separating sequential equilibria, the intuitive criterion can be applied in a standard way to single out just this one.

[B] Hybrid equilibria with two signals and partial allocative losses. Such equilibria appear when $\alpha a \leq w \leq a$. To construct one, pick $R^* \in [\alpha a, \min\{w, \gamma a\}]$ and set $r^* = 0$. Let $p(R) = \frac{R^*}{a}$ for $R \in [R^*, w]$ and $p(r) = 0$ for $r < R^*$. Finally, set $\mu(r) = \frac{R^*}{\gamma a}$ for $r \in [R^*, w]$ and $\mu(0) = 0$ for $r < R^*$.

This is a hybrid equilibrium in the sense that some low types also announce R^*. The fraction λ that do so is given by $\lambda = \frac{\alpha a - \beta R^*}{(1-\beta)R^*}$. So the *total* number of agents bidding R^* is $\beta + \lambda(1-\beta)$ and the conflict costs are $C = R^*[\beta + \lambda(1-\beta)] = \alpha a$, for all equilibria and all w in the relevant interval. The allocative costs are equilibrium-dependent. Compute the number of low types who bid R^*, which is $\lambda(1-\beta) = \frac{\alpha a - \beta R^*}{R^*}$. Of these, a proportion $p(R^*)$ receive a permission and induce a loss of potential output. Therefore, the allocative loss is $A = \frac{\alpha a - \beta R^*}{a}(b-a)$. Adding this to C, the total loss is $L_h = \alpha b - \beta R^* \frac{b-a}{a}$.

The total loss varies with the equilibrium, but upper and lower bounds — $\underline{L}_h$ and $\bar{L}_h$ — are easy to compute by setting R^* to its extreme values. These are

$$\underline{L}_h = \max\{\alpha b - \beta w \frac{b-a}{a}, \alpha a\} \text{ for } w \in [\alpha a, a], \tag{2}$$

while

$$\bar{L}_h = \alpha\left[(1-\beta)\, b + \beta a\right] \text{ for } w \in [\alpha a, a]. \tag{3}$$

There are three aspects of these hybrid equilibria which bear mentioning. First, as argued earlier, the high types never bid the low amount (it follows from $\beta > \alpha$ that the low bid receives no permissions and so must be set equal to zero). Second, the low types who make both announcements must be indifferent between the two (this is what pins down the allocation probability at R^* and therefore the population that announces R^*). Finally, the restriction $w \leq a$ prevents the partial pool at R^* from being broken by the intuitive criterion. For a high type to persuade the planner that a deviation could *not* have been made by the low type, he must make a bid that *strictly* exceeds a. But such a bid is impossible, given the wealth constraint.

[C] Pooling equilibria with one signal and full allocative loss. Such equilibria exist whenever $w \leq a$. To construct one, pick $R^* \in (\max\{w - (1-\alpha)a, 0\}, \min\{w, \alpha a\})$. Now set $p(r) = 0$ for $r < R^*$ and $p(r) = \alpha$ for $r \in [R^*, w]$. Finally, set the posterior $\mu(R) = \beta$ for all $r \in [0, w]$.

The conflictual costs are $C = R^*$, with bounds $C^m = \max\{w - (1-\alpha)a, 0\}$ and $C^M = \min\{w, \alpha a\}$. The allocative costs are constant over all such equilibria: $A = \alpha(1-\beta)(b-a)$. Adding, the total costs are given by

$$\underline{L}_p = \alpha(1-\beta)(b-a) + \max\{w - (1-\alpha)a, 0\} \text{ for } w \in [0, a], \tag{4}$$

while

$$\bar{L}_p = \alpha(1-\beta)(b-a) + \min\{w, \alpha a\} \text{ for } w \in [0, a]. \tag{5}$$

Notice that in a pooling equilibrium the planner cannot update her beliefs and hence assigns the slots randomly, with probability α. The range of possible announcements is restricted by our equilibrium conditions.[5]

To summarize this section, we see that the various possible equilibrium configurations critically depend on the wealth of the economy. If the economy is "rich" — $w \geq a$ — there is full allocational efficiency, though there is loss in terms of conflict. Below this threshold level we can distinguish three regions. In the uppermost region, with $\gamma a \leq w \leq a$, full allocational efficiency is still possible, but other (allocatively) inefficient equilibria make an appearance. In the middle region, with $\alpha a \leq w \leq \gamma a$, allocatively efficient equilibria cease to be available. Finally, at the lower end, with $w \leq \alpha a$, only pooling equilibria are left.

5 Discussion

In Esteban and Ray [1999] we examine a new route through which inequality may slow down economic growth by inducing a misallocation of public resources. However, it is important to make a distinction between efficiency losses attributable to inequality and losses that stem from low average wealth (with no inequality at all). This is the issue we address in this paper. Indeed, as shown in the last section, the equilibria reached — and their efficiency — depend critically on average wealth in the economy (assuming an egalitarian distribution of that wealth).

Had an efficiency-minded government been endowed with perfect information regarding the productivity of each agent (or sector), it would have simply allocated permissions to the high types and no resources would have been expended in lobbying. The presence of incomplete information induces two sorts of departures from this benchmark. There are losses from lobbying and losses from wrong allocation. We shall now compare these losses across the various equilibria.

Notice that there is a trade-off between the conflictual and the allocative costs. To minimize allocative costs we need sufficient resources to be committed to signalling, possibly driving conflictual costs to a high level. On the other hand — as in the pooling equilibria — we can have an allocative disaster with relatively low expenditures on lobbying. It isn't clear that intensified lobbying is worth the allocative gain, and indeed, our model brings out this ambiguity.

There are two ways of seeing this. First, suppose that the economy is "rich" —

[5]The upper bound on R^* is just as in part [B] and is easy to understand. To understand the lower bound $\max\{w-(1-\alpha)a, 0\}$, consider the minimum announcement R' that is necessary (under the intuitive criterion) for a high type to convince the planner that he is indeed high. This is given by the condition $a - R' = \alpha a - R^*$, or equivalently, $R' = R^* + (1-\alpha)a$. Now, if $R^* < w - (1-\alpha)a$, we see that $R' < w$. Consequently, such a deviation would be feasible for the high type, destroying the equilibrium.

$w \geq a$ — but that it is common knowledge that the government allocates permissions randomly so that no one is lobbying. The efficiency loss will be purely allocational and will be worth $\alpha(1-\beta)(b-a)$. Compare this to the conflict cost the economy will have to incur to perfectly allocate the permissions. This will be αa. It is immediate that, whenever $a < b \leq \frac{2-\beta}{1-\beta}a$, the efficiency gains are not worth the information costs.

A second comparison can be made over various equilibria. The pooling-separating comparison is exactly as in the previous paragraph, so concentrate here on the comparison of hybrid and pooling equilibria. Look at the minimal losses associated with each such equilibrium type, given by (2) and (4) respectively. At $w = \alpha a$, we see that

$$\underline{L}_h = \alpha b - \alpha\beta(b-a),$$

while

$$\underline{L}_p = \alpha(1-\beta)(b-a) + \max\{(2\alpha - 1)a, 0\}.$$

It is easy to see that the former expression exceeds the latter. It follows that at the threshold $w = \alpha a$, the switch from a fully pooling equilibrium to a hybrid equilibrium can result in additional losses (regardless of other parametric restrictions).

We end our paper with some brief remarks on the interrelationship between inequality and efficiency. First, as explored further in Esteban and Ray [1999], inequality is negatively related to allocative efficiency (at least when average wealth is not too low). But complications do arise for low average wealth. Without going into a full-fledged analysis, we can provide a revealing example of the nature of this relationship. Suppose that, given *per capita* wealth w, a proportion κ of the population has wealth $\frac{w}{\kappa}$ while the rest $(1-\kappa)$ has no wealth at all. Clearly, inequality strictly decreases in κ (with perfect equality at $\kappa = 1$). Assume that inequality is independent of productivity types.

Suppose that a fully separating equilibrium exists when $\kappa = 1$. As κ decreases, this property will be lost. Specifically, as soon as $\kappa\beta < \alpha$ separation is no longer possible and some permissions will be distributed among the low bidders, thus rendering the allocation increasingly inefficient. In the limit, as $\kappa \to 0$ we will converge towards a pooling equilibrium with maximum allocative inefficiency. This accords with the recent emphasis in the literature on the negative role played by inequality.

On the other hand, suppose that the economy is extremely poor and we begin with a pooling equilibrium, with all endowed wealth dissipated in lobbying. Just as in the previous example, let us make the distribution more unequal by choosing lower values of κ. Now (for small enough κ) it is possible to check that every equilibrium has *some* degree of allocative efficiency. [To be sure, the allocation of permissions is completely biased in favor of the rich, but we are concerned with efficiency here.]

Thus it may be that for very poor economies some inequality is necessary for efficiency (as in other contexts in economic development; see, e.g., Matsuyama [1999] or Ray

[1998]). However, as wealth rises beyond some threshold level, more inequality produces lower allocative efficiency.

The reverse implication is also worth exploration: efficiency produces inequality. When the allocation of permissions is fully inefficient, all players have an ex-ante equal opportunity of receiving support by the government and increase their production. At the other extreme, only the high productivity players benefit from the action of the government. Thus, the distribution of ex-ante expected income over the two types of player is more unequal the more efficient the allocation of permissions.[6] This is to be expected. It is essentially a special case of a well-known argument linking inequality with growth: fast growth may require support for the most productive, hence stretching the distribution of rewards.

If one combines the two causal relationships, one running from inequality to efficiency, and the other running in exactly the opposite direction, it is possible to visualize a complex dynamic process in which inequality and efficiency interact and evolve together. This is beyond the scope of our current research, though the problem merits serious investigation.

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[6]Indeed, it is easy to see that the Lorenz curves of the distributions of ex-ante expected net gains from production (expected net income minus the unearned income from the initial wealth endowment) under the three types of equilibria can be ranked. The most egalitarian concentration curve is indeed the one corresponding to pooling equilibrium.

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