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"What is the right level? A pricipal-agent building block for the study of decentralization and integration"

Mariano Tommasi
(CEDI - Fundación Gobierno y Sociedad) UdeSA)

Federico Weinschelbaum
(UdeSA)

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WHAT IS THE RIGHT LEVEL?
A Principal-Agent Building Block for the Study of Decentralization and Integration

Mariano Tommasi

CEDI (Fundación Gobierno & Sociedad)

Universidad de San Andrés

tommasi@udesa.edu.ar

Federico Weinschelbaum[1]

Universidad de San Andrés

fweinsch@udesa.edu.ar

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Comments Welcome

Abstract

The architecture of public decision making in the world is being changed through processes of "economic integration" and of "decentralization". Some policy decisions are now taken at a higher level (i.e., monetary policy in Europe, trade policy in part of South America), while others are taken by smaller political units "closer to the people" (i.e., health and education policies in many Latin American countries).

We provide a building block for the study of such processes, emphasizing the trade-off between the advantages of centralized decision making (internalization of externalities) and those of decentralized decision making (increased principal-agent control by the citizens).

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1 Introduction

The architecture of public decision making in the world is being dramatically altered through processes of "integration" and of "decentralization." Some policy decisions are now taken at a higher level (i.e., monetary policy in Europe, trade policy in part of South America), while others are taken by smaller political units "closer to the people" (i.e., health and education policies in many Latin American countries).

In a sense, both processes are the two faces of the same coin. When it is deemed beneficial to provide public goods (or to make policy decisions) at a higher level of aggregation, we speak about integration. When it is considered that the provision of some public goods is better located at a lower level than the current one, we speak about decentralization.

The objective of this paper is to contribute to a growing body of literature (loosely, on "federalism") analyzing these issues, and to attempt to identify some of the characteristics of the goods, policies or circumstances that call for provision at different levels in a governmental hierarchy.[2]

In particular, we want to formalize the trade offs between some advantages of centralized decision making - namely, the internalization of externalities and economies of scale - and some of its disadvantages - namely the "democratic deficit" of having decision making further removed from the citizenry. To focus on this latter point, we believe that it is necessary to remove the assumption of benevolent governments, and to utilize a principal agent framework.[3]

We believe that with larger and more dispersed populations it is harder to solve the free-rider and coordination problems that arise in controlling "the agent" we call the government. In that sense, decentralization (bringing government closer to the people) is a way

[2]Besley and Coate (1998) provide an excellent overview of that literature, as well as making a particular contribution.

[3]We share the spirit of Qian and Weingast (1997) who also call for opening the black box of political organizations in the study of federalism.

of alleviating political control problems.

As a first step in this agenda, for the sake of generality and comparability with other areas of application, we cast our analysis in a relatively standard principal-agent framework. We analyze a case in which the principal is not a single individual but a group, a population. The core of the problem is the interaction inside this "collective principal". To our surprise, the "collective principal" case is a piece of the agency literature which is not well developed. To our knowledge, there is no paper that deals formally with this problem. We have, hence, borrowed the "common agency" model (Dixit, 1996) to give a first cut to the study of the problem.

Our main result is that, even with a homogeneous population, there are environments where decentralized decisions about the provision of local public goods (or decentralized policy decisions more generally) dominate centralized ones. That is, unlike an important part of the previous literature, we do not need heterogeneity in order to generate some advantages of decentralization.

When there are no coordination problems in agency control, centralization dominates decentralization. But when coordination problems arise the result is ambiguous, when policy externalities are strong, centralization is optimal but when they are weak decentralization dominates.

Certainly, our first step is just that, a first one. There are obvious limitations to applying the "vanilla" principal agent model to political settings. Real world political control technologies seem to be much more restrictive than the general space of payment contracts in the standard literature. Barro (1973), Ferejohn (1986) and Persson, Roland and Tabellini (1997) are good examples of attempts to model what seem to be more realistic political control technologies - elections being a central instrument.[4] Notice that in the most intuitive

[4]Those papers, as ours, do operate under the representative democracy case. There is an interesting literature on the political economy of federalism under direct democracy (for instance, Persson and Tabellini 1996 and 1996b). For obvious reasons, those papers cannot deal with the problems of political agency we emphasize here.

political applications, the agent signs a contract with the whole population, while in our set up, it does so with each citizen.[5] Of course, one might argue that voting is not the only reward technology, as emphasized in the literature on the political economy of trade (Grossman and Helpman, 1994 and 1995).[6] In any case, a natural next step would be to embed the centralization / decentralization trade-off in some of the more "kosher" political control set ups.[7]

Also, one will have to be very careful to apply the logic of these models straightforwardly to real world policy situations. Some of our colleagues in Political Science were pretty appalled when they saw us applying a principal (citizen) - agent (governor) framework to think about the possible effects of decentralization in, say, Latin America. Their concerns might be translated as a version of Madison´s Dilemma (Kiewiet and Mc Cubbins, 1991). This is a general problem in all agency relations: the resources and authority turned over to the agent for the purpose of furthering the interests of the principals can be turned against the principals. That general agency problem is of particular importance when, as in our case, the agents involved are those in a position of power. One might speculate that some of those "reverse" control instruments might be more common in smaller communities. We think this is an interesting challenge, and believe that the type of framework we are utilizing might potentially be enriched to include such considerations.

Even though the "generic" agency model we have chosen has limitations to study political applications (as those listed above), it has the advantage of allowing us to link with other

[5]Indeed, it would be an excellent question to study why is it the case that such "restrictive" technologies are used - i.e. which is the logic behind the apparent restrictions on the set of feasible payment schemes in political contracting. It might be the case that the "optimality"of that restrictions might arise as a response to the collective action problems in political control we emphasize in this paper.

[6]For an overview see Rodrik (1995).

[7]Seabright (1996) extends Ferejohn's model towards the study of accountability under alternative federal structures. His results do require citizen heterogeneity in order to find cases where decentralization is advantageous.

areas of application. For instance, our results could be of some use in the theory of the firm: for instance the coordination necessary for agency control will influence the optimal ownership structure of firms, the optimal size and configuration of the firms and therefore might affect market structures.[8]

2 The Model

We will consider alternative "federal" organizations; one in which there is one agent serving the whole population, and another in which there is one agent per locality. There are K towns. A local public good has to be provided for each town. Hence, we have a K goods economy $\mathbf{x} = (x_1, x_2, ..., x_n)$. There are $N = n_1 + n_2 + ... + n_K$ citizens (principals) of type $1, 2, ...K$ respectively.

We assume that each principal has linear preferences according to his type

$$u_i(\mathbf{x}) = b_{i1} \cdot x_1 + b_{i2} \cdot x_2 + ... + b_{iK} \cdot x_K = \mathbf{b}_i \cdot \mathbf{x}$$

$b_{ii} \geq 0$ is the utility that each principal of type i gets for a unit of his own local public good and $b_{ij} \geq 0$ $(i \neq j)$ is the externality that he gets for a unit of local public good in town j.

The production technology is given by a level of "effort" (t_i) chosen by the agent responsible to provide the local public good for each town plus an error term (ε_i). The error terms are independently and normally distributed with mean 0 and variance σ_i^2. (In the general case there will be a variance matrix Ω which might include non-zero off-diagonal elements.)

$$\mathbf{x} = \mathbf{t} + \boldsymbol{\varepsilon},$$

where $\mathbf{t}$ is the vector of the agent(s)' efforts, $\mathbf{t} = (t_1, t_2, ..., t_n)$, and $\boldsymbol{\varepsilon} \in R^K$ is the vector of error terms.

[8] Our problem is similar to the problem of controlling the managers of a firm with disperse ownership. Schleifer and Vishny (1986) propose having one big shareholder with very strong incentives to control the agent as a solution to that problem. It seems hard to apply such a solution to our multi-layer government case; we cannot give to a citizen neither the incentives nor the right to make him behave as a big shareholder.

As common in the principal-agent literature, agents are risk averse. We assume that they have constant absolute risk aversion, with utility function

$$u_a(w) = -e^{-rw},$$

where w is the monetary measure of the utility and is composed by the payment z that they receive from the principals minus a quadratic cost of effort $\mathbf{t}'C\mathbf{t}$ where[9]

$$C = \begin{bmatrix} c_1 & 0 & 0 & \cdots & 0 \\ 0 & c_2 & 0 & \cdots & 0 \\ 0 & 0 & c_3 & \cdots & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & 0 & 0 & c_K \end{bmatrix}.$$

Hence when there is only one agent, his payoff is

$$w = z - \frac{1}{2}tCt' = z - \frac{1}{2}\sum_{j=1}^{K} c_j t_j^2;$$

and when there are K agents, their payoffs are

$$w_i = z_i - \frac{1}{2}t_i^2 c_i.$$

Principal i expected utility is $\sum_{j=1}^{K} b_{ij}t_j - z_i$. The "aggregate" principal gets, in expected value

$$\sum_{j=1}^{K} \left(\sum_{i=1}^{K} n_i b_{ij} \right) t_j - z,$$

where $z = \sum_{i=1}^{K} z_i$.[10]

[9]The assumption of C being a diagonal matrix rules out the possibility of having externalities in the production side.

[10]We are using the notation j to refer to goods, and i to reserve to principals' type.

In the remainder of this section, we evaluate the welfare that is attained under two alternative institutional arrangements: *centralization*, when the whole population hires one agent to provide the whole vector of goods, and *decentralization*, when each town hires its own agent to provide the local public good. We do so under three different contexts in terms of observability of the agents effort and in terms of the nature of interactions among principals. . In subsection 2.1., effort is observable and verifiable (hence contractable) and the principals act as unified actors – there is no problem of coordination among principals in contracting with the agent. In subsection 2.2., we maintain the assumption of united principals, but effort is not observable. Finally, in subsection 2.3., effort is not observable and principals act in an uncoordinated manner. The first two cases serve as benchmark for the third one, the one we want to focus on.

As it is a standard practice in these models, we assume that the principal offers a contract and the agent can accept or reject it, implicitly giving all the bargaining power to principals. When effort is not observable, the agent, after signing the contract, will decide the level of effort that he will offer.

2.1 Observable and Verifiable Effort, United Principals

In this case principals and agents can write contracts contingent on the agents providing a stipulated level of effort.

2.1.1 Centralized case

Since the payment is only a transfer and it will be at the level that gives to the agent his reservation utility, the principal(s) will choose the level of effort that maximizes aggregate surplus,

$$\sum_{j=1}^{K}\left[\sum_{i=1}^{K} n_i b_{ij} t_j - \frac{1}{2} c_j t_j^2\right] \tag{1}$$

The first order condition with respect to t_j, leads to

$$\sum_{i=1}^{K} n_i b_{ij} = c_j t_j.$$

Marginal social benefit is equated to marginal social cost. As usual in principal-agent models, when effort is contractable, the solution is optimal (for this centralized case). The level of effort is

$$t_j^{COU} = \frac{\sum_{i=1}^{K} n_i b_{ij}}{c_j} = t_j^*$$

for all j, where COU stands for (Centralized, Observable, United), and $*$ stands for the socially optimal level.

We will use this case not only to compare it with the decentralized one, but also as a benchmark to compare with other environments. Since the aggregate surplus is a quadratic function on t_j that achieves a maximum when $t_j = \frac{\sum_{i=1}^{K} n_i b_{ij}}{c_j}$ we know that below this level the aggregate surplus is increasing, hence we know that if $t_j < \frac{\sum_{i=1}^{K} n_i b_{ij}}{c_j}$, t_j is a measure of welfare.[11]

2.1.2 Decentralized case

Now the agents are separated and their respective costs are $\frac{1}{2} c_i t_i^2$.

Since the payment that the aggregate principal of each region gives to his agent is only a transfer and it will be the level that gives to the agent the reservation utility, the principal will choose the level of effort that maximizes the aggregate surplus of his region.

Type i principals maximize $\sum_{j=1}^{K} n_i b_{ij} t_j - \frac{1}{2} c_i t_i^2$ with respect to t_i,taking t_k $k \neq i$ as given, leading to $n_i b_{ii} = c_i t_i$, that is the marginal social cost equals the marginal social benefit *of the region.* So, although the effort is contractable the result is not optimal since each

[11] This is clearly valid when the agents' payment is riskless, as in this case. When effort is not observable, contracts will be such that agents' will bear some risk, and social surplus will have a term in addition to those in equation (1) to capture that loss. We will show that the claim of t being a sufficient statistic for welfare will still be valid in that case.

principal does not take into account the externalities that its good provides to the other regions. The level of effort in a decentralized world is

$$t_i^{DOU} = \frac{n_i b_{ii}}{c_i} = \frac{\sum_{i=1}^{K} n_i b_{ij}}{c_i} \frac{n_i b_{ii}}{\sum_{i=1}^{K} n_i b_{ij}} = t_i^* \frac{n_i b_{ii}}{\sum_{i=1}^{K} n_i b_{ij}}.$$

We will have under-provision of effort.

Therefore, centralization is better due to the spillovers, which we might want to call consumption externalities. With positive production externalities ($c_{ij} < 0$) the effect would be magnified. If we introduce now a parameter γ reflecting the average size of spillovers, such that $u_i(\mathbf{x}) = b_{ii} \cdot x_i + \gamma \cdot \sum_{j \neq i} b_{ij} \cdot xj$, we see that the departure from the centralized solution with respect to the federal case is $\Delta t_i = \frac{\gamma \cdot \sum_{j \neq i} b_{ij}}{c_i}$, which reduces to zero for the case of pure private (or pure local public) goods ($\gamma = 0$), and reaches a maximum for the case of pure global public goods ($\gamma = 1$).

2.2 Non Observable Effort, United Principals

2.2.1 Centralized case

Now principals can monitor the efforts $\mathbf{t}$ but only imperfectly, i.e., they observe $\mathbf{x}$ but not $\mathbf{t}$. The agent is hired through contracts with payments

$$z = \boldsymbol{\alpha}\mathbf{x} + \beta.$$

We follow Dixit (1996) in restricting attention to linear reward schemes, since they go naturally with quadratic payoffs (see also Holmstrom and Milgrom 1987 and 1991). $\boldsymbol{\alpha}$ is the vector of incentive payments for each activity, while β is used to fulfill the agent's participation constraint.

The agent's certainty equivalent (CE) is $\boldsymbol{\alpha}\mathbf{t} + \beta - \frac{1}{2} r \boldsymbol{\alpha} \Omega \boldsymbol{\alpha}' - \frac{1}{2} \mathbf{t} C \mathbf{t}'$, and the principals benefit is $\sum_{j=1}^{K} \left(\sum_{i=1}^{K} n_i b_{ij} - \alpha_j \right) x_j - \beta$.

The optimal solution for the agent is

$$\max_{\mathbf{t}} \quad \sum_{j=1}^{K} \alpha_j t_j - \frac{r}{2} \sum_{j=1}^{K} \alpha_j^2 \sigma_j^2 - \frac{1}{2} \sum_{j=1}^{K} c_j t_j^2 + \beta$$

which leads to

$$t_j = \frac{\alpha_j}{c_j}$$

for all j.

The expected social surplus is then

$$\sum_{j=1}^{K}\left[\left(\sum_{i=1}^{K} n_i b_{ij}\right)\frac{\alpha_j}{c_j} - \frac{r}{2}\alpha_j^2\sigma_j^2 - \frac{1}{2}c_j\left(\frac{\alpha_j}{c_j}\right)^2\right] \tag{2}$$

The principal maximizes (2) with respect to $\boldsymbol{\alpha}$ leading to $\alpha_j^{CNU} = \frac{\sum_{i=1}^{K} n_i b_{ij}}{\left(1+c_j r\sigma_j^2\right)}$, which implies

$$t_j^{CNU} = \frac{\sum_{i=1}^{K} n_i b_{ij}}{c_j}\frac{1}{\left(1+rc_j\sigma_j^2\right)} = t_j^*\frac{1}{\left(1+rc_j\sigma_j^2\right)}$$

The level of effort is lower than the optimal whenever the coefficient of absolute risk aversion (r) is positive. This is the "traditional" principal agent problem, with its associated trade off between incentives and risk sharing.

Note that the expected social surplus is quadratic in α_j, then α_j is a measure of welfare when $\alpha_j < \alpha_j^{CNU}$, and so is t_j since it is increasing in α_j, when $t_j < t_j^{CNU}$.

2.2.2 Decentralized case

The problem of the agents, and its solution, is the same as the one of the centralized case.

Type i principals maximize

$$\sum_{j=1}^{K} n_i b_{ij}\frac{\alpha_j}{c_j} - \frac{r}{2}\alpha_i^2\sigma_i^2 - \frac{1}{2}c_i\left(\frac{\alpha_i}{c_i}\right)^2$$

with respect to α_i taking α_k $(k \neq i)$ as given, obtaining $\alpha_i^{DNU} = \frac{n_i b_{ii}}{\left(1+c_i r\sigma_i^2\right)}$, which implies

$$t_i^{DNU} = \frac{\sum_{i=1}^{K} n_i b_{ij}}{c_i}\frac{n_i b_{ii}}{\sum_{i=1}^{K} n_i b_{ij}}\frac{1}{(1+c_i r\sigma_i^2)} = t_i^*\frac{n_i b_{ii}}{\sum_{i=1}^{K} n_i b_{ij}}\frac{1}{(1+c_i r\sigma_i^2)} \tag{3}$$

The effort exerted by the agent is, again, lower for this case than for the centralized economy, except when consumption externalities are zero. As it can be seen in equation (3),

in this case there are two sources of the under provision of effort, the externalities ($n_i b_{ii} < \sum_{i=1}^{K} n_i b_{ij}$) that the principals do not take into account, and the low power incentive schemes that is given to the agents in order to accommodate the risk sharing.

Note that in the two cases considered so far, centralization is preferable. That is because we haven brought into play yet the potential disadvantage of centralization, in terms of a harder agency problem do to the larger number of principals. To that we turn now.

2.3 Non observable Effort, Separate Principals

2.3.1 Centralized case

Now each of the N principals can contract the agent. Principals can again monitor the efforts $\mathbf{t}$ only imperfectly. The agent is hired through individual contracts with principal i and payment $z^i = \boldsymbol{\alpha}^i \mathbf{x} + \beta^i$, where $\boldsymbol{\alpha}^i = (\alpha_1^i, \alpha_2^i, ..., \alpha_K^i)$. Each principal will offer a contract, taking as given the contracts offered by the other principals.[12] Let $\alpha_j = \sum_i \alpha_j^i$ and $\beta = \sum_i \beta^i$. The agent's CE is $\boldsymbol{\alpha}\mathbf{t} + \beta - \frac{r}{2}\boldsymbol{\alpha}\Omega\boldsymbol{\alpha}' - \frac{1}{2}\mathbf{t}C\mathbf{t}'$.

The agent optimal solution is

$$\max_{\mathbf{t}} \quad \sum_{j=1}^{K} \alpha_j t_j - \frac{r}{2}\sum_{j=1}^{K} \alpha_j^2 \sigma_j^2 - \frac{1}{2}\sum_{j=1}^{K} c_j t_j^2 + \beta$$

which leads to $t_j = \frac{\alpha_j}{c_j}$.

Let $A_j^i = \sum_{k \neq i} \alpha_j^k = \alpha_j - \alpha_j^i$,and $B^i = \sum_{k \neq i} \beta^k = \beta - \beta^i$. If only principal i does not sign a contract with agent j , the latter best strategy will be $t_j = \frac{A_j^i}{cj}$, and his CE will be

$$\sum_{j=1}^{K} \left[\frac{\left(A_j^i\right)^2}{c_j} - \frac{1}{2}\left(A_j^i\right)^2 \sigma_j^2 - \frac{1}{2}\frac{\left(A_j^i\right)^2}{c_j} \right] + B^i = \sum_{j=1}^{K} \left(A_j^i\right)^2 \left[\frac{1}{2c_j} - \frac{r}{2}\sigma_j^2 \right] + B^i$$

whereas if he signs the contract his effort will be $t_j = \frac{\alpha_j}{c_j}$, and his CE will be

$$\sum_{j=1}^{K} \left(A_j^i + \alpha_j^i\right)^2 \left[\frac{1}{2c_j} - \frac{r}{2}\sigma_j^2 \right] + B^i + \beta^i.$$

[12] This is the standard set up in the common-agency literature (Bernheim and Whinston 1986, Grossman and Helpman 1994, Dixit 1996).

The marginal gains in signing the contract are

$$\sum_{j=1}^{K}\left(\left(\alpha_j^i\right)^2+2A_j^i\alpha_j^i\right)\left(\frac{1}{2c_j}-\frac{r}{2}\sigma_j^2\right)+\beta^i. \tag{4}$$

Principal i expected utility if he does not sign the contract is $\sum_{j=1}^{K} b_{ij}\frac{A_j^i}{c_j}$, whereas if he signs the contract it will be $\sum_{j=1}^{K}\left(b_{ij}-\alpha_j^i\right)\frac{A_j^i+\alpha_j^i}{c_j}-\beta^i$, and the marginal gains are

$$\sum_{j=1}^{K} b_{ij}\frac{\alpha_j^i}{c_j}-\alpha_j^i\frac{A_j^i+\alpha_j^i}{c_j}-\beta^i. \tag{5}$$

From (4) and (5), the marginal expected surplus is then

$$\sum_{j=1}^{K} b_{ij}\frac{\alpha_j^i}{c_j}-\alpha_j^i\frac{A_j^i+\alpha_j^i}{c_j}+\left(\left(\alpha_j^i\right)^2+2A_j^i\alpha_j^i\right)\left(\frac{1}{2c_j}-\frac{r}{2}\sigma_j^2\right). \tag{6}$$

Maximizing (6)with respect to α_j^i leads to

$$\begin{aligned} 0 &= \frac{b_{ij}}{c_j}-\frac{A_j^i+2\alpha_j^i}{c_j}+\left(\alpha_j^i+A_j^i\right)\left(\frac{1}{c_j}-r\sigma_j^2\right)= \\ &= b_{ij}-\alpha_j^i-\left(\alpha_j^i+A_j^i\right)c_j r\sigma_j^2. \end{aligned}$$

After solving for α_j^i we get $\alpha_j^i\left(1+rc_j\sigma_j^2\right)=b_{ij}-A_j^i rc_j\sigma_j^2$. Recalling that $A_j^i=\alpha_j-\alpha_j^i$ we obtain $\alpha_j^i=b_{ij}-\alpha_j rc_j\sigma_j^2$. Adding over all the principals we obtain

$$\alpha_j=\sum_{i=1}^{K}\alpha_j^i=\sum_{i=1}^{K} n_i b_{ij}-N\alpha_j rc_j\sigma_j^2.$$

Therefore, for this case we have

$$\alpha_i^{CNS}=\frac{\sum_{i=1}^{K} n_i b_{ij}}{1+Nrc_j\sigma_j^2}.$$

This gives a level of effort

$$t_j^{CNS}=\frac{\sum_{i=1}^{K} n_i b_{ij}}{c_j}\frac{1}{1+rc_j\sigma_j^2}\frac{1+rc_j\sigma_j^2}{1+Nrc_j\sigma_j^2}=t_j^*\frac{1}{1+rc_j\sigma_j^2}\frac{1+rc_j\sigma_j^2}{1+Nrc_j\sigma_j^2}, \tag{7}$$

which is smaller than in the case of united principals. The first term in the right hand side of (7) is the optimal value of t_j but this is multiplied by $\frac{1}{1+rc_j\sigma_j^2}$ the "risk sharing" effect and by $\frac{1+rc_j\sigma_j^2}{1+Nrc_j\sigma_j^2}$ the "collective principal" effect.

2.3.2 Decentralized case

For the decentralized case we impose the same restrictions on the contracts that we have set above. The marginal gain for agent i in signing a contract with one principal of his type is $\left(\left(\alpha_i^i\right)^2 + 2A_i^i\alpha_i^i\right)\left(\frac{1}{2c_i} - \frac{r}{2}\sigma_i^2\right) + \beta^i$.

Principal i expected utility if he does not sign the contract is $\sum_{j=1}^{K} b_{ij}\frac{A_j^i}{c_j}$, whereas if he signs the contract it will be $\sum_{j=1}^{K} b_{ij}\frac{A_j^i+\alpha_j^i}{c_j} - \alpha_i^i\frac{A_i^i+\alpha_i^i}{c_i} - \beta^i$. The marginal expected social surplus is then

$$\sum_{j=1}^{K} b_{ij}\frac{A_j^i+\alpha_j^i}{c_j} - \alpha_i^i\frac{A_i^i+\alpha_i^i}{c_i} + \left(\left(\alpha_i^i\right)^2 + 2A_i^i\alpha_i^i\right)\left(\frac{1}{2c_i} - \frac{r}{2}\sigma_i^2\right). \tag{8}$$

Maximizing (8) with respect to α_i^i leads to

$$0 = b_{ii} - \alpha_i^i - \left(\alpha_i^i + A_i^i\right)rc_i\sigma_i^2.$$

After solving for α_i^i we obtain $\alpha_i^i\left(1 + rc_i\sigma_i^2\right) = b_{ii} - A_i^i rc_i\sigma_i^2$. Recalling that $A_i^i = \alpha_i - \alpha_i^i$ this leads to $\alpha_i^i = b_{ii} - \alpha_i rc_i\sigma_i^2$. Adding over all the principals that can contract agent i we obtain $\alpha_i = n_i b_{ii} - n_i\alpha_i rc_i\sigma_i^2$. Therefore, for this case we have

$$\alpha_i^{DNS} = \frac{n_i b_{ii}}{1 + n_i rc_i\sigma_i^2}$$

This gives a level of effort

$$t_i^{DNS} = \frac{\sum_{i=1}^{K} n_i b_{ij}}{c_i}\frac{n_i b_{ii}}{\sum_{i=1}^{K} n_i b_{ij}}\frac{1}{1 + rc_j\sigma_j^2}\frac{1 + rc_j\sigma_j^2}{1 + n_i rc_i\sigma_i^2} = t_i^*\frac{n_i b_{ii}}{\sum_{i=1}^{K} n_i b_{ij}}\frac{1}{1 + rc_j\sigma_j^2}\frac{1 + rc_j\sigma_j^2}{1 + n_i rc_i\sigma_i^2} \tag{9}$$

In this case we have three effects that reduce the level of effort, 1) the externalities, 2) the risk sharing effect and 3) the collective principal. Comparing (9) with (7) we see that although with centralization there is no problem of externalities, this time it is not clear when the level of effort (and hence welfare) is higher. This is because the agency problem is stronger in the centralized case. The larger the population of principals, the deeper the problem of lack of coordination in contracting with agents. Decentralization will be preferable

to centralization whenever the externality effect is less important than the differences of the coordination effect.

$$\frac{n_i b_{ii}}{\sum_{i=1}^{K} n_i b_{ij}} \frac{1+rc_j\sigma_j^2}{1+n_i rc_i\sigma_i^2} > \frac{1+rc_j\sigma_j^2}{1+Nrc_j\sigma_j^2} \iff \frac{n_i b_{ii}}{\sum_{i=1}^{K} n_i b_{ij}} > \frac{1+n_i rc_i\sigma_i^2}{1+Nrc_j\sigma_j^2} \tag{10}$$

To simplify the comparisons, we assume now that $b_{jj} = b$ and $b_{ij} = \gamma b$, with $\gamma \in [0,1]$, so that we have a symmetric case. In that case (10) becomes

$$\frac{n_i b}{n_i b + (N-n_i)\gamma b} = \frac{n_i}{n_i + (N-n_i)\gamma} > \frac{1+n_i rc_i\sigma_i^2}{1+Nrc_j\sigma_j^2}.$$

It is easy to se that:

When $\gamma = 0$ (no externalities), decentralization is the preferred institutional arrangement; and when $\gamma = 1$ (pure public goods), centralization is the preferred institutional arrangement.

More generally, since we know that $\frac{\partial t_i^{DNS}}{\partial \gamma} = 0$ *and* $\frac{\partial t_i^{CNS}}{\partial \gamma} = (N-n_i)\frac{b}{(1+Nrc_j\sigma_j^2)c_j} > 0$, there will be a cut-off point $(\overline{\gamma}_j)$ such that when $\gamma > \overline{\gamma}_j$ centralization is better and when $\gamma < \overline{\gamma}_j$, decentralization is better.

To find $\overline{\gamma}_j$, we have to make $t_i^{DNS} = t_i^{CNS}$. This implies

$$\frac{n_i rc_i\sigma_i^2}{1+n_i rc_i\sigma_i^2} = \overline{\gamma}_j.$$

Letting $\delta_j = n_j rc_j\sigma_j^2$ we have

$$\frac{\delta_j}{1+\delta_j} = \overline{\gamma}_j$$

which implies that for each δ there is a critical γ above which the centralized solution is better, as shown in Figure 1.

Since we are assuming that γ is independent of the region, but the δ_j can differ, it could be the case that some goods are better provided by a centralized agent while others by a decentralized one.

3 A Recap: On Modelling Decentralization

I

Our model has two essential ingredients: an externality problem in the provision of ("local") public goods (favoring centralization as the desired institutional arrangement), and a collective action problem among (citizen) principals in controlling political agents (favoring decentralization). The first component has been a standard feature in the discussion of the trade-offs between centralized and decentralized provision of public goods since, at least, the seminal work of Oates (1972). In that paper, the externality/spillover effect was traded-off against the cost of centralized provision in terms of a "one size fits all" policy of uniform public good provision, independently of local needs and tastes. Oates´ Decentralization Theorem states that in the absence of spillovers (and of cost-savings from centralized provision), decentralization is preferable. This has to be read as "preferable to *uniform* provision." But, in a setting of perfect information, nothing will prevent a benevolent central planner to prescribe the right amounts for each jurisdiction.

Later work has emphasized, hence, that the case for decentralization has to be driven by political economy considerations. Besley and Coate (1998), Lockwood (1998) and Seabright (1996) present models in which potential benefits of decentralization are derived through endogenous choices under alternative political aggregation mechanisms.

Many of those papers, do require interjurisdictional heterogeneity "a la Oates" in order to derive benefits of decentralization. One of the features of our formalization is that it does not require heterogeneity.

In the simplest formulation of the heterogeneity issue, decentralization can improve the efficiency of governments because local officials have better information to match the mix of services produced by the public sector and the preferences of the local population (i.e., the have the *means* to be responsive). The principal-agent avenue that we pursue emphasizes the *incentives* of politicians to better serve their people.

We think that our model provides a useful step in the process of formalizing some of the

key concepts being discussed in the decentralization debate around the globe. We provide below a listing of some of the usual claims being heard in favor of the decentralization of political power and public services (see, for instance World Bank, 1999), and try to interpret those claims in more formal language. The "catch-all" expression behind most of those claims is the notion of *accountability.*

II

The first channel through which smaller jurisdictions seem to improve political control is the standard Olsonian relationship between group size and free-riding in the voluntary provision of a public good. The application of that logic to the public good of political control is what, in a particular way, we have modelled here. Later on we discuss the generality of this result.

The second oft-mentioned channel is what we might call "the proximity effect." Namely, local officials can be held accountable because they are closer (Ostrom, Schroeder and Wynne, 1993). We interpret this effect as deriving from the fact that citizens and politicians in small communities do interact repeatedly in multiple settings, hence giving the principals (citizens) additional instruments to punish misbehavior in related games - for instance, socially ostracizing a bad governor. (We will argue later that this proximity might also empower local officials to abuse citizens). Notice that this sort of proximity argument might also provide a microfoundation for the association of smaller numbers of people with larger provision of the public of control (in that case, the emphasis will be on the horizontal relation among principals while in this paragraph we emphasize the relation of each principal to the agent).[13]

A third channel is that of yardstick competition. Given the standard assumption of unobservable effort, citizens have to infer the governor´s behavior from outcomes. If the shocks that create the wedge between effort and outcomes are correlated across jurisdictions, citizens might condition their payments also on outcomes in the other jurisdictions (as in

[13]It is worth reminding that there are some conflicts between these two dimensions since, as higlighted by our model, each principal might have the incentive of offering a "private" contract.

Besley and Case 1995).[14] We conjecture that such extension of our model might generate an increase in the desirability of decentralization.

Another channel might operate through the experimentation/learning possibilities of having multiple jurisdictions. This argument is somewhat tied to some of the previous (or other political-economy) channels, since in principle a centralized government can also experiment over the territory.[15]

III

Focusing now on the channel which we have chosen to emphasize, the first one, the size effect, several caveats are in order. First, the intuition that "larger groups will provide smaller amounts of a public good" is not a universal result neither theoretically (for instance, Chamberlin 1974), nor empirically (Isaac and Walker 1988).

This leads to a second point: aggregation technologies (i.e., the way in which individual contributions map into aggregate and individual benefits) do matter, and the incentives resulting from different institutional settings vary according to the nature of the (public) good in question. (See, for instance, the recent paper by Arce and Sandler 1999).

More specifically, of a wide space of possible aggregation technologies, some (but probably not all) of them will be applicable to the specific problem of principals controlling agents. There are in turn, several possible "technologies" for such control. The particular one we have chosen, is the common-agency model of Bernheim and Whinston (1986) and Dixit (1996).

[14] Presumably this correlation is higher within the regions of a given country than across countries (control variables). This argument also applies to the experimentation/learning point we make in the next paragraph.

[15] To the previous four arguments one might add, and it is indeed done (World Bank, 1999) the standard Tiebout (1956) argument that when the population is mobile and citizens can "vote with their feet", decentralization may also result in local governments competing with each other to better satisfy the wishes of citizens. As Seabright (1996) forcefully argues, there are conceptual problems in extrapolating the Tiebout results to the centralization/decentralization discussion.

Even though the common-agency (or multiprincipal) model is a standard one in the literature and did allow us to obtain some insights into the centralization-decentralization question, it is not the most natural framework to think about political control. The archetypical political control technology, voting, is far more restrictive than the set of contracts we have allowed here.[16] One intriguing possibility would be to explore whether an "optimal" constitutional restriction on the set of contracts that citizens can offer to politicians can lead from the space of contracts we model here to the ones observed in reality.

It is clear that, on top of the vertical control mechanism of (retrospective) voting, there are also constitutional arrangements such as division of powers that might also lead to increased government accountability (Persson, Roland and Tabellini 1997). This opens up the door to the modelling of multiprincipal-multiagent situations, which characterize real politics, and to the need of looking into some of the details of more complex governance structures, including the possibility of multiple layers of government operating *simultaneously*, unlike in our model. The simultaneous presence of various levels of government also requires dealing with multiplicity of public goods (or tasks), something that we have not done here, but can in principle be handled within the common agency framework (as in Dixit's 1996 multitask-multiprincipal model).

Finally, it is worth pointing out that there are other instruments through which citizens (or groups of citizens) can punish or reward government officials, such as lobbying, campaign contributions, picketing, striking, violence, and other political technologies. Most of these technologies seem to be asymmetrically distributed across citizens, a force that might be behind the "agency rents" we model in a simplistic way here – low effort might be read as policies that favor specific influential groups rather than the general population. Those additional control technologies may also be differentially available in large versus small communities.

[16] Barro (1973) and Ferejohn (1986) are the classics in the economic modeling of principal-agent control through voting. Seabright (1996) takes some elements of Ferejohn's model into the decentralization discussion.

IV

This leads to another point we want to raise in this section: the drawbacks of decentralization (World Bank 1999). We can organize these drawbacks into those that can be quite directly related to principal-agent problems and those that cannot. We begin with the latter ones.

The most common caveat that enthusiasts of decentralization have in the developing world is the fact that many subnational governments seem to "lack the technical capacities" necessary to undertake many of the decentralized duties. Furthermore, those capacities seem to be unevenly distributed across sub-national units, generating the possibility of a dynamic effect of increasing inequality (imagine for instance the dynamic effect of differential qualities of public education).[17]

Coming to principal-agent related problems, there are two related caveats about decentralization in the developing world: the risk of "capture" by local elites, and the Madisonian problem of reverse control we allude to in the Introduction. These problems might be more salient in smaller political units, perhaps due to reduced political competition within the locality (the downside of the yardstick story) if there is a fixed national pool of political contestants. The increased control of politicians over citizens might also be the downside of the proximity story. It seems promising to attempt to formalize some of these issues within a principal-agent framework.

V

[17]The point seems to be a realistic one, but we have some trouble conceptualizing it theoretically. The total pool of human capital is, in principle, independent of the political organization of the country. Why is it the case that any "capacity" available in the centralized case cannot be replicated in the decentralized case? The answer may relate to economies of scale, agglomeration externalities, the fact that smart people do not want to live away of the largest urban centers which have the better amenities. It might be also a transitional effect dur to lack of previous experience, or it might relate to more fundamental political economy or institutional issues that do not give local governments the incentives or opportunities to build those capacities. This is a question worth pursuing.

Most of this section has concentrated on the technology of control in the principal agent problem between the citizens and government officials, the second of the two main ingredients of our model. We turn now to the second one, the related issue of the technology for production and consumption of the public good in question, and the possible interpretations and limitations of what we have modelled so far.

1)

a- in the model, varying parameters

b- not in the model (Arce-Sandler, etc)

2) MULTIPURPOSE GOVERNMENTS (links with previous point on governance structures)

4 Conclusions and Extensions

We analyze the advantages and disadvantages of centralization in a model with homogeneous people. We find that when there are coordination problems among citizens in controlling the government, decentralized political structures could be optimal.

We only study efficiency aspects of the problem. Some of the solutions found are consistent with many different distributions, the distributive aspects jointly with the political arrangements will determine whether the efficient organization will be reached or not, it is not hard to imagine situations where efficient outcomes are dominated politically by suboptimal ones.

As already mentioned, the common agency framework does not fully capture the problem of political control by citizens. The framework assumes that each citizen signs a contract with the agent, while in reality some of these "contracts" are signed collectively through the aggregation of some actions of principals such as voting. (Moreover in many cases it is prohibited that a member of the population signs a contract with the agent to act on his behalf.) This reinforces the claim of the need of study a "collective" principal problem.

Finally, we have not yet fully exploited the framework in order to answer the fundamental question of exactly what goods, under what circumstances will be provided by different

levels of government. We can give some partial answers by varying some of the parameters (such as b_{ij}) in our model, but there are types of public goods not captured by our production/consumption technology. Furthermore, we also need to look at a multi-good economy. Several of these steps can be taken from the framework we used here, and constitute the next steps in the agenda.

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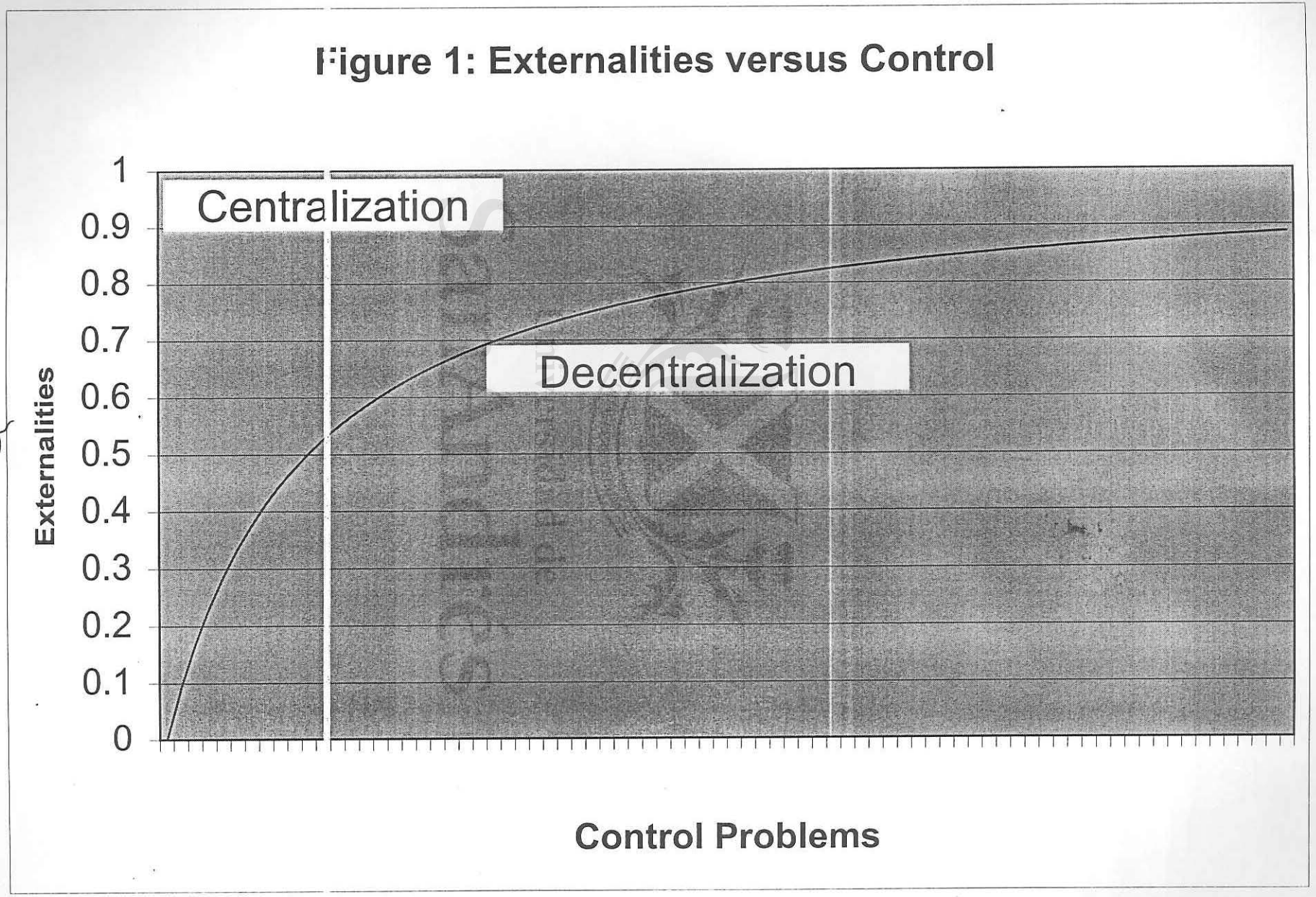
Figure 1: Externalities versus Control
Centralization
Decentralization
Externalities
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Control Problems