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Electoral Control under Decentralization: Decentralization as unbundling of public goods provision.

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Electoral Control under Decentralization

Decentralization as unbundling of public goods provision.

February 27, 2010

Abstract

This paper addresses the question of whether a decentralized government is subject to a stronger level of electoral control than a centralized government. When electoral control is strong an incumbent investing a low level of effort in providing public goods will face a serious threat of being voted out of office. This threat should provide the incentives to the incumbent to exert effort in order to be re-elected as shown by Barro (1973) and Ferejohn (1986). According to the literature decentralization should increase electoral control due to the fact that under centralization the incumbent only needs to please the half plus one of the electorate in order to be re-elected. This paper presents analytically two new sources of differences in electoral control: assuming that public goods can be classified in lower tier public goods (e.g. sub-national or local level) and upper tier public goods (e.g. national public goods), then under centralization there are potential advantages derived from bundling the provision of both types of public goods, whereas under decentralization there are potential advantages derived from a clear delimitation of the responsibilities of the provider of each type of public good. We show that the trade-off depends on the probability distribution of the shocks and on the size of these shocks.

Keywords: Decentralization; electoral control; provision of public goods, bundling of issues

1 Introduction

In the last decades decentralization reforms have been adopted by many developed and developing countries with the aim, among others, of improving the accountability of its governments. This, in turn, should have increased the level of public service delivery, fostered economic growth and improved the living standards of the population of these countries. The mechanisms through which decentralization is supposed to deliver these benefits are manifold. However, the mechanism considered to be more relevant, especially in the case of developing countries, is that “decentralization brings policymaking closer to its constituencies” and this increases accountability of the different tiers of government. Some years after these far-reaching decentralizing reforms have been implemented the effect of these reforms remains still unclear. Furthermore, the exact meaning of accountability and how exactly decentralization improves it remains still a moot point in many aspects.

In this paper we analyze theoretically whether decentralization, understood as the introduction of elections at the sub-national or local level, actually enables the voter to control non-benevolent policymakers in a tighter way. We expand the model of electoral control of Ferejohn (1986) from one public good to two public goods: an upper tier public good, which can be considered as a national public good (defense, monetary policy. . .) and another lower tier public good, which can be understood as a local or sub-national public good (education, health. . .). Centralization is defined as the joint or “bundled” provision of both public goods: upper tier public good and lower tier public good. The performance of the office holder in providing both public goods will be rewarded by the voters at the end of the term with re-election or punished by being voted out of office. In the decentralized case one office holder provides the upper tier public good and another one provides the lower tier public good. The performance of each incumbent will be evaluated by the voter in two different electoral processes, one for each incumbent, at the end of their respective terms.

This novel way of modeling decentralization attempts to reflect the fact that in centralized democratic regimes national governments are typically responsible in front of the electorate for two tiers of policymaking: national and sub-national policies. In decentralized democratic regimes, in contrast, the national government is responsible only for national policies and the different sub-national governments are responsible for sub-national policies. Although these responsibilities might be blurring in real life, it is clear that, at least in principle, decentralized regimes should present a better degree of accountability versus centralized regimes: a centralized government performing poorly in one tier (e.g. sub-national policies) but satisfactorily in the other tier (e.g. national policies) could still be re-elected, whereas in a decentralized government the responsible of one tier performing poorly would never be re-elected.

However, bundling the provision of both national and sub-national public goods allows the centralized provider to substitute resources among both goods in case they are affected by shocks in a different way. The centralized provider might reduce the provision of the good affected negatively and increase the provision of the good affected positively, keeping the overall level of welfare of the voter constant. This possibility is not available to a decentralized provider affected by a negative shock. In this case the decentralized provider affected by a negative shock might prefer to be voted out of office instead of investing the high amount of

resources or effort required to satisfy the voter and be re-elected. Therefore, a trade-off exists between the “gains of accountability” obtained under decentralization and the “gains from substitution” available under centralization.

In the literature, the main models of electoral control of politicians are Barro (1973) and Ferejohn (1986). In these models electoral control is understood as a minimum level of one general public good, taken in a broad sense, that the incumbent must deliver in order to be re-elected. Producing the public good is costly to the incumbent and these costs vary according to random shocks observable to the incumbent but not to the voter. The future benefits derived from being re-elected and staying in office are weighed by the incumbent against the costs of producing these public goods. Therefore, the fear of losing office is the main incentive that disciplines and motivates a self-interested incumbent to deliver public goods to the voter. As mentioned before, we expand Ferejohn(1986) by adding a second public good.

Another strand of the literature sees elections mainly as an instrument of selecting “good” politicians. In this family of models it is typically assumed that politicians belong to a type based on its a priori degree of benevolence or competence. The true type is private information of the incumbent, but the performance of the incumbent while being in office acts as a signal of the type to the voter and this determines the re-election probabilities of the incumbent. See for instance the initial works of Rogoff and Sibert(1988), Rogoff (1990) or, for a more recent review, Besley (2005). We prefer to focus on the disciplining aspect of elections rather than on the selecting aspect.

Concerning decentralization and accountability, proponents of decentralization in developing countries often argue that the main benefit of decentralization for these countries should be a strengthening of their weak accountability mechanisms, see Bardhan (2002), for instance. However, how exactly these accountability gains happen is being recently object of much attention by researchers.

Traditional models of decentralization based on the fiscal federalism literature starting from Tiebout (1956) emphasize the role of factor mobility in disciplining local governments (“voting with the feet”). The other traditional strand of the literature based on Oates’ Decentralization Theorem (Oates 1972, p.54) focuses on the trade-off between some advantages specific of each regime. Centralization is supposed to allow for the internalization of positive spillovers in production or in the consumption of public goods while forced to offer a unique policy or amount of public goods to all districts. Decentralization is supposed to be able to adapt the supply of public goods to the heterogeneous preferences of each district, being able to achieve a better “matching of preferences”. Nevertheless, none of them capture the “closer to the people” argument of accountability.

More recent literature focuses on the problem inherent to any centralized system of aggregating the preferences of the different jurisdictions if public goods can not be adapted to each jurisdiction (Besley and Coates, 2003a). Seabright (1996) presented the argument that can be called the “selective discrimination of jurisdictions” aspect of centralization. According

to Seabright(1996), a national incumbent only needs to please half of the electorate plus one in order to be re-elected. A self-interested incumbent will thus neglect the other half of the jurisdictions that are not necessary for his re-election. This leads to a lower probability of a single jurisdiction being pivotal to the re-election of the incumbent under centralization which means lower accountability. Recently Hindriks and Lockwood (2009) analyze the impact of this mechanism in a “selection of politicians” model and Kessing (2009) also uses this framework to show how random factors affecting re-election can influence differently decentralized and centralized systems.

Our approach departs from this literature in that we are not studying the problems of a centralized system in aggregating the preferences of different jurisdictions but we are rather focusing on the consequences for electoral accountability derived from bundling the provision of public goods. Interestingly, the consequences of bundling or unbundling upper tier and lower tier public goods will arise even in a regime with one single jurisdiction, where the traditional fiscal federalism and decentralization literature would argue that there should be no difference between decentralization and centralization. To make clear how our approach departs from this literature we quote Persson and Tabellini (2000, p.230):

“Another difference between local and national elections (...) (is that with) local elections, incompetent incumbents are always ousted out of office. With national elections, on the other hand, an incumbent who is incompetent in only in one locality can remain in office by winning (in the other) two localities out of three.”

We apply this argument to the delivery of two public goods in one jurisdiction instead of applying it to one public good being delivered to three jurisdictions as Persson and Tabellini do.

Bundling of issues has a long tradition in theory of the firm, see for instance Bolton and Dewatripont(2005, Ch.6). But in this literature it is mainly applied to problems of sellers of two goods facing some uncertainty about the preferences of the buyer and deciding whether to sell the two goods bundled or separated. In political economy Besley and Coate (2000) and (2003b) analyze the problem of bundling two political issues with different saliency for the voters into one single election. In the latter paper they consider whether the elected representative having authority over public expenditure (very salient to the voter) should also appoint the regulating authority(very salient for special interest groups but secondary for the voter) which will constitute the bundling case or whether the voters should elect both positions. In Besley and Coate (2000) unbundling of issues means allowing citizens to place decisions directly on the ballot. This means that instead of voting once over candidates with positions over multiple issues, the voters are able to single out some specific issues and vote on them individually. In both cases bundling issues with different salience leads to an increase of the risk of regulatory capture. Our approach considers both public goods equally salient in order to present our results more clearly.

In our model the main effects of decentralization on electoral control will depend on the trade-

off between two forces: on the one hand, centralization understood as the concentration of the provision of both public goods in one provider, allows this centralized provider to share the risks derived from supply shocks between both public goods. If for instance the national public good becomes very expensive due to a supply shock unknown to the public, the centralized provider can substitute national public good by the cheaper local public good and achieve a higher efficiency. In the decentralized case, the provider of national public goods suffering a negative supply shock unknown to the public will not have the possibility of substituting and if the shock is too severe will simply give up and focus on other activities that benefit him personally but that are not welfare increasing (e.g. corruption) and accepting that he will certainly lose elections.¹

On the other hand centralization makes the evaluation of the office holder by the citizen more difficult. Since centralization can only set one cut-off level for two public goods, there is a loss of electoral control and therefore the incumbent can be re-elected exerting a lower level effort. Decentralization in contrast allows for a clear distinction of responsibilities and facilitates electoral control, or in other words, it unbundles the accountability for the provision of each public good.

The rest of the paper is organized as follows. Section 2 presents the setup of our model. In section 3 we develop the decentralized case, whereas in section 4 we present the centralized case. In section 5 we will compare both settings and show under which circumstances one regime will be preferred from a welfare point of view. Section 6 concludes.

2 Setup of the model

We expand the setup of the Ferejohn (1986) model of electoral control with one unique public good and one incumbent to a model with two public goods and one or two incumbents. These two public goods can be understood as a national and a local public good, but also as any pair of tasks that can be allocated either to a single policy maker or to two different policymakers. We will speak of centralization when the production and delivery of both public goods is concentrated in one single office-holder, which is held accountable through one single election. By decentralization we will refer to the production and delivery of each public good by an independent office, each of them held accountable to the voter through an individualized and independent election.

2.1 Elements of the model

The elements of the model are the following:

¹This mechanism can be compared to the well studied mechanism of inter-jurisdictional risk-sharing (see for instance Lockwood (1999) or Persson and Tabellini (1996 a) and (1996 b) among many others). In these models there is a jurisdiction-specific risk and a central government could be able, in principle, to insure jurisdictions of this risk. Here we assume public good-specific risk, even within a single jurisdiction, and a centralized provider can insure the voter of part of this risk.

a) Public good production function:

The production function of each public good is:

$$y_i = \varepsilon_i \cdot e_i$$

where y_i is the output or amount of public good $i = [1, 2]$, ε_i is the realization of a random shock and e_i is the level of effort invested by the incumbent in producing the public good i . These shocks can be understood as supply shocks that affect the productivity of the public good provider.² It is also assumed that it is not possible to save amounts of public goods from one period to the other.

b) Distribution of the shocks. In this simplified model, the shocks ε_i can only take two possible values:

- With probability p the shock takes a high value: $\varepsilon_i = \bar{\varepsilon}$.
- With probability $(1 - p)$ the shock takes a low value: $\varepsilon_i = \underline{\varepsilon}$, where $\bar{\varepsilon} > \underline{\varepsilon} > 0$.

The shocks for both public goods follow the same distribution but the realizations are identically and independently distributed.

c) Representative voter utility function: There is only one representative jurisdiction with one representative voter. Both public goods have equal weight in the utility function of the representative voter³: $U = U_1 + U_2$, where $U_1 = y_1$ and $U_2 = y_2$. The voter can neither observe ε_i nor e_i , but can observe y_i , for both $i = [1, 2]$.

d) Utility function of the office holder: The single-period utility of the office holder in the centralized case is:

$$V = \chi^c - e_1^\phi - e_2^\phi$$

In the decentralized case:

$$V_i = \chi_i^{dc} - e_i^\phi$$

where χ^c and χ_i^{dc} are the perquisites of holding office in each regime. For simplicity we will assume that $\chi^c = 2 \cdot \chi_i^{dc}$, which means that the perquisites under centralization are the same as the aggregated perquisites under decentralization.

The disutility of effort is captured by e_i^ϕ , where $\phi > 1$ in order to avoid corner solutions.⁴ This effort can be understood in a literal way, but also as the opportunity cost of the alternative lucrative activities (e.g. corruption) that the office holder forgoes when he devotes his time to provide public goods.

The incumbent can observe both ε_i and e_i of the good or goods of which provision he is responsible for before deciding on his level of effort.

²By modeling the production function in this linear way we abstract for the sake of clarity from potential benefits from economies of scale under centralization which are considered a key issue in the strand of the literature analyzing the size of the nations and the determinants of decentralization, see for instance Panizza (1999).

³With this specification we abstract from the potential effects of different salience studied in Besley and Coate(2000) and (2003b) and from the potential effects of spillovers among public goods often discussed in the literature, e.g. Oates(1974)or Besley and Coate (2003a)

⁴Values $0 < \phi < 1$ would imply that even with identical positive shocks to both public goods, the incumbent would prefer to exert effort in only one public good rather than splitting effort among both of them.

e) **Retrospective voting rule:**

The voter has no influence over the wage of the officeholder. At the end of the term the voter can either re-elect the incumbent or elect a different candidate. We assume that the candidate to replace the incumbent is drawn randomly from a pool of infinite identical candidates. The fact that the number of potential candidates is assumed to be infinite implies that once an incumbent is voted out of office the probability that he returns to office is almost zero.⁵

Since for the voter the only observable indicator of the performance of the office holder is the level of output and the only disciplining tool available to him is the non re-election threat, it is clear that the voter will use a retrospective voting rule linking re-election with a certain level of observed performance. This voting rule will specify the minimum amount of utility (henceforth referred as cut-off value of voter's utility) that the voter must receive in order to re-elect the incumbent.⁶

The main difference between centralization and decentralization will arise in the arguments of the retrospective voting rules:

- **Retrospective voting rule under centralization**

\hat{y}_c : Cut-off level of total output set by the voter to the centralized provider of both public goods as a condition to re-elect him.

- **Retrospective voting rule under decentralization**

$\hat{y}_{dc,i}$: Cut-off level of output of public good $i = [1, 2]$ set by the voter to the provider of public good i as a condition to be re-elect him.

2.2 Sequence of the game

The sequence of the game is as follows:

- a) The voter chooses centralization or decentralization.
- b) If centralization was chosen the voter sets an overall cut-off value. If decentralization was chosen the voter sets a cut-off value for each specific public good provider.
- c) Incumbent observes the realization of the shock that affects him and chooses his level of effort in accordance to it.
- d) Voter observes output of public good 1 and of public good 2.
Under centralization if the overall level of public goods is greater or equal than the overall cut-off value then voter re-elects the incumbent for another period. If not, incumbent is voted out of office and a new candidate is randomly chosen to replace him.
Under decentralization the voter compares the level of each public good with its specific

⁵We adopt in this aspect a particular case of Ferejohn (1986). There the probability of returning to office played a mayor role since that work focused on the potential weakness of two-parties systems versus multi-party systems. We consider that the focus of our analysis is on the differences between decentralization and centralization and not between two-parties and multi-parties system.

⁶See Ferejohn (1986) or Banks and Sundaram (1998) for applications of cut-off values conditioning re-election.

cut-off value and in case the provided level is larger or equal than the cut-off level then voter re-elects that provider for another period. If the level of output of that public good does not reach the cut-off level, the incumbent of the office responsible for that public good i is voted out of office and a new candidate is randomly chosen to replace him.

3 The solution under decentralization

Under decentralization we have a different incumbent responsible for delivering each public good i . The problem of each incumbent is to choose his optimal level of effort for a given cutoff value and then decide whether it is better for him to exert this effort or not. The problem of the voter is to set a re-election cutoff value of each public good such that his expected utility is maximized. The problem will be solved by backward induction. The first step is to determine the optimal response of the office holder to each possible size of the shock and to each cut-off level of public good i .

Minimum level effort to be exerted by the incumbent in order to produce the cutoff value:

In case the office-holder wants to be re-elected the single-period problem of each office holder is the following:

$$\begin{aligned} \max_{e_i} V_i &= \chi^{dc} - e_i^\phi \\ \text{s.t. } \hat{y}_{dc,i} &\leq \varepsilon_i \cdot e_i \end{aligned}$$

The minimum effort that the incumbent must exert in order to be re-elected is:

$$\hat{e}_{dc,i} = \frac{\hat{y}_{dc,i}}{\varepsilon_i}$$

Condition for the incumbent to exert effort :

The incumbent will exert this level of effort only if the benefit of being re-elected (holding office in period $t + 1$) minus the disutility of the effort required to be re-elected is larger or equal than the utility that the office holder can obtain from being voted out of office but not having exerted any effort. The value of being voted out of office is normalized to zero for the sake of simplicity. Formally, the condition will be:

$$\chi^{dc} - \left(\frac{\hat{y}_{dc,i}}{\varepsilon_i} \right)^\phi + \beta \cdot V_{t+1}^{IN} \geq \chi^{dc}$$

where V_{t+1}^{IN} is the utility of the office holder at period $t + 1$ if he is in office.

In order to determine $V_{t+1,i}^{IN}$ we define $q(\hat{y}_{dc,i})$ as the probability that the realization of the shock is such that it is rational for the incumbent to exert effort again and be re-elected for

period $t + 2$. Accordingly, $(1 - q(\hat{y}_{dc,i}))$ will be the probability that the shock is so small that the incumbent prefers not to exert effort and lets himself be voted out of office. In this case we have assume that the utility of being out of office is zero and the probability of returning to office is practically zero since there is an infinite number of candidates. This means:

$$V_{t+1,i}^{IN} = \chi_i^{dc} + q(\hat{y}_{dc,i}) \cdot \left(-(\hat{\varepsilon}_{dc,i})^\phi + \beta \cdot V_{t+2,i}^{IN} \right)$$

which is equivalent to:

$$\begin{aligned} V_{t+1,i}^{IN} &= (1 + q(\hat{y}_{dc,i}) \cdot \beta + q(\hat{y}_{dc,i})^2 \cdot \beta^2 + \dots) \cdot \chi_i^{dc} - \\ &- (1 + q(\hat{y}_{dc,i}) \cdot \beta + q(\hat{y}_{dc,i})^2 \cdot \beta^2 + \dots) \cdot q(\hat{y}_{dc,i}) \cdot \hat{\varepsilon}_{dc,i}^\phi \end{aligned}$$

therefore:

$$V_{t+1,i}^{IN} = \frac{1}{1 - q(\hat{y}_{dc,i}) \cdot \beta} \cdot \left(\chi_i^{dc} - q(\hat{y}_{dc,i}) \cdot \hat{\varepsilon}_{dc,i}^\phi \right)$$

The maximum cut-off value that the voter can set for a a given ε_i and still induce the incumbent to exert effort will then be:

$$\hat{y}_{dc,i} = \left(\beta \cdot \chi_i^{dc} \right)^{1/\phi} \cdot \varepsilon_i$$

For higher cut-off values, given ε_i , the incumbent will not find it rational to exert effort. In the case when $\varepsilon_i = \bar{\varepsilon}$ and if the voter could observe it, the maximum cutoff value that would leave office holder with reservation utility would be:

$$\hat{y}_{dc,i}^H = \left(\beta \cdot \chi_i^{dc} \right)^{1/\phi} \cdot \bar{\varepsilon}$$

let us define this maximum cutoff value when shock is high as $\hat{y}_{dc,i}^H$.

In the case when $\varepsilon_i = \underline{\varepsilon}$ the maximum cutoff value that the voter can set, defined as $\hat{y}_{dc,i}^L$, will be:

$$\hat{y}_{dc,i}^L = \left(\beta \cdot \chi_i^{dc} \right)^{1/\phi} \cdot \underline{\varepsilon}$$

Voter's choice of the optimal cut-off value.

Knowing the reaction function of the incumbent, the expected utility of the voter will depend on the cutoff value chosen. It is clear that any cutoff value other than $\hat{y}_{dc,i}^H$ or $\hat{y}_{dc,i}^L$ will be sub-optimal and that by symmetry the cutoff values of both goods will be identical. Therefore

the choice of the voter is between the high and the low cutoff values. The expected welfare from the provision of both public goods on each case is:

$$E(U|\hat{y}_{dc,i}^H) = 2 \cdot p \cdot \hat{y}_{dc,i}^H$$

$$E(U|\hat{y}_{dc,i}^L) = 2 \cdot \hat{y}_{dc,i}^L$$

The high cutoff value will be chosen when: $E(U|\hat{y}_{dc,i}^H) \geq E(U|\hat{y}_{dc,i}^L)$ which will only happen when:

$$p \geq \frac{\bar{\varepsilon}}{\underline{\varepsilon}}$$

Therefore, the larger the difference between the size of high shocks and the size of low shocks the lower is the probability required for a high cutoff value to be the choice of the voter. We define this probability as \hat{p}^{dc} .

Proposition 3.1 *Under decentralized provision of public goods 1 and 2:*

a) *The high cut-off value of public good i will be:*

$$\hat{y}_{dc,i}^H = \left(\beta \cdot \chi_i^{dc}\right)^{1/\phi} \cdot \bar{\varepsilon}$$

and it will be chosen by the voter if $p \geq \hat{p}^{dc}$, where $\hat{p}^{dc} = \bar{\varepsilon}/\underline{\varepsilon}$.

b) *The low cut-off value of public good i will be:*

$$\hat{y}_{dc,i}^L = \left(\beta \cdot \chi_i^{dc}\right)^{1/\phi} \cdot \underline{\varepsilon}$$

and it will be chosen by the voter if $p < \hat{p}^{dc}$.

4 The solution under centralization

The centralization case will be solved also by backward induction. First we will find the optimal effort that the incumbent will exert for a given cut-off value set by the voter, then we will find the maximum cut-off value that the voter can set in case the realization of shocks is known in order to leave incumbent indifferent between exerting effort and not exerting it. Finally we will determine which cut-off value the voter will choose depending on the distribution of the shocks.

4.1 Minimum level of effort to be exerted by the incumbent in order to produce the cutoff value:

The single period problem of the office holder if he wants to achieve the cutoff value is the following:

$$\begin{aligned} \max_{e_1, e_2} V &= \chi^c - e_1^\phi - e_2^\phi \\ \text{s.t. } \varepsilon_1 \cdot e_1 + \varepsilon_2 \cdot e_2 &\geq \hat{y}_c \end{aligned}$$

Setting the Lagrangian and differentiating with respect to e_1 and e_2 we find:

$$\hat{e}_{c,i} = \left(\frac{\varepsilon_i^{\frac{1}{\phi-1}}}{\varepsilon_1^{\frac{\phi}{\phi-1}} + \varepsilon_2^{\frac{\phi}{\phi-1}}} \right) \cdot \hat{y}_c$$

where $\hat{e}_{c,i}$ is the minimum effort that the incumbent exerts in producing public good i in order to achieve the cutoff value \hat{y}_c .

4.2 Condition for the incumbent to exert effort:

The incumbent will only exert effort $\hat{e}_{c,i}$ if the expected future utility derived from being re-elected is at least as large as the disutility of exerting the effort required to be re-elected. Recall that we assumed that the future utility after being voted out of office is normalized to zero:

$$\chi^c - e_1^\phi - e_2^\phi + \beta \cdot V_{t+1}^{IN} \geq \chi^c$$

The condition for the incumbent to exert effort will thus be:

$$\left(\left(\frac{\varepsilon_1^{\frac{1}{\phi-1}}}{\varepsilon_1^{\frac{\phi}{\phi-1}} + \varepsilon_2^{\frac{\phi}{\phi-1}}} \right) \cdot \hat{y}_c \right)^\phi + \left(\left(\frac{\varepsilon_2^{\frac{1}{\phi-1}}}{\varepsilon_1^{\frac{\phi}{\phi-1}} + \varepsilon_2^{\frac{\phi}{\phi-1}}} \right) \cdot \hat{y}_c \right)^\phi \leq \beta \cdot V_{t+1}^{IN}$$

which can be transformed into:

$$\hat{y}_c \leq (\beta \cdot V_{t+1}^{IN})^{\frac{1}{\phi}} \cdot \left(\varepsilon_1^{\frac{\phi}{\phi-1}} + \varepsilon_2^{\frac{\phi}{\phi-1}} \right)^{\frac{\phi-1}{\phi}}$$

We already found the value of V_{t+1}^{IN} for the decentralized case. Following the same logic we can find that:

$$V_{t+1}^{IN} = \frac{1}{1 - q(\hat{y}_c) \cdot \beta} \cdot \left(\chi^c + q(\hat{y}_c) \cdot \left(-(\hat{e}_{c,1})^\phi - (\hat{e}_{c,2})^\phi \right) \right)$$

As a consequence, the maximum cutoff value that the voter can set will be:

$$\hat{y}_c = (\beta \cdot \chi^c)^{\frac{1}{\phi}} \cdot \left(\varepsilon_1^{\frac{\phi}{\phi-1}} + \varepsilon_2^{\frac{\phi}{\phi-1}} \right)^{\frac{\phi-1}{\phi}}$$

4.3 Voter's choice of the optimal cut-off value

Recall that under decentralization the number of states of nature that each incumbent could potentially face and which realization the voter could not observe was two: high shock or low shock. Under centralization the number of states unobservable to the voter that the office holder faces is going to be four, although due to the symmetricity of the model the actual number of states of nature is indeed three: both shocks high, both shocks low and one of the shocks high and the other low.

Depending on the realization of the shocks we define the following three possible scenarios:

- Scenario 1: High productivity.
 - Both shocks are high: $\varepsilon_1 = \varepsilon_2 = \bar{\varepsilon}$.
 - The probability of this scenario is p^2 .
- Scenario 2: Medium productivity.
 - One shock is high and the other one is low: $\varepsilon_1 = \bar{\varepsilon}$ and $\varepsilon_2 = \underline{\varepsilon}$ or $\varepsilon_1 = \underline{\varepsilon}$ and $\varepsilon_2 = \bar{\varepsilon}$
 - The probability of this scenario is: $2 \cdot (1 - p) \cdot p$
- Scenario 3: Low productivity.
 - Both shocks are low: $\varepsilon_1 = \varepsilon_2 = \underline{\varepsilon}$.
 - The probability of this scenario is: $(1 - p) \cdot (1 - p)$

4.3.1 Cutoff values under perfect information

If voter can observe the realization of the shocks before setting the cut-off value, then the cut-off value in each scenario will be the maximum possible for that scenario:

- High productivity: $\hat{y}_c^H = (\beta \cdot \chi^c)^{\frac{1}{\phi}} \cdot \left(\bar{\varepsilon}^{\frac{\phi}{\phi-1}} + \bar{\varepsilon}^{\frac{\phi}{\phi-1}} \right)^{\frac{\phi-1}{\phi}}$,
which implies: $\hat{y}_c^H = (\beta \cdot \chi^c)^{\frac{1}{\phi}} \cdot 2^{\frac{\phi-1}{\phi}} \cdot \bar{\varepsilon}$
- Medium productivity: $\hat{y}_c^M = (\beta \cdot \chi^c)^{\frac{1}{\phi}} \cdot \left(\bar{\varepsilon}^{\frac{\phi}{\phi-1}} + \underline{\varepsilon}^{\frac{\phi}{\phi-1}} \right)^{\frac{\phi-1}{\phi}}$
- Low productivity: $\hat{y}_c^L = (\beta \cdot \chi^c)^{\frac{1}{\phi}} \cdot \left(\underline{\varepsilon}^{\frac{\phi}{\phi-1}} + \underline{\varepsilon}^{\frac{\phi}{\phi-1}} \right)^{\frac{\phi-1}{\phi}}$,
which implies: $\hat{y}_c^L = (\beta \cdot \chi^c)^{\frac{1}{\phi}} \cdot 2^{\frac{\phi-1}{\phi}} \cdot \underline{\varepsilon}$

It is straightforward that $\hat{y}_c^H > \hat{y}_c^M > \hat{y}_c^L$.

4.3.2 Cutoff values under imperfect information

Under imperfect information the voter must choose ex-ante a unique cut-off value that should maximize its expected utility. As in the decentralization case, it is clear that any cut-off value that does not coincide with \hat{y}_c^H, \hat{y}_c^M or \hat{y}_c^L will not be optimal. To see why assume that a cut-off value different than the three mentioned before is chosen. Then it could always be possible to either increase the cut-off value until an upper cut-off value is reached without reducing the incentives of the incumbent to provide public goods, or it could be possible to reduce the cut-off until a lower cut-off value that could induce effort in more scenarios.

The choice among the different cut-off values will depend on a trade-off between what we call “losses due to *excessive leniency*” versus “losses due to *excessive rigor*”. Losses due to *excessive leniency* happen when in a given scenario and for a given realization of the shock the cutoff value set ex-ante by the voter turns out to be lower than the cut-off value that would have been chosen under perfect information. As a result, the effort exerted by the incumbent will be lower in this scenario than it would have been under perfect information. Losses due to *excessive rigor* happen when in a given scenario and for a given realization of the shock the cutoff value set ex-ante by the voter turns out to be higher than the cut-off value that would have been set under perfect information. As a result, the incumbent exerts no effort in these scenarios.

The expected utility of each cutoff value will be:

Case $\hat{y}_c = \hat{y}_c^H$

With this cutoff value the incumbent will only exert effort in the “high productivity” scenario. There will be no losses due to *excessive leniency* in this scenario. In the rest of scenarios no effort will be exerted in providing public goods, therefore losses from *excessive rigor* will be expected in the medium and low productivity scenario. The expected utility derived from this cut-off value will be:

$$E(U|\hat{y}_c^H) = p^2 \cdot \hat{y}_c^H = p^2 \cdot (\beta \cdot \chi^c)^{\frac{1}{\phi}} \cdot 2^{\frac{\phi-1}{\phi}} \cdot \bar{\varepsilon}$$

Case $\hat{y}_c = \hat{y}_c^M$

In this case, optimal effort will be invested in the medium productivity scenario. In the high productivity scenario the medium cut-off value will turn out to be *too lenient* and the incumbent will only exert effort in order to achieve \hat{y}_c^M which is lower than \hat{y}_c^H . In the low productivity scenario the medium cut-off value will turn out to be *too rigorous* and no effort will be exerted. The expected utility derived from this cut-off value will be:

$$E(U|\hat{y}_c^M) = (p^2 + 2 \cdot (1-p) \cdot p) \hat{y}_c^M = (2-p) \cdot p \cdot (\beta \cdot \chi^c)^{\frac{1}{\phi}} \cdot \left(\bar{\varepsilon}^{\frac{\phi}{\phi-1}} + \underline{\varepsilon}^{\frac{\phi}{\phi-1}} \right)^{\frac{\phi-1}{\phi}}$$

Notice that this cut-off value has a special property: In the medium productivity scenario it allows the incumbent to substitute effort from the public good suffering the low productivity

shock to the good suffering the high productivity shock no matter which one is receiving each shock. This possibility of substitution is not available for decentralized provider of public goods and under some conditions it leads to superiority of centralization, as we will show.

Case $\hat{y}_c = \hat{y}_c^L$

With this cutoff value the incumbent will exert effort in all scenarios but this effort will be just the sufficient to achieve this low cutoff value. Therefore there will be no losses from *excessive rigor* but there will be losses from *excessive leniency* in the high and medium scenarios. The expected utility derived from this cut-off value will be:

$$E(U|\hat{y}_c^L) = \hat{y}_c^L = (\beta \cdot \chi^c)^{\frac{1}{\phi}} \cdot 2^{\frac{\phi-1}{\phi}} \cdot \underline{\varepsilon}$$

4.3.3 Comparison of the expected utilities of each cutoff value

Comparison $E(U|\hat{y}_c^H)$ **versus** $E(U|\hat{y}_c^M)$:

The higher cutoff value will be preferred to the medium cutoff value if: $E(U|\hat{y}_c^H) \geq E(U|\hat{y}_c^M)$ which means that:

$$p^2 \cdot (\hat{y}_c^H - \hat{y}_c^M) \geq 2 \cdot (1-p) \cdot p \cdot \hat{y}_c^M$$

The left hand side of the inequality is the differential expected gain in the high productivity scenario. Here the high cut-off value is optimal and the medium cut-off value is *too lenient*. The right hand side of the inequality is the differential expected loss in the medium productivity scenario. Here the high cut-off value is too rigorous and no effort is exerted, whereas the medium cut-off value is optimal.

This inequality will hold if and only if:

$$p \geq \frac{2 \cdot \hat{y}_c^M}{\hat{y}_c^H + \hat{y}_c^M}$$

which is equivalent to:

$$p \geq \frac{2 \cdot \left(\bar{\varepsilon}^{\frac{\phi}{\phi-1}} + \underline{\varepsilon}^{\frac{\phi}{\phi-1}} \right)^{\frac{\phi-1}{\phi}}}{2^{\frac{\phi-1}{\phi}} \cdot \bar{\varepsilon} + \left(\bar{\varepsilon}^{\frac{\phi}{\phi-1}} + \underline{\varepsilon}^{\frac{\phi}{\phi-1}} \right)^{\frac{\phi-1}{\phi}}} = \hat{p}_c^{MH}$$

where \hat{p}_c^{MH} is the threshold value of p . For values of p below this threshold the medium cutoff value is preferred and for values of p above this threshold the high cutoff value is preferred. It is straightforward to show that $0 < \hat{p}_c^{MH} < 1$, which means that there will always exist a threshold.

Comparison $E(U|\hat{y}_c^M)$ versus $E(U|\hat{y}_c^L)$:

The expected utility from setting a medium cutoff value will be larger than that of setting a low cutoff value if $E(U|\hat{y}_c^M) \geq E(U|\hat{y}_c^L)$, which implies that:

$$(p^2 + 2(1-p)p) \cdot (\hat{y}_c^M - \hat{y}_c^L) \geq (1-p)^2 \cdot \hat{y}_c^L$$

The left hand side of the inequality is the differential expected gain in the medium and high productivity scenarios. In these scenarios the low cut-off value will be *too lenient* in comparison to the medium cut-off value. The right hand side is the differential expected loss in the low productivity scenario. Here the medium cut-off value is *too rigorous* and does not induce effort.

For values of p close to 1 the low productivity scenario becomes very unlikely and the medium cutoff level will be preferred to the low one. If p tends to zero the low productivity becomes very likely and the losses from the effort lost by setting the medium cutoff value will make the low cutoff to be preferred. In particular, the medium cutoff value will be preferred if:

$$p \geq 1 - \sqrt{\frac{\hat{y}_c^M - \hat{y}_c^L}{\hat{y}_c^M}}$$

which is equivalent to:

$$p \geq 1 - \sqrt{\frac{\left(\bar{\varepsilon}^{\frac{\phi}{\phi-1}} + \underline{\varepsilon}^{\frac{\phi}{\phi-1}}\right)^{\frac{\phi-1}{\phi}} - 2^{\frac{\phi-1}{\phi}} \cdot \underline{\varepsilon}}{\left(\bar{\varepsilon}^{\frac{\phi}{\phi-1}} + \underline{\varepsilon}^{\frac{\phi}{\phi-1}}\right)^{\frac{\phi-1}{\phi}}} = \hat{p}_c^{LM}}$$

where \hat{p}_c^{LM} is the threshold value of p . For values of p below this threshold the low cutoff value will be preferred and for values above the threshold the medium cutoff value will be preferred. It can also be shown that $0 < \hat{p}_c^{LM} < 1$ which implies that this threshold probability always exists. Furthermore, it will always be that $\hat{p}_c^{MH} > \hat{p}_c^{LM}$.

Comparison $E(U|\hat{y}_c^H)$ versus $E(U|\hat{y}_c^L)$:

The high cutoff value will be preferred to the low cutoff value if $E(U|\hat{y}_c^H) \geq E(U|\hat{y}_c^L)$ or, equivalently, when:

$$p^2 \cdot \hat{y}_c^H \geq \hat{y}_c^L$$

which just says that the expected gains from exerting higher control over the office holder (but only in the high performance scenario) must be larger than the utility that the lower cutoff value yields in all scenarios. We can transform this inequality into:

$$p^2 \cdot (\beta \cdot \chi^c)^{\frac{1}{\phi}} \cdot 2^{\frac{\phi-1}{\phi}} \cdot \bar{\varepsilon} \geq (\beta \cdot \chi^c)^{\frac{1}{\phi}} \cdot 2^{\frac{\phi-1}{\phi}} \cdot \underline{\varepsilon}$$

which will hold only if:

$$p \geq \sqrt{\frac{\underline{\varepsilon}}{\bar{\varepsilon}}} = \hat{p}_c^{LH}$$

where \hat{p}_c^{LH} is the threshold value of the probability. For values of p below it the low cutoff value will be preferred and for values above it the high cutoff value will be preferred. Since $0 < \underline{\varepsilon} < \bar{\varepsilon}$ it can directly be seen that $0 < \hat{p}_c^{LH} < 1$.

Furthermore it can also be shown that $\hat{p}_c^{LM} < \hat{p}_c^{LH} < \hat{p}_c^{MH}$ at least for any $\bar{\varepsilon} > \underline{\varepsilon} \geq 1$, $0 < \beta < 1$, $\phi > 1$ and $\chi^c > 0$.

Proposition 4.1 *Under centralized provision of public goods 1 and 2:*

a) *The low cut-off value of the aggregated volume of public goods 1 and 2 will be:*

$$\hat{y}_c^L = (\beta \cdot \chi^c)^{\frac{1}{\phi}} \cdot 2^{\frac{\phi-1}{\phi}} \cdot \underline{\varepsilon}$$

and it will be chosen by the voter if $p < \hat{p}_c^{LM}$, where:

$$\hat{p}_c^{LM} = 1 - \frac{\left(\bar{\varepsilon}^{\frac{\phi}{\phi-1}} + \underline{\varepsilon}^{\frac{\phi}{\phi-1}} \right)^{\frac{\phi-1}{\phi}} - 2^{\frac{\phi-1}{\phi}} \cdot \underline{\varepsilon}}{\left(\bar{\varepsilon}^{\frac{\phi}{\phi-1}} + \underline{\varepsilon}^{\frac{\phi}{\phi-1}} \right)^{\frac{\phi-1}{\phi}}}$$

b) *The medium cut-off value of the aggregated volume of public goods 1 and 2 will be:*

$$\hat{y}_c^M = (\beta \cdot \chi^c)^{\frac{1}{\phi}} \cdot \left(\bar{\varepsilon}^{\frac{\phi}{\phi-1}} + \underline{\varepsilon}^{\frac{\phi}{\phi-1}} \right)^{\frac{\phi-1}{\phi}}$$

and it will be chosen by the voter if $\hat{p}_c^{LM} \leq p < \hat{p}_c^{MH}$, where:

$$\hat{p}_c^{MH} = \frac{2 \cdot \left(\bar{\varepsilon}^{\frac{\phi}{\phi-1}} + \underline{\varepsilon}^{\frac{\phi}{\phi-1}} \right)^{\frac{\phi-1}{\phi}}}{2^{\frac{\phi-1}{\phi}} \cdot \bar{\varepsilon} + \left(\bar{\varepsilon}^{\frac{\phi}{\phi-1}} + \underline{\varepsilon}^{\frac{\phi}{\phi-1}} \right)^{\frac{\phi-1}{\phi}}}$$

c) *The high cut-off value of the aggregated volume of public goods 1 and 2 will be:*

$$\hat{y}_c^H = (\beta \cdot \chi^c)^{\frac{1}{\phi}} \cdot 2^{\frac{\phi-1}{\phi}} \cdot \bar{\varepsilon}$$

and it will be chosen by the voter if $p \geq \hat{p}_c^{MH}$.

5 Comparison of decentralization versus centralization

So far we have seen how the choice of the cutoff levels in each regime will depend critically on p , ϕ , β , $\underline{\varepsilon}$ and $\bar{\varepsilon}$. Now we will see which regime will be chosen by the voter assuming he knows these parameters and that he can choose the regime at a constitutional stage. For the sake of comparability we will assume in this section that $\phi = 2$ and that $\bar{\varepsilon} = 2 \cdot \underline{\varepsilon}$. For these parameter values the different probability threshold values will be: $\hat{p}^{dc} = 0.5$, $\hat{p}_c^{MH} = 0.88$, $\hat{p}_c^{LM} = 0.39$ and $\hat{p}_c^{LH} = 0.7$

Which means that for the decentralized case we will have:

$$\hat{y}_{dc,i} = \begin{cases} \hat{y}_{dc,i}^L & \text{if } p < 0.5 \\ \hat{y}_{dc,i}^H & \text{if } p \geq 0.5 \end{cases}$$

and for the centralized case:

$$\hat{y}_c = \begin{cases} \hat{y}_c^L & \text{if } p < 0.39 \\ \hat{y}_c^M & \text{if } 0.39 \leq p < 0.88 \\ \hat{y}_c^H & \text{if } p \geq 0.88 \end{cases}$$

Assuming that the voter is able to choose the structure of the state that brings him a larger expected utility we will have to analyze the following four cases:

$$\hat{y} = \begin{cases} \hat{y}_{dc,i}^L \text{ or } \hat{y}_c^L & \text{if } p < 0.39 \\ \hat{y}_{dc,i}^L \text{ or } \hat{y}_c^M & \text{if } 0.39 \leq p \leq 0.5 \\ \hat{y}_{dc,i}^H \text{ or } \hat{y}_c^M & \text{if } 0.5 \leq p < 0.88 \\ \hat{y}_{dc,i}^H \text{ or } \hat{y}_c^H & \text{if } p \geq 0.88 \end{cases}$$

Case $p < 0.39$:

In this case we have the lower cutoff value in both regimes. This means that the low level of effort will always be exerted, no matter the scenario. Furthermore it can be shown that, if $\chi^c = 2 \cdot \chi_i^{dc}$, then $E(U|\hat{y}_c^L) = E(U|\hat{y}_{dc,i}^L)$. The voter will be indifferent between centralization and decentralization.

Case $0.39 \leq p < 0.5$:

Now the voter can choose between $\hat{y}_{dc,i}^L$ and \hat{y}_c^M . We just have seen that $E(U|\hat{y}_c^L) = E(U|\hat{y}_{dc,i}^L)$ and from the previous section we know that for $0.39 \leq p < 0.61$ we will have

that $E(U|\hat{y}_c^M) > E(U|\hat{y}_c^L)$. Therefore it must necessarily be that $E(U|\hat{y}_c^M) > E(U|\hat{y}_{dc,i}^L)$. This means that in this interval centralization will dominate.

Case $0.5 \leq p < 0.88$

Having to choose between \hat{y}_c^M and $\hat{y}_{dc,i}^H$, decentralization will be preferred if: $E(U|\hat{y}_{dc,i}^H) \geq E(U|\hat{y}_c^M)$. This inequality will hold if:

$$p^2 \cdot (2 \cdot \hat{y}_{dc,i}^H - \hat{y}_c^M) \geq (2 \cdot p \cdot (1 - p)) \cdot (\hat{y}_c^M - \hat{y}_{dc,i}^H)$$

The left hand side is the differential expected gain in the high productivity scenario. Under decentralization both public goods are produced at its high cutoff value amount whereas under centralization the average production will be only $\hat{y}_c^M < 2\hat{y}_{dc,i}^H$. The right hand side shows the differential expected loss in the medium productivity scenario. Under centralization both goods will be produced, more quantity of the good with high shock and less quantity of the good with low shock. In the decentralized case only the good with high shock will be produced. Recall that $\hat{y}_{dc,i}$ refers only to one public good, while \hat{y}_c refers to both public goods.

In general it can be shown that the inequality will hold if:

$$p \geq 2 - \frac{2^{\frac{\phi-1}{\phi}}}{\left(\frac{\bar{\varepsilon}^{\frac{\phi}{\phi-1}} + \varepsilon^{\frac{\phi}{\phi-1}}}{\bar{\varepsilon}^{\frac{\phi}{\phi-1}}}\right)^{\frac{\phi-1}{\phi}}} = \hat{p}_{c,dc}^{M,H}$$

In our particular case with $\phi = 2$ and $\bar{\varepsilon} = 2 \cdot \varepsilon$ the threshold probability level between centralization with medium cutoff value \hat{y}_c^M and decentralization with high cutoff value $\hat{y}_{dc,i}^H$ will be $\hat{p}_{c,dc}^{M,H} = 0.74$. Therefore, for $0.5 < p \leq 0.74$ centralization with medium cutoff value \hat{y}_c^M will dominate and for $p \geq 0.74$ decentralization with high cutoff value $\hat{y}_{dc,i}^H$ will dominate.

Case $p \geq 0.88$

In this case the comparison will be between the high cutoff values of decentralization and centralization: the decentralization regime will be preferred if the inequality $E(U|\hat{y}_{dc,i}^H) \geq E(U|\hat{y}_c^H)$ holds, which means that:

$$p^2 \cdot (2 \cdot \hat{y}_{dc,i}^H - \hat{y}_c^H) + (2 \cdot (1 - p) \cdot p) \cdot \hat{y}_{dc,i}^H \geq 0$$

Again, the first term of the left hand side of the inequality is the differential gain in the high productivity scenario. It can be shown that $2 \cdot \hat{y}_{dc,i}^H = \hat{y}_c^H$ implying that both regimes perform equally well in this scenario. In the medium productivity scenario, however, the decentralized case produces the good with the high shock, whereas the centralized office holder has no incentives to exert effort at all. Clearly, decentralization with high cutoff value dominates centralization with high cutoff value.

Figure 1 compares the levels of expected utility under each regime when $\phi = 2$ and $\bar{\varepsilon} = 2 \cdot \varepsilon$ and $\varepsilon = 1$.

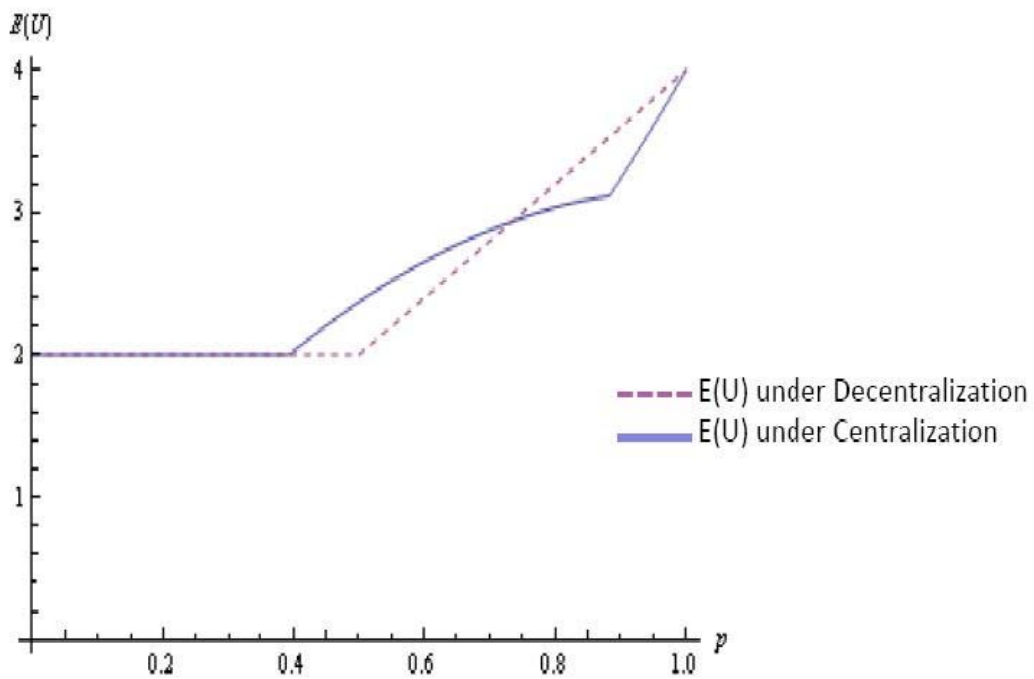


Figure 1: Expected utility under centralization and under decentralization

Probability	Regime chosen	Cutoff value chosen
$p < 0.39$	Indifferent	\hat{y}_c^L or $\hat{y}_{dc,i}^L$
$0.39 \leq p < 0.74$	Centralization	\hat{y}_c^M
$p \geq 0.74$	Decentralization	$\hat{y}_{dc,i}^H$

Table 1: Regime and cutoff value chosen

Table 1 summarizes our results for the case when $\phi = 2$ and $\bar{\varepsilon} = 2 \cdot \underline{\varepsilon}$ and $\underline{\varepsilon} = 1$.

Simulations for other parameters values are available upon request. The results obtained for other parameter values affect the relative position of the probability thresholds and the values of expected utility, but in all cases a clear pattern emerges: there is a first interval of low probability values in which the low cut-off value is preferred and there is no difference between centralization and decentralization. Afterwards, there is always a second interval in which centralization with medium cut-off values is preferred. Finally, for higher values of probability decentralization with high cut-off value is always preferred.

6 Conclusion

We have compared the level of electoral control under two different regimes. In the first regime the provision of two public goods is responsibility of one single authority subject to one single election, that is, the accountability and the responsibility for the provision of both public goods are bundled in one authority. We called this regime centralization. In the second regime the provision of each of the two public goods is responsibility of a different authority and each authority is subject to elections, that is, the accountability and the responsibility for the provision of both public goods is unbundled in two different authorities. We called this regime decentralization.

We found that the degree of electoral control to which the office holder is subject can be different under centralization and under decentralization. This difference in electoral control can affect the incentives of the office holder to provide public goods and accordingly the level of public goods provided can be different under each regime. This difference can exist even in the absence of the traditional sources of differences discussed in the decentralization and fiscal federalism literature, for instance: spillovers, economies of scale in the production of public goods, heterogeneity of preferences, factor mobility or selective discrimination of districts not belonging to the minimum winning coalition supporting the central government.

These differences arise because the differences in the probability of occurrence of the shock affect differently the two opposite effects caused by the bundling of the provision of both public goods. These effects are: a) under decentralization in most cases the clear delimitation of responsibilities of each provider does not allow any of the incumbents to underperform. b) Under centralization, in some cases, the provider of both goods can substitute and insure the voter of the risk of public good-specific negative shocks. Given that the voter is aware of this, the cutoff value may also be higher, thus implying a higher level of electoral control.

Whether the expected utility will be higher under one regime or the other will depend critically on the probability distribution of the shocks to the production function:

- a) When the probability of having high shocks is sufficiently high, decentralization with a high cut-off value will be preferred.
- b) When the probability of having high shocks is relatively similar to the probability of

having low shocks, a centralized solution with a medium cut-off value will be preferred.

- c) When the probability of having high shocks is sufficiently low, decentralization and centralization will yield the same results and the low cut-off value will be preferred.

These results imply that the analysis of decentralization reforms should include an additional caveat disregarded so far in the literature. Volatility in the public goods production functions is a relevant factor to be taken into account in the analysis of the desirability of decentralization, especially if the goal is to strengthen the accountability mechanisms of developing countries. Although the common wisdom that tells us that decentralization allows for a clear delimitation of responsibilities has been confirmed by our model, accountability may not be higher under decentralization in all cases. In a moderately volatile environment a centralized government might be more apt to respond to supply shocks and insure a certain level of provision of both goods. Decentralized providers of public goods might not be able to react to negative shocks and, as a consequence, might turn more often to private (often illegal) activities given that the legal path of pursuing re-election through better service to the voter might be less attractive. In developed countries, if we assume that the production and delivery of public goods are relatively stable, then decentralized provision of public goods might allow the voter to better allocate responsibilities and is more effective in disciplining incumbents.

We have restricted our analysis to the case of shocks to the production function of public goods but we suspect that the introduction of other types of shocks to the model, especially demand shocks, would yield similar results as long as the structure of the information asymmetry does not change, that is, as long as the shocks are only observable by the incumbent. Therefore the relevance of these findings should not be constrained to only supply shocks but could also be extended to any kind of risk specific to public goods in general.

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